Chapter 1

Association Between a Socio Economic System and Environmental Problems

<Summary of Chapter 1>

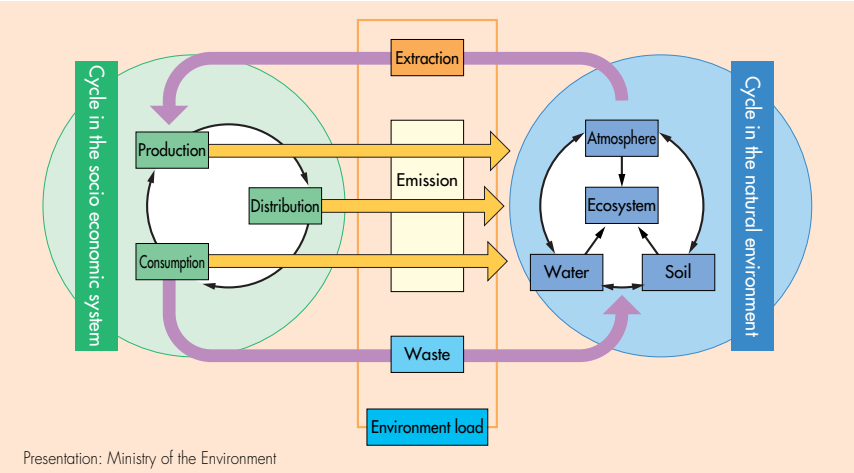
Today's social economic system is maintained by using the benefits from nature and discharging unnecessary materials into the natural environment. Expansion of economic activities in the socio economic system of mass production, mass consumption, and mass waste generation has caused a rapid increase of environment load, and has started to disturb the balance of the natural environment, which is the foundation of survival of the human race. These problems started to appear as various environmental problems on a global scale.

This chapter examines the association between a socio economic system and environmental problems and clarifies the importance of improvements of environmental efficiency to realize a sustainable society.

1. Development of Social Economy and Transition of Environmental Problems

1) Cycles in the socio economic system and natural environment

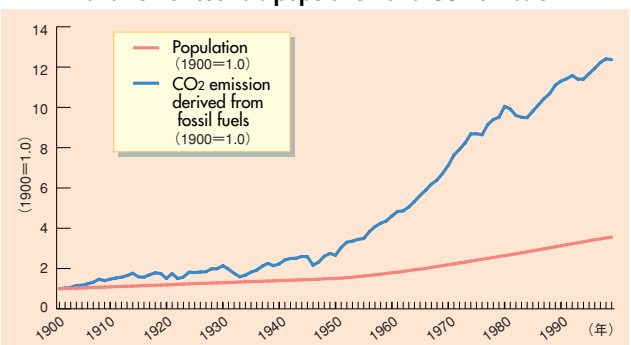
Cycle in the socio economic system and cycle in the natural environment



Presentation: Ministry of the Environment

The natural environment of the Earth can exist only while materials circulate between the atmosphere, the hydrosphere, the soil system, and the overall ecosystem maintains this delicate balance. At the same time, the socio economic system of mass production, mass consumption, and mass waste generation imposes an impact on the natural environment through collection of resources and energy and discharge of unnecessary materials. The natural environment is essential for survival of human beings such as purification of water, soil formation and maintenance, and temperature adjustment and also accommodates resources of various living organisms. The natural environment also has a function for absorbing and reducing the impact that is generated in the socio economic system within its own cycle, in addition to providing various benefits to the human race such as a valuable source for recreation and tourism. However, the capacity is limited and the functions are compromised by destruction of the natural environment and the deterioration of nature due to an increase of forestry mismanagement. As a result, the total environment load that is generated by socio economic activities exceeds the limit of the absorption and reduction functions through the cycle of the natural environment, causing various environmental problems including pollution and the destruction of nature.

Transition of World's population and CO_2 emission



Source: (Population) For the data of 1950 and earlier: United Nations, "The Determinants and Consequences of Population Trends" Vol. 1, 1973
For the data of 1950 and after:United Nations, "World Population Prospects:1998"
Presentation: (CO_2) Carbon Dioxide Information Analysis Center (CDIAC)

With regard to global warming, a large volume of fossil fuels such as oil and coal has been consumed since the Industrial Revolution. The emissions of carbon dioxide, which is the primary cause of global warming, has increased by about 12 times over the last 100 years and the density of carbon dioxide in the atmosphere has increased by 30% compared to that before the Industrial Revolution. As a result, the surface air temperature has increased by 0.6±0.2℃ globally and by 1.0℃ in Japan. IPCC (Inter-government Panel on Climate Changes) predicts that the average temperature of the ground surface will increase by 1.4℃ to 5.8℃ and the sea level will rise by 9cm to 88cm by the end of the 21st Century.

The decrease and the deterioration of forests are becoming problems due to bush fires and illegal deforestation in addition to untraditional slash-and-burn methods and inappropriate commercial deforestation. During the period from 1990 to 2000, the forest area on the global scale decreased by 94,000,000 ha. Each year, 14,200,000 ha of natural forests, which is equivalent to about the two third of Honshu in Japan, is disappearing from the tropical zone. Excessive grazing and excessive logging for making of firewood and charcoal are causing desertification and about 3,600 million ha of the land area, which is equivalent to about one fourth of the total land area of the Earth, is subject to desertification. The amount of yield from crops that are collected from the natural environment through agriculture has increased by about 2.7 times during the period from 1950 to 1995.

For diversification of organisms also, there are currently 5,435 types of animals and 5,611 types of plants that are exposed to the danger of extinction.

The impact on the natural environment is also caused by discharge of unnecessary materials. Urban wastes in the major countries in the world are increasing and in terms of the material balance in Japan, only about 10% of the total amount of wastes is recycled. Each household uses 130kg of resources per day, of which about 50kg are discharged as unnecessary materials.

With regard to resources, during the period from 1950 to 1995, the production of oil has increased by about 6.3 times and the production of iron and steal have increased by about 6.5 times. The acid rain that is caused by sulfur oxides and nitrogen oxides that are discharged into the atmosphere as a result of burning of oil and coal causes serious damage such as acidification of lakes and swamps and degradation of forests.

Condition of species that may become extinct

(Endangered animal species, 2000)

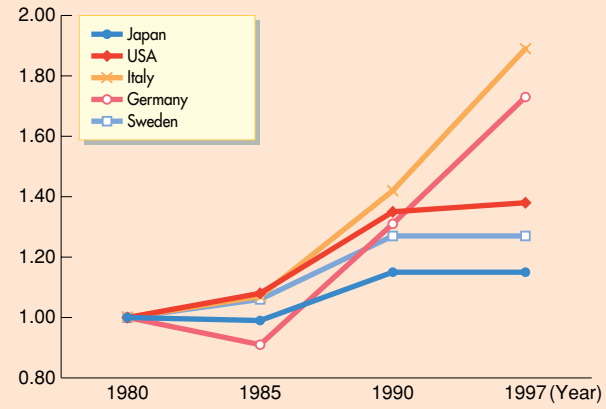
Species / Condition	Mammal	Fowls	Reptiles	Amphibia	Others	Total
Extinct	83	128	21	5	456	693
Extinct in the wild	4	3	1	0	25	33
Threatened	1,130	1,183	296	146	2,680	5,435
Endangered Ⅰ	520	503	135	63	1,057	2,278
Endangered Ⅱ (Vulnerable)	610	680	161	83	1,623	3,157
Near threatened	676	730	77	27	504	2,014

(Endangered plant species, 2000)

Species / Condition	Total number (species)
Extinct	73
Extinct in the wild	17
Threatened	5,611
Endangered Ⅰ	2,280
Endangered Ⅱ (Vulnerable)	3,331
Near threatened	951

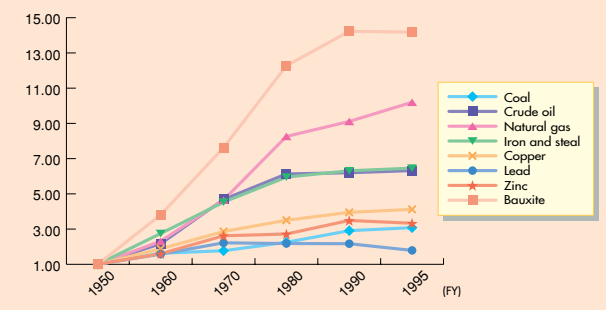
Note: Extinct in the Wild refers to the condition where the species exist under breeding or cultivation only.
Source: "The 2000 IUCN Red List of Threatened Species" IUCN

Transition of amount of wastes discharged from metropolitan areas



Note: Based on the value in 1980 as 1.
Presentation: Prepared by Ministry of the Environment based on "Environmental Data 1995," "Environmental Data 1997,"OECD

World mineral production

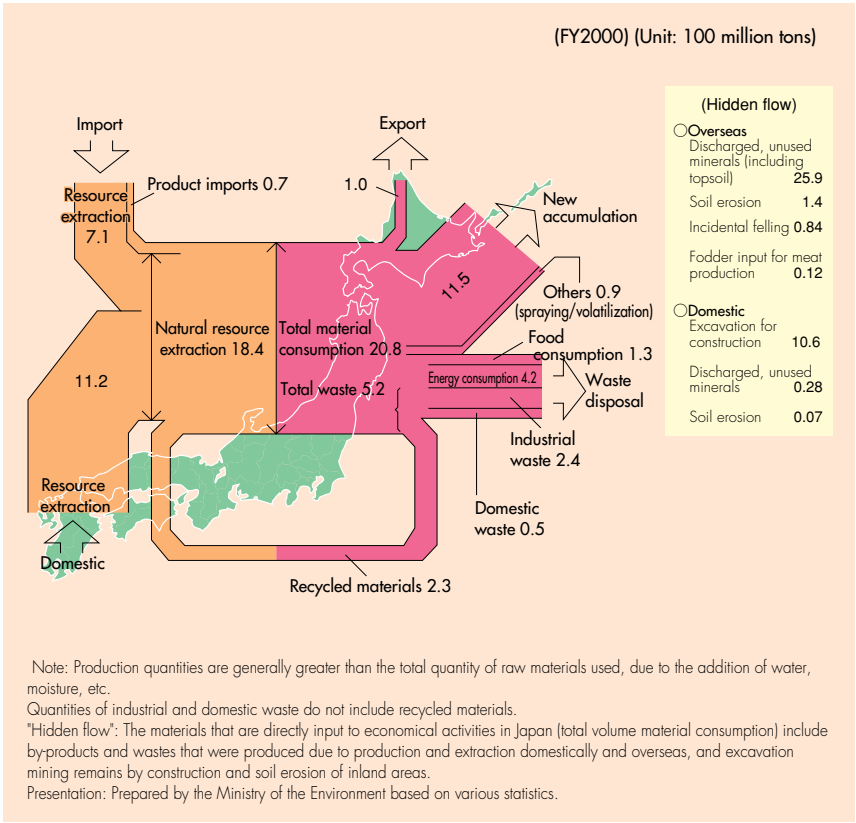


Note: Based on the value in 1950 as 1
Presentation: Created by the Ministry of the Environment based on the "Energy Production, Supply and Demand Statistics Yearbook" and "Annual resource statistics report" by the Ministry of Economy, Trade, and Industry

Ozone layer depletion is a problem caused by the emissions of CFCs that are chemically stable and non-toxic to humans and are used in many industries. An "Ozone hole" which appears when the total amount of ozone is extremely low was observed above Antarctic around 1985 and the size has expanded to 26,470,000 km^2 by 2001.

Environmental pollution problems are also caused by harmful chemical substances. Currently, about 100,000 types of chemical substances distributed globally. Many chemical substances that are considered to be harmful are detected within various environments. For instance, PCBs that was banned 30 years ago was detected in seals from the North Pole. The causes of the increase in use of the natural environment for resources and the increase of discharge of wastes include expansion of economic activities and the increase of population, which is the premise of the expansion of economic activities. During the period from 1950 to 1995, the world's GNP increased about 5.5 times and during the period from 1950 to 2000, the world's population increased to about 6000 million, which is 2.5 times over that period.

Flow of materials



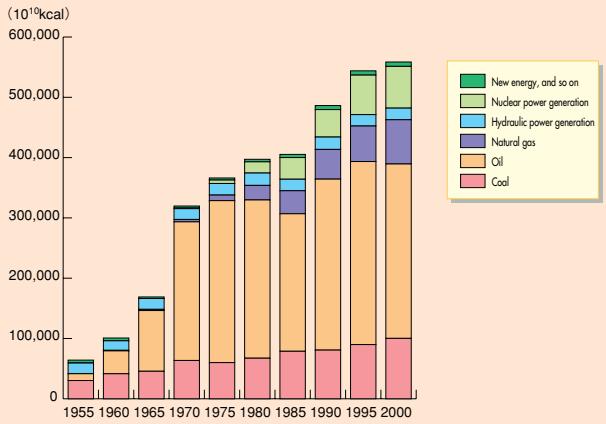
Note: Production quantities are generally greater than the total quantity of raw materials used, due to the addition of water, moisture, etc.
Quantities of industrial and domestic waste do not include recycled materials.
"Hidden flow": The materials that are directly input to economical activities in Japan (total volume material consumption) include by-products and wastes that were produced due to production and extraction domestically and overseas, and excavation mining remains by construction and soil erosion of inland areas.
Presentation: Prepared by the Ministry of the Environment based on various statistics.

In this way, the current socio economic system is continuously imposing considerable impact on the natural environment, disturbing the balance between the socio economic system and the natural environment. As a result, deterioration of the quality of the natural environment is progressing in every situation.

2. Transition of environmental problems in Japan

This section discusses the relationship between the socio economic system and the natural environment, tracing the history back to the postwar era in Japan.

Energy supply of Japan



Presentation: Prepared by the Ministry of the Environment based on the "Comprehensive Energy Statistics" of the Resource Energy Agency

During the period of rapid economic growth (first period) from mid-1950's to mid-1960's where post war economic recovery was the first priority, the energy consumption increased sharply and the rapid progress of the heavy and chemical industries that generate a large amount of pollutants per unit production value degraded the environment rapidly. Those days which the worst air pollution, the visibility dropped to 30 to 50m and some areas were filled with the penetrating odor of sulphur oxides. Red tide that is caused by explosive reproduction of plankton near the surface of water, has damaged fishery products throughout the Seto Inland Sea in 1970. Serious air pollution and water pollution evolved into major social problems, such as causing four major pollution-related diseases (Minamata disease, Niigata Minamata disease, Itai-itai disease, and Yokkaichi asthma).

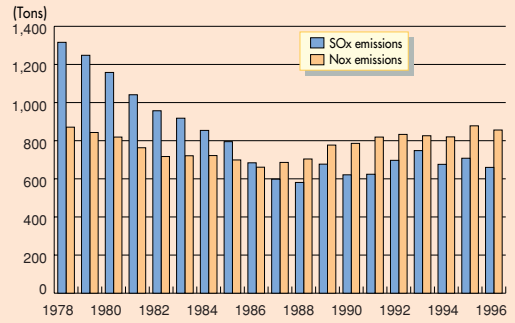
Transition of environmental problems of Japan

	Year	Social economy and science and technology	Environment status and international movement	Environmental measures of Japan
High-growth period when industrial pollution was generated (1st stage, around 1960's to 1972)	1955	- The "Economic White Paper" declared "it is no longer a post-war" material (1956) - Joined the United Nations. (1956) - Opening of metropolitan expressway (1959) Jimmu economy November 1954 to June 1957	- Itai Itai disease was detected (Jinzu River basin). (1955) - Minamata disease was detected. (1956) - Protest against factory effluent by the Tokyo Bay fishermen. (1958)	- Memorandum was exchanged with the local factory (Shimane Prefecture) * First Pollution Control Agreement by the local public bodies (1952) - Smoke Control ordinance was established (Tokyo) (1955) - Natural Parks Law was established. (1957) - Law regarding water quality conservation of public basins and law regarding factory effluent were established. (1958) - Factory Location Law was established. (1959)
	1960	- The Japan - U.S. Security Treaty was signed. (1960) - National income doubling plan (1960) - National total development plan (1962) - Joined OECD (1964) - Opening of Tokaido Shinkansen (1964) - Host the Tokyo Olympics. (1964) Iwato economy June 1958 to December 1961 Olympic economy October 1962 to October 1964	- Slime accumulation in Tagonoura, Shizuoka Prefecture (1960) Yokkaichi pollution became serious (asthma, etc.) - Smog was generated over one week. (Tokyo) (1962) - Rachel Carson, "Silent Spring" (1962) - The construction project of Mishima/Numazu industrial complex was canceled due to protest from the residents. (1964) - The second Minamata Disease was detected (Agano River basin). (1965)	- Law regarding smoke and soot emission control was established. (1962)
	1965	- The population in Japan exceeded 100 million. (1966) - European Community (EC) was established. (1967) - Japan's GNP ranked the 2nd in the world. (1968) - The first human landed on the moon. (1969) Izanagi economy October 1965 to July 1970	Expansion of Red Tide - Niigata Minamata Disease lawsuit and Yokkaichi pollution lawsuit(1967)	- Basic Law for Environmental Pollution Control was established. (1967) - Air Pollution Control Law and Noise Regulation Law were established. (1968)
	1970	- Osaka EXPO was held. (1970) - Number of passenger vehicles owned exceeded 10 million. (1971) - The Okinawa Return Agreement was signed. (1972) - The "Plan for Remodeling the Japanese Archipelago" was announced. (1972) - Club of Roma "Limits to Growth" (1972) Remodeling the Japanese Archipelago December 1971 to November 1973	- Photochemical smog damage frequently occurred in Tokyo. (1970) Serious air pollution by smoke, soot, and SOx occurred. Environmental pollution problem caused by PCB - The policy of imposing the responsibility on those who caused pollution was accepted by OECD. (1972) - Declaration on the Human Environment was accepted by the United Nations Conference on the Human Environment. (1972) - The World Environment Day (June 5) was decided by the UN General Meeting. (1972) - The UN Environment Plan (UNEP) was established. (1972)	- Fourteen pollution related measures were established in the 64th Diet session. (1970) (Marine Pollution Prevention Law, Waste Management and Public Cleansing Law,Water Pollution Control Law, Law concerning Entrepreneurs' Bearing of the Cost of Public Pollution Control Works were established.) (1970) - The Environment Agency was established. (1971) - Construction of Oze automobile road was cancelled. (1971) - Nature Conservation Law was established. (1972)
Stable-growth period when urban type pollution become noticeable (2nd stage, 1973 to middle of 1980's)	1973	- Changed to the floating exchange rate system. (1973) - 1st oil crisis caused by the 4th Middle East wars (1973) - 2nd oil crisis occurred (1979) - Three-Mile Island nuclear power plant accident occurred (USA) (1979)	- Washington Convention was accepted (UN). (1973) - The possibility of ozone depletion by CFCs was indicated. (1974) - London Convention became effective. (1975) - Serious Red Tide occurred in Seto Inland Sea. (1976)	– Law Concerning Special Measures for Conservation of the Environment of the Seto Inland Sea was established. (1973) - Chemical Substances Control Law was established. (1973) - Pollution-related Health Damage Compensation Law was established. (1973) - Notice of Japanese Version of Muskie Act (1974) - SOx emission control system was introduced. (1974) - Law Concerning the Rational Use of Energy was established. (1979) - Total pollutant load control of COD. (1979)
	1980	– Number of Japan's automobile production reached No.1 in the world. (1980) - Iran-Iraq War (1980) - The USA launched the first space shuttle. (1980)	- SOx environmental quality standard was almost accomplished. (1980) The occurrence of photochemical oxidants was decreasing. Ground subsidence expanded nationwide.	- NOx emission control system was introduced. (1981) - Law Concerning Special Measures for the Preservation of Lake Water Quality was established. (1984)
Period when global environmental problems were beginning to be recognized (3rd stage, from middle of 1980's)	1985	- Tsukuba Science EXPO was held. (1985) - Chernobyl nuclear power generation plant accident occurred. (1986) - The National Railways was divided and privatization was implemented. (1987) - World's share market collapsed (Black Monday). (1987) - The Seikan tunnel was opened and Seto Bridge was completed. (1988) Bubble Economy November 1986 to February 1991	- An ozone hole was discovered above Antarctic. (1985) - Vienna Convention for the Protection of the Ozone Layer was accepted. (1985) Continuously decrease in automobile traffic noise environmental quality standards accomplishment rate. Ground water pollution by trichloroethylene and so on spread more widely. The NO_2 environmental quality standard accomplishment rate (general bureau) deteriorated. - "Our Common Future" was announced (WCED). (1987) - The Montreal Protocol was accepted. (1987) - An Intergovernmental Panel on Climate Change (IPCC) was established. (1988) The household wastewater pollution problem became serious in the enclosed basins.	- Ozone Layer Protection Law was established. (1988)
	1989	- Tokyo Stock exchange price average reached the highest in its history (38,915 yen) (1989) - Consumption tax (3%) was introduced. (1989) - The Berlin Wall collapsed. (Integration of East Germany and West Germany) (1989) - Gulf War (1991) - Soviet Union collapsed and CIS was established. (1991) - The five-day working week system became stable and schools started to introduce the system. (1992)	- Valdez oil leakage accident (1989) The agricultural chemical problem of golf courses became evident. Automobile air pollution in metropolitan areas became serious. The dioxin problem became evident. - Basel Convention was implemented. (1992) - United Nations Framework Convention on Climate Change was accepted. (1992) - Acceptance of Biodiversity Convention (1992) - A Global Summit was held in Rio de Janeiro. (1992)	- Water Pollution Control Law was revised (prevention of groundwater pollution was regulated) (1989) - The global warming prevention activity plan was decided by the Cabinet. (enacted in1990) - Law for the Promotion of Utilisation of Recyclable Resources. (enacted in1991) - Automobile NOx Law was established. (1992) - Law for the Conservation of Endangered Species of Wild Fauna and Flora was established. (1992) - The Government development aid principle was decided by the Cabinet. - "Environmental conservation" as the basic principle. (1992)
	1993	- WTO was established. (1994) - The Product Liability Law (PL Law) was established. (1995) - Great Hanshin Earthquake (January), Underground Sarin incident (March) (1995) - The exchange rage of Japanese yen reached 1 dollar = 79 yen 75 sen (highest in the postwar history). (1995) - The consumption tax was increased to 5%. (1997) - Hong Kong was returned to China. (1997)	Pressure in the final landfill site - "Global Warming has already started" IPCC Secondary assessment report (1995) - Convention on Prevention of Desertification was accepted. (1996) - Nakhodka Oil Spill accident (1997) - Kyoto Protocol was accepted (COP3) and an emissions reduction commitment was set. (1997)	- Basic Environment Law was established. (1993) - The environment basic plan was decided by the Cabinet. (1994) - Law for Promotion of Sorted Collection and Recycling of Containers and Packaging. (enacted in 1995) - Keidanren Environment Appeal - declaration of Voluntary Action of business community (1996) - Environmental Impact Assessment Law was established. (1997)
	1998	- Single currency "Euro" was launched. (1999) - Number of people who are without jobs reached 3 million. (1999) - Reorganization of the central government ministries (2001) - Simultaneous terrorism occurred in the USA. (2001)	- Rotterdam Convention on PIC was adopted. (1998) - Tokorozawa Dioxin vegetable problem (1999) - "Climate change 2001" IPCC 3rd Assessment Report (2001) - Stockholm Convention on POPs was adopted. (2001) - COP7 (Marrakesh Agreement) (2001)	- Law for Recycling of Specified Kinds of Home Appliances was established. (1998) - Global Warming Measure Promotion Law was established. (1998) - Law Concerning the Rational Use of Energy was revised (introduction of top runner method, and so on). (1998) - Law Concerning Reporting,etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management was established (PRTR Law). (1999) - Law Concerning Special Measures for Dioxins was established. (1999) - Law on Promoting Green Purchasing was established. (2000) - Basic Law for Establishing the Recycling-Based Society.(enacted in 2000) - Food Recycling Law. (enacted in 2000) - Construction Materials Recycling Act (enacted in 2000) - New environment basic plan was decided by the Cabinet. (2000) - Fluorocarbons Recovery and Destruction Law was established (2001) - Law Concerning Special Measure against PCB waste(enacted in 2001) - Automobile NOx Law was revised (PM was added). (2001)

Presentation: Prepared by the Ministry of the Environment

From the mid-1970's to mid-1980's, the economy shifted from rapid growth to stable growth due to the oil crisis (2nd period) that hit twice and in the industrial sector, energy conservation has progressed, although the energy consumption increased in the household sector and the transportation sector. Pollution problems caused by industrial activities started to converge as a result of pollution prevention agreements made by municipalities and effects of rules and regulations of the country, and measures taken by enterprises. For instance, sulfur oxide measures regarding air pollution showed their distinguished effects. However, during this period, urban life type pollutions associated with daily living and normal business activities have become problems due to concentration of population in metropolitan areas, air pollution caused by automobile exhaust as a result of the circulation of automobiles caused by increase of income, and water pollution caused by sewage.

Emissions of sulfur oxides and nitrogen oxides (fixed source)



Presentation: Prepared by the Ministry of the Environment

In and after the middle of 1980's (3rd period), imports of not only raw materials but all the products increased and at the same time, production of high energy consumption type industries such as chemicals and pulp increased due to the price drop of crude oil. In Japan, population concentration in Tokyo accelerated and consumer spending increased due to the bubble economy. However, after the bursting of the bubble economy, Japan faced a long-term economic recession and consumption stagnation. Since the framework of environmental measures had already been constructed during the expansion period of rapid economic growth, industrial pollutions were not repeated. However, urban life type pollutions started to prevail, causing new environmental problems such as waste and recycling problems. During this period, problems of endocrine disrupters (so-called environmental hormone) were detected, many of whose scientific characteristics including toxicity are still unknown.

3. Lessons from the past examples

Turning our attention to the world's situation, in regions with the most fragile environment in the world there are some cases where destruction of the ecosystem is imposing serious influences on the social economy. Among them are examples of Aral Sea, whose size was reduced to one third and India and China, whose underground water levels are dropping sharply. Examples of the Sumer Civilization and Easter Island Civilization indicate that a civilization is ruined when the environment is degraded to an unrecoverable state. The natural environment exists in a delicate balance and we must examine the significance of the influence on the environment by continuation of such economic activities, considering these examples.

2. Socio Economic System and Environmental Efficiency

1. Sustainability and eco-efficiency

Various ideas were submitted regarding the ideal relationship between the socio economic system and the natural environment while our socio economic activities are consuming resources of the Earth gradually, and environmental pollution exceeding the self-purification capability of Nature is becoming more eminent. Of all the ideas, the idea called "sustainable development" has influenced many countries so that the idea was taken up as the main theme of the global summit held in 1992. The idea indicates the development that satisfies the desires of the current generation while satisfying the desires of the next generation. In the "Basic Environment Plan" that was revised in 2000, Japan summarized and introduced the "sustainable society" as the society that maintains the healthy relationship with various systems that are formed by the mutual relationship among the air, water, soil, and organisms that form the environment. These components carry out activities within the range that allows maintenance of self-purification capability of the environment and functions of the ecosystem, without reducing the resources, in order to avoid any adverse influence on the systems.

By linking the current economical activities and the environmental load, concepts such as "factor 10" and "factor 4" were submitted by various organizations regarding the measures to be taken by the society in order to realize a sustainable society. The common suggestion of these ideas is the necessity for reduction of environmental load per unit economical activity by improving the efficiency of the use of resources and energies as much as possible. This concept can be expressed as "eco-efficiency." Adopting the idea of eco-efficiency, this document examines particularly what roles the technology has played and how Japan's eco-efficiency has changed.

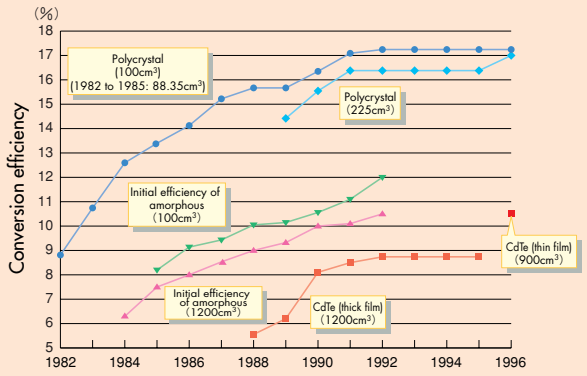
2. Improvement of eco-efficiency and progress of environmental technology

Japan has almost completely overcome serious problems created during the rapid growth period. The primary factors of this background are establishment and implementation of various regulations and the introduction of pollution control facilities by many enterprises. Constant improvement of the performance control facilities and progress in the development of engines for reduction of automobile exhaust are also to be noted. After the oil crisis, Japan has rapidly improved the energy efficiency of production facilities, transportation facilities, and electrical appliances.

Steady reduction of environment load, that is improvement of eco-efficiency, can be traced in the process of economical growth, with background development of various environmental technologies such as pollution reduction technology and energy conservation technology. It is possible to discover that, in many cases, introduction of new regulations and promotion measures in terms of policies are extremely effective.

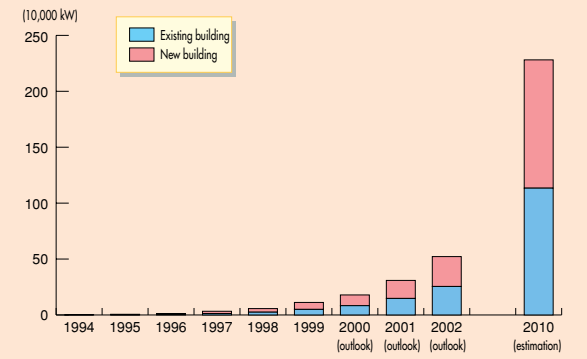
For instance, the strict exhaust gas regulation that was introduced in Japan for the first time in 1978 was one factor of the onslaught of the Japanese automobile industry on the world market. Active development of low pollution vehicles brought Japan into a superior position in the world's low pollution vehicle market, and the active development promotion policy for solar power generation resulted in rapid improvement of power generation efficiency and rapid propagation into general households. In order to realize and propagate fuel cell batteries, and to lead the world in this regard, Japan is constantly progressing with the promotion of technology development and active introduction of fuel cell batteries in public organizations including Governments.

Transition of solar battery conversion efficiency in the New Sunshine plan (cell based)



Note: CdTe: Cadmium tellurium
Source: Presentation submitted by the Comprehensive Resource Energy Research Association, New Energy Section

Result and outlook of introduction of residential solar power generation



Source: New Energy Foundation

Plan for introduction of low-emission vehicles as general public vehicles of Japan

Year	Up to 2000	Up to 2001	Up to 2002	Up to 2003	Up to 2004	Total
Number of vehicles introduced	316	1,013	1,860	1,931	1,901	7,021
Electric-powered vehicles	8	0	0	0	0	8
Natural gas vehicles	57	26	59	58	52	252
Methanol vehicles	0	0	0	0	0	0
Hybrid vehicles	251	689	1,039	1,101	1,100	4,180
High fuel efficiency/superior emissions vehicles	0	298	762	772	749	2,581

Number of ownerships	316	1,329	3,189	5,120	7,021
Introduction rate %	4	19	45	73	100

Includes the Parliament and Courts in addition to Agencies and Ministries. The number of vehicles in 2001 is an expected value and may be changed. In this case also, the installation is 100%.
Presentation: Ministry of the Environment

Conversion processes and efficiencies of various power generation methods

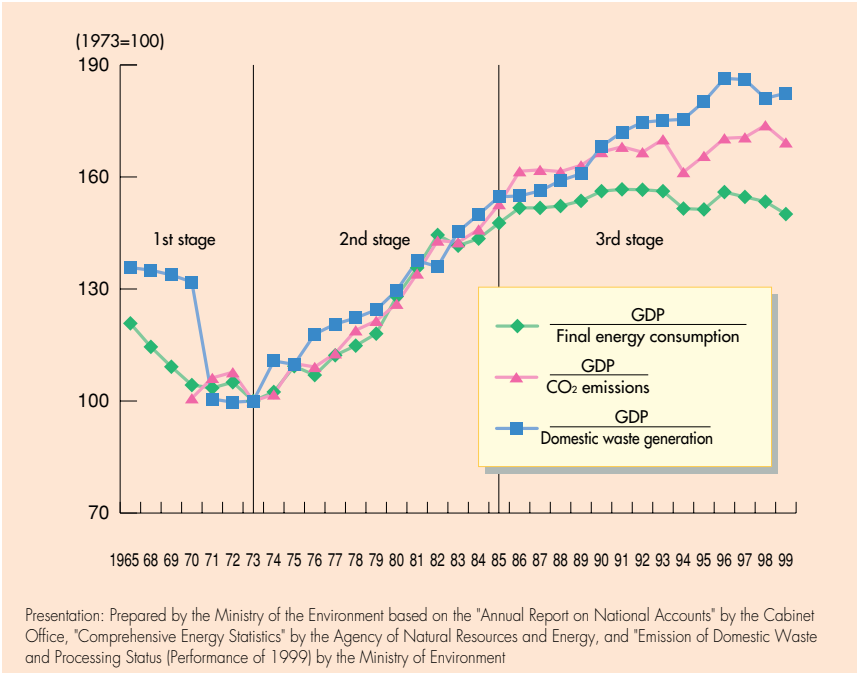
Power generation method	Conversion process	Efficiency %
Fuel cell battery	Chemical→electricity	40～60
Steam gas turbine power generation	Heat→ machine→electricity	30～42
Diesel power generation	Heat→machine→electricity	25～35
Thermoelectric converter	Heat→electricity	8～15
Thermal converter	Heat→electricity	6～10
Solar battery	Light→electricity	10～20

Note: The efficiency indicates the percentage of electric energy converted from the energy source that is indicated on the left-hand side of the conversion process.
Source: Prepared by the Ministry of the Environment based on "Story of Battery" by Hironosuke Ikewa and "Resource Energy Yearbook" by the Data Examination Association of the Ministry of International Trade and Industry

3. For improvement of eco-efficiency

This section reviews the history of Japan in terms of eco-efficiency, based on the classification by period. In this review, we took up five items as typical environmental indexes, namely, energy that is inevitable to economical activities, carbon dioxide, a contributor to global warming, nitrogen dioxide and sulfur dioxide that are air pollutants, and domestic waste that is discharged from daily life. We also took up the typical GDP as the economic index and examined the transition of eco-efficiency that is calculated by dividing an economic index by each environmental index.

Transition of eco-efficiency (final energy consumption, CO_2 emissions, an domestic waste generation)

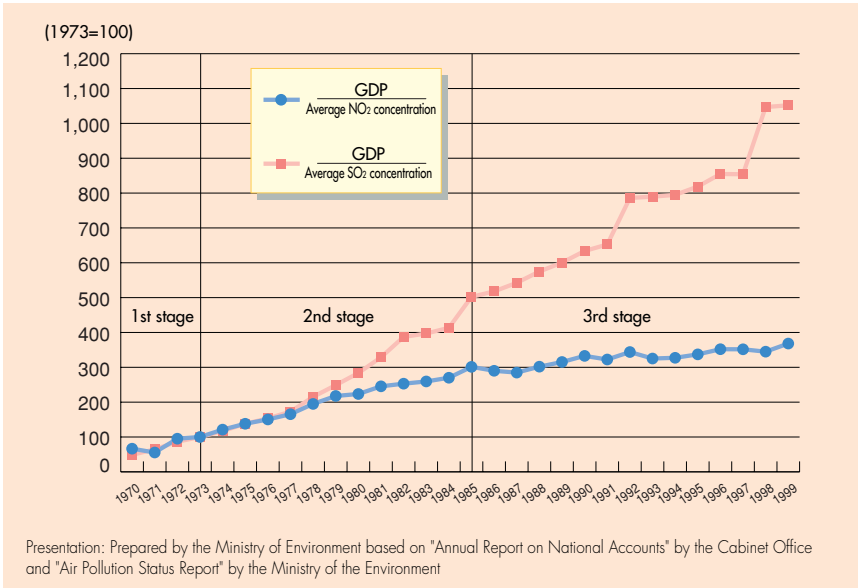


Presentation: Prepared by the Ministry of the Environment based on the "Annual Report on National Accounts" by the Cabinet Office, "Comprehensive Energy Statistics" by the Agency of Natural Resources and Energy, and "Emission of Domestic Waste and Processing Status (Performance of 1999) by the Ministry of Environment

Initially, during the period up to 1973, which is up to the occurrence of the first oil crisis (1st period), the eco-efficiency deteriorated gradually, regarding energy and domestic waste. This is because Japan was in the rapid growth era and priority was given to economic growth, instead of giving adequate consideration to environmental conservation and as a result the environment load increased at a rate exceeding the economic growth rate. The eco-efficiency of nitrogen dioxide and sulfur dioxide is improving as a result of improvement of various regulations.

During the 2nd period (from early 1970's to 1985) when the Japanese economy shifted from the rapid economic growth to a stable economic growth, the eco-efficiency improved in all the environmental indexes. The eco-efficiencies of energy, carbon dioxide and general waste improved at the same speed. This was due to the thorough application of energy conservation and resource conversation in the national level, which was triggered by the oil crisis. In particular, within the energy field, the eco-efficiency in the industrial sector improved constantly, while the eco-efficiency of the residential sector of the consumer sector has leveled off. The reason is that although there were factors for improving the eco-efficiency by energy conservation of various appliances, the spread of household electrical appliances to each household prevented improvement of the eco-efficiency. In the transportation sector, the eco-efficiency of the passenger sector leveled off or slightly deteriorated. One of the causes that can be considered is that automobile ownership increased at a rate exceeding the economic growth rate.

Transition of eco-efficiency (average NO_2 concentration and average SO_2 concentration)

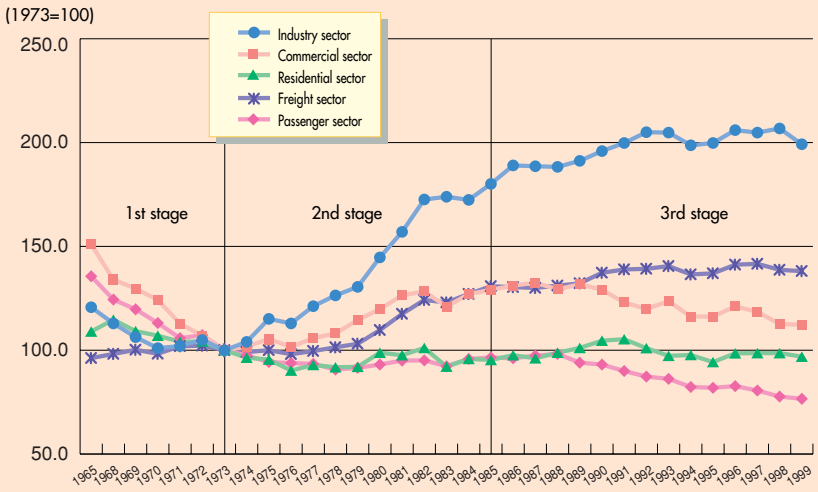


Presentation: Prepared by the Ministry of Environment based on "Annual Report on National Accounts" by the Cabinet Office and "Air Pollution Status Report" by the Ministry of the Environment

Finally, for the period from 1985 (3d period), when global environmental problems started to be recognized as serious issues, the eco-efficiencies of nitrogen dioxide and sulfur dioxide, and domestic waste have improved smoothly, however, the eco-efficiencies of energy and carbon dioxide remained on the same level although slight improvements were made.

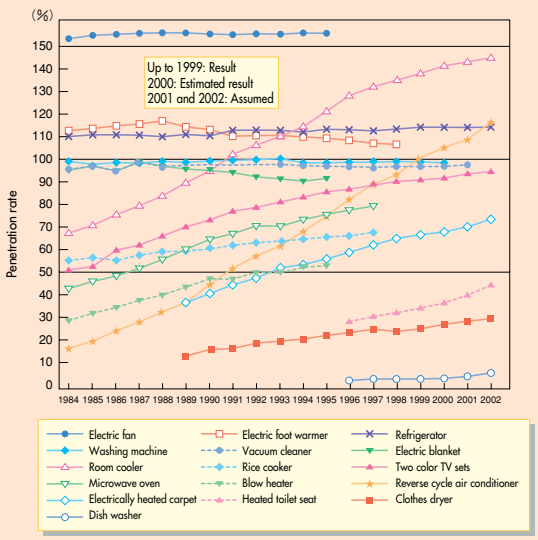
Regarding the energy eco-efficiency by sector, initially some business types of the industrial sector made gradual improvements. However, the eco-efficiencies have deteriorated in most business types since 1992 and 1993 under the background of stability of the price of crude oil at a low level from 1985 and restraining of investment to expensive energy conservation facilities. The eco-efficiency of the residential sector remained the same, while the eco-efficiency of the commercial sector deteriorated due to the increase of office areas and introduction of personal computers. In the transportation sector, increase of shipment of small items such as door-to-door deliveries hindered improvement of eco-efficiency in the freight sector and at same time, the eco-efficiency of the passenger sector showed continuous deterioration due to the increased popularity of large passenger vehicles.

Transition of energy eco-efficiency in each sector



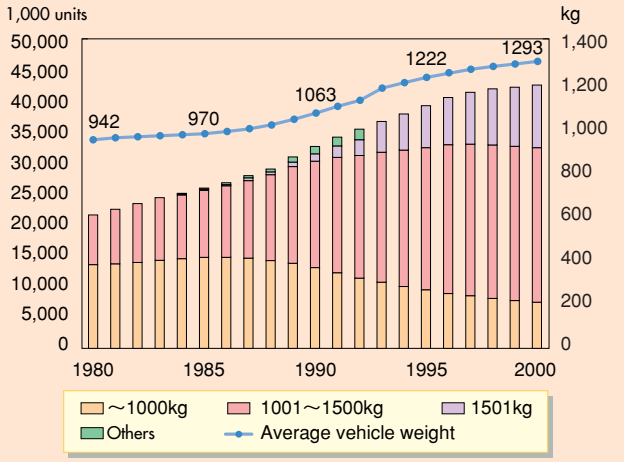
Presentation: Prepared by the Ministry of the Environment based on the "Annual Report on National Accounts" by the Cabinet Office, "Comprehensive Energy Statistics" by the Agency of Natural Resources and Energy,

Home electrical appliances penetration rate



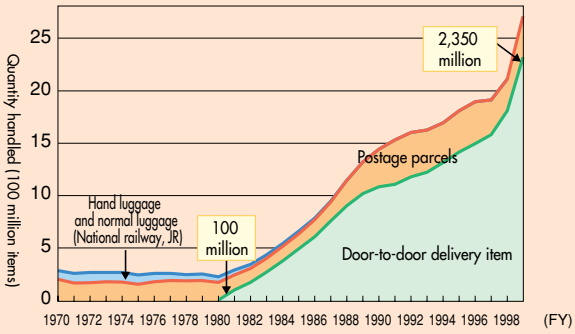
Note: The penetration rate of color TV sets refers to the second and subsequent TV sets.
Source: Japan Power Investigation Committee

Transition of automobile ownership and average body weight by vehicle type



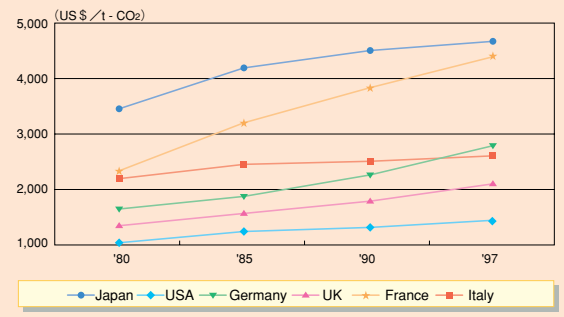
Note: In 1992 or earlier, mini-van and one-box cars of 1501kg or more were classified as "Others", however, from 1993, they were classified by weight.
Presentation: Number of vehicle ownerships by type: Prepared by the Ministry of Land, Infrastructure, and Transport based on the "Automobile Inspection & Registration Association."

Transition of small item transportation amount



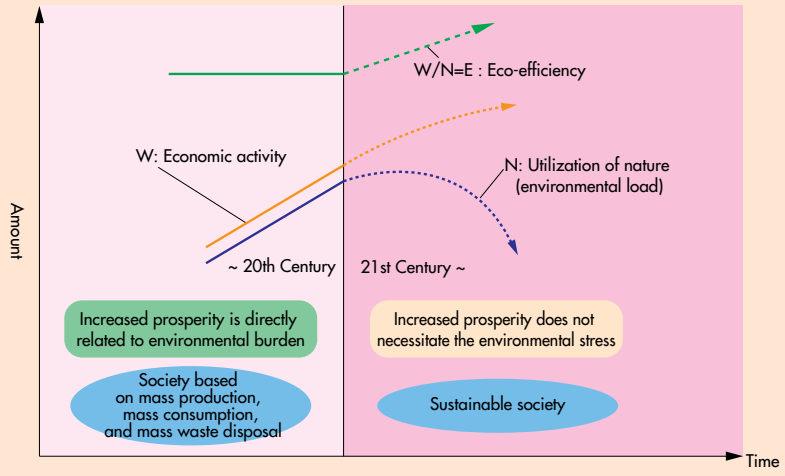
Source: "Summary of Transportation Economic Statistics" by the Ministry of Land, Infrastructure, and Transport

International comparison of transition of eco-efficiency associated with carbon dioxide



Presentation: Prepared by the Ministry of the Environment based on OECD "Environmental Date 1999" and EDMC" Summary of Economy of Energy Statistics"

Move toward a sustainable society



Presentation: Prepared by the Ministry of the Environment based on the data of EEA (European Environment Agency)

The eco-efficiency in Japan is progressing as described above. In comparison with other countries using carbon dioxide as an example, the eco-efficiency of Japan is extremely high although other countries have shown improvements in eco-efficiency.

However, such eco-efficiency in each country is still not adequate.

As discussed in Section 1, the impact on the global environment is still increasing and the balance between human activities and the eco-system such as environmental purification is quite unstable. To improve this situation, reduction of the environmental load as a whole is imperative and to realize this objective, the eco-efficiency must be improved to a level exceeding the economic growth.

Japan once steadily increased the eco-efficiency during the stable economic growth period. Therefore, it is possible to improve the eco-efficiency while achieving economic growth. In particular, Japan holds the 2nd position in the world on the economic scale and emits about 5% of world's carbon dioxide, which ranks it in the 4th position in the world. Thus, under the circumstances where Japan is imposing a serious environmental load on the Earth and reduction of the environmental load is a serious issue on the global scale, Japan must make greater efforts in improvements of eco-efficiency by utilizing its experiences.