

## Environmental issues confronting China and necessary measures : Implications drawn from Japan's experience

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# Environmental issues confronting China and necessary measures

-Implications drawn from Japan's experience-

Katsuaki Nagaike

## Abstract

Japan has overcome the various environmental problems it has experienced since the postwar high-growth era on the basis of cooperation between the public and private sectors. As a result, Japan possesses various world-leading environmental pollution prevention technologies.

Continued growth of the world economy is in prospect, centering on China and the wider Asia region. Having largely completed the economic take-off phase, the countries involved are on track to eventually become mature industrial societies. However, economic growth exacerbates issues concerning the environment and natural resources.

Without improved environmental technology, continued growth of the economies of China and neighboring countries would disrupt the relationship among the environment, natural resources and economic growth. The disruption would have serious consequences for the global environment. Only by deploying state-of-the-art environmental technologies can China and countries elsewhere in Asia achieve economic growth without disrupting this relationship. Japan's efforts to tackle environmental issues have not always met with complete success or proceeded smoothly. Rather, progress has been achieved through a process of trial and error. It is to be hoped that China will deal with environmental issues by adopting rational approaches, learning from Japan's experience and avoiding any repetition of its errors.

## Key Words

environment, natural resources, economic growth, regulations, technological development

## Contents

### I. Environmental issues confronting Shanghai as a frontrunner of China

1. Environmental issues confronting Shanghai
2. Environmental measures implemented by Shanghai

### II. Activities in Japan

1. From industrial pollution to urban and lifestyle-related environmental problems



2. Responses to environmental problems

**III. Issues concerning global warming, exhaustion of resources (including waste issues), and chemical substances**

1. Issues concerning global warming

2. Issues concerning exhaustion of resources (including issues concerning waste and waste disposal sites)

3. Issues concerning chemical substances

**IV. Conclusion**

**I. Environmental issues confronting Shanghai as a frontrunner of China**

**1. Environmental issues confronting Shanghai**

Only within the last two decades have the environmental issues affecting Shanghai come to be perceived as constituting a major problem. In particular, issues concerning pollution of the atmosphere and water and solid waste have become pressing. Regarding atmospheric pollution, TSP (total suspended particulate) and SO<sub>2</sub> (sulfur dioxide) have posed major problems. From 1981 to 1987, both were at levels twice or three times in excess of the international standard. Despite some temporary improvement in the situation, motorization has emerged recently as a new source of pollution.

Water pollution has long been a problem for Shanghai. Major pollutants used to be heavy metals, phenol, phosphor and petroleum waste. These chemical substances were discharged as a result of agriculture and from industrial parks, as well as from sewers. In the early 1990s industry accounted for 85% of these major pollutants discharged in China, and sewers accounted for 14%. Suzhou Creek became seriously polluted from the 1950s onward, and the Huanpu River from the 1970s. The number of days when an offensive odor was apparent in Shanghai increased from 28 days in 1975 to 229 days in 1988. However, the situation has improved dramatically owing to the efforts of the city administration.

Shanghai is also confronted by the problem of industrial waste. Waste generated by the industrial sector has more than doubled in the past 15 years. Discharges, which averaged 5.8 million tons per year during the 1980s, had risen to 13.1 million tons by 1996. In that year, municipal waste in Shanghai amounted to 4.18 million tons. As a result of the city administration's campaign to reduce discharges of waste, 84% of the waste is now reprocessed. Also, a large waste treatment facility has been opened at the mouth of the Yangtze.

During the 1980s there were about 10,000 factories on the outskirts of Shanghai releasing large volumes of industrial waste gases, effluents, and chemical waste, as well as causing noise pollution. From the 1950s onward Shanghai promoted development of heavy industry and the chemical industry—industries requiring large inputs of natural resources. To provide electricity for these industries, the city constructed a coal-fired 6,000 MW power plant. Consumption of coal reached 35 million tons in 1995 (Shanghai Statistics Bureau, 1996). Emissions



of SO<sub>2</sub> and TSP increased. For example, SO<sub>2</sub> emission increased from 390,000 tons in 1989 to 510,000 tons in 1996.

## 2. Environmental measures implemented by Shanghai

### 1) Major measures to date

The City of Shanghai has made great efforts to deal with its environmental problems. The ratio of Shanghai's investment in environmental measures to its GDP increased from 0.85% in 1991 to 2.4% in 1996.

Table 1. Shanghai's investment in environmental measures and the ratio to GDP (%)

	91	92	93	94	95	96
Investment in environmental measures	1	2	4.23	5.14	6.12	
Ratio to GDP (%)	0.85	1.36	2.13	1.98	1.89	2.4

Source: The Shanghai Environmental Protection Bureau, 1996, Fu-Chen Lo & Peter Marcotullio, "Globalization and the Sustainability of Cities in the Asia Pacific Region," 2001, The United Nations Univ.

In accordance with the laws and regulations of China and the City of Shanghai concerning prevention of environmental pollution and resource management, the City of Shanghai implemented the following measures to prevent environmental pollution.

#### Major environmental measures

- Improvement of laws and regulations concerning the environment
- Improvement of environmental assessment systems
- Pre-registration system concerning environment
- Imposition of penalties concerning pollution
- Improvement of pollution prevention facilities

### 2) New goals

In its latest five-year plan, Shanghai has established a new set of pollution-prevention goals at the heart of its efforts to deal with environmental issues.

- Establishment of environmental standards on a par with those of leading international cities
- Establishment of long-term goals for environmental measures (up to 2010)
- Promotion of the Green Project by the Environmental Protection Bureau

### 3) Shanghai's emergence as an international city and expected environmental issues

The City of Shanghai has dealt with environmental issues by implementing the series of measures mentioned



above and investing heavily. Some good results have been achieved.

Nevertheless, it is essential that Shanghai continue to promote environmental protection measures with the utmost vigor. Assuming that Shanghai continues to enjoy real economic growth of 9-10% per year, environmental problems are expected to increase as the economy expands.

At the same time, Shanghai needs to tackle various problems so as to attract foreign investment and emerge as an international city where international companies like to do business, and moreover, provide a secure desirable environment for everyone living and working in Shanghai.

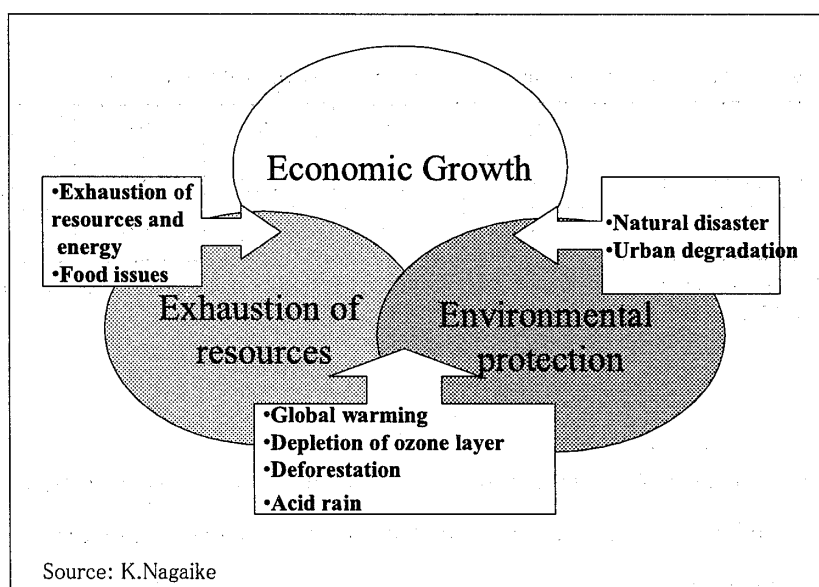


Fig. 1 Conflicting claims of economic growth, environment and natural resources

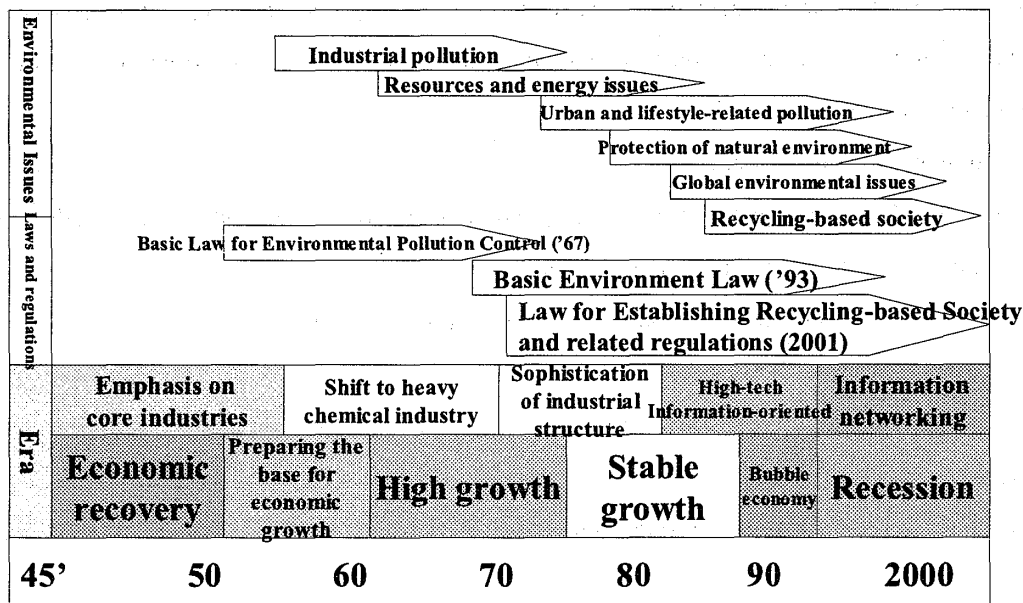
## II. Activities in Japan

### 1. From industrial pollution to urban and lifestyle-related environmental problems

In Japan industrial pollution posed severe problems during the postwar years of high economic growth. Indeed, diseases attributable to pollution, notably Minamata disease and itai-itai disease, caused grave concern throughout society. Regarding atmospheric pollution, smog emerged as a problem in 1962, and sludge pollution caused by effluents from factories occurred. The enactment in 1967 of the Basic Law for Environmental Pollution Control marked the beginning of the thorough implementation of pollution countermeasures in Japan. However, in 1970 photochemical smog affected the inhabitants of Tokyo and other cities. Thus, pollution of the atmosphere, soil and water became a major concern across much of the country.

In the 1970s the Club of Rome's "Limits to Growth" report focused on the natural-resource constraints on economic expansion, triggering widespread debate on the topic. The oil crises of 1974 and 1979 brought this issue home with a vengeance. Although the Japanese economy, based on large inputs of natural resources and





Source: Prepared by K. Nagaike

Fig. 2 Japan's environmental issues and background

mass production, was damaged by the crises, energy-saving measures helped it enter a period of stable growth. Subsequently, various environmental pollution problems attributable to excessive urbanization worsened. Whereas industrial pollution had previously been the main culprit, urban and lifestyle-related environmental problems, as well as global environmental problems, came to the fore in the 1990s. The priority accorded to the economy and efficiency in urban development fueled the growth of conurbations with major environmental impacts. Impacts attributable to developments in urban lifestyles, such as increasing water contamination and the heat island phenomenon due to increased energy consumption, became prominent in the context of the overall issue of the environment.

## 2. Responses to environmental problems

The Basic Environment Law was formulated by the Ministry of the Environment (the Environment Agency at the time) in 1993 and the Environmental Policy Outline was formulated by the Ministry of Land, Infrastructure and Transport (the Ministry of Construction at the time) in 1994.

The Environmental Policy Outline states that the environment consists of natural phenomena, such as the atmosphere, water, land and organisms, and artificial phenomena, such as public facilities, housing and other buildings and structures, and that various activities of human beings are based on the environment. It contends that, because the development of housing and the social infrastructure affects the natural environment, in the execution of projects the maximum consideration should be accorded to environmental protection while accomplishing the objective of creating a better environment for everyone.

Based on this fundamental principle, the Japanese government is promoting the creation of a richer



environment through the improvement of systems, clarification of goals, securing of the necessary budgets, enhancement of awareness among people, and cooperation with relevant ministries, local authorities, the construction industry and private bodies.

The concrete measures are as follows:

- (1) Creation of a high-quality, aesthetically pleasing environment to be bequeathed to succeeding generations
- (2) Conservation of a sound and bountiful environment
- (3) Promotion of energy-efficient residential property and other buildings
- (4) Improvement of energy-efficient road transport
- (5) Development of urban and regional structures conducive to lower CO<sub>2</sub> emissions
- (6) Promotion of urban planting
- (7) Development of environmentally conscious public transportation

### III. Issues concerning global warming, exhaustion of resources (including waste issues), and chemical substances

As mentioned above, Japan has experienced various environmental problems since the period of high economic growth. They are listed below.

- (1) Water contamination
- (2) Atmospheric pollution
- (3) Global warming
- (4) Energy issues
- (5) Issues concerning control of chemical substances
- (6) Issues concerning treatment of waste
- (7) Issues concerning contamination of soil and groundwater

In the course of implementing measures to deal with these problems, Japan has accumulated expertise and experience that can contribute to solutions.

This paper focuses on three of these environmental issues: global warming, exhaustion of resources (including waste issues), and chemical substances.

Shanghai appears to have already overcome the seven typical types of pollution concerning the atmosphere, water and offensive odor, whereas the three problems highlighted in this paper are expected to become pressing for Shanghai for the following reasons.

1) Environmental problems characteristic of large cities will become more serious in Shanghai just as they have in cities in Japan, 2) issues concerning the consumption of large amounts of energy and increase in waste and issues concerning chemical substances will come to the fore as personal consumption rises in line with the growth of GNP and population.



In order to give appropriate consideration to environmental issues and overcome problems, it is important to have the right mix of environmental laws and regulations, improve the environmental infrastructure, and develop technology. For this purpose, it is essential that a single body have paramount and clear responsibility for each of these elements. If a paramount body is not clearly established, it is difficult to solve environmental problems because in the absence of an authoritative organization no body is inclined to take the initiative.

Firstly, the government is responsible for the formulation of laws and regulations with which the private sector must comply. Rather than focusing solely on control, the government should provide support in order to facilitate compliance by the private sector. To that end, various measures need to be implemented. Secondly, the government should take the initiative in improving the infrastructure. Thirdly, it is crucial that both the government and the private sector engage in technological development and cooperate.

Thus, it is essential that the public and private sectors clarify their roles in terms of the above three aspects and address environmental problems.

## **1. Issues concerning global warming**

### **1) Current problems and expected problems**

(1) Due to heavy consumption of energy derived from fossil fuels, CO<sub>2</sub> emissions increase and global warming is exacerbated.

(2) Problems concerning energy security (power shortages, unstable supply, instantaneous power failure, etc.)

(3) Heat island phenomenon

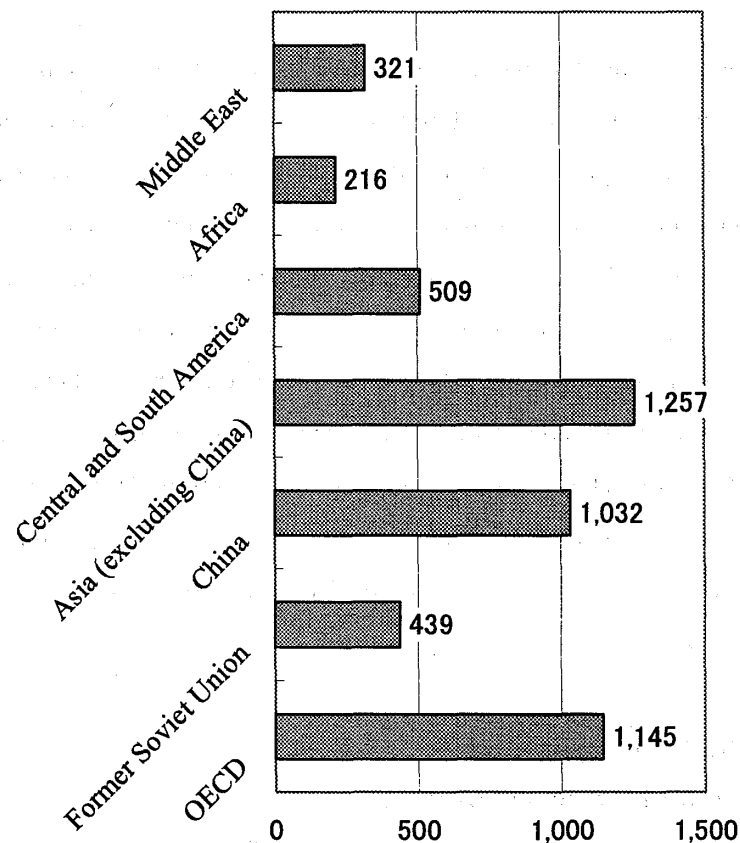
(The average temperature in Tokyo increased 2.9% in the last 100 years; it increased 1.8% in the last 10 years.)

(4) Circular Route No. 8 cloud: the appearance of strange clouds over Circular Route No. 8 in Tokyo

Among the causes of these phenomena is the growing affluence of society and individuals, 1) the diffusion rate of electrical home appliances (especially air conditioners and refrigerators) has risen, and the capacities of these appliances have increased, 2) the diffusion rate of cars has increased, and 3) constant connection to power has become commonplace in line with the development of IT.

According to the trend of worldwide energy demand for different types of fuel, the proportion of natural gas is expected to increase from 22% in 1997 to 26% in 2020, whereas those of oil and coal are expected to decrease slightly. Despite the fluctuation of proportions, consumption of oil, coal and natural gas will increase as worldwide energy demand rises. China and countries elsewhere in Asia are expected to account for 45%, 77% and 25% of the increases in consumption of oil, coal and natural gas, respectively, during the period from 1997 to 2020.





Note: Asia: South Korea, Taiwan, ASEAN countries, India  
Source: IEA World Energy Outlook, 2000

Fig.3 Growth of demand for primary energy  
(1997-2020)

Considering these prospects, if economic growth continues and the world population grows until the middle of the 21st century, CO<sub>2</sub> emissions, CO<sub>2</sub> concentration and SO<sub>2</sub> emissions are certain to increase and the temperature of the Earth will rise. As a result, the rise in sea levels is likely to become a pressing issue.\*

\*According to the second assessment report (1995) of the Intergovernmental Panel on Climate Change (IPCC), the global average surface temperature was projected to rise by 1 to 3.5°C over the period from 1990 to 2100, but this was revised to a 1.4 to 5.8°C rise in the third assessment report (September 2001).

To deal with such problems, it is essential to promote energy saving on a global scale.

## 2) International activities

Major international activities concerning global environmental issues include the following:

- i ) Establishment of the Intergovernmental Panel on Climate Change (IPCC) (1988)
- ii ) United Nations Framework Convention on Climate Change (1992)



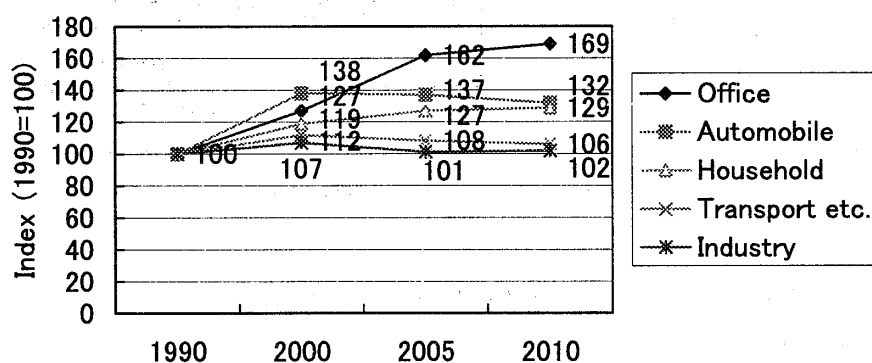
- iii) Kyoto Protocol (1997) → Kyoto Mechanism → Ratification (ratification during the current year is highly unlikely.)

### 3) Activities in Japan

Energy consumption is forecast to increase in the administrative and household sectors.

Forecast of energy consumption in Japan by sector (benchmark year: 2001)

Countermeasures in Japan are discussed below in terms of policies (laws and regulations), improvement of infrastructure and systems, and technology development.



Source: White Paper on the Environment

Fig.4 Forecast of energy consumption in Japan by sector  
(benchmark year: 2001)

(Source: Report by the Advisory Committee on Energy and Natural Resources)

#### (1) Policies (laws and regulations)

The following are major laws and regulations.

##### i) Law concerning the Rational Use of Energy

- 1) 1979: Oil shock
- 2) Revised in 1993
- 3) Revised in 1998: Top Runner Program. Designated types of business are required to achieve 1 % improvement per year.
- 4) Revised in 2002: Designation of certain types of business required to achieve 1 % improvement per year was eliminated (office buildings, large stores, hospitals, hotels, theme parks, etc.).

For example, the home appliances industry is making vigorous efforts to reduce the energy consumed by all types of home appliances (televisions, washing machines, refrigerators, etc.) and good results have been achieved.



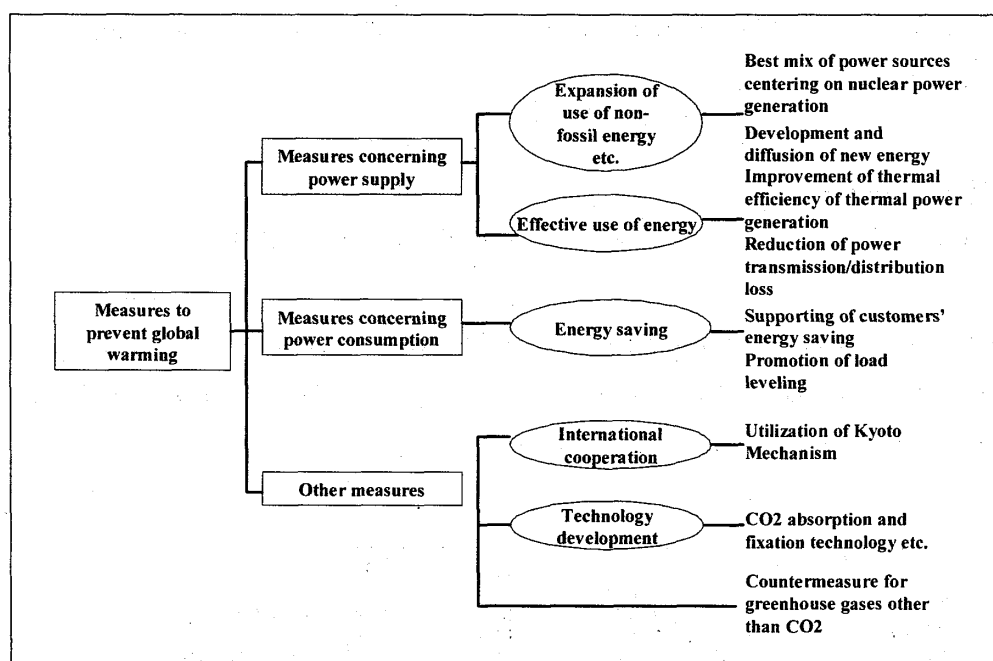


Fig. 5 Commitment to prevention of global warming

## ii) Law concerning Measures to Cope with Global Warming

1) Enacted in 1998

2) Revised in 2002: Ensuring of precise and smooth execution of the Kyoto Protocol, formulation of a plan to achieve the targets of the Kyoto Protocol\*, establishment of a global warming prevention headquarters

\*The government is required to formulate a plan to achieve the targets of the Kyoto Protocol, and review the targets and measures set by the plan in 2004 and 2007 and change them, if necessary. A draft plan is to be drawn up by the government's global warming prevention headquarters for approval by the cabinet.

## iii) Outline for Global Warming Prevention

1) 1998: The government's global warming prevention headquarters (Chief: the prime minister)

2) Revised in 2002: Targets fulfillment of obligations of the Kyoto Protocol (a 6 % reduction in emissions by 2010 compared with 1990)

## (2) Improvement of infrastructure and systems

i) Tax privileges for energy-saving facilities

ii) Fuel shift (coal, oil → natural gas)

iii) Promotion by municipal ordinances (Municipal ordinances set stricter requirements than national laws.)



iv) Rooftop garden promotion system\* Heat island countermeasures

\*Rooftop garden (living space)

In line with urban development, there will be more reinforced concrete buildings and steel-framed reinforced concrete buildings and less open space and vegetation. The roofs of such buildings are covered with waterproof asphalt or waterproof urethane. The temperature of buildings increases and areas where the density of buildings is high become heat islands. Moreover, air conditioning releases a lot of heat during the summer and the urban air temperature becomes two to five degrees higher than that of the surrounding countryside. To prevent the urban heat island effect, it is necessary to implement measures for reducing air temperature, for example, by creating rooftop gardens. Measures include the planting of trees and grass to absorb solar energy and installation of solar panels.

Improvement of expressways

v) Promotion of modal shift\*\*

**\*\* (Related matters)**

Japan's electronics and IT companies are restructuring physical distribution in Japan and overseas as part of their efforts to reduce the environmental impact of their operations. They are endeavoring to reduce CO<sub>2</sub> emissions, a cause of global warming, by shifting from truck and air transportation to rail and sea transportation. The Ministry of Land, Infrastructure and Transportation has started preparing legislation to support modal shift to more environmentally friendly means of transportation.

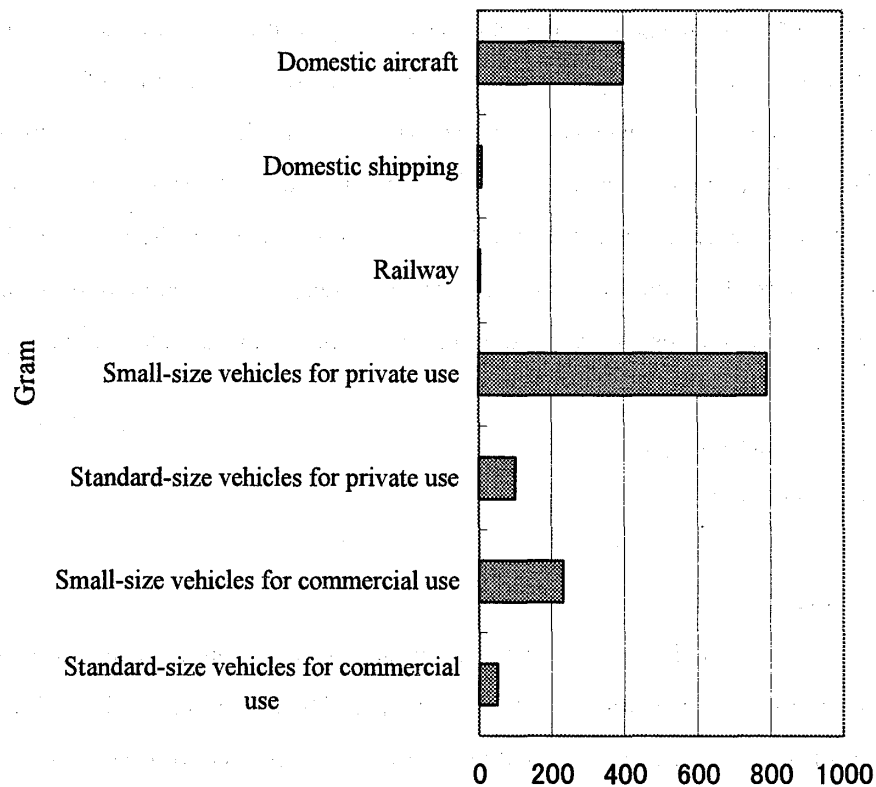
(Modal shift: The shift of freight transportation from trucks and air to railroads, ships, and other means of transportation that use less energy per unit of cargo transported.)

NEC intends to completely switch transportation to Japan of desktop personal computers manufactured in China from air to sea within the current fiscal year. NEC will also restructure physical distribution within Japan. Its truck transportation network will be restructured to create a network based on trunk lines. Canon is switching about 20% of transportation of products from truck to rail and sea during the current fiscal year. Matsushita and Hitachi have started collaborative development of a unique indicator for accurate clarification of the environmental impact of trucks, which will be used as a criterion for selecting transportation companies. Companies that use fuel-efficient trucks for highly efficient transportation will be accorded priority in the selection process.

At COP3 held in Kyoto in 1997, Japan was allocated the target of reducing greenhouse gas emissions by 6% in 2010 compared with 1990. In the Outline for Global Warming Prevention revised in March 2002, the Japanese government announced its intention of reducing CO<sub>2</sub> emissions by 9.1 million tons by means of modal shift and more efficient physical distribution. The Ministry of Land, Infrastructure and Transport is preparing a bill concerning modal shift for submission to the ordinary session of the Diet next year. Under the contemplated



system, provided that a CO<sub>2</sub> reduction plan formulated by a company is approved, the state will subsidize some portions of the cost incurred by the company.



Source: White Paper of Environment 2000

Fig.6 CO<sub>2</sub> emissions for different means of freight transport  
(Conversion into CO<sub>2</sub> carbon quantity emitted per 1 km/1 ton transportation)

Table 2 Environmental measures of Japanese electronics and IT companies concerning physical distribution

NEC	15% reduction of CO <sub>2</sub> emissions in Japan in fiscal 2004 compared with fiscal 2000
Canon	20% reduction of CO <sub>2</sub> emissions in Japan by fiscal 2006 compared with fiscal 2000
Matsushita	5 % reduction of CO <sub>2</sub> emissions in Japan by fiscal 2003 compared with fiscal 2001
Hitachi	Preparation of an environmental indicator jointly with Matsushita within the current year and selection of transportation companies
IBM Japan	10 to 20% of PC servers manufactured in China were switched from air to sea transportation from May 2002.
Sharp	15% of physical distribution of products in Japan is to be switched to rail by fiscal 2004.
Mitsubishi Electric	6 % of home appliances and heavy apparatus for the Japanese market is transported by rail.
Sony	Use of rail containers jointly with Toshiba
Toshiba	Use of rail containers jointly with Sony
Fujitsu	16% increase in the use of rail containers in fiscal 2003 compared with fiscal 2001

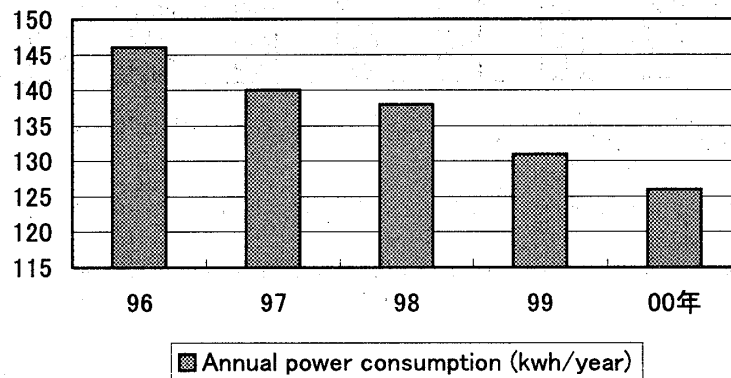
Source: Nihon Keizai Shinbun



### (3) Technology development

#### i) Trend of power consumption of home appliances

The figure below shows the trend of annual power consumption of a TV. The downward trend is evident at a glance.

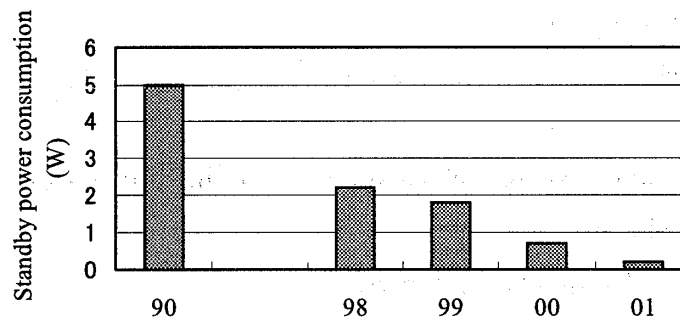


Source: CECC-JEITA

Fig.7 TV annual power consumption (kwh/year)  
(28"-29"TV with BS tuner/unit: Annual average)

#### ii) Decline of standby power of home appliances

The downward trend of power consumption covers all types of home appliances. The figure below shows power consumption of home appliances during standby. It is also on a downward trend.



Source: CECC-JEITA

Fig.8 Standby power consumption of home appliances  
(Annual average per unit)

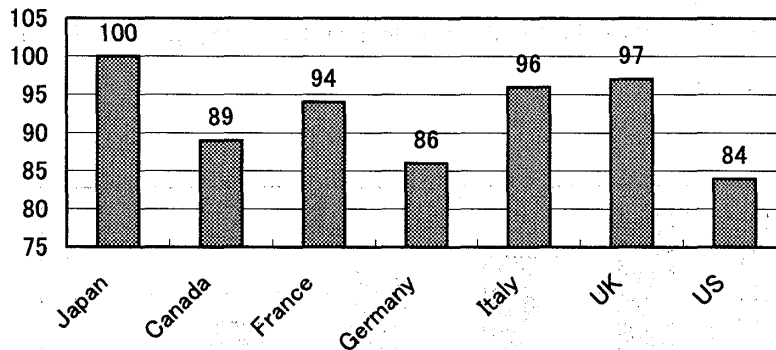
#### iii) Non-fossil fuel cogeneration

#### iv) Fuel cells

#### v) Desulfurization technology



- vi) Coal gasification combined-cycle power generation
- vii) High-efficiency power generation



Source: Estimation based on the Energy Balances of OECD Countries, 1998 (TEPCO)

Fig.9 International comparison of thermal efficiency of thermal power generation  
(Japan: 100)

- viii) Hybrid vehicles
- ix) Fuel-cell-powered vehicles

Toshiba is working on the following:

- i) Improvement of energy efficiency of facilities characterized by heavy consumption of energy (freezers, compressors, boilers)
- ii) Vigorous investment in energy saving, promotion of energy saving that does not require investment, well-balanced operation through improvement of clean rooms
- iii) Vigorous development of energy-saving products: Top Runner Program of the Law concerning the Rational Use of Energy
- iv) Fuel cells (including fuel cells for home use currently under development)

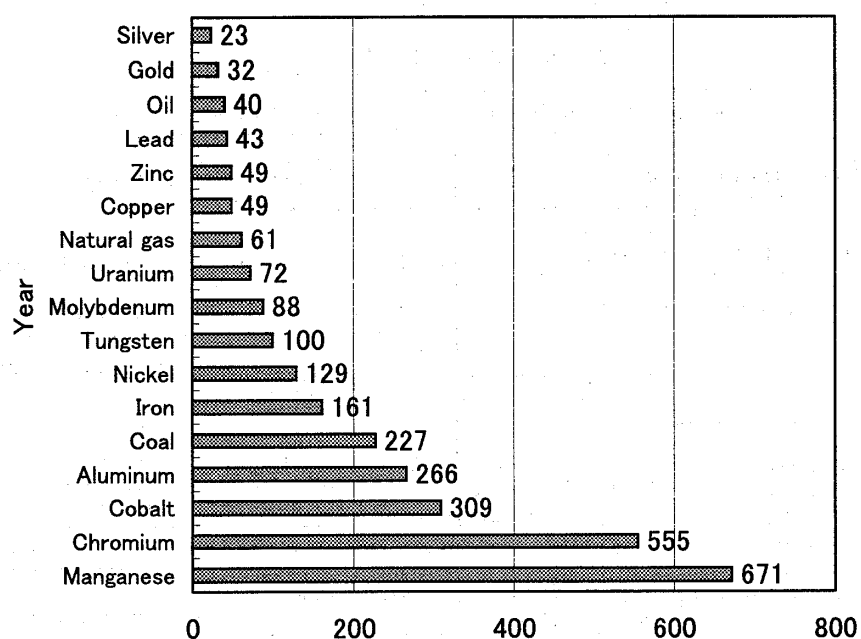
## 2. Issues concerning exhaustion of resources (including issues concerning waste and waste disposal sites)

### 1) Current problems and expected problems

In line with the increase in population and rising affluence, household waste (including raw garbage) has been increasing. As a result, problems concerning exhaustion of resources are arising.

- i) Shortage of waste disposal sites
- ii) Generation of dioxins by incinerator plants
- iii) Increase in illegal disposal of waste
- iv) Outflow of toxic substances from landfill disposal sites (contamination of groundwater)





Degree of exhaustion of resources  
Source: White Paper on the Environment

Fig.10 Number of years remaining for major energy and mineral resources

Causes of these problems include the following:

- v ) Increasing wastefulness as affluence rises (throwaway culture, one-way containers)
- vi ) Steep rise in disposal costs due to shortage of disposal sites → Illegal disposal of waste
- vii ) Generation of dioxins by intermittent incineration

The following countermeasures need to be promoted:

- i ) Improvement of legal framework and systems, such as clarification of treatment methods and securing of disposal sites
- ii ) Countermeasures at the source (Reduce, Reuse, Recycle)
- iii ) Effective utilization of resources and reduction in waste volume through promotion of recycling

## 2) International activities

Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal (Basel Treaty, 1989) and Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (Bamako Treaty, 1991) are major international moves.

## 3) Activities in Japan

Activities conducted in Japan are described in the following order: policies (laws and regulations), improvement of infrastructure and systems, and technology development.



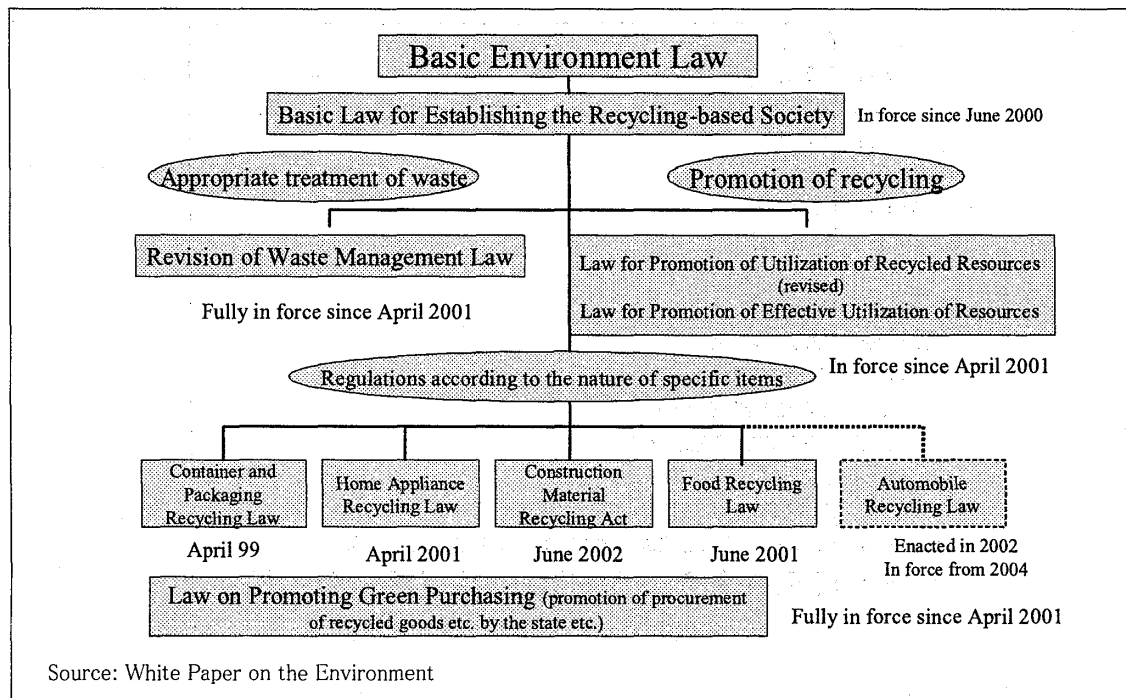


Fig.11 Legal framework for building a recycling-based society

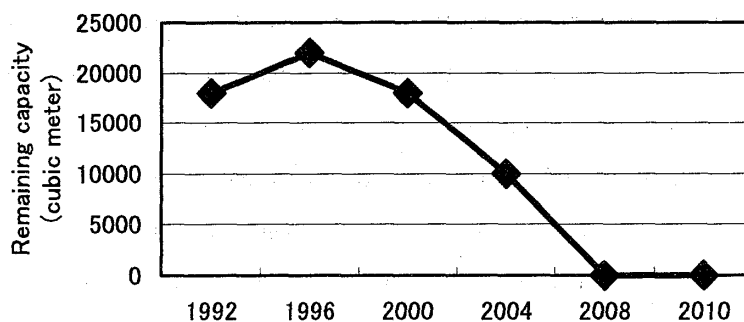
( 1 ) Policies (laws and regulations)

- i ) Waste Management Law: Appropriate processing
- ii ) Law for Promotion of Effective Utilization of Resources: Promotion of recycling
- iii ) Basic Law for Establishing the Recycling-based Society: This framework law superior to i ) and ii ) defines recycling of resources.
- iv ) Law Concerning the Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities (Law on Promoting Green Purchasing): Mandates the according of priority to procurement of environmentally friendly products
- v ) Laws on recycling of specific items: Home Appliance Recycling Law, Container and Packaging Recycling Law, Construction Material Recycling Act, Food Recycling Law, Automobile Recycling Law: Promote recycling of end-of-life products that are massive in quantity, large, and difficult to treat

( 2 ) Improvement of infrastructure and systems

- i ) Incinerator plants: Establishment of more sophisticated plants for each municipality
- ii ) Securing of garbage disposal sites: Debt guarantee system funded by the public and private sectors for constructing garbage disposal sites
- iii ) Monitoring of illegal dumping: Monitoring cameras, neighborhood-watch patrols, cooperation on monitoring of illegal dumping (TAXI), formulation of various measures by municipalities





Source: White Paper on the Environment

Fig.12 Remaining capacity of final disposal sites

### (3) Technology development

- i ) Development of technology related to incinerator plants: Unintentionally generated substances
- ii ) Recycling technology

Toshiba is promoting the following:

- i ) Zero emission (Zero emission is expected to be achieved in fiscal 2002.)

## 3. Issues concerning chemical substances

There are some 100,000 to 200,000 chemical substances used in industry. Erroneous use or handling of these substances can cause environmental pollution. Numerous issues have not been clarified scientifically and early implementation of comprehensive measures is important.

### 1) Current problems and expected problems

- i ) Health damage caused by air pollution due to toxic substances is expected to occur frequently.
- ii ) Regarding impacts on the ecosystem, impacts on the human body via the food chain are a concern.
- iii ) Sick house syndrome (new construction materials) may be caused.\*

\*Allergic reaction caused by formaldehyde released from adhesive agents contained in new construction materials and paints, and by agricultural chemicals used for extermination of termites. Sick house syndrome, a type of hypersensitivity to chemical substances, is becoming a focus of attention. To avoid this syndrome, homes should be built using construction materials that do not contain toxic chemical substances and ventilation should be adequate during construction and occupation. The Japan Federation of Housing Organizations, comprising enterprises related to housing, has issued guidelines on the quality of indoor air in order to control formaldehyde released from construction materials. Formaldehyde becomes formalin when dissolved in water. The guidelines recommend that formalin-containing adhesive agents for wallpaper and paints and adhesive agents containing organic solvents, such as toluene and xylene, not be used.

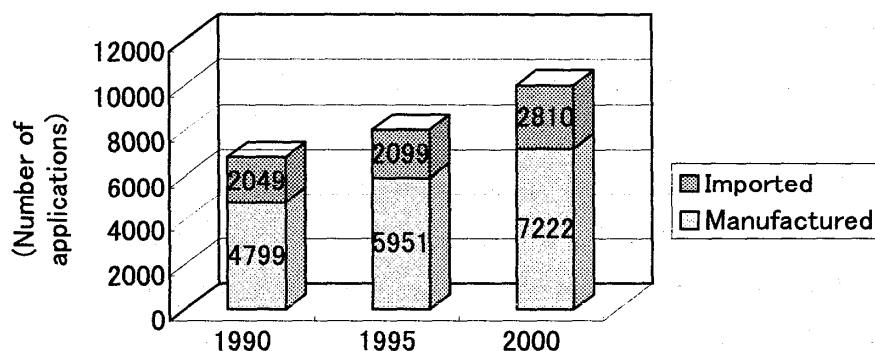


The underlying reality is that contemporary lifestyles are sustained by various products containing chemical substances. Some 50,000 types of chemical substances are commercially available in Japan. As well as being contained in products, chemical substances released into the environment, contaminating the atmosphere, water and soil, and at various phases of business activities from manufacturing to disposal may be degraded swiftly or accumulated in the environment, eventually entering living organisms via the food chain.

- i ) Development of new chemical substances (Several hundred new chemical substances are developed and enter use each year.)
- ii ) Many substances have been marketed without their toxicity being clarified.

The safety of many chemical substances currently available has not been assessed and their impacts on human health and the ecosystem are unknown. Also, some chemical substances may have an adverse impact on human health and the ecosystem depending on the method of production, use and emission.

No chemical substance should be accorded the benefit of the doubt; rather, measures grounded in a rigorously scientific approach should be implemented. Not only conventional regulatory approaches, but also new approaches are required to reduce the environmental impacts of chemical substances effectively and economically.



Source: Ministry of Health, Labor and Welfare, Ministry of Economy, Trade and Industry, Ministry of the Environment.

Fig.13 Number of applications filed for new chemical substances in accordance with the Law concerning the Examination and Regulation of Manufacture etc. of Chemical Substances

- iii ) Unintentional generation of chemical substances

Some newly developed chemical substances may have unexpected impacts.

An annual "Tracking survey of incidences of pollution due to toxic chemical substances" has been conducted since 1985 to clarify the persistence of unintentionally generated chemical substances in the environment. (The name of the survey was changed to "Tracking survey of incidences of pollution due to unintentionally generated chemical substances" in 1993.) In fiscal 2000, PCB pollution of water, bottom sediment, organisms (fish) and the atmosphere and



brominated dioxin pollution of bottom sediment were investigated.

Manufacture and importation of PCB and use of PCB in an open environment ceased in 1972. However, considerable quantities of PCB still exist. There is a need for continued monitoring and clarification of the pollution mechanism. Although the quantity of residual brominated dioxins is less than that of chlorinated dioxins, measurement sensitivity needs to be improved in order to grasp the actual situation. Enactment of the Law Concerning Special Measures against Dioxins has prompted the launch of research projects. For example, a survey of incidences of brominated dioxin pollution is conducted periodically.

Because dioxins are extremely toxic and do not degrade easily, intake of tiny amounts may eventually have a large impact. Dioxins are generated unintentionally during combustion of substances containing carbon, hydrogen or chloride. At present, garbage incinerator plants are the major sources of dioxins in Japan. Other sources include thermal processes for metal refining. The following are measures concerning unintentionally generated chemical substances.

- Emission inventory
- Improvement of inspection systems for dioxins
- Clarification of impacts on health and the environment
- Promotion of research and technology development
- Promotion of waste treatment and recycling measures

## **2) International activities**

International activities concerning toxic chemical substances include the following:

- i ) Implementation of PRTR systems in OECD countries
- ii ) Upon recommendation of the OECD, Japan started a pilot program in 1997 and introduced PRTR in 2001
- iii) WEEE and RoHS Directives
- iv) The European Parliament adopted a directive on waste electrical & electronic equipment (WEEE Directive) and a directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive) in May 2001, and a proposal for an EEE Directive on the environmental impact of electrical and electronic equipment was submitted in February 2001.

## **3) Activities in Japan**

(1) Policies (laws and regulations)

- i ) Law concerning the Examination and Regulation of Manufacture etc. of Chemical Substances:  
Class 1 specified chemical substances (11 substances: prohibition of actual use), Class 2



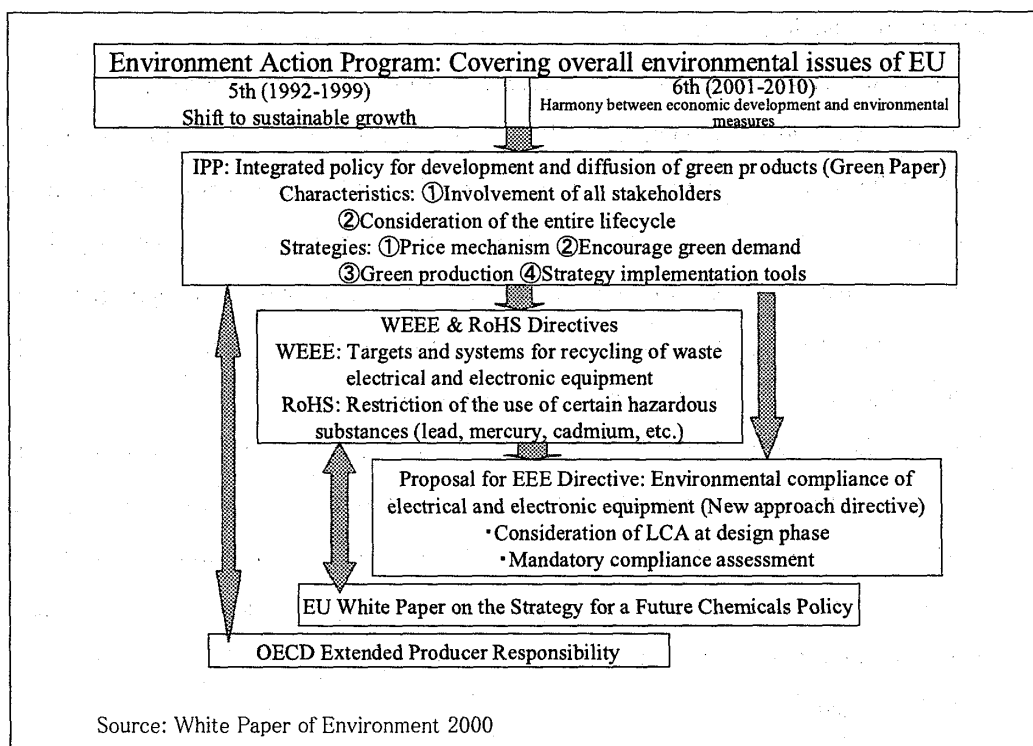


Fig.14 EU systems for electrical and electronic equipment

specified chemical substances (23 substances: standards for technology and labeling), Designated chemical substances (342 substances)

- ii) Industrial Safety and Health Law: Prohibition of manufacturing, permission of manufacturing, labeling; Ordinance on the Prevention of Organic Solvent Poisoning, Ordinance on Prevention of Hazards due to Specified Chemical Substances
- iii) Fire Defense Law: Hazardous materials
- iv) Poisonous and Deleterious Substances Control Law
- v) Law Concerning Special Measures against Dioxins (2000)
- vi) Law Concerning Reporting etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (PRTR and MSDS Law) (2000) (actually 2001)
- vii) Law Concerning Special Measures against PCB Waste (2001)
- viii) Law Concerning Recovery and Destruction of CFCs (2002)
- ix) Law Concerning Measures against Soil Pollution (2003?)

## (2) Improvement of infrastructure and systems

- i) MSDS (Material Safety Data Sheet)\*

\*MSDS: In order to promote improvements in companies' management of chemical substances, in the case that a company transfers or provides any product containing chemical substances subject to MSDS to another company, the company transferring or providing such product is



**Table 3** Comparison of PRTR systems of major countries (Source: Ministry of the Environment)

Country	System	Substances within the scope	Facilities within the scope	Handling of submitted data	Commencement
US	TRI (Toxic Release Inventory) Program	Approx. 620 substances	Manufacturers etc. (Specified industry groups. Number of employees and annual amount handled)	Individual data and aggregated data are disclosed	1986
Canada	NPRI (National Pollutant Release Inventory)	268 substances	Manufacturers etc. (Specified industry groups. Number of employees and annual amount handled)	Individual data and aggregated data are disclosed	1993
UK	PI (Pollution Inventory)	Approx. 150 substances	Manufacturers etc. (Industry groups are listed. Annual amount released)	Individual data are disclosed	1990
Japan	PRTR (Pollutant Release and Transfer Register)	354 substances	Manufacturers etc. (Industry groups are listed. Number of employees and annual amount handled)	Aggregated data are disclosed (Individual data are disclosed upon request)	2001

Note: PRTR (Pollutant Release and Transfer Register) Program: Companies clarify the amounts released to the environment of chemical substances that are potentially harmful to human health and the ecosystem and the amounts of such chemical substances transferred as waste, and report the amounts to the authorities. Based on the reports and estimates made using statistics, the authorities clarify the amounts of chemical substances subject to PRTR released to the environment and the amounts of such substances transferred as waste, aggregate the data and disclose the data.

obliged to provide data on the nature and handling of the chemical substance in advance.

ii) Risk assessment (assessment of toxicity etc.)

iii) Construction of hazard database

iv) Labeling

### (3) Technology development

i) Development of detoxification equipment

ii) Replacement

iii) Detoxification

iv) Adoption of a closed system

v) Recycling (including refining)

vi) Green sustainable chemistry (GSC): Chemical industry

Toshiba is promoting the following:

i) Mandatory assessment of new raw materials

ii) Control of chemical substances based on classification into three categories (prohibition of use, reduction of use, control of release) and reduction of the amount consumed and the amount emitted

iii) Optical and catalyst decomposition methods for PCB



## IV. Conclusion

### 1) Japan's experience

Japan has overcome the various environmental problems it has experienced since the postwar high-growth era on the basis of cooperation between the public and private sectors. As a result, Japan possesses various world-leading environmental pollution prevention technologies.

Continued growth of the world economy is in prospect, centering on China and the wider Asia region. Having largely completed the economic take-off phase, the countries involved are on track to eventually become mature industrial societies. However, economic growth exacerbates issues concerning the environment and natural resources.

Without improved environmental technology, continued growth of the economies of China and neighboring countries would disrupt the relationship among the environment, natural resources and economic growth. The disruption would have serious consequences for the global environment. Only by deploying state-of-the-art environmental technologies can China and countries elsewhere in Asia achieve economic growth without disrupting this relationship. Japan's efforts to tackle environmental issues have not always met with complete success or proceeded smoothly. Rather, progress has been achieved through a process of trial and error. It is to be hoped that China will deal with environmental issues by adopting rational approaches, learning from Japan's experience and avoiding any repetition of its errors.

### 2) Implications of Japan's experience for China

China should address three principal environmental issues: global warming, exhaustion of resources (including waste problems), and chemical substances.

These three environmental issues also require a commitment at the global level. For its part, Japan is endeavoring to tackle these issues.

This paper has introduced Japan's efforts to deal with the various environmental problems it has experienced, while also touching on international activities. Although certain problems have been solved, others remain.

The following conclusions are reached based on a consideration of the problems experienced by Japan and the countermeasures it has employed.

- 1) It is critical to strike a balance among the conflicting claims of economic growth, environmental issues and natural resource issues.
- 2) In order to give appropriate consideration to environmental issues and overcome problems, it is important to have the right mix of environmental laws and regulations, improve the environmental infrastructure, and develop technology. For this purpose, it is essential that a single body have paramount and clear responsibility for each of these elements. If a paramount body is not clearly established, it is difficult to solve environmental problems because in the absence of an authoritative organization no body is inclined



to take the initiative.

Firstly, the government is responsible for the formulation of laws and regulations with which the private sector must comply. Rather than focusing solely on control, the government should provide support in order to facilitate compliance by the private sector. To that end, various measures need to be implemented. Secondly, the government should take the initiative in improving the infrastructure. Thirdly, it is crucial that both the government and the private sector engage in technological development and cooperate.

Thus, it is essential that the public and private sector clarify their roles in terms of the above three aspects and address environmental problems.

In particular, the exercise of dynamic leadership by the municipal government is a prerequisite for success.

- 3) China should be preparing thoroughly for the environmental problems referred to above. As illustrated by the control of automobile exhaust (the Muskie Act), laws and regulations to deal with environmental problems should impose standards that are as strict and high as possible. Although it may be difficult initially to satisfy the standards, strict laws and regulations stimulate the vigorous efforts and awareness of companies and individuals regarding environmental issues and lead to the improvement of environmental technologies.
- 4) Furthermore, it is important to enhance the quality of human resources development, maintenance of facilities and management know-how in order to promote utilization of environmental problem prevention facilities. In this regard, Japan's abundant experience and human resources should make it an attractive partner for China.

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