Chapter 1

HISTORY OF AIR POLLUTION CONTROL IN JAPAN

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1.1 INTRODUCTION

The quality of a country's environment depends on complex relationships. These include the country's economic growth patterns, use of resources, density of population, geographical formations, political administration, and social attitudes. Accordingly, this chapter discusses the impact of these and other factors on the principal events that comprise the history of air pollution control in Japan.

Japan lies on a 3000 km-long archipelago situated in the western Pacific. Ragged mountain ranges run down the center of the main island of Honshu and form the divide between the Pacific Ocean and Japan Sea sides of the country. Japan is in a temperate climatic zone and has four seasons. It is a small country, consisting of about 370,000 km^2, of which only a quarter is flat. Nearly 60% of the population lives in 2.6% of the total land area. Japan's population was 34 million in 1868, 73 million in 1946, and 120 million in 1984. In 1983, life expectancy was 74.20 years for men and 79.78 years for women. In 1984, the birth rate was 12.5 per 1000, the crude death rate was 6.2 per 1000, and the natural increase rate was 6.3 per 1000. At present, 9.8% of the population is over 65 years old.

The Meiji Restoration of 1868 marks the end of the rule of feudal shoguns and the emergence of the modern Japanese state. The arrival of Commodore Perry's canon-bearing black ships ten years earlier and the subsequent realization that Japan was far behind the West in technological development convinced the Meiji leaders that Japan urgently needed rapid economic development.

Economic growth was especially swift during the 1950s and 1960s. The economic growth during this period amplified the factors which formed the basis of Japan's air pollution problem. Population, GNP, assets, and energy consumption per unit of habitable land increased dramatically. Table 1.1 shows that in Japan in 1983 these variables were much higher than in West Germany, France, Great Britain, and the United States. In addition, the size of Japanese industrial sectors which consumed energy and raw materials expanded in relation to all industrial sectors. Between 1935 and 1983, primary energy consumption in Japan increased 10.9 times, and electric power generation increased 25.0 times. In the late 1950s, hydropower began to supplement coal, which was Japan's primary energy source. In the mid-1960s, petroleum largely replaced coal, and in 1965 nuclear power began to be used increasingly. In accordance with policies adopted to deal with the first and second oil shocks, petroleum consumption has declined and coal and nuclear energy consumption have increased. In 1969, liquid natural gas was introduced as an alternative, clean fuel. In the past two decades, the energy demand structure has also changed. The mining and manufacturing sectors consume less energy due to conservation programs, and the transportation and consumer sectors consume more. The latter is due to a shift in the mode of transportation from railroads to automobiles and in the increased use of air conditioning in homes and offices.

Six principal factors had an impact on the management of air pollution control in Japan. These are: (i) relevant clauses in the Meiji Constitution and the current constitution; (ii) the role and effectiveness of the central and local governments; (iii) the court decisions in the pollution trials; (iv) legislation, economic incentives, and technology related to air pollution control; (v) growth, development, energy, and transportation policy; and (vi) international pollution-related events. Table 1.2 presents a chronological overview of pollution-related events from 1868-1984.

1.2 THE PREWAR PERIOD

The Meiji Restoration of 1868 ended the rule of the Tokugawa Shogunate and Japan's 300-year-old, closed-door policy. The new, Meiji leaders restored the seat of sovereignty to the emperor and created a modern, central government. They moved the capital from Kyoto to Edo, newly named Tokyo. In 1868, the two

TABLE 1.1
Population, GNP, assets, and energy consumption per km^2 of habitable land

	Japan	W.Germany	France	Britain	U.S.A.
Population	1,452	386	158	357	55
GNP (10^6 YEN)	2,989	1,161	436	648	130
Total Fixed Assets (10^6 YEN)	952	265	94	137	20
as percentage of DNA	31.9%	22.8%	21.6%	20.3%	15.7%
Energy Consumption (Coal Equivalent; ton)	5,230	2,240	700	1,750	520

Source: National Land Agency, Annual Report 1983 largest cities were Tokyo and Osaka, and the population of Tokyo was already over one million. Urbanization and industrialization in Tokyo, Osaka, and other cities began to cause environmental degradation. The worst problems were cholera, urban filth, black smoke, and offensive odours from animal processing plants. This section describes some of the most famous cases of air pollution in the prewar period.

The Ashio copper mine case. Copper had been mined at Ashio along the banks of the Watarase River since the early 1600s. By 1880, air and water pollution from the mine began to take its toll on the lives of the area's farmers and fishermen. Emissions from the mine's smelter contained a high concentration of SO_2, which devastated about 5000 ha of forest in the vicinity.[1]

The mine's effluent contained sulfuric acid, ammonia, aluminum oxide, magnesia, iron, copper, chlorine, arsenic, nitric acid, and phosphoric acid. The effluent drained into the Watarase River, which irrigated the land, and ruined the farmers' crops.[2]

In 1891, Ashio's farmers and fishermen began to demand that the government order the mine to take pollution control measures or to shut down completely. In the following years, they gained the support of prominent Meiji scholars, writers, and statesmen. M.P. Shozo Tanaka called on the government to protect the people's constitutional rights and to revoke the mine's concession. The government responded by forming the Ashio Mining Hazards Study Committee under direct control of the Cabinet, but little concrete action was taken. On 23 March 1897, 800 farmers marched to Tokyo to demand action. They were intercepted by police and a violent skirmish broke out. Faced with a peasant uprising, the government had no recourse but to take action. On 27 May 1897, the Minister of Agriculture and Commerce issued a schedule for preventive construction. Accordingly, in 1898 the Ashio mine built precipitation and filtration ponds and installed desulfurization equipment. However, these measures proved largely ineffective and air pollution from the mine continued to devastate the forest and farmland in the area.

The Besshi copper mine case. Records indicate that residents who lived near the Besshi mine in Shikoku were already lodging complaints against the mine during the Tokugawa era in the 1600s. In 1885, the government approved the installation of a new blast furnace in the village of Niihama on the sea coast, despite the protest of farmers' unions in the surrounding area. The new furnace discharged smoke with a high concentration of SO_2, and farmers began to notice crop damage, as they had warned would happen. The farmers appealed to the prefectural government to take relief measures and remove the blast furnace from Niihama. The Osaka Mine Safety Bureau and the agricultural laboratory of the Ministry of Agriculture, Trade and Industry confirmed the existence of crop damage from smoke. Nevertheless, the operators of the mine continued to deny

Table 1.2

A chronological overview of pollution-related events from 1868-1984

Year	Age Character & Population	Economic, Social & Political Remarks
1868 1888	Meiji Restoration 34×10^6 1872	Open to foreigners, Catch up with West, Modern state, Urbanization
1889 1930	Imperial Congress 39×10^6 1889	Strong nation, Wealthy state, Social movement Wars, Heavy industry
1931 1945	Mobilization for War, Militarism 65×10^6 1931	Economic panic, Rural decline, Suppression
1946 1949	Post War Chaos, New Constitution 73×10^6 1946	SCAP order, War-devasted cities, Poverty, Hunger, Disorganization of old power
1950 1954	Economic Recovery, Peace Treaty, Korean War 83×10^6 1950	National Comprehensive Development Law; (Food, Energy, Disaster)
1955 1959	Economic Growth 89×10^6 1955	Urbanization, Industrialization, Energy Shift (Coal to Petroleum
1960 1964	Regional Industrial Development 93×10^6 1960	Mass production, Consumption, Organized anti-pollution action
1965 1969	Adverse Side Effects of High Economic Growth 98×10^6 1965	Socialist power locally, Archipelago reform plan
1970 1974	Special Congress, Court Decisions, Social Crisis 111×10^6 1970	Social & political crisis, $ shock, Oil shock, Stockholm Conference, PPP
1975 1979	Crisis is Over, World Recession 120×10^6 1975	Economic recession, International Issues
1980 1984	Administrative Reform, Global issues 120×10^6 1984	New, high technology, Structural change of industry, International issues, Responsibility

Environmental Issues
Epidemics, Urban filth, Black smoke, Offensive odours, National heritage protection, Police control
Mining hazard disputes, (Ashio, Besshi, Hitachi) Industrial pollution, Mining Law, Factory Law, City Planning Law etc.
Urban hygiene (air, noise), National park, Rural sanitation, Strict liability
Epidemics, DDT spray, Special city plan for reconstruction, Industrial Pollution Control Ordinance (Tokyo)
Public Ceasing Law, Ube City approach to air pollution, MHW survey on pollution, Atomic bomb test at Bikini
Smoke Control Law, Public investment for sewage, Incinerator nightsoil digestion plant
Basic Law for EP Control Measures, MHW conclusion of itai-itai disease, Low sulfur fuel supply plan by MITI
Drastic policy changes, Environment Agency, Compensation Law, Strict liability, Total Mass Regulation, EIA etc.
Amenity, Habitat, Energy & resource saving, Stringent autoexhaust control
Lake eutrophication, Transport & Environment, Terminal disposal of wastes, Green conservation, Cabinet Resolution of EIA, Global Environment

any connection between the smoke from its plant and the farmers' crop damage.

In 1898, the Osaka Bureau of Mines issued an order based on the Mining Law of 1890 directing the mine to move its operations to Shisaka Island in the Inland Sea. The company moved the mine in 1905, but this resulted in an expanded zone of smoke damage in the new area.[4]

In 1923, the mine installed new stacks, but they proved ineffective in reducing air pollution. In 1925, the mine installed a Petersen-type sulfuric acid recovery system and increased the height of its stacks to 48 m.[5] These measures at last succeeded in reducing smoke damage.

The Hitachi copper mine case. In 1905, the new owners of the Hitachi mine in Ibaraki prefecture greatly expanded the mine's operations. Heavy smoke poured from the smelting works and caused damage to the forest and farmland near the plants. By 1912, the damage extended to over twenty surrounding towns and villages. The village of Irishima was especially hard hit, and the village farmers' union lodged many protests. In 1909, the central government established the Committee for Prevention of Mining Hazards, which undertook an investigation of the matter. On the advice of the committee, the mine established a meteorological observatory and built a low, thick stack in 1913. However, the new stack only aggravated the smoke pollution problem. Angry farmers countered by establishing an anti-pollution organization which took daily recordings of the smoke level. The mine's meteorological work resulted in the discovery of high altitude air currents flowing towards the sea. The mine then built a high stack of 150 m to discharge its emissions into this air current. Thereafter, smoke damage gradually decreased.[6]

Other cases. Numerous instances of pollution damage occurred near other mines as well. Some of these included the Toroku, Saganoseki, Kosaka, Kamioka, and Annaka mines. After the 1940s, aluminum smelter plants caused air pollution damage to the areas in their vicinity. The most famous of these is Nippon Keikinzoku in Kambara, Shizuoka prefecture. In addition, pharmaceutical companies emitted Cl_2 gas which caused extensive air pollution. An especially notable episode occurred in Kanagawa prefecture in 1910.[7]

The Asano Cement Company case. In 1883, the government transferred a cement plant that it owned and operated in Tokyo to the Asano Cement Company. Especially after 1903, dust from the plant began to cover the surrounding neighborhood. Citizens became angry and demanded the removal of the plant. After years of inaction by the government, Asano introduced an electric dust collector in 1917. The so-called Cottrell's precipitator turned the dust into potash fertilizer. This advance in technology solved the dust problem and the citizens dropped their complaints.[8]

The Osaka Alkali Company case. In 1906-7, Osaka Alkali, a copper refinery, discharged high concentrations of SO_2 and H_2SO_4, which caused damage to crops in the surrounding farmland. Thirty-six landlords and tenants sued Osaka Alkali in the Osaka District Court for negligence. The court held the defendant liable, and the decision was upheld on appeal in the Osaka High Court. However, the Supreme Court ruled that the use of the best available, pollution-control technology would shield the defendant from liability and remanded to the High Court. On December 27th, 1919, the Osaka High Court held that Osaka Alkali had never used the best available technology because its stacks were only 100-120 shaku (30-40 meters) high whereas the stacks of the Hitachi mine and foreign smelters were much higher.[9]

The Yahata iron and steel works case. The government set up a large iron and steel works in Yahata in Fukuoka prefecture to provide iron and steel for the army and navy. Almost the entire community was directly or indirectly dependent on the industry for their livelihood. The works belched a dense, colorful smoke visible from anywhere in the town. Yet, there is no record of complaints by the citizens. This is because the smoke was seen as a symbol of the town's prosperity.[10]

The early legislative and administrative efforts at pollution control were primitive. In 1877, the Tokyo police started regulating boilers. Also in 1877, the Osaka police began to regulate factories under a new ordinance entitled Regulations on the Control of Manufacturing Plants. The law prohibited locating an animal processing plant in the metropolitan district. In 1882, Osaka amended this regulation and made the control of environmental pollution and other public hazards one of the aims of factory regulation. The new rule required the selection of industrial sites so as to minimize pollution. The ordinance used the term "kōgai" (environmental pollution) and created a basis in law for air pollution-related legal action. In 1888, the Osaka police prohibited locating a factory with a stack in the central part of the city. In 1913, the Osaka prefecture established the Smoke Abatement Committee in the Institute of Industrial Technology. The committee attempted to enact the proposed Regulation on Smoke Abatement, but business interests put up a strong challenge and the measure failed that year. It was finally passed in 1932. In 1912, the government passed the Factory Law after many years of lobbying. The law permitted government personnel to make inspections of factories. The law did not expressly list pollution control as one of the aims of the inspections, but this was done under the rubric of protecting public security. Business and industrial groups opposed the new law and managed to delay its implementation for three years.[11]

In 1913, the Osaka Municipal Hygiene Institute began to monitor air pollution in Osaka by measuring deposited matter. In addition, Osaka began to monitor CO in 1928, and SO_2 by the PbO_2 method in 1933.[12]

In 1927, Tokyo began an air pollution monitoring program similar to the

Osaka program. The Tokyo Metropolitan Police recorded a sharp increase in the number of pollution-related complaints around 1932.[13]

In 1928 the Sanitation Bureau sponsored an official meeting of prefectural health officers in which the problems of air pollution control were discussed.[14]

These early efforts at pollution control were largely ineffective. Pollution levels in the large cities continued to increase. However, certain developments quietly took place during the prewar period that would enable the formulation and implementation of strong, pollution-control policies two decades later. This was the development of the prefectural and municipal government system. Irate victims of a factory's pollution invariably turned first to local government for redress. Local initiatives provided the first programs of pollution control and compensation upon which later national programs were modeled. In addition, the prewar period saw the establishment of a network of national and local hygiene laboratories. Finally, the compulsory education system raised the general level of competency and produced a pool of talented bureaucrats and technicians equipped to deal with the many complex issues of pollution control.

1.3 LOCAL INITIATIVES IN THE POSTWAR PERIOD

The legal basis of local autonomy. The central government organized the system of local government in 1871, and established cities, towns, and villages in 1881, and prefectures in 1890. Although the Imperial Constitution of 1889 did not grant autonomy to local governments, the ministry of the Interior in fact permitted a measure of local autonomy. However, the Ministry maintained considerable authority by appointing the prefectural governors, who also served as the director-generals of the prefectural police. The administration of public health matters came under the jurisdiction of the police.

In 1946-7, the Supreme Commander of the Allied Powers abolished the Imperial Constitution, disbanded the Ministry of the Interior, and assisted in drafting the new constitution. The new constitution provided for local autonomy, and the central government passed the Local Autonomy Law in 1947. The Local Autonomy Law provided for the election of prefectural governors and municipal mayors, and authorized local governments to enact ordinances which did not conflict with national laws. Thus, prefectures, cities, towns, and villages now had the legislative authority to regulate pollution.

Tokyo. In 1949, the metropolitan government of Tokyo passed the Factory Pollution Prevention Ordinance in response to complaints by the citizens about industrial pollution. The ordinance authorized the metropolitan government to stop or limit a factory's operations where the community was harmed by dust, offensive odours, poisonous gases, steams, liquid wastes, noise, or vibrations.

The specific devices used were notifications, permits, and orders to install pollution-control equipment. In addition, the ordinance required new factories to apply for permits, the issue of which was linked to building permits and city planning.

The ordinance was of limited value in achieving air pollution control. For example, it did not set quantitative emission standards, and the standards for factory operations were absent or unclear. Moreover, there were no penalties for violations. From a regulatory perspective, the ordinance was virtually ineffective.[15]

Kanagawa, Osaka, and Fukuoka. U.S. military spending during the Korean War helped to accelerate economic growth in Japan during the 1950s. This in turn led to pollution in many of Japan's industrial centers. In 1951, 1954, and 1955, the Kanagawa, Osaka, and Fukuoka prefectures each passed ordinances modeled on the Tokyo ordinance.

Ube. The three main industries in the city of Ube in Yamaguchi prefecture were coal mining, cement making, and chemical manufacturing. Ube's approach to the control of air pollution from these industries was unique. Instead of the local government unilaterally setting mandates for pollution control to which industry was required to comply, Ube's city government, industry, and local university cooperated. Ube formed a committee comprised of representatives from city government, local industry, the university, and interested citizens to jointly develop a pollution control program. Professor Y. Nose, a professor of public health at Yamaguchi University Medical School, conducted an epidemiological study of the health effects of air pollution. In 1951, the city council passed a resolution recommending that local industries install dust collectors, and that the city purchase a water spray truck and expand urban greenery. In 1954, K. Nakayasu, vice president of Ube Kosan, visited the United States and was deeply impressed with the progress in air pollution control in Pittsburgh, Pennslyvania since his last visit. Nakayasu decided to adopt business policies which would help make Ube an attractive, clean industrial city. The joint committee commissioned technical and economic feasibility studies and finally decided to adopt voluntary quantitative emission standards for dust. The standard was set at 1.2 g/m^3 with 97% dedusting efficiency to be achieved by FY 1960. From 1951-63, industry invested nearly ¥1.2 billion for more than 40 dedusting facilities. This resulted in a reduction in dust to one-seventh of the former level.[16]

The central government was impressed with the success of the Ube program, and it adopted the Ube emission standard for the Smoke and Soot Regulation Law of 1962.

Yokkaichi. In 1959, a huge complex of oil refineries and petrochemical and power plants began operations in the city of Yokkaichi in Mie prefecture. Soon afterwards, animals and plants in the area began to die, and the fish emitted a strong, oily smell. More serious evidence of environmental degradation began to appear in 1961. Local doctors reported a sharp increase in the incidence of asthma, emphysema, bronchitis, and other respiratory ailments among residents of Isozu a village near the factories. The Smoke and Soot Regulation Law of 1962 was ineffective against the new type of pollution emitted by the petrochemical complex. Gases from the complex contained SO_x, not the visible, black smoke or heavy deposits targeted by the Smoke and Soot Regulation Law. Moreover, desulfurization technology was still not available.

Residents of the area lodged protests against the complex, but the operators largely ignored their pleas. Thereafter, the Mie prefecture health center in Yokkaichi and the Yokkaichi city government began an investigation of the health effects of the pollution. They systematically and continuously monitored air pollution levels and meteorological conditions. They were assisted in this, and in the analysis of the collected data, by Professor K. Yoshida of the public health department of the Medical School of Mie Prefectural University and the prefectural health department. Also, they developed a simulation model of the air flow of the pollutants in the area.

Later, the Ministry of Health and Welfare (MHW) and the Ministry of International Trade and Industry (MITI) established the Kurokawa Investigation Task Force to investigate the air pollution problem at Yokkaichi and make recommendations. In accordance with the Kurokawa recommendations, the complex installed higher stacks in 1963. This resulted in greater emission diffusion and lowered the peak concentrations of SO_2, which had been as high as 2.5 ppm/hr. However, it also had the effect of expanding the pollution zone.[17]

In 1965, Yokkaichi city began a Special Medical Relief Program for Pollution-Related Diseases, financed by Mie prefecture. The program was based on the pollution and health effect studies carried out by Mie prefecture, Mie University, and the Ministry of Health and Welfare. The program provided free medical examinations for the sick and financial relief for a few officially certified victims. Despite the remedial measures which had been taken, the pollution worsened from 1965-67. In 1967, twelve victims filed suit against the petrochemical complex for damage to their health. The press provided extensive coverage of the trial. In 1972, the court issued a decision solidly upholding the plaintiffs' claims. The decision broke new doctrinal ground on several fronts. In response to the decision, Mie prefecture enacted the Environmental Pollution Control Ordinance. The new ordinance regulated total SO_2 mass emissions such that an air quality standard of 0.017 ppm/year would be met. According to Professor Yoshida, the total mass emission regulation was very effective.[18]

Later, the central government modeled national legislation on the Yokkaichi project.

The pre-siting studies conducted by Osaka and Nishinomiya were crude, early examples of environmental impact assessments. Osaka and Nishinomiya devised and carried out these pre-siting assessments entirely on their own, local initiative, without the assistance or involvement of the central government.[19]

Mishima-Numazu. In 1963, the central government designated the Mishima-Numazu area in Shizuoka prefecture as a "special industrial development zone" under the National Comprehensive Development Plan of 1962. In 1963, Shizuoka prefecture announced plans for the construction of the nation's largest petrochemical complex on the site. The plans called for an electric power station, a petroleum refinery, and several petrochemical plants. At that time, the municipal governments of Mishima and Numazu supported the designation, but the citizens organized anti-pollution and anti-development campaigns under the slogan "No More Yokkaichi". Mishima residents persuaded local landowners not to sell their land to the advancing industries, and Numazu residents held mass demonstrations against the complex. In addition, they organized study sessions on the problems of air pollution and invited scientists to attend. Also, they made observation trips to Yokkaichi. The groups opposing the petrochemical complex claimed over 10,000 supporters, and they set the social and political climate of the time.

In accordance with Shizuoka prefecture's request, MITI and MHW recommissioned the Kurokawa Investigation Task Force, which had earlier investigated medical relief program and the total mass emission ordinance.

Osaka and Nishinomiya: Environmental impact assessments. The problems at Yokkaichi alerted local governments elsewhere to the need for environmental impact assessments of proposed industrial complex projects. In 1960, Osaka prefecture planned to build a huge industrial complex on reclaimed land in Osaka Bay. The Department of Commerce and Industry of Osaka prefecture established an expert committee to conduct pre-siting reviews of the environmental protection plans of companies planning to locate plants on the reclaimed land. The expert committee solicited data on the companies' pollution abatement plans and extracted written commitments for pollution-control measures. These measures were taken prior to the final siting decision. The expert committee conducted the reviews in secret, and did not disclose any information submitted by the companies to the public.

Similarly, the city of Nishinomiya in Hyogo prefecture planned to build an industrial complex in another land-reclamation project in Osaka Bay. Nishinomiya city and an anti-development group comprised of traditional brewers independently organized pre-siting study teams. Nishinomiya city built a meteorological observation post with an automatic air pollution monitor. In the end, however, the governor of Hyogo prefecture cancelled the proposed

Yokkaichi. The Kurokawa team made an in-depth assessment of the impact of the proposed plants on the area's environment. At one point, it met with representatives from the anti-pollution and anti-development campaigns, but the groups could not reach a consensus. Under intense pressure from local residents, the city councils of Mishima, Numazu, and neighboring Shimizu each voted to cancel the project. The central and prefectural governments and the participating industries capitulated and withdrew their proposals.

The forced cancellation of the Mishima-Numazu project shocked industrial and economic organizations. It threatened to disrupt Japan's heretofore single-minded pursuit of economic growth. Even more upsetting, the initiative and energy for the cancellation came from local sources.[20]

Isogo and the routine use of environmental impact assessments and anti-pollution agreements. In 1964, the Tokyo Electric Power Company sought to purchase reclaimed land in Isogo from Yokohama city and Kanagawa prefecture in order to build a coal-fired power station. The electric company presented a master plan of the proposed project to the National Electricity Power Source Development Council of the Economic Planning Agency, a unit of the central government. Residents of Yokohama adamantly opposed the proposed construction, and they elected Mr. Asukada, a Socialist Party candidate who campaigned in favor of strict pollution control, as mayor of Yokohama. However, the headquarters of the Socialist Party in Tokyo urged Asukada to accept the coal-fired power station because the coal miners' union was an important constituent of the Socialist Party. In any event, Yokohama established an independent team of experts to conduct an environmental impact assessment of the proposed power plant. The team carried out their work on a scale and at a level of sophistication similar to that carried out by the Kurokawa Investigation Task Force at Mishima-Numazu. The Yokohama team developed detailed pollution control measures which it recommended that the city require the power station to implement.

Yokohama and Kanagawa entered into negotiations with the Tokyo Electric Power Company on the terms of an anti-pollution agreement. The proposed agreement set strict standards for dust, SO_x, and noise for the plant, required it to install stipulated pollution control equipment, use low sulfur oil and coal, permit city officials to inspect its facilities, and to observe all future municipal instructions for pollution prevention.[21]

The emission standards required in the agreement were far stricter than those required by law. Asukada declared that Yokohama would permit the construction of the power plant only if it agreed to the terms of the proposed antipollution agreement. The approval of the master plan required the central government to solicit the opinion of the governor of Kanagawa, but he did not express his opinion in view of the delicate social and political situation.

Fearing another cancellation like that at Mishima-Numazu, both MITI and MHW urged the power plant to accept the anti-pollution agreement. Finally, Tokyo Electric conceded to the local demands, and construction of the plant began.[22]

The procedures taken at Isogo -an environmental impact assessment and an anti-pollution agreement between the local government and the power company- became a standard part of the National Electricity Power Source Development Council's review of the basic plans for power stations. This development was hastened by the election of socialist governors in Tokyo and Osaka, although soon pollution control became a top priority of all political parties.

After the enactment of the Basic Law for Environmental Pollution Control Measures in 1967, the practice of signing anti-pollution agreements became standard for all polluting enterprises. Occasionally, residents' groups themselves negotiated these agreements directly with the applicant industries, while at other times the agreements were tripartite arrangements among local citizens, municipal or prefectural governments, and industry. The terms of some agreements granted procedural rights, such as the right to inspect factories while others established special trust funds to compensate individuals injured by pollution. Most agreements set additional standards and imposed other obligations on the applicant industries beyond those already established by law.[23]

For example, Osaka prefecture set up a pollution control center consisting of a modern laboratory, mobile units, monitoring equipment, and a telemeter system. It then negotiated with individual industries to set up a direct telemeter link between emission sources and the pollution control center. In addition, prior to the implementation of MITI's desulfurization plan in 1969, Osaka formulated a Blue Sky Plan in which individual industries agreed to implement agreed-upon desulfurization measures.

The cumulated experience of negotiating anti-pollution agreements with different types of industries served to increase the technical expertise of local government personnel. Whereas early agreements were abstract because local government lacked the knowledge to negotiate and draft more specific provisions, recent agreements have been precise and rich in content. In fact, today local governments are a storehouse of information on pollution control technology and finance. In addition, there is an active, regional exchange of monitored data, pollution impact assessment analysis, and control-technology information. The central government subsidizes a regional telemeter system in the Osaka and Tokyo Bay areas.[24]

Sapporo. More recently, the city of Sapporo and Miyagi prefecture have regulated the use of spiked tires on vehicles during the snow season. Spiked tires puncture the road surface, and create dust pollution in the spring.[25]

Summary. A number of reasons can be cited for the success of local initiatives in pollution control. In Japan, local government has been more immediately responsive to the concerns of citizens than the central government bureaucrats in Tokyo. Since the Local Autonomy Law provided for the election of prefectural governors and municipal mayors in 1947, these officials have been highly susceptible to public appeal. From 1964-73, pollution control was the central issue in the campaigns of conservative, liberal, and far left candidates. In addition, local government found itself in a good bargaining position vis-a-vis private industry. Available land for new plants was scarce, and in the intensely competitive world of Japanese business, industries had to concede to tough local demands in order to find suitable sites for their industrial plants. Also, Japan is a society where harmony and consensus are valued, and industries wanted good relations with the local communities. Thus, they were apt to concede to strict terms during the negotiation of anti-pollution agreements.

1.4 THE ROLE OF THE CENTRAL BUREAUCRACY IN REGIONAL INDUSTRIAL DEVELOPMENT AND THE SMOKE AND SOOT REGULATION LAW OF 1962

The central bureaucracy. The different ministries of the executive branch of government rarely acted in concert in the management of air pollution. The health- and development-oriented ministries each had their own, often conflicting, agenda. In 1953, the Bureau of Sanitation of MHW conducted a nationwide survey of environmental pollution by polling all the prefectural governments on the status of pollution-related illnesses in their respective jurisdictions. The survey found that 10,044,241 persons living in 43 prefectures had pollution-related illnesses resulting from 102,290 pollution cases. In the category of air pollution, the survey showed that the worst problems were dust, offensive odours, gases, and smoke, in descending order of severity.[26]

In 1954, MHW requested that the Japan Public Health Association investigate the tolerance limits to smoke and noxious gases. Using this and other data, MHW drafted pollution-control legislation in 1955.

MITI and other development-oriented ministries strongly opposed MHW's proposed, pollution-control legislation, and they eventually forced MHW to withdraw it.[27]

MITI's relentless goal during the 1950s and 1960s was to oversee the economic rehabilitation and growth of Japan. The other main, pro-development agencies were the Ministry of Construction and the Economic Planning Agency. MOC was in charge of actual physical construction and EPA's functions included medium- and long-term economic planning and the formulation of a national comprehensive development plan. In 1960, Prime Minister H. Ikeda proposed an ambitious, ten-year, income-doubling plan. Also in 1960, the Diet passed the New Industrial City Development Law. Communities everywhere welcomed industry, and the idea of the supremacy of the economy prevailed all over Japan.

In this pro-development milieu, MHW lacked the political leverage to push its pollution-control programs. Other ministries considered MHW a threat to the all-important regional industrial development projects they were pushing. Moreover, there were structural limitations on MHW's ability to act. Its budget for environmental pollution control studies, for example, was only ¥350,000. Also, it did not have any enforcement powers for pollution violations. However, the other ministries began to listen more to MHW after the occurrence of several severe pollution episodes. The mass citizen protests at Yokkaichi and the horrible suffering of Minamata disease and itai-itai disease victims began to generate more sympathy for MHW's pollution control agenda. In addition, MHW's influence expanded because it had jurisdiction over the national health center network and the sanitation administration at the prefectural and municipal levels. Local public health laboratories fulfilled an important function in pollution measurement and analysis. Over the years, MHW benefitted from the cumulated experience of the many local programs and the joint efforts between MHW and local government.

The Smoke and Soot Regulation Law of 1962. The provisions of the government's first attempt at comprehensive anti-pollution legislation in 1962 reflected the relative strength and weakness of MITI and MHW. The Smoke and Soot Regulation Law of 1962 regulated smoke, soot, dust, and SO_x emissions generated by combustion, heating, and melting processes. The law was a piecemeal effort in that it applied only to these types of emissions, and then only in designated air pollution control districts. The law did not apply to mines, power stations, and gas works, which were regulated by other, existing laws under the jurisdiction of MITI. The 1962 law set quantitative emission standards for designated pollutants classified by the type of emission source. For soot and dust, the standard ranged between 0.6 g/m^3 and 2.0 g/m^3. For example, the standard for soot and dust emissions from a pervilized coal combustion boiler was 1.2 g/m^3. The standard for SO_x emissions ranged from 0.18% to 0.22% by volume of maximum stack output. The law required factories to notify the prefectural governor of new or modified smoke-emitting facilities. However, the government's only recourse in the event of emission violations was to issue a clean-up or desist order. In addition, the law required prefectural governments to monitor air quality routinely and to issue alerts if the pollution level posed a danger to health.

The Smoke and Soot Regulation Law was effective in controlling the traditional types of pollutants--dense, visible smoke and heavy deposits--but it did not help to curtail SO_x emissions. This was because the SO_x emission standards were set in terms of the concentration of the pollutant at the stack. A factory could easily circumvent the intent of the law, while still complying with its specific terms, by increasing the number of stacks, using larger stacks, or diluting concentrations with fresh air. Moreover, the SO_x emission limitations were not strict enough to do any good. SO_x emissions from the worst pollutors in Yokkaichi were only 0.17% when the strictest standard was 0.18%[28]

During the preparation of the Smoke and Soot Regulation Law, MHW made an extensive study of existing programs in Great Britain, the United States, West Germany, and other countries. Great Britain's smokeless coal program was impressive for its integration of anti-pollution and energy supply policies. However, the Great Britain example was not transferable to Japan due to differences in the availability of coal and the stage of industrial development in Japan. Despite MHW's efforts to include strict anti-pollution provisions, in the end the shape of the bill showed MITI's stronger influence. Pollution control was still a halfhearted policy in Japan in the early 1960s.[29]

But perhaps the most important contribution of the 1962 law for future pollution control was the monitoring provisions. The issue of alerts under the law was the first time that the government disclosed data on pollution levels to the public. The disclosures increased public awareness of the worsening air quality situation, and this created the information basis for later demands by the citizens for the enactment of strict pollution control programs.

<u>Kurokawa Investigation Task Force.</u> The interests of MITI and MHW were not always at odds, however, and they cooperated in pollution control when their interests overlapped. After the petrochemical complex at Yokkaichi commenced operations in 1959, and doctors reported an increase in the incidence of asthma and other respiratory diseases, MHW began to worry that the case would develop into a serious pollution episode with many casualties. After consulting with the governor of Mie prefecture, MHW proposed that it and MITI commission an interdisciplinary team of experts to study the pollution situation at Yokkaichi and make recommendations for pollution control. MITI agreed, and the Kurokawa Investigation Task Force was established. Dr. M. Kurokawa was the director-general of MITI's Institute of Industrial Technology and an expert on fuel science and technology. The other members of the task force included top scholars and practitioners in the fields of emissions, the environment, meteorology, public health, city planning, and industrial siting. After a six-month investigation, the Kurokawa team submitted its report to MITI and MHW in 1964.[30]

The Kurokawa report contained 13 main recommendations. (i) Establish special emission standards for SO_2 at Yokkaichi. (ii) Develop and utilize desulfurization technology for the petroleum refinery plant. (iii) Construct higher stacks for better emission diffusion. (iv) Improve the air pollution control measures in the sulfuric acid, carbide, and titanium plants. (v)

Institute better practices with respect to fuel use and combustion at the small, Banko ceramic plant. (vi) Design a redevelopment plan. (vii) Provide medical care for victims of pollution-related diseases. (viii) Establish air monitoring and meteorological observation stations. (ix) Improve procedures for plant operation, maintenance, and safety. (x) Develop mechanisms that maximize plant utilization and minimize emissions, effluents, and other wastes. (xi) Encourage the different plants at the petrochemical complex to install joint pollution abatement equipment. (xii) Improve community relations. (xiii) Consider the costs of the recommended programs. The government carefully reviewed the Kurokawa report, and in time the companies at the petrochemical complex instituted all of the recommendations.

In 1964, MITI and MHW recommissioned the Kurokawa Investigation Task Force to conduct an environmental impact assessment of the Mishima-Numazu petrochemical complex and to recommend preventive, anti-pollution measures. The task force studied all aspects of the proposed complex, including developing a simulation model and conducting wind-tunnel experiments. The team formulated recommendations for fuel, combustion, stacks, emissions, and other aspects of the complex's operation. This was the first sophisticated, large-scale environmental impact assessment conducted in Japan.[31]

In view of the Kurokawa recommendations, MHW proposed that Yokkaichi and Mishima-Numazu be designated under the Smoke and Soot Regulation Law. However, MITI and industrial and economic groups opposed the proposed designation. They succeeded in stalling the Yokkaichi designation until 1966, by which time the city had certified 355 patients of air pollution-induced pulmonary disease. MITI was successful in preventing the designation of other areas as well. In fact, during the five years of the law's existence, the government designated only 20 areas.[32]

However, environmental impact assessments became a standard part of the pre-siting approval process for regional development projects. Beginning in 1965, the government provided a budget for the assessment program jointly conducted by MHW, MITI, and local government. The program did not include public hearings where citizens could express their views, however. The environmental impact assessments were technical in nature and only the results were disclosed to the public. They did serve to increase the sophistication of government officials on pollution control matters.

1.5 THE 1967 BASIC LAW, THE 1968 AIR POLLUTION CONTROL LAW, AND THE AAQS FOR SO_2

The Basic Law. In 1965, the government began to see the need for a comprehensive approach to pollution control. Pollution awareness had increased in all sectors. It was the main topic of political campaigns, where politicians described industrial pollution as a threat to human health, even to life itself. The public became infuriated by the events in Yokkaichi and Minamata Bay.

In 1965, both houses of the Diet established Special Standing Committees for Industrial Pollution Control. This signaled the start of an intensive debate among the political parties and the ministries on the shape of general pollution policy that was to result in the 1967 Basic Law for Environmental Pollution Control Measures. The main issues centered on whether government or industry should be responsible for pollution control, and whether anti-pollution considerations should be harmonized with the need for economic growth.

The first piece of legislation considered by the Special Standing Committees was a bill chartering the Environmental Pollution Control Service Corporation. The brainchild of the MHW, the service corporation was a government-owned and operated entity which selected environmentally sensible sites, purchased land, established green belts, installed pollution control and abatement equipment, and thereafter conveyed title to the property of the concerned enterprise. It also made loans to small- and medium-size enterprises for the installation of pollution control equipment and waste-treatment plants.[33]

The government used excess funds from the national pension fund to finance the service corporation. MITI supported the MHW-initiated chartering legislation, and the bill was passed in 1965.

MHW sponsored other pollution-related projects as well. With the assistance of the Ministry of Construction, it built a health and welfare community facility in Ichihara, Chiba prefecture. The community facility was built as a buffer zone between the industrial and residential areas of Ichihara. The idea for a buffer zone in Ichihara had come from the mistakes in city planning made at Yokkaichi. In 1964, the Kurokawa Investigation Task Force recommended that a similar community facility be built at the perimeter of the petrochemical plant in Yokkaichi, and the buffer zone project was later carried out.[34]

In 1964-65, MHW and MITI added new divisions which made them better equipped to deal with policy-making in the pollution area. In 1964, MHW established the Division of Environmental Pollution Control, and in 1965 MITI established the Division of Industrial Pollution Control. Also in 1965, MHW established the Pollution Commission, a forty-member advisory body to MHW which played a critical role in determining many of the important policies embodied in the Basic Law. In 1967, after the enactment of the Basic Law, the government transferred the functions of the Pollution Commission to the Central Advisory Council on Environmental Pollution Control Measures, initially located within the Prime Minister's Office. With the establishment of the Environment Agency in 1971, the Central Advisory Council was reorganized as the principal advisory organ to the new agency's director-general.[35]

In 1965, the MHW instructed the Pollution Commission to draft a report which would provide basic policy recommendations for future legislation. In August 1966, the Pollution Commission submitted its Interim Report to the Minister of Health and Welfare. The report assigned responsibility for pollution control to industry and urged that industry be held strictly liable for pollution damage. In addition, it noted the inadequacy of existing pollution legislation and recommended that new, comprehensive measures be adopted which give explicit priority to health over industrial development. All pollution programs, it said, should be designed with the purpose of achieving ambient air quality standards.

The Interim Report met with intense controversy, especially from the Keidanren. The Keidanren and other economic and business groups argued that pollution control should in no way harm industry's development. Nevertheless, the Pollution Commission's Final Report retained the original, hard-line stance, and on October 7th 1966 it was submitted to the Minister of Health and Welfare and the Cabinet.

The Prime Minister then requested MHW to prepare draft legislation for the Basic Law. At this point, a serious jurisdictional dispute broke out among the 14 ministries and agencies which claimed responsibility for aspects of pollution control policy. For example, MITI possessed regulatory powers over the factories which were the sources of pollution; the Ministry of Agriculture and Fisheries had an interest in the protection of farming and fisheries; and the Ministry of Local Autonomy represented the interests of local government, which wanted the authority to enact stricter pollution standards than the national laws required.[36]

In view of the need for a referee, the government decided that the Liaison Council for Pollution Control Promotion, an interministerial coordinating body, would oversee the preparation of the draft legislation. Within the Liaison Council, MITI and the Economic Planning Agency attacked MHW's emphasis on public health and environmental concerns. They asserted that these policies should be harmonized with the need for sound economic development. Under pressure from the pro-development ministries, the Liaison Council weakened or eliminated many of MHW's recommendations. For example, it eliminated proposals for strict liability for industry, the establishment of an administrative compensation fund, and the creation of an independent administrative body for pollution control. The public was especially dissatisfied over the harmonization clause and the elimination of the principle of strict liability. But the Special Standing Committees for Industrial Pollution Control urged the government to submit a bill as soon as possible.

On February 24th, 1967, the Cabinet directed MHW to incorporate the proposals agreed upon in the Liaison Council into a bill. After a few amendments and more review by the concerned ministries, the Cabinet submitted the bill to the Diet on May 16th, 1967. The Diet debated the provisions of the bill and enacted the Basic Law on August 3th, 1967.

The Basic Law was essentially a long-range charter for pollution control. It set broad policy and identified the respective responsibilities of government and industry, but left many of its specific applications to later legislation. The law defined environmental pollution as air, water, and soil pollution, noise, vibration, ground subsidence, and offensive odours. The controversial harmony principle appeared in the purpose clause. Article 1 stated that the law's purpose was to protect the health of nationals and conserve their living environment. However, article 2 explicitly stated that with respect to the conservation of the living environment (but not human health), "harmony with sound economic development should be considered." Article 9 required the government to establish ambient quality standards for air, water, and noise. However, the law made these standards administrative targets rather than rigid limitations. Again, with respect to the ambient standards for the protection of the living environment, the harmony principle applied. Article 10 required the government to establish emission standards for air, water, and soil pollutants. In other provisions, the law reflected the government's recognition of the responsibility to plan. Article 11 mandated land use controls for environmentally degradated areas; article 13 exhorted the government to set up monitoring and measurement systems; and article 17-1 stressed the need to include environmental protection provisions in the planning and implementation of regional industrial development. In addition, the Basic Law helped to consolidate the administration of pollution control. It established an interministerial Environmental Pollution Control Council that replaced the Liaison Council for Pollution Control Promotion, and also established several local Environmental Pollution Control Councils. Article 21-1 required the government to establish a mediation or arbitration board to resolve pollution disputes, and article 21-2 required the government to set up a pollution-related health damage compensation system. Finally, article 22 required private industry to pay for all or part of government pollution control programs.[37]

Critics complained that the Basic Law did not contain a strict liability provision. However, article 3-2 set forth a new principle of indirect enterprise responsibility. It stated that companies "shall endeavor to take precautionary measures to prevent environmental pollution which might otherwise be caused by the use of the products which it manufactures or processes." In any event, Prime Minister Sato pledged to make efforts to enact strict liability legislation in the near future.

<u>The 1968 Air Pollution Control Law.</u> The Basic Law directly influenced the

passage of the 1968 Air Pollution Control Law. The most important achievement of the 1968 law was that it set an emission standard for SO_2 discharges. Generally, an emission standard is a cap on the quantity or concentration of a pollutant that may be discharged from a specific source per unit of time. It is binding and enforceable. In contrast, an ambient standard is a targeted ceiling on the concentration of a pollutant in a receptor medium, such as air or water. It does not, by itself, impose a constraint upon an individual polluting facility, and the facility is not liable simply because an ambient standard is not met.

The 1968 Air Pollution Control Law was a major advance beyond the Soot and Smoke Regulation Law, which it replaced. First, it applied to all areas, even areas not yet polluted. Thus, it applied to the new industrial development projects.[38] Second, it set stricter emission standards for new emission sources.

Third, it replaced the ineffective earlier approach to emission controls with the k-value system. Under the new system, SO_2 emissions from an individual emission source were limited by a complex formula (Q = k X 10-3He2). The standard is defined in terms of a quantity of pollutant, but it is (partly) a function of the volume of exhaust gas, which means that it is possible to increase the quantity of pollutant discharged by means of dilution. However, this possibility is limited by the fact that the speed and temperature of exhaust gas (which would be modified by an increase in volume) are taken into account in the calculation of the standard.[39]

The k-value was calculated as 584 C_{max}/hr (maximum ground level concentration ppm). At first, there were eight k-value classifications, depending on local air pollution levels. Later, the government added three additional, stricter k-value classifications for areas which exceeded the ambient air quality standard.

To meet the k-value standards, many industries began to construct higher stacks. This improved peak SO_2 concentrations, but it also resulted in greater diffusion and thus a wider polluted area. Mie prefecture tested and confirmed this phenomenon in Yokkaichi.[40]

Beginning in 1969, the electric power stations in the Tokyo Bay area started importing ING to help meet the new emission standards.

AAQS for SO_2. In addition to emission standards in the Air Pollution Control Law, the 1967 Basic Law spawned ambient air quality standards for SO_2. Soon after the enactment of the Basic Law, the Central Advisory Council on Environmental Pollution Control Measures established an expert committee on ambient quality standards for SO_2 and requested it to review the existing data and to offer its opinion on the appropriate standard. The expert committee relied on the epidemiological and clinical studies from Yokkaichi as well as other domestic and foreign data. In 1968, the expert committee recommended a very strict AAQS for SO_2: 0.1 ppm/hr (0.1 ppm for 1 hr average) and 0.05 ppm/24hr (0.05 ppm for 24 hrs average).[41]

Immediately, the petrochemical, power, and other industries mounted a fierce attack against the proposed standards. They argued that achieving the standards would require desulfurization both in the refinery and the stack, that this was too costly, and that it would disadvantage Japanese business internationally.[42] They also argued that the proposed standard was unwarranted scientifically.

In FY 1966, MITI began working on a large-scale project to develop desulfurization technology. MITI's goal was to lower the cost of desulfurizing petroleum to either ¥500/kl or ¥1000/kl. The price of crude oil in 1967 was about ¥6000/kl. In a study done in 1967, MITI calculated that the impact of these targeted desulfurization costs would not significantly burden total production costs, although the impact would be detectable. See Table 1.3.

Despite MITI's data showing that desulfurization was affordable, industry groups succeeded in lowering the proposed AAQS for SO_2. In February 1969, the Cabinet adopted standards which were lower by a factor of three. Also, the government extended the period for the standard's attainment, and exempted their application to areas exclusively for industrial use.[43]

The adopted AAQS for SO_2 was as follows: (i) More than 99% of the total number of hours of a year to be below 0.2 ppm/hr; (ii) More than 70% of the total days number of a year to be below 0.05 ppm/24hr; (iii) More than 88% of the total number of hours of a year to be below 0.1 ppm/hr; (iv) The annual average hourly value not to exceed 0.05 ppm/yr; (v) The total number of days

TABLE 1.3

Economic impact of fuel desulfurization on production costs

Industry		500 Yen/kl	1,000 Yen/kl
Agriculture, Forestry, Fishery		0.09%	0.19%
	Average;	0.19%	0.39%
Mining & Manufacturing Industry	Chemical Industry;	0.24%	0.49%
	Ceramic Industry;	0.67%	1.33%
	Iron & Steel Industry;	0.41%	0.81%
	Electricity, Gas;	0.94%	1.89%
Transportation & Traffic Service;		0.05%	0.11%

Source: Economic Monthly Report, Economic Planning Agency September 1967

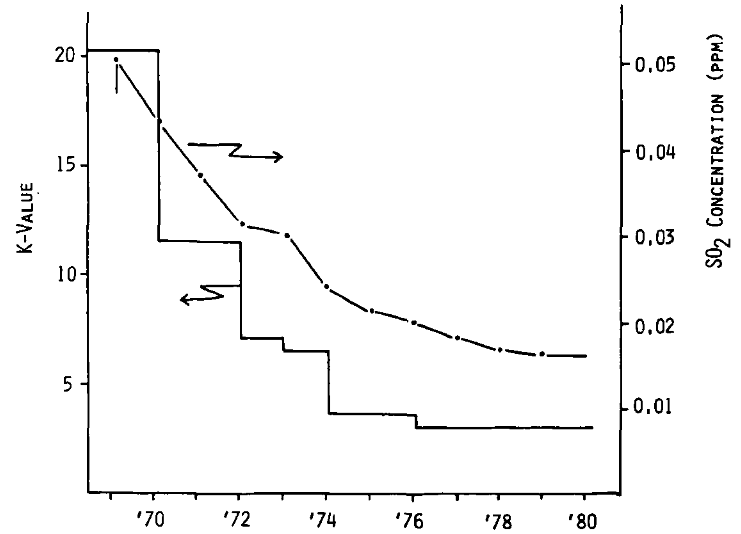


Fig. 1.1. Changes in K-values and SO_2 concentrations

with an incidence of an alert condition not to exceed 3% of the total days in a year, and no incidence of an alert condition should last for more than 3 consecutive days.[44] Although it was not disclosed in 1969, achieving these standards was equivalent to about 0.03 ppm/yr.

By the late 1960s, it was apparent that the government needed a long-term, comprehensive desulfurization policy. In December 1969, MITI requested its advisory organ, the Comprehensive Energy Investigation Committee, to submit a

TABLE 1.4

Sulfur fuel demand to achieve AAQS of SO_2

Fiscal Year	1967			1973			1978		
	Fuel	Fuel	Air	Fuel	Fuel	Air	Fuel	Fuel	Air
Area Classification	10^4 kl	S wt%	SO_2 ppm	10^4 kl	S wt%	SO_2 ppm	10^4 kl	S wt%	SO_2 ppm
Congested	2,297	2.41	0.38	3,920	1.00	0.27	5,500	0.55	0.20
Polluted	1,037	2.51	0.24	2,880	1.30	0.20	4,600	0.80	0.20
Preventive	-	-	-	2,560	1.55	0.20	5,400	1.00	0.20
Other	3,604	2.45	-	9,360	1.25	-	15,500	0.80	-

Source: Ministry of International Trade & Industry; December 1969

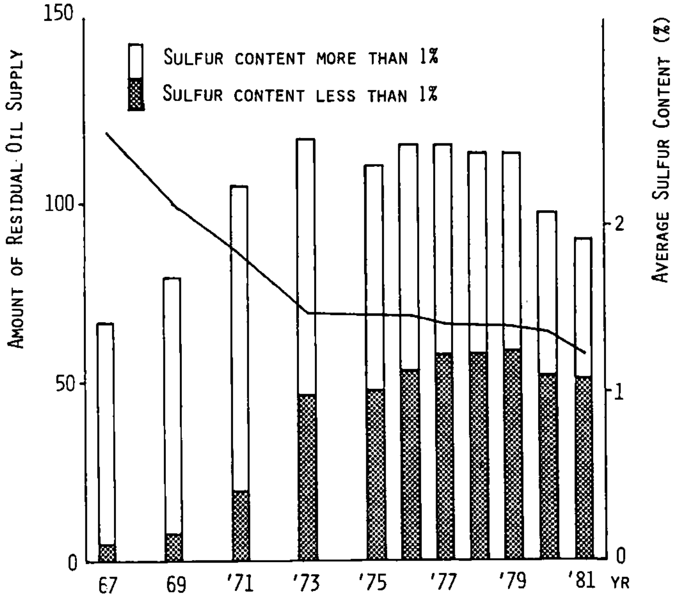


Fig. 1.2. Annual trends in residual oil supply and sulfur content

recommendation on a national energy supply program designed to meet the AAQS for SO_2. The energy committee's plan set FY 1973 as the interim target for achieving the standard and FY 1978 as the final target[45]

See Table 1.4. The implementation of the ten-year desulfurization plan took into account the expansion of Japan's petroleum refining capability and investment plan formulated by MITI's Industrial Structure Council. By 1970, five plants had installed stack gas desulfurization equipment. Between 1970 and 1976, the government issued stricter k-values step by step in accordance with Japan's capacity to supply low-sulfur oil. See Fig. 1.1. The expansion of nuclear power stations also helped to cut SO_2 pollution in the Tokyo and Osaka Bay areas. Fig. 1.2 shows a clear improvement of SO_2 levels since 1968.

In May 1973, the government tightened the AAQS for SO_2. The 1969 standard was equivalent to 0.03 ppm/year and the new 1973 standard was equivalent to 0.017 ppm/year. By 1973, before the oil crisis, Japan's refinery desulfurization capacity had expanded to the point where it could meet the demand for low-sulfur fuel. As a result of the oil crisis and the increase in the cost of oil, stack gas desulfurization became more economical than low-sulfur fuel. Fig. 1.3 shows the increase in the installation of stack gas desulfurization equipment.

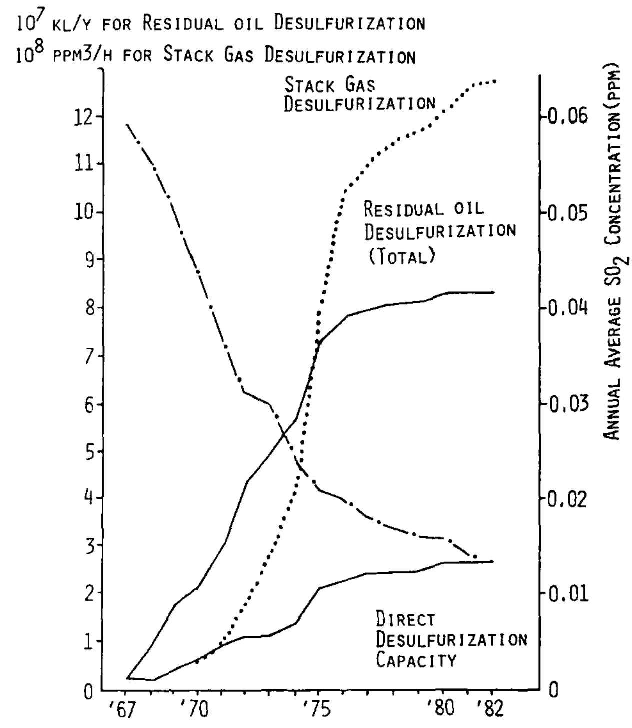


Fig. 1.3. Annual trends in desulfurization capacity

Monitoring programs. In order to assess its pollution programs, the government continued environmental impact assessments and air monitoring programs. MHW and MITI, in cooperation with local government, conducted surveys of regional development projects modeled on the pre-siting survey done at Mishima-Numazu. The surveys included tracer experiments, topographical and meteorological studies, and evaluations of appropriate stack heights. The data collected from the surveys provided a scientific basis for the implementation of pollution controls and evaluation of the appropriate air monitoring systems. The government also conducted follow-up surveys to determine the effectiveness of the pollution controls. These were often done in the worst seasonal conditions from the standpoint of pollution levels. The surveys helped scientists to gain an understanding of the topographic features of diffusion and the meteorological parameters at each site. Finally, they helped in the construction of a computer-assisted simulation model.[46]

In addition, central government provided more funds to expand the local air-monitoring networks and to install a telemeter system to connect the local stations with the central air pollution headquarters. Several prefectures and cities set up electronic demonstration panels which showed real-time pollution trends as part of a public education program. The government's policy was to disclose publicly all air monitoring data, except source telemeter data.[47]

In the fall of 1965, the government disclosed the results of its air pollution and health effect studies done at Yokkaichi and Osaka.[48]

See Table 1.5 and Fig. 1.1.

1.6 1970-74: THE PACE OF CHANGE QUICKENS

Catalysts for change. Beginning in 1970, a number of events took place in rapid succession that drew attention to the government's procrastination and inadequacy in combating pollution, and roused the public to demand immediate, effective action. A national survey of environmental pollution caused by mercury and cadmium discharges showed that these heavy metals were widely distributed in the nation's waterways. In May 1970, newspapers reported that residents of Yanagimachi in Shinjuku Ward, Tokyo were being poisoned by lead. The Tokyo Metropolitan Government disproved the reports two years later in a comprehensive study undertaken by a team of experts.[49]

But other adverse publicity continued. In July 1970, Tokyo experienced episodes of photochemical smog that reportedly induced partial suffocation and hospitalized a number of school children. The smog also caused acute damage to vegetation. The Institute of Environmental Pollution of the Tokyo Metropolitan Government announced that these reactions were due to a high concentration of photochemical oxidant and sulfuric acid mist.[50]

Also, news reports on the phenomenon of cross-media pollution in the air, water, soil, and biosphere shocked the public. In 1967 and 1968, the victims of Minamata disease in Niigata prefecture, itai-itai disease in Toyama prefecture, and air pollution in Yokkaichi filed lawsuits for damage to their health. The suits attracted intensive press coverage, and spawned the formation of several support groups. Also, other anti-pollution and anti-development

TABLE 1.5
Standardized prevalence rate of chronic bronchitis symptoms in Osaka and Yokkaichi, 1964 (Standardized by age and smoking)

	Osaka		Yokkaichi	
	Male	Female	Male	Female
High Pollution Area	6.8%	3.8%	15.1%	11.3%
Low Pollution Area	5.2%	1.0%	5.5%	2.8%

Source: Ministry of Health & Welfare, Division of Environmental pollution 1966.

interest groups formed and accused government and industry of inadequate or misguided environmental policies.

These domestic events coincided with rising international concern over pollution. In 1970, President Nixon issued a provocative statement on the importance of environmental protection. In his remarks, Nixon indirectly criticized Japan for taking an unfair trade advantage by neglecting the environment and thereby not incurring the costs of domestic pollution controls. For its part, the United States passed the National Environmental Policy Act and established the Environmental Protection Agency. In 1970, the Organisation for Economic Co-Operation and Development established an Environmental Committee, which generated many reports on the problems of modern society. In 1972, the United Nations held an international conference on the human environment in Stockholm and issued a widely-read final report.

At home, scientists noted that exhaust from automobiles was chiefly responsible for the increase in NO_x and hydrocarbon levels in recent years. In response to calls to control this pollution, MITI adopted a lead-free gasoline plan in June 1970, and the Ministry of Transportation set a target date of 1975 for the control of automobile exhaust.

The central and local governments often disagreed on the shape of pollution-control measures. In general, local governments, controlled by the Socialist or Communist Parties, demanded more far-reaching measures than the central government, controlled by the Liberal Democratic Party, was willing to allow. In the Diet, members of the special standing committees of both houses began to question government officials, and both committees passed resolutions calling for more aggressive government action. It was felt that a new, unifying body was needed in order to coordinate the views of government agencies with an interest in pollution control.

<u>The 1970 special Diet session.</u> In July 1970, Prime Minister Sato ordered the establishment of the Central Headquarters of Environmental Pollution Control to accelerate the formulation of new policies and measures. The Prime Minister himself directed the new body, and it was staffed by 15 senior administrators (at the deputy director-general and director level) and 19 assistant administrators (at the deputy director level). In addition, the Cabinet organized a special Ministers Conference for Pollution Control, which met seven times in a three-month period to consider 14 pieces of legislation for submission to the special Diet session in November 1970. Also, the three, main opposition parties submitted proposals to the government and the Liberal Democratic Party. All four political parties reached consensus on emergency policy measures on eight major subjects.

The special Diet session, held from the end of November to the end of December 1970, was a productive one. The Diet passed all 14 pieces of pollution legislation during the short, hectic session. In connection with air pollution control, five major laws were passed. (i) One law repealed the harmony clause of the Basic Law. In the 1967 Basic Law, measures to conserve the living environment were to be balanced, or harmonized, with the need for "sound economic development." This harmony clause had in fact been used to justify tilting all pollution policies in favor of economic growth, and was thus repealed. (ii) The 1968 Air Pollution Control Law was amended to abolish the system of designated districts. Under the 1970 amendments, the law applied to all of Japan, not just the former designated districts. In addition, the amendments created a national minimum emission standard, and authorized local governments to set more stringent emission standards. Finally, the law provided emission standards for specific hazardous substances and strengthened penalty provisions. (iii) The Soil Pollution Abatement Law was newly enacted. The law empowered prefectural governors to set strict enforcement standards in order to control soil pollution. (iv) The Environmental Pollution Crime Law was newly enacted. This special criminal law defined a pollution crime as the discharge of pollution which causes health damage. In prosecuting a pollutor, the law permitted the government to rely on a rebuttable presumption of causation when proving the pollutant-disease nexus. The presumption was based on the bitter experiences with the Minamata disease in Kumamoto and Niigata prefectures. (v) The Law for Cost Bearing by Enterprises for Public Pollution Abatement Work was newly enacted in accordance with article 22-2 of the Basic law. The law required pollutors to contribute to the costs of government pollution control programs.[51]

In 1971, the Diet passed the Offensive Odour Abatement Law. The Law provided for district designation, odorous substance designation, a range of ambient standards, and a step-by-step schedule of odour abatement. Offensive odours in urban settings had been a problem since early Meiji days. However, abatement efforts were hindered by the fact that most sources of offensive odours were small- and medium-scale companies in the agricultural and fishery fields, and the Air Pollution Control Law was not designed for these types of pollution sources. A second problem was the difficulty of scientifically detecting and identifying low concentrations of odorous pollutants in spite of strong complaints from residents. This was a case of the human nose being more sensitive than measuring instruments.

The Environment Agency. On July 1st 1971, the government established the Environment Agency within the Prime Minister's Office. The agency is headed by a director-general who is a member of the Cabinet and holds the rank of state minister. It performs the functions of coordination and planning in regard to pollution control and environmental conservation. The agency's charter authorizes the director-general to collect information from other agencies and advise them regarding the formulation of environmental policies. The new agency took over jurisdiction of the Air Pollution Control Law from MHW and MITI, and established an Air Conservation Bureau to administer it.

The Environment Agency succeeded in raising a number of pollution standards. The new standard cut the emission ceiling by two-thirds of the former ceiling for existing sources, and by one-third for new sources. The emission standard for SO_2 was raised in accordance with progress in the desulfurization program. In September 1971, the agency began to address the top-priority photochemical oxidant problem. It established an Expert Committee for Long-Term Approaches to Automobile Emission Control within its advisory organ, the Central Advisory Council on Environmental Pollution Control Measures. In January 1972, the Environment Agency set ambient standards for suspended particulates.

The anti-pollution arsenal. The social and political crisis generated by the pollution problem continued throughout 1974. The episodes of photochemical oxidant pollution reached a peak in 1973, causing thousands of people to experience throat and eye irritation. From 1971-73, the courts decided strongly in favor of the victims in the four major pollution trials. The passage of the U.S. Clean Air Act of 1970 stimulated demands for automobile exhaust control. In 1972, the OECD announced the pollutors-pay-principle, which had a significant domestic impact.

These factors contributed to the passage of new environmental policies. This occurred despite the adverse economic and trade impact of the devaluation of the dollar in 1971 and the energy crisis of 1973 when oil supplies dwindled and prices jumped. In 1972, the Diet passed strict liability legislation, which removed the difficult issue of negligence from pollution lawsuits. Also in 1972, the Cabinet by resolution required environmental impact assessments on all public works. In 1973, the government enacted the Pollution-Related Health Damage Compensation Law. Also in 1973, the government set stringent ambient air quality standards for SO_2, NO_2, and oxidant. In 1974, it passed total mass emission regulations for SO_2-pollution control, a law regulating plant sitings, and a law instituting a factory pollution-control manager system. Finally, the second National Comprehensive Development Plan of 1969, the so-called Japanese Archipelago Reform, met with nationwide opposition from anti-pollution and anti-development groups. The pace of these developments, coming one after the other in the span of a few years, was unique in Japanese history.

From the Meiji Restoration until Mishima-Numazu in 1964, Japan was a pollutor's heaven. From 1965-69, the government took some anti-pollution measures in response to growing public protest, but these were largely ineffective. The turning point was the pandemic episodes of severe, photochemical smog and the news reports of ambient lead poisoning. They ignited the fighting spirit of the people, and thereafter change was not long in coming. From 1970-74, Japan completed its arsenal of this time effective anti-pollution legislation. Japan had plunged into a pollutor's hell.

1.7 THE POLLUTION TRIALS

There were four major pollution cases: the Niigata Minamata disease case (decided September 29th 1971), the Yokkaichi air pollution case (decided July 24th 1972), the Toyama itai-itai disease case (decided August 9th 1972), and the Kumamoto Minamata disease case (decided March 20th 1973). In all four cases, the courts ruled in favor of the victims, and the decisions made bold new law and set high standards of care for the pollutors. Of the four cases, the Yokkaichi air pollution case was the most far-reaching; it immediately influenced the passage of the Pollution-Related Health Damage Compensation Law and the government's stricter administration of the air pollution laws.

The Yokkaichi air pollution case. On September 1st 1967, twelve residents of Isozu in Yokkaichi sued six companies in the petrochemical complex for health damage from obstructive pulmonary disease allegedly caused by the defendant's SO_2 discharges. The case rested on a theory of negligence based upon article 709 (torts) and article 719 (joint torts) of the Civil Law. The plaintiffs invoked the joint tort statute because the discharges of some of the defendants by themselves were insufficient to cause the plaintiffs' damage.

The court's decision in favor of the plaintiffs centered on four issues: joint tort, causation, negligence, and damage. The case presented daunting evidentiary issues. In order to prove the defendants' production, emission, and transmission of pollutants, the plaintiffs submitted the following evidence. (i) Data showing a reasonable time sequence between the start-up of the petrochemical complex and the development of increased air pollution in the community. (ii) Data showing that the SO_2 levels at Isozu exceeded the relevant ambient air quality standard. (iii) Data showing a correlation between a seasonal SO_2 downwash phenomenon causing a high SO_2 peak and certain wind direction and velocity conditions. This was simulated by a diffusion model and contour patterns. (iv) Data showing a correlation between the trends in annual ambient SO_2 levels at Isozu and trends in annual SO_x emissions from the petrochemical plant. (v) Data showing a correlation between the incidence of high concentrations of SO_2 and the occurrence of a certain wind direction.

In order to show the causal nexus between pollutant and disease, the plaintiffs submitted the following evidence. (i) Data showing that high levels of SO_2 occurred before the incidence of obstructive pulmonary disease. (ii) Data showing a correlation between high pollutant levels and high disease prevalence. (iii) Data showing higher morbidity and mortality in polluted areas than in the unpolluted, control areas. (iv) Data showing a higher frequency of asthma-like attacks once the SO_2 level reached 0.2 ppm/week, and a correlation between the frequency of disease onsets and level of SO_2 pollution. (v) Data showing an exacerbation of clinical symptoms resulting from the controlled exposure to air pollution, such as by relocation or air conditioning in a hospital ward. The plaintiffs here relied on epidemiological, clinical, and air pollution measurement data. (vi) Data showing that such factors as allergies, smoking, or aging in the plaintiffs' medical histories, while not negligible, did not detract from the role of air pollution in disease etiology. (vii) Data showing that experiments on animals corroborated the real observations.

Based on the evidence submitted, the court ruled that the defendants were negligent in siting and operating the complex, and that the harm caused was forseeable. The court said that the defendants had a duty to use the best available technology to control emissions. It also criticized the government in its verdict. The decision was a very strict application of the joint tort statute in an air pollution case.[52]

The strict verdicts in the pollution trials prompted the government to pass a number of environmental laws. On June 22nd, 1972, it passed a law which added strict liability provisions to the Air and Water Pollution Control Laws. In 1973, it enacted the Pollution-Related Health Damage Compensation Law. The Compensation Law adopted the use of standard scales used in the Yokkaichi case for calculating the amount of disability benefits to be awarded victims. In addition, the Yokkaichi court's discussion of foreseeability of harm prompted the Cabinet to pass a resolution requiring the government to make an environmental impact assessment of public works projects. Also, between 1973 and 1974, the government enacted other laws requiring sectoral environmental impact assessments. Directly in response to the Yokkaichi case, the director-general of the Environment Agency made a commitment to strengthen the enforcement of the nation's environmental laws.

In 1972, Mie prefecture enacted the Environmental Pollution Control Ordinance, which regulated total mass emissions of SO_2. In May 1973, the central government established stringent ambient air quality standards for NO_2 and oxidant, and raised the ambient standards for SO_2. In 1974, the government followed Mie prefecture's lead and amended the Air Pollution Control Law, providing total SO_2 mass emission regulations. Also in 1974, the Diet passed the Industrial Siting Law, requiring environmental impact assessments; the Industrial Pollution Factory Manager Law; and the National Land Use Planning Law, which set the rules for land use, development and conservation for the future. With these new laws and the decisions in the pollution trials, Japan had in a hurried five years put in place the basic policy instruments to deal with air pollution.

1.8 POLLUTION MANAGEMENT AND TOTAL MASS EMISSION REGULATION

Pollution-control investment. After 1970, Japanese industry began to take the business of pollution-control more seriously. This new attitude is reflected in the size of pollution-control investments between 1970 and 1975, as reported by the OECD.[53] See Table 1.6.

The size of pollution-control investments began to increase markedly starting in FY 1971, when the air and water pollution control regulations were tightened. In FYs 1971 and 72 and again in FYs 1974 and 75, total private-sector investment declined. The 1971-72 decline coincided with the devaluation of the dollar, leading to export constriction, and the 1974-75 decline coincided with the energy crisis, when the price of oil quadrupled. Also, in FY 1974, Japan experienced high inflation and negative GNP growth. Despite these economic hard times, Japanese industry increased its pollution-control investment during FYs 1971 and 1972 and FYs 1974 and 1975.

On February 28th, 1973, MITI issued a report analyzing Japanese anti-pollution investment. The report found that in 1973 air pollution control investment comprised 58.2% of total pollution control investment. In addition, the report found that in 1973 the ratio of total, pollution-control investment to total investment broken down by the industrial sector was as follows: electric power generation--24.8%; mining--20.4%; pulp and paper--18.5%; petroleum refining--14.8%; and iron and steel--12.9%.

Econometric studies. In October 1971, the Environment Agency's Central Advisory Coucil on Environmental Pollution Control Measures began working on a long-term environmental conservation plan for Japan. The Advisory Council formed an Expert Committee for Econometrics which issued an interim report in 1974. In 1973, the Economic Planning Agency published an economic white paper

Table 1.6
Estimates of anti-pollution investments in the private sector, direct method, 1970-75

	Total investment in private sector (billion Yen)	Anti-pollution investment in private sector (billion Yen)	Share of Anti-pollution Investment in private sector (%)
1970	14,494	232	1.6
1971	14,908	403	2.7
1972	14,723	559	3.8
1973	22,304	839	3.8
1974	22,929	1,333	5.8
1975	21,072	1,783	8.5

Source: OECD, Environmental Policies in Japan

TABLE 1.7

Changes in macro-economic variables generated over time by a soft environmental policy. As estimated by Murakami and Tsukui

	After 5 Years	After 10 Years	After 15 Years
Output	-2.8%	-0.5%	-3.0%
Consumption	-1.4%	-0.2%	-3.1%
Gross Investment	+26.9%	+1.8%	-12.9%
Productive Investment	+11.5%	-3.2%	-16.1%
Housing Construction	+11.5%	-2.5%	-16.1%
Resources Import	-16.8%	-2.0%	-3.7%
Export	+1.8%	+8.2%	+10.7%

Source: OECD Environmental policies in Japan

which included an econometric impact study of environmental expenditures. In addition, economists from different theoretical schools carried out research projects to assess the impact of pollution controls. See Table 1.7.

In 1973, the OECD Environment Commitee also began an econometric impact assessment on Japan. In its study, the OECD integrated data on the impact of total mass emission regulation for SO_2 and NO_x into its assumptions for long-term environmental conservation and planning. The Environment Agency included these OECD econometric models for environmental conservation when it developed medium-term social and economic development plans for the late 1970s.[54]

See Table 1.8. In May 1977, the Environment Agency published its long-term environmental conservation plan.[55]

See Table 1.9. In FY 1975, Japan spent 2% of GNP on pollution control. In 1977, the OECD Environment Committee reviewed all the econometric models and impact assessments. It concluded that the economic impact of the high environ-

TABLE 1.8

Changes in macro-economic variables generated over time by stricter environmental policy, as estimated by The Economic Planning Agency

	After 5 Years	After 10 Years
GNP	-0.3%	-2.8%
Productive Investment	-0.4%	-7.7%
Prices (GNP Deflation)	+3.1%	+2.9%

Source: OECD Environmental policies in Japan

TABLE 1.9

Effects of pollution abatement costs on the national economy in FY 1985

	A Case 2×10^{13} Yen Pollution Abatement Investment	B Case Without Special Reinforcement of Enforcement	A - B
Real GNP (Average Anrrugi Growth; '75-'85)	6.12%	6.13%	-0.01%
Whole Sale Price (ibd)	4.77%	4.57%	0.20%
Consumers Price (ibd)	6.05%	5.96%	0.09%
Real Export (ibd)	6.15%	6.22%	-0.07%

Source: Long Term Plan of Environment Conservation, Environment Agency 1977

mental costs during the 1970s was detectable in macroeconomic indicators and that there were sectoral differences in the impact. However, it said that the impact was manageable with appropriate implementation and that there were no adverse economic trade effects on the Japanese economy.[56]

Total mass emission regulation. In 1974, the government introduced total mass emission regulation to assist in attaining the ambient air quality standards. The idea was to remedy the defects of the k-value system by restricting the total emission of pollutants in a given area. Mass emission regulation is not per se binding on pollutors; it is a policy objective which is translated into a set of emission standards. The limit on total emissions has the advantage of imposing controls on individual firms. Under the system, a company may allocate pollution discharges within its factories and choose the most economical method of limiting discharges. Thus, it encourages efficient resource allocation.[57]

The government designated 24 districts for total mass emission regulation in November 1974, December 1975, and September 1976.

1.9 AUTOMOBILE EXHAUST CONTROL, 1965-83

As early as 1928, Japanese scientists began to note the problem of urban air pollution caused by carbon monoxide from automobile exhaust. In 1955, air pollution generated by rapid urbanization and motorization began to be a serious problem. A number of factors contributed to this development. In 1955, MITI began to provide administrative guidance to foster the development of the automobile industry and promoted the idea of the "National Car." The large-scale construction projects for the 1964 Olympic Games in Tokyo also contributed to increased air pollution. In 1965, the government commenced a five-year road-construction plan.

When the Diet passed the Smoke and Soot Regulation Law in 1962, it requested the government to study options for automobile exhaust control. Accordingly, MHW commenced a project to develop automatic automobile exhaust monitoring instruments in 1963 with research funds provided by the Science and Technology Agency. Also, MITI and the Ministry of Transportation (MOT) began to conduct similar research and development projects in 1963. In 1964, MHW constructed three roadside automobile exhaust monitoring stations in the Tokyo metropolitan area.

At a meeting of the Liberal Democratic Party, a Diet member complained bitterly about being personally subject to exhaust fumes during his campaign for office. He had campaigned all day in an open car but got caught behind a large, diesel truck belching thick, black smoke. This apparently was a common problem for candidates running for office. A few older candidates had even died soon after the campaign was over. The Diet member advised the police to arrest the driver of the offending truck for operating his vehicle in violation of the Road Transport Vehicle Law. A few days later, the police spotted the truck with the aid of the license plate number provided by the Diet member, and took the driver into custody. He promised to repair his truck's exhaust system immediately. This personal exposure to the automobile exhaust problem had made the politician keenly aware of the growing problem.

In 1964, the government held an interministerial meeting at the vice-minister level to discuss automobile exhaust control. In 1965-66, MHW conducted a two-year study of automobile exhaust air pollution and its health effects. It organised a questionnaire survey, a pulmonary function test, and a CO-Hemoglobin test for roadside residents and traffic police working on congested streets. The study recorded complaints from annoyed residents and a significant increase in CO-Hemoglobin levels.[58]

In the mid-1960s, Los Angeles, New York, and Paris were experiencing automobile exhaust pollution problems similar to those experienced by Tokyo. In Los Angeles, buildups of automobile exhaust caused photochemical smog to settle over the city. In 1963, the Los Angeles Pollution Control District enacted ordinances regulating hydrocarbon emissions from the automobile crankcase and planned future regulations of hydrocarbon emission from the tailpipe. Also in 1963, New York initiated crankcase emission control, and the U.S. federal government announced automobile exhaust emission limits for cars used by the federal government. In Paris, the police authority introduced idling adjustments to regulate carbon monoxide (CO) emissions.

In 1963, Japanese car makers modified their export models to meet the crankcase emission standards set by New York and California. However, they did not comply with an MHW request in 1963 to build domestic models with lower emissions. The car makers claimed that there was no evidence linking automobile exhaust and illness and that Tokyo did not have a photochemical smog problem. The industry's denials were what led MHW to install air quality monitoring equipment at roadsides. In August 1967, the U.S. Public Health Service officially informed MHW that, of 35 automobile companies from all over the world, five companies had passed the U.S. automobile exhaust control standards. Toyota and Nissan were among the five passing companies. This development was good for Japanese exports, but many people were puzzled because the Japanese government had not conducted similar tests for domestic models.

Professor T. Kitagawa urged that the government first concentrate on controlling CO emissions. CO was the main pollutant in automobile exhaust emissions. Accordingly, in 1967 MOT instituted regulations to control CO emissions by making an idling adjustment. In addition, Tokyo, Osaka, and Kanagawa prefectures each announced that they would implement measures on their own initiative to control CO. Osaka prefecture reported that its automatic monitoring station had recorded a maximum CO concentration of 48 ppm/hr at a highway tollgate and 38 ppm/hr in front of the Adult Disease Center.

Dr. J. Middleton, Director of the Air Pollution Control Division of the U.S. Public Health Service and a member of the Air Pollution Control Board of the Los Angeles Air Pollution Control District, came to Tokyo to attend the Pacific Academic Assembly. While in Tokyo, he tested the photochemical oxidant pollution by using gum paper at the window of his hotel room. He observed the same cracking as happened with gum paper in Los Angeles. MHW learned of Dr. Middleton's experiment and asked him for advice on improving Japan's air measurement technology. Tokyo already had an automatic oxidant monitoring station as part of the national air-sampling network. However, the monitoring station recorded lower than expected levels of oxidant despite objective and subjective evidence of high photochemical oxidant concentrations. Dr. Middleton advised MHW to install a device in the monitoring station which would eliminate the interference caused by sulfuric acid mist.[59]

MHW took Dr. Middleton's advice and remodeled its monitoring station. The station then recorded CO at the expected higher levels. The instant peak was 0.35 ppm and the hourly peak was 0.17 ppm.

MHW again urged Japanese car makers to reduce hydrocarbon emissions for domestic models as they had done in their export models. But the Japan Automobile Industry Association was recalcitrant. It questioned the accuracy of the air monitoring stations and sent a team to the U.S. to study the treatment of oxidant there.

On July 18th, 1970, newspapers reported incidents of lead poisoning among roadside residents in Yanagimachi. Several patients were hospitalized, and many experienced adverse medical reactions.[60]

The public exploded in anger and demanded the immediate institution of stringent automobile exhaust controls.

The government responded to the crisis quickly. In July 1970, MITI cut the alkyl-lead content in premium gasoline by 1/2 and planned to implement a lead-free gasoline program within five years. MITI based these measures on its past research on automobile exhaust control technology and on the fact that alkyl lead in gasoline shortened the life of the catalyzer. At first, the lead-free gasoline program experienced problems with valve recession. The process was helped by the introduction of electronically controlled fuel injection.

MOT responded to the 1970 smog incidents by issuing target dates for automobile exhaust emission controls. MOT's 1974 target was 7 g/km for hydrocarbon and 0.6 g/km for NO_x. Japanese car makers accelerated their research and development programs to meet these targets.[61]

Developments in the U.S. had an impact on automobile exhaust control efforts in Japan. In July 1970, Congress passed the Clean Air Act, which set stiff standards for automobile exhaust emissions. The U.S. Environmental Protection Agency was responsible for enforcing the Clean Air Act. However, in February 1972, the U.S. Office of Science and Technology issued a report entitled "Cumulative Regulatory Effects on the Cost of Automotive Transport." The report recommended a flexible attitude in the enforcement of the tough Clean Air Act standards, claiming that such strict regulation unacceptably increased transportation costs.[62]

U.S. automobile makers joined the attack on the Clean Air Act. They filed suit against the Environmental Protection Agency to stop the emission standards planned for 1975 and 1976.

After the government established the Environment Agency in 1970, it became responsible for setting automobile exhaust emission standards under the Air Pollution Control Law. The MOT was responsible for enforcing the emission standards under the Road Transport Vehicle Law. It did this by reviewing applications for type specifications for the production of new cars.

T. Sakakibara, director of the Automobile Pollution Control Division of the Environment Agency, managed difficult and complex negotiations involving MOT, MITI, car makers, and other interested groups. In February 1972, he left his office and did not return. An extensive search did not locate him and it is assumed that he committed suicide. This was a tragic result of the difficult manoeuvers in formulating a policy on automobile exhaust control.

In August 1972, the expert committee of the Central Advisory Council for Environmental Pollution Control Measures published its interim report on the proposed automobile exhaust emission standards for 1975 and 1976. The expert committee adopted proposed standards equivalent to those in the U.S. Clean Air Act. There were technical differences between the U.S. and Japanese testing procedures for automobile type approval. The U.S. standard is expressed as a mean value while the Japanese standard is a maximum permissible limit. Also, the driving mode is different due to differences in traffic patterns between the U.S. and Japan.

When the expert committee issued its proposed standards, MITI did not comment in view of the charged social and political situation in Japan. The public was angry and demanded tough laws. The automobile companies also kept a low profile. They knew that a change was pending in U.S. policy toward the enforcement of the Clean Air Act, yet they worked hard to meet the 1975 and 1976 standards while claiming that there was not enough time to meet them.[63]

In September 1972, the Air Management Section of the OECD held a meeting in Tokyo. At this time, newspapers reported that Honda and Mazda had met the 1975 emission standards. The U.S. delegates were shocked that the standards could be met so quickly and asked Honda and Mazda to confirm the reports, which they did. In October 1972, the Environment Agency formally issued the 1975 and 1976 standards, which were equivalent to the U.S. 1976 standards. In December 1972, MOT issued the emission standards for 1973.

In November 1972, the Tokyo metropolitan government published Professor K. Tsuchiya's report on biological responses to ambient lead exposure in Tokyo residents. The report concluded that there was no significant increase of delta ALA in Tokyo residents, which is the initial biological response to ambient lead exposure. Furthermore, it stated that the accumulation of lead in the human body was distributed within the range of measurement error. However, the report cautioned that there could be significant differences between residents in the concentration of lead in the blood and noted that further research was needed.

In February 1973, the U.S. Environmental Protection Agency revealed that Honda and Mazda had passed the 1975 standards under the Clean Air Act. However, in April 1973, the Environmental Protection Agency decided to postpone the effective date of the 1975 standards to 1976.

Immediately after the dramatic U.S. decision, Japanese automobile makers lobbied the Environment Agency to delay the implementation of the Japanese standards. Honda and Mazda were confident that they could meet the standards but the other automobile makers expressed difficulty. The Environment Agency held a hearing for each automobile maker to collect the following information: (i) the status of research and development for pollution control; (ii) estimates of the cost of meeting the 1975 and 1976 standards; (iii) progress of past research and current problems; (iv) forecast of future production; and (v) forecast of production after 1975. As a result of the hearings, the government concluded that Honda and Mazda could meet the standards, and other car makers could meet the standards for some, but not all, of their models.[64]

The Environment Agency decided to keep the timetable for the enforcement of the 1975 emission standards. It advised car makers with models which could not meet the standards to stop production of those models. However, the Environment Agency was convinced that the 1976 standards could not be met, given the then state of research and development.

On June 5th, 1973, Environment Day, Senator Muskie was invited to Japan to give a lecture. The Environment Agency provided him with a car which already met the 1975 emission standards. This was an impressive achievement, although the car's fuel efficiency was low. The government encouraged people to purchase cars meeting the 1975 emission standards and provided a special tax benefit for such purchases in FY 1974.

The next year, the Environment Agency held another round of hearings with each car maker to review progress on compliance with the 1976 emission standards. All the car makers stated that they were unable to meet the 1976 standards on schedule and requested a postponement of their implementation. The Environment Agency agreed with them that it would be impossible to meet the deadline. Prime Minister K. Tanaka gave his consent to the postponement, and the Environment Agency requested the Central Advisory Council to reconsider the implementation schedule for the 1976 standards.

Many local governments, led by Tokyo, Yokohama, and Osaka, and pro-environment citizens' organizations criticized the reluctant automobile makers' attitude. They demanded that the Environment Agency enforce the 1976 standards on schedule. The press supported the efforts of the local governments and citizens. In August 1974, seven large cities jointly organized a study team to review the 1976 standards. These cities were Tokyo, Kawasaki, Nagoya, Kyoto, Osaka, and Kobe. In September 1974, the joint study team issued an interim report. The report claimed that the proposed 1976 standards could be achieved given the state of current technology. The report criticized the automobile makers for not trying hard enough to achieve the standards and the government for giving in to industry's requests. The seven cities demanded the enforcement of the 1976 standards on schedule.

MITI, however, advised that the 1976 standards for NO_x emissions be postponed. In September 1974, the Diet held a hearing for automobile industry representatives to review the 1976 standards. Toyota and Nissan stated that a standard of 0.9 g/km for NO_x emissions would be feasible in 1976; Honda and Mazda stated that 0.6 g/km was feasible. In July 1970, MOT set an emission standard of 0.6 g/km for NO_x to be implemented in 1975. The Central Advisory Council held a meeting with representatives from the seven-city group, but no consensus was reached. All members of the expert committee of the Central Advisory Council concluded that the 1976 standards could not be achieved given the then state of technology. The expert committee discussed proposals for a two- and three-year delay, but could not reach agreement. In December 1974, the expert committee recommended the implementation of provisional emission standards for NO_x in 1976 and a postponement of the original 1976 standards to 1978. The proposed provisional standard was 0.6 g/km for small cars and 0.85 g/km for large cars.

The expert committee presented its proposals at a plenary session of the Central Advisory Council. However, the plenary session could not reach agreement and it was decided to convene the Comprehensive Committee of the Advisory Council. The Comprehensive Committee discussed the proposals exhaustively, but could not reach agreement. Finally, Dr. R. Wadachi, president of the Central Advisory Council, offered to make a decision based on the discussions which had taken place. All members concurred with Dr. Wadachi's offer. Dr. Wadachi decided to adopt the original recommendation of the expert committee, with a few amendments adding stricter language. The Advisory Council accepted Dr. Wadachi's recommendation.

In January 1975, M.P. T. Fuha, secretary-general of the Communist Party, criticized Prime Minister Miki and the director-general of the Environment Agency regarding a leak of matters discussed at a meeting of the expert committee of the Central Advisory Council. Fuha claimed that a member of the expert committee, who was a representative of the automobile industry, had leaked information to car makers. The meetings of the expert committee were supposed to be secret and closed to the press and public. In view of the incident, the government decided that representatives from the automobile industry could not be members of the expert committee and that, if the expert committee needed to hear the views of the automobile industry, it would hold a hearing for that purpose. This issue became very controversial in the budget committee of the Diet.

To avoid repeating such a fiasco, the Environment Agency set up a Technology Review Council (TRC) comprised of four university professors who were experts in the field of internal combustion engines. The TRC's function was to review the state of technology development for the control of NO_x emissions from automobiles. This was a purely scientific task. The TRC invited representatives from automobile manufacturers to give candid explanations of the state of their technology. The TRC promised to keep all trade secrets confidential. The idea was to publish the state of technological advance of each company in order to stimulate competition.

The TRC held its first meeting in August 1975. It requested each automobile company, with which it met separately, to present all information and data on their technology. The Environment Agency attended the meetings as observers.

TRC and Environment Agency members also visited each company to view research in their laboratories and to see driving tests on their test fields. The TRC drafted its first report without outside assistance. Then each company deleted portions which it considered confidential. It was agreed not to identify the automobile companies individually. In December 1975, the Environment Agency released the report to the public and the TRC members held a press conference to allow questions from journalists. The report was widely read by members of the Diet, other ministries, local governments, citizen groups, and concerned industries.

The report enabled people to understand the state of automobile exhaust control and helped in the process of setting a date for the implementation of the emission standards. For example, it helped consumer groups to better understand the problems of the car makers in meeting the deadlines. The report also stimulated intense competition among the automobile makers to be the first to achieve the standards. Some companies used portions of the report for public relations and advertising. Automobile dealers promoted cars which were clean and fuel efficient. At the request of the Environment Agency, the Japan Automobile Association funded the translation of the full text of the report into English and distributed it all over the world in the spring of 1976. This was done because the automobile is an international commodity, and trade considerations were important for the development of further, pollution-control programs.[65]

The automobile makers could not meet the 1975 hydrocarbon emission standards for two-cycle passenger cars in time for the April 1975 deadline, and were forced to stop production. Suzuki was the biggest maker of two-cycle cars and so the failure had the most impact on it. According to the TRC, NO_x emissions from Suzuki's two-cycle engine were lower than the 1978 NO_x emission standards, but hydrocarbon emissions were high due to the nature of combustion in the engine. Suzuki's engines in fact had better fuel efficiency than other types of engines. Although Suzuki continued research on its engines to try to meet the hydrocarbon standard, the TRC concluded that the 1975 hydrocarbon emission standard could not be met in the near future.

In its December 1975 report, the TRC recommended that the government adopt provisional hydrocarbon emission standards for two-cycle engines. Accordingly, the Environment Agency organized an interministerial meeting to consider an exemption for the 1975 hydrocarbon emission standards. The other ministries were consulted because pollution policy on the hydrocarbon matter had a great potential impact on employment, energy, and trade policy, given the factory shut-down of two-cycle engine cars. The MOT and the Ministry of Labor were in favor of the exemption. In the end, the government adopted a 1976 provisional hydrocarbon emission standard exclusively for two-cycle engine cars.

In May 1976, the Environment Agency held a meeting with foreign automobile manufacturers to inform them of the Japanese automobile exhaust control regulations. The foreign car makers were well informed about the state of automobile exhaust control technology in Japan, and the Environment Agency and the TRC were also aware of foreign automobile exhaust control technology. At the second meeting for foreign car makers, also held in May 1976, all the companies announced that they had developed pilot cars meeting the 1978 emission standards. The companies reported that the key to their achievements had to do with the fact that they put their research into developing better combustion. They also reported that fuel efficiency had improved as compared to cars built prior to the 1973 standards. By the final meeting in August 1976, all companies had moved into the mass production stage for cars that met the NO_x emission standards.

The TRC published its second report on the state of automobile exhaust control technology in Japan in May 1976, and its third in October 1976. For the third report, all car makers agreed to have the report identify the names of the car makers with their technology. The Japan Automobile Association also translated and distributed the second and third reports worldwide.

In November 1976, the OECD Environment Committee held a special session in Tokyo to review Japanese environmental policies. The OECD report praised Japan's success in automobile exhaust control. Also, the OECD report commented that Japan's stringent automobile exhaust standard was not a trade barrier against foreign imports. It noted that the standard was necessary to achieve the desired air quality and that the domestic automobile industry had opposed the standards.[66]

In 1976, Japan held a ministerial-level meeting to discuss ways to encourage people to buy cars meeting the 1978 standards rather than the old emission standards. MOT published test data on emission levels and fuel efficiency of new cars approved for production. This helped to promote sales of clean,

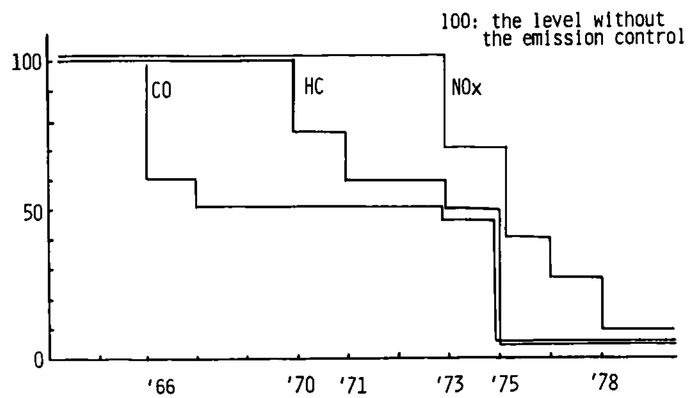
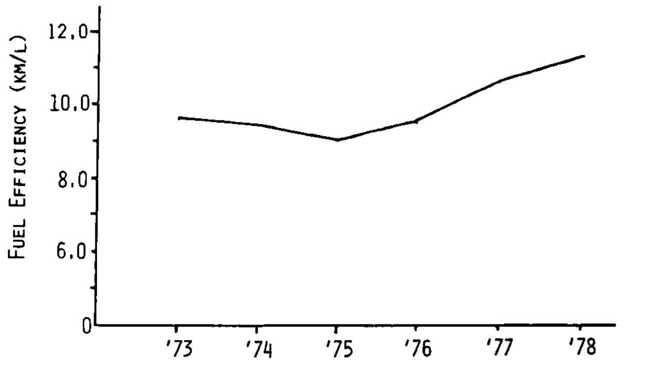


Fig. 1.4. Autoexaust emission controls for passenger cars



SOURCE : JAPAN AUTOMOBILE MANUFACTURING ASSOCIATION '79

Fig. 1.5. Trends in fuel efficiency of passenger cars

efficient cars. Also, the government provided a tax incentive to encourage people to buy cars meeting the 1978 NO_x standard prior to the enforcement date in April 1978.

In addition, the ministers discussed whether to grant a grace period for compliance with the 1978 standards for U.S. and European automobile imports. U.S. officials requested a two-year grace period, and European Community officials met with their Japanese counterparts to request a similar grace period. As a result of the European meeting, Japan decided to offer a three-year grace period for foreign automobile imports, and the U.S. and European Community agreed. The Environment Agency then set up a program to visit foreign automobile manufacturers to explain Japanese emission standards.

Fig. 1.4 shows Japanese emission control standards for passenger cars. Fig. 1.5 shows trends in fuel efficiency of Japanese cars. Fuel efficiency declined from 1973-75, and increased again in 1978. These charts show the progress of the automobile makers in meeting the emissions standards of 1975, 1976, and 1978. Developing clean cars had the unexpected side effect of improving combustion. It shows that stringent pollution control standards sometimes lead to technological innovation. It also improved the international competitiveness of Japanese cars. However, without the strong public demand for automobile exhaust control, the government and automobile makers probably would not have achieved the success they did.

1.10 TRUCK AND BUS EXHAUST CONTROL

In the 1970s, a change occurred in the mode of cargo transport in Japan--railways were used less and less and trucks were used more and more. Noise and

Table 1.10
Reports of the vehicle pollution control technology review council and enforcement schedule, 1978-1985

Report	Time of Evaluation	Published Year	Notification Year
1st Report	1978 August	1979 May	1979 September
2nd Report	1979 August	1980 May	1980 September
3rd Report	1980 August	1981 May	1981 August
4th Report	1981 August	1982 May	1982 September
5th Report	1982 August	1983 May	1983 September
6th Report	1983 August	1984 May	1984 October
7th Report	1984 Oct. Nov. (Air) 1984 August (Noise)	1985 May	Not Yet

Note: Vehicle means heavy duty car (truck, bus, trailer
Source: Environment Agency, Bureau of Air Conservation,

Enforcement Schedule	
Implementation Year	Vehicle Classification
1981 Standard	Light Gasoline Vehicle (NOx) Middle Weight Gasoline Vehicle (NOx)
1982 Standard	Heavy Weight Gasoline (NOx) Light (NOx) Indirect Injection Diesel (NOx) Passenger Car (Noise)
1983 Standard	Direct Injection Diesel (NOx) Middle Size (Noise)
1984 Standard	Big Size Bus (Noise) Small Size (Noise) Except 4 WD Motorbike; Less than 50cc (Noise)
1985 Standard	Large Size Truck (Noise) Except 4 WD, Tractor, Trailer, Light Autobicycle (Noise)
1986 Standard	Large Size 4 WD, Tractor, Crane (Noise) Motorbike; More than 50cc (Noise) Manual Speed Gear Diesel Passenger Car (NOx)
Not Yet	

etc.) unless stated as passenger car.
Division of Automobile Pollution Control, 1985

black smoke from heavy, diesel trucks and bus traffic became a major nuisance. Since the 1960s, the Vehicle Safety Law and the Road Traffic Law had set qualitative controls on visible smoke without setting definite emission standards. In 1972, the government set a black smoke concentration standard of 50% based on the Bosch smoke scale. In 1974, it set CO, hydrocarbon, and NO_x emission standards for diesel trucks and buses. In 1976, it set noise limits for trucks and buses, and in 1977 it set long-term NO_x emission standards for trucks and buses. These regulatory statutes were to an extent contradictory, especially with respect to black smoke, NO_x, and noise. By 1980, the truck and bus manufacturers had developed the technology to meet the NO_x emission standards, and they incorporated it in 1983 models.

In 1978, in view of the success of the TRC in evaluating emission control technology for passenger cars, the Environment Agency commissioned the Vehicle Pollution Control Technology Review Council (VPCTRC) to evaluate control technology for trucks and buses. The VPCTRC had air and noise control subcommittees, and issued reports annually. In 1984, it set emission standards for trucks and buses to be enforced in 1986. See Table 1.10.

The implementation of emission controls for trucks and buses was different from that for cars in two important respects. There is much less competition among truck and bus manufacturers than there is among car manufacturers. Thus, there was no incentive to be the first to meet the standards and thereby increase market share. Also, buyers of trucks and buses, as opposed to cars, are usually businesses rather than individuals. Private companies generally purchase trucks for transporting cargo and public corporations generally purchase buses for transporting people. More than individuals, businesses are concerned about keeping costs down in their purchases of capital equipment.

<u>Transportation and urban air pollution.</u> By the middle of the 1970s, there was a remarkable improvement in the urban air pollution of SO_2, CO, suspended particulates, and photochemical oxidants. This was largely due to emission controls on stationary sources and passenger cars. However, roadside zones of large metropolitan areas have experienced almost horizontal trends in NO_2 and noise levels. This was due, in part, to the fact that truck cargo transport increased steadily by about 2% a year.

In 1980, the Diet passed the Law for Environmental Development in Roadside Zones. However, the designation of roadside zones under the law did not progress very rapidly because of the difficulty of obtaining consensus among roadside residents. In 1983, the Central Advisory Council formulated recommendations to deal with pollution in roadside zones. The proposals included land use, building siting, and truck traffic flow. The Cabinet had required environmental impact assessments for new roads since 1972, and the Ministry of Construction had implemented a number of environmental measures in road con-

TABLE 1.11

Trends in the NOx emission structure during FYs 1983-88

— Tokyo Capital Area —

		1983 FY		1988 FY		
		Amount of Emission 1000 t/year	Share (%)	Amount of Emission 1000 t/year	Share (%)	88/83
Stationary Sources	Factory, Business Office	11.6	20	11.6	23	1.00
	Mass of Small Sources	3.7	6	3.7	7	1.00
	Sub-total	15.3	26	15.3	30	1.00
Mobile Sources	Automobile	40.3	69	33.1	65	0.82
	Other Mobile Sources	2.6	5	2.6	5	1.00
	Sub-total	42.9	74	35.7	70	0.83
Grand Total		58.2	100	51.0	100	0.88

Source: The Medium Term Perspective of NOx Control Measures in Large Metropolitan Area, December 1985

struction. However, environmental impact assessments were lacking for regional highway construction projects.

The Environment Agency devised several programs to control NO_x automobile exhaust. In 1978, the environmental quality standard for NO_2 was revised from 0.06 ppm/24hr to 0.04 ppm/24hr at the 98 percentile value. The program called for achieving this standard by 1985. In 1982, the government implemented total mass emission regulation by designating districts. In addition, the Environment Agency set emission standards for passenger cars in 1978 and heavy-duty trucks in 1983. The MOT enforces the emission standards at the time it gives type approval.

Despite these efforts at NO_x emission control from stationary and mobile sources, Japan failed to meet the AAQS for NO_2 by May 1985, the date set for its achievement. The Environment Agency responded by developing a medium-term plan of NO_x control measures for implementation in metropolitan areas. It analyzed emission and pollution data to identify reasons for the failure to meet the 1985 standard and tried to predict future emission and pollution trends from current data.[67]

The agency's report identified four reasons for the failure: (i) The increase in traffic flow due to the marked increase in cargo transport by trucks. (ii) The increase in the size of trucks for cargo transport, and the increase in the number of diesel trucks with direct fuel injection engines. (iii) The extension of car life from seven to ten years, which has slowed the shift from old cars to new cars meeting emission standards. (iv) The failure for the simulation model to properly account for NO to NO_2 conversion.

The Environment Agency concluded that the May 1985 NO_x AAQS could not be achieved before 1988. In FY 1986, it started a research project to develop a better simulation model that accounted for the conversion of NO to NO_2. In addition, it implemented a new policy to encourage turnover from old trucks and buses to new ones meeting the emission standards. Table 1.11 presents trends in the NO_x emission structure in FYs 1983 and 1988.

1.11 AAQS FOR NO_2 AND THE NO_x CONTROL PLAN

The Smoke and Soot Regulation Law of 1962 first designated NO_2 as a specific noxious substance. The government based this designation on a past pollution dispute arising from a chemical plant. Also, research conducted in Los Angeles in the late 1950s on the photochemical oxidation process indicated that NO_2 was a precursor to photochemical oxidant formation. The drafters of the Smoke and Soot Regulation Law foresaw the increase in NO_2 pollution and the subsequent appearance of photochemical smog as Japan entered a period of fast growth and high energy consumption.

In 1962, MHW developed automatic air monitoring instruments for NO, NO_2, and oxidant. Three automatic air monitoring stations were placed at roadsides in the Tokyo metropolitan area, and they recorded a steady increase in the concentration of NO_x, beginning in 1967. During the same period, a National Air Sampling Network Station in Tokyo recorded high peaks of oxidant. In 1965, MHW began to fund an experiment conducted on animals on the chronic effects of long-term exposure to NO_2. A study conducted under contract by Y. Nakajima found that pulmonary laveoral cells developed structural changes after thirty days' exposure to NO_2 at a concentration of 0.7-0.8 ppm.[68]

In view of the results of this study, MHW focused its research on the health effects of long-term exposure to low-level NO_2. The photochemical smog episodes in 1970 further increased the interest in studies showing the health effects of oxidant and NO_2.

In the fall of 1970, the Central Advisory Council formed an expert committee to study proposals for an AAQS for NO_2 and oxidant. Soon after that, the Environment Agency began a continuous, five-year study of the community health effects of air pollution in six cities. It issued an interim report in 1970 on results obtained during the winter of 1970-71.[69]

The NO_2 expert committee adopted the report as a reference to be consulted for the formulation of NO_2 criteria and guides.

In June 1972, the expert committee recommended an AAQS for NO_2 of "less than 0.02 ppm for 24hr average in a community environment". In selecting this standard, the expert committee noted the possible adverse health effects of chronic bronchitis and the synergic effects of SO_2. The expert committee did not have the accumulated pollution measurement data when it developed this standard. It had to rely on studies conducted on animals and a few epidemiological studies conducted in Japan and overseas. The foreign material which the expert committee consulted included a document prepared by the U.S. Environmental Protection Agency in January 1971 on NO_2 criteria and a conference report of the World Health Organization expert meeting in April 1972.

The expert committee arrived at the 0.02 ppm/24hr (equivalent to 0.01 ppm/year) standard by twice applying a safety factor of 0.5 to a standard of 0.04 ppm/year. The 0.04 ppm/year NO_2 standard corresponds to a 5% prevalence rate of chronic bronchitis symptoms in adult male workers in the Tokyo metropolitan area when simultaneously exposed to SO_2 at the 0.05 ppm/year level. This is nearly twice the background prevalence rate. This accounts for the first safety factor. The second safety factor is due to the risk of cancer suggested by the abnormal structural changes reported in the experiments on animals. This was the thinking of the expert committee in a period of intense social concern about the quality of the air.

The 0.02 ppm/24hr standard was very strict. By comparison, the U.S. Clean Air Act set an NO_2 AAQS of 0.05 ppm/year in April 1971. The U.S. automobile industry attacked even this comparatively lax standard as too strict in September 1971.[70]

In Japan, economic and industrial organizations, led by the Iron and Steel Federation, criticized the proposed 0.02 ppm/24hr standard. But the critics met strong resistance. The social and political climate surrounding pollution control was different in the U.S. and Japan. In the U.S., the devaluation of the dollar in August 1971 had cooled the resolve for environmentalism, but in Japan the Yokkaichi trial had strengthened the environmental movement. The government had empowered the Environment Agency to establish environmental quality standards by agency notification rather than by Cabinet resolution.

In May 1973, the Environment Agency finally decided to accept the recommendation of its expert committee, despite the protests, and issued a notification setting an NO_2 AAQS of 0.02 ppm/24hr. It set ten years as the target date to achieve the standard, with an interim target of 0.04 ppm/24hr. At the same time, it set a photochemical oxidant AAQS of 0.06 ppm/hr and raised the SO_2 AAQS from 0.05 ppm/24hr to 0.04 ppm/24hr. The Environment Agency based the stricter SO_2 standard on morbidity data at Yokkaichi.[71]

The Environment Agency's new NO_2 AAQS prompted related anti-pollution developments. In September 1973, Osaka prefecture responded to the new, strict NO_2 AAQS by formulating a major plan for environmental conservation. The Osaka plan included Japan's first total mass emission regulation, enacted one year in advance of the national regulation. In addition, the new NO_2 AAQS served as a guide for environmental impact assessments. The Environment Agency applied a guide of 98 percentile value of one-year monitoring data. Local governments reviewed the siting and expansion plans of electric power plants, petrochemical complexes, and iron and steel plants. The Environment Agency instituted a strict policy on plant sitings and expansions in order to help meet the NO_2 AAQS. In July 1973, the Sumitomo Chemical Company introduced the first dry denitrification process at its plant in Chiba. In December 1973, the Tokyo Electric Power Company installed the first wet denitrification process at its Minami-Yokohama works. In Hokkaido, the prefectural government took the new NO_2 AAQS into account while conducting an environmental impact assessment on a giant industrial development project that was part of the 1969 Japanese Archipelago Reform. As a result of the assessment, in August 1974 the Hokkaido government and the electric power company agreed that the power company would install denitrification equipment at its coal-fired power station.

The Kawasaki Iron and Steel Company case shows an example of intervention by the Environment Agency to ensure the construction of clean plants. Chiba prefecture entered into negotiations for a pollution control agreement with Kawasaki Iron and Steel regarding Kawasaki's plans to expand a furnace. As a result of the negotiations, Chiba prefecture agreed to lenient terms of pollution control. At the same time, Chiba requested that the government designate the area surrounding the iron and steel plant under the Pollution-Related Health Damage Compensation Law, which had been enacted in 1973. At this point, the Environment Agency entered the picture. It argued that Chiba's policy was contradictory: on the one hand it had conceded to lenient terms of pollution-control, and on the other, it had requested designation for compensation purposes. The Environment Agency stated that it would oppose Kawasaki's expansion plans unless it instituted stricter pollution control. Under pressure, Kawasaki agreed to install denitrification and desulfurization equipment and to build a high stack for the furnace. The Iron and Steel Federation strongly criticized Kawasaki's pollution control measures because it had set a precedent which in time other iron and steel companies would have to meet.

In 1975, the Environment Agency intervened in another iron and steel company's expansion plans. It required the Nippon Kokan Company to install state-of-the-art denitrification and desulfurization equipment at its Oogishima plant. Nippon Kokan and the local government strongly criticized the Environment Agency for requiring costly anti-pollution measures. The U.S. Environmental Protection Agency took an interest in the pollution control facilities at Oogishima and requested permission to study the facilities in detail. However, at the request of the U.S. Iron and Steel Industry Association, Nippon Kokan denied the Environmental Protection Agency's request. The U.S. iron and steel companies were afraid that the Environmental Protection Agency would be impressed with the Oogishima facilities and require U.S. plants to install similarly advanced, pollution-control equipment.

In April 1974, Professor S. Shishido of Tsukuba University conducted a study on the macroeconomic impact of pollution-control expenditures for the Japan Economic Study Federation and the OECD Environment Committee. His study examined the period from FYs 1972-77 and analyzed the macroeconomic impact of maintaining current pollution-control standards and of raising the standards. Professor Shishido's study concluded that the macroeconomic impact was detectable, but not significant.[72]

Japanese industry had always been critical of the NO_2 AAQS, but the criticism reached a peak in FY 1975. In FY 1974, the Japanese economy shrank in terms of GNP. In addition, the devaluation of the dollar and the energy crisis helped to bring about a new social climate. The attack on the NO_2 standard was carried out at a technical level, rather than an emotional or political level. A famous scholar of chemical engineering specializing in air pollution control and one of the five major Japanese daily newspapers supported the attack on the NO_2 standard. In some respects, the attack was similar to the U.S. Environmental Protection Agency's criticism of the epidemiological studies supporting the U.S. NO_2 ambient standard. Japanese industry distributed the report of the hearings held by the U.S. Congress's Senate Committee of Public Works on November 5th and 6th, 1973.[73]

The Environment Agency commenced a study of the health effects of exposure to high levels of NO_2 and low levels of particulates and SO_2. In 1974, it estimated it would cost a total of ¥2000 billion to achieve the NO_2 ambient standard. In addition, it estimated that NO_x emissions would have to be cut by more than 90%. In FY 1975, two expert committees began a three-year review of NO_x emission control technology--one for automobile exhaust emissions and the other for stationary source emissions. The stationary source committee held hearings and made site visits to emission control equipment manufacturers and users. The committee reviewed both combustion and denitrification technology to find ways to reduce NO_x in fuel and in the air.

The Environment Agency took the position that it should listen closely to industry's arguments against the NO_2 ambient standard. But it also felt the review should center on a re-evaluation of the June 1972 Central Advisory Council expert committee report which formed the basis for the NO_2 standard. The review was difficult. Experts offered conflicting testimony; the interests of diverse groups clashed. In the process, the administration was guided by article 9-3 of the Basic Law for Environmental Pollution Control Measures. Article 9-3 stated that environmental quality standards should be reappraised periodically, and revised if necessary.

At this time, MITI and the Environment Agency agreed to conduct separate, independent reviews of the NO_x ambient standard without any cooperation or interference. The reviews were scheduled for completion by May 1978.

To benefit from an international perspective in its reconsideration of the NO_2 standard, in 1976 Japan asked two organizations to conduct a review of its environmental policies--the Joint Expert Committee of the World Health Organization and the UNEP, and the Environment Committee of the OECD. Japan agreed to have the results of the review made public. The WHO-UNEP Joint Expert Committee, which included members on the expert committee of the Central Advisory Council in 1972, released its report in 1977. The Joint Committee concluded that the epidemiological studies upon which the NO_2 ambient standard was based could not, by themselves, provide a quantitative basis for evaluating the health risks of exposure to NO_2. Specifically, the Joint Committee said that the NO_2 concentrations for given periods did not correspond conclusively to the health effects reported in the epidemiological studies. This is because the epidemiological studies estimated the amount of NO_2 exposure when increases in the prevalence of chronic respiratory disease were reported. Accordingly, the Joint Committee noted the need for more in-depth studies of populations exposed to changing concentrations of air pollutants. The Joint Committee recommended a maximum, short-term exposure standard of 0.10-0.17 ppm/hr. It derived this standard by applying a safety factor of 3-5 to 0.5 ppm/hr, the threshold for hazardous health effects on animals. A standard of 0.10-0.17 ppm/hr is equivalent to 0.065-0.125 ppm/24hrs and 0.018-0.035 ppm/yr.

The OECD report made the following conclusions:

> It seems true that the available epidemiological studies on which [the NO_2 AAQS] is based are not very convincing. But the contrary (namely that such concentrations would not constitute health hazards) is not rigorously proven either. More generally, the notion of a 'scientifically-based' standard must be viewed with some skepticism. Epidemiological studies can only provide dose-effect relationships. In the best case, such relationships will exhibit thresholds that can suggest quality standards. In all cases, they only provide information to be taken into account in the selection of standards. But the selection is made by men, not by science.[74]

In January 1977, the Environment Agency summarized its community health study of housewives in six cities. The results were translated into English and distributed to the World Health Organization, the U.S. Environmental Protection Agency, and interested scholars and organizations. The report was inconclusive with respect to the relationship between air pollution and the prevalence rate of respiratory symptoms in residents living along roads with heavy traffic. However, residents of polluted roadside areas lodged more complaints about pollution from the traffic than residents of non-polluted areas.

In March 1977, the director-general of the Environment Agency requested the Central Advisory Council to study the health effects of NO_2 and recommend standards. The Council organized an expert committee and reported back to the director-general a year later. The expert committee recommended the following short- and long-term standards as necessary for the protection of human health: 0.1-0.2 ppm/hr (short-term exposure) and 0.02-0.03 ppm/year (long-term exposure under conditions of combined air pollution).[75]

The expert committee classified health effects as follows: (i) No effects are observable with current biological and medical methods. (ii) Medical and biological effects are observable, but they are reversible and within the homeostasis range of the living body. (iii) It is unclear whether the observed effects are reversible or a disruption of the homeostasis or the beginning of ill health. (iv) The observed effect can be associated with disease. (v) The observed effect can be diagnosed as disease. (vi) Death.[76]

This can be compared to the classification of health effects for the SO_2 studies in 1968 and 1973 as stated in the Expert Committee Report of the Environmental Quality Standard for SO_2. There were four classifications: (i) Exacerbation of patient symptoms cannot be proved by epidemiological studies. (ii) Increase of mortality rate cannot be proved. (iii) Increase of the prevalence of obstructive pulmonary disease cannot be proved. (iv) Adverse reaction or hazard of pulmonary function among children cannot be proved by epidemiological studies.

The Central Advisory Council's expert committee interpreted the results of epidemiological studies differently from the Joint Expert Committee of the World Health Organization and the UNEP, and the 1977 report of the U.S. National Academy of Sciences. The National Academy of Sciences report stated as follows:

Reports of excess chronic respiratory disease associated with low concentrations of ambient nitrogen dioxide (0.053 ppm) do not provide convincing evidence that other pollutants that were measured at relatively high concentrations were not a probable cause of excess disease. In the presence of low concentrations of sulfur oxide and particulates, three investigators failed to detect excess chronic respiratory disease in areas where nitrogen dioxide exposures were less than 0.053 ppm. Exposure doses calculated only from ambient air concentrations do not provide realistic estimates of actual human exposure times, particularly because of extensive movement into and out of polluted areas by any individual on any given days.[77]

In addition, there were differences between the Prime Minister's inquiry to the Central Advisory Council in 1970 and the Environment Agency director-general's inquiry to the Central Advisory Council in 1977. The 1970 inquiry directly requested proposals for an ambient air quality standard whereas the 1977 inquiry indirectly requested proposals for criteria and guides. Scientific information constituted the criteria and the expert committee's scientific judgement constituted the guides. The Environment Agency was responsible for making the administrative decision regarding the AAQS given the available scientific information. In 1977, the Environment Agency said, "Criteria and guides are a matter of science; standards are a matter of administration and politics. The Environment Agency will choose the AAQS based on the criteria and guides." The Environment Agency made its role clear at the last session of the Central Advisory Council when it concluded its report on the criteria and guides for NO_2, at the press conference, and in the Diet. The weighing of risks and benefits in the standard setting process was addressed in the World Health Organization Expert Committee report (TRS-554) issued in 1974.[78]

The debate was set--whether to maintain the high 1972 NO_2 AAQS of 0.02 ppm/24hr (equivalent to 0.01 ppm/year), adopt the mid-level expert committee proposal of 0.1-0.2 ppm/hr and 0.02-0.03 ppm/year, or concede to the lower standard of 0.05 ppm/year (equivalent to the U.S. standard) favored by business interests.[79]

Interested groups attempted to influence the decision-making process for the NO_2 AAQS. Industrial and economic groups, especially the iron and steel industry and the automobile industry, waged an extensive propaganda campaign to revise the AAQS to the U.S. standard of 0.05 ppm/year. On the other side, environmentalist groups, citizen's organizations, and some local governments, especially those controlled by the socialist and communist parties, worked to keep the 1973 standard of 0.02 ppm/24hr. In Chiba and Osaka, patients certified under the Compensation Law filed suits seeking an injunction against activity by industrial and transport groups opposing the 0.02 ppm/24hr standard. The patient groups also lobbied the Environment Agency to maintain the current standard. In addition, a group of environment scholars (Kogai Kenkyu), led by Professor S. Tsuru, announced its opposition to the revision of the NO_2 standard.

The pro-environment groups argued that there was a need to maintain the safety factor built into the conversion of the 1973 guide to the 1973 standard

TABLE 1.12

The state of compliance with the proposed NO_2 guides of 1978

Proposed-guides	Monitering Site	Saltzmand	Index
		0.72	0.84
0.02 ppm/Year	Area Station	53%	68%
(0.04 ppm/24 hr)	Roadside Station	7%	16%
0.03 ppm/Year	Area Station	86%	94%
(0.06 ppm/24 hr)	Roadside Station	39%	53%

Source: Environment Agency; Based on 1977 Monitering Data

of 0.02 ppm/24hr. But the Environment Agency countered that an adequate safety factor had already been built into the guide recommended by the expert committee in 1978, and thus that it did not violate the repeal of the Basic Law's harmony principle to consider economic and technical feasibility factors in the process of converting the guide to the 1978 standard. Feasibility studies indicated that such considerations weighed against a further raising of the proposed 1978 guides. The most difficult problems in adopting a standard higher than 0.02 ppm/year were automobile exhaust emission control and the large numbers of small, urban pollutors.[80]

Moreover, the proposed guides were still the strictest air quality requirements in the world. On the other hand, the Environment Agency did not concede to the demands of business groups for a NO_2 AAQS of 0.05 ppm/year, equivalent to the U.S. standard. The agency reiterated that the Basic Law prohibited the consideration of economic factors to lower the standards beyond those required by the sole consideration of safety factors, as expressed in the proposed 1978 guides.

Table 1.12 shows the state of compliance with the proposed guides in 1977.

In April 1978, the Environment Agency released the third report on NO_x control technology. Because automobile makers had already met the 1978 NO_x emission standard for passenger cars in 1976, the key area in NO_x control planning was stationary sources. The agency implemented the third enforcement schedule for stationary sources in June 1977 based on the progress of the second NO_x control technology report issued in 1977. Scientists had already developed a low NO_x burner and a low NO_x cement kiln (NSP kiln) which both burned fuel more efficiently than the existing burners and kilns. Tables 1.13 and 1.14 show the state of denitrification programs in terms of unit cost and

TABLE 1.13

Installation cost classified by process, per 105 Nm^3/hr gas treatment

	Installation Cost
Direct: Denitrification a Process	0.8 to 2.3 x 10^8 Yen
Direct: Denitrification b Process	1.0 to 2.5 x 10^8 Yen
Heating & Heat Recovery Process	2.0 to 5.3 x 10^8 Yen
Catalyser-Free Reduction Process	2.0 to 0.6 x 10^8 Yen
Wet Process (De-SOx + De-NOx)	8.0 to 9.0 x 10^8 Yen

Source: EA, ACB, April 1978

cost effectiveness.

The Environment Agency developed NO_x control options based on the classification of areas according to NO_2 pollution levels and the classification of NO_x control technology.[81]

For each option, the agency estimated the total cost of pollution control, the annual cost of pollution control, and fuel demand for denitrification plants. The agency also estimated NO_x emissions for each area and space limitations on the installation of denitrification equipment. See Table 1.15.

TABLE 1.14

Annual cost classified by process, equivalent to Yen/Kl of oil

Direct Denitrification a Process	1,000 to 2,100
Direct Process b Process	1,500 to 2,700
Heating & Heat Recovery Process	2,800 to 5,000
Catalyser-Free Reduction Process	700 to 1,300
Wet Process De-SOx + De-NOx	7,700 to 11,800

Source: EA, ACB, April 1978

Table 1.16

Estimated share of types of control investments, classified by NOx control options. FY 1985

	A Option	B Option	C Option	D Option
Combustion Improvement	68%	22%	19%	15%
Dry Denitrification	18	52	65	75
Catalyser-Free	14	21	16	10
Total	100%	100%	100%	100%

Source: EA, ACB, April 1978

Table 1.15 shows that increases in NO_x investment costs result in a higher emission cut rate but not in decreases in pollution levels. Based on the data in Table 1.15, the agency concluded that a reasonable and feasible goal for roadside stations in A areas was 0.048 ppm/24hr with 64% cut of emission from stationary sources. With an additional 10% cut in traffic volume, 0.045 ppm/24hr was possible. Option D was feasible only in theory. Table 1.16

TABLE 1.17

NOx control cost rate to production cost, classified by control options & Industrial Sectors

	A Option	B Option	C Option	D Option
Chemical Industry	0.01%	0.11%	0.18%	0.31%
Petroleum Refinary	0.02	0.06	0.08%	0.18
Cement Industry	0.46	0.51	0.65	1.44
Glass Industry	0	0	0	0.13
Iron & Steel Industry	0.10	0.18	0.21	0.29
Electric Power Industry	0.26	1.43	1.98	2.35

Source: EA, ACB, April 1978

Table 1.15

Cost effectiveness of NOx control options, classified by areas graded by pollution level

		A area	B area	C area
98% tile of Annual Data of '75 Daily Av.	Upper 3 Average	0.0093ppm	0.0070ppm	0.0048ppm
	Maximum Minimum	0.112 0.081	0.075 0.061	0.059 0.041
Ground Level Concent-ration As Target of NOx Control Options Including Emission Cut Rate (%)	A Option 3rd (1977) Enforcement only	0.070	0.054	0.040
	B Option Coal; 0.06 ppm	0.056 -40%	0.049 -24%	keep Present Level
	C Option Coal; 0.04 ppm	0.048 -64%	0.045 -55%	0.035 -21%
	Includes 10% Traffic Cut	0.045	0.043	
	D Option Maximum Feasible by Model	0.044 -76%	0.043 -70%	0.032 -47%
	Includes 10% Traffic Cut	0.041	0.040	
NO avail-able Space for De-NOx Installation	1975FY	50%	40%	40%
	1985FY	30%	25%	25%
Amount of NOx Emission 75 t/year:100%	91.6×10^4	24.7×10^4 27.0%	7.0×10^4 7.7%	19.0×10^4 20.7%

Source: EA, ACB April 1978

D area	Total Investment Cost for NOx Control	Annual Cost for NOx Control	Heating Oil Demand for De-NOx Plant Operation
0.0029ppm			
0.040 0.070			
0.027	194 Billion Yen	88 Billion Yen	8×10^4 Kl/year
keep Present Level	471 Billion Yen	310 Billion Yen	4 to 5 $\times 10^5$ Kl/year
keep Present Level	674 Billion Yen	445 Billion Yen	8 to 9 $\times 10^5$ Kl/year
keep Present Level	859 Billion Yen	572 Billion Yen	1 to 1.2 $\times 10^6$ Kl/year
40%			
25%			
40.9×10^4 44.6%			

presents the estimated share of the types of control investments classified by NO_x control options. In addition, the Environment Agency calculated the added value and economic impact on total production costs of each control option. The impact was different in different economic sectors. See Tables 1.17 and 1.18. Finally, the agency looked at the macroeconomic impact of the control options. It concluded that an adverse impact on growth, trade,and prices was detectable but not significant. This conclusion was similar to the conclusion reached by the OECD in 1975.

In December 1977, MITI published an independently conducted study on the costs of achieving various ambient NO_x levels at area stations. See Table 1.19. MITI made the assumption that an area station ambient concentration of 46 ppb (0.046 ppm/24hr) was the limit for NO_x control planning. MITI's cost estimates were higher than the Environment Agency's estimates. This was due in part to the fact that MITI used control technology data from 1977 while the Environment Agency used data from early 1978. Both the MITI and Environment Agency models predicted additional fuel demand for denitrification and fuel change.

TABLE 1.18

NOx control cost rate to added value classified by control options & industrial sectors

	NOx Control Cost Rate to Added Value				Surplus Added Value Rate 1975FY
	A Option	B Option	C Option	D Option	
Chemical Industry	0.04%	0.32%	0.55%	0.92%	28.8%
Petroleum Refinary	0.05	0.17	0.22	0.49	12.2
Cement Industry	1.21	4.06	5.03	5.72	24.6
Glass Industry	0	0	0	0.34	24.6
Iron & Steel Industry	0.48	0.90	1.06	1.47	15.2
Electric Power Industry	0.46	2.54	3.52	4.16	26.3

Source: EA, ACB, April 1978

TABLE 1.19

Costs of NOx control for stationary sources. Unit: ¥108 Yen

Ambient Con. of NO_2 ppb.	60	55	50	46	30
Control Investment Cost	3,600	5,800	9,500	19,100	57,200
Annualized Control Cost	1,700	2,600	4,000	9,400	24,800

Source: MITI December 1977

The Environment Agency's simulation showed a sharp increase in fuel demand around 0.03 ppm/24hr, and MITI's simulation showed a similar sharp increase around 0.046 ppm/24hr. The Environment Agency study also showed that the stationary sources designated by the Air Pollution Control Law contributed 35% of ground-level concentration in area A. Mobile sources contributed about 1.5 times all stationary sources. The large numbers of small emission sources contributed about 6%. The prediction for the 10% automobile cut was based on the assumption that all trucks and buses would be shifted to the new, standard vehicles of the second target of the long-term goal. This is a rather optimistic assumption. The maximum level of air pollution at a roadside station was 0.124 ppm/24hr at 98th percentile of yearly monitoring data. The Environment Agency estimated that if there is no increase in traffic volume, and all trucks and buses are shifted to the second target of the long-term goal, it is feasible to clear 0.06 ppm/24hr as 98 percentile value. This is another optimistic assumption, in view of the traffic volume and the increasing regional impact of pollution.

The Expert Committee for Criteria and Guides for NO_2 reported that the Saltzman Index will change from 0.84 to 0.72. Accordingly, the measured value will be 0.83 times the present measured value.

The ambient air concentration of NO (as opposed to NO_2) had declined since the implementation of emission controls for stationary and mobile sources in 1973. Scientists did not understand the mechanisms and kinetics of the conversion of NO to NO_2. Thus, this introduced errors in the simulation model of the hour and 24-hour average values.

The Environment Agency estimated that the 0.02 ppm/year standard (equivalent to 0.04 ppm/24hr at 98th percentile) could be achieved in area stations by 1985, if total mass emission regulation of stationary sources could be implemented effectively. However, the agency concluded that it would be impossible to achieve this standard in roadside areas even with all trucks and buses meeting the second stage emission standard. The agency further estimated that the 0.03 ppm/year standard (equivalent to 0.06 ppm/24hr) could be achieved if all trucks and buses meet the second stage emission standard by about 1990 with no increase in traffic volume.

The Environment Agency studied what would happen if a single standard rather than the 0.02-0.03 ppm/year range was adopted. With a single 0.03 ppm/year standard, there would be no further progress in stationary source control. With a single 0.02 ppm/year standard, road expansion in Tokyo, Osaka, and Nagoya would have to be stopped.

For its photochemical oxidant control strategy, the Environment Agency decided to minimize the total amount of photochemical reaction products by limiting NO_x emissions, in addition to hydrocarbon emission control. This strategy differed from U.S. strategy, which was limited to hydrocarbon emission control. Japan stressed the need to minimize photochemical reaction products in order to improve the high peak of oxidant through long-range transport to distant spots. According to the Environment Agency, the U.S. strategy was effective in improving the oxidant peak in the medium-range zone. This was the experience of the Los Angeles Air Pollution Control District, which cut hydrocarbon emissions extensively but NO_x emissions only slightly. The Tokyo Metropolitan Environmental Pollution Control Institute formulated a strategy to keep NO_2 at 0.02 ppm/24hr. But this was not realistic from the point of view of cost-risk-benefit analysis.

All of these issues were exhaustively debated by the Diet, the Central Advisory Council, local governments, economic and industrial organizations, patients' groups, environmentalists' groups, citizens' groups, and journalists. Finally, on July 11th, 1978, the Environment Agency issued a notification setting the NO_2 AAQS as "within the range of 0.06 ppm/24hr to 0.04 ppm/24hr or less." The notification also set 1985, seven years hence, as the target date for achieving the NO_2 AAQS. In addition, the Environment Agency stated that the principle of nondegradation would be applied to areas which currently met the ambient standard.

A small group of environmentalists and citizens filed suit against the Environment Agency and requested a cancellation of the notification. The court ruled for the Environment Agency, and the case is now on appeal in the Tokyo High Court.

In 1979, the agency implemented the fourth stage of the emission control program for stationary sources. In 1982, the government implemented total mass emission regulation to achieve the NO_2 AAQS by 1985. In 1983, the agency implemented the fifth stage of the control program for combustion boilers. The agency designed the fifth stage to prevent the degradation of NO_2 pollution due to the energy shift from petroleum to coal after the second energy crisis of 1979. It was also based on the NO_x control technology review for combustion boilers, especially huge coal-fired electric power stations.

In June 1985, some roadside stations in Tokyo failed to meet the new AAQS. Accordingly, the Environment Agency began a re-examination of NO_x control programs.

1.12 AIR POLLUTION CONTROL AND ENERGY

The traditional air pollutants were black smoke and heavy deposited matter and the Smoke and Soot Regulation Law of 1962 and the Heat Management Law were designed to control this type of pollution. Coal industrial complexes were a source of noxious gases as well as black smoke and heavy deposited matter. As described earlier, the city of Ube developed a successful air pollution control program to curtail black smoke. Ube's emission standard was incorporated in the Smoke and Soot Regulation Law.

Beginning in 1955, Japan experienced an energy shift from coal to petroleum. Whereas coal produced visible, black smoke and soot, petroleum derivatives produced an invisible gas. The Yokkaichi petroleum refinery, chemical plants, and high-sulfur crude oil power station generated SO_2 concentrations exceeding 2.5 ppm/hr at the maximum. It was years before the industry began to take countermeasures, which included the use of low-sulfur fuels, low-sulfur crude oil, LNG, stack gas desulfurization, low-NO_x combustion, and denitrification. In December 1969, MITI implemented a low-sulfur fuel supply program to help achieve the SO_2 AAQS required by the Basic Law. With this, Japan had integrated its energy, pollution control, and public health policies.

The Air Pollution Control Law of 1968 provided a new emission standard based on the K-value instead of a volume percent. This led to higher stack construction and desulfurization programs. As the capacity of low-sulfur fuel expanded, the government tightened the K-value.

In 1955, coal comprised 49.2% of the primary energy supply; in 1973, it had declined to 15.5% During the same period, the share of petroleum increased from 20.2% to 77.7%. Accordingly, after black smoke and heavy deposits were under control, the government targeted SO_2 for control. The K-value standard did not distinguish between petroleum and coal. In Tokyo, Osaka, and Nagoya, the K-value was tightened almost every two years corresponding to the expansion in the capacity of low-sulfur fuels. In these cities, coal-fired power stations either installed stack-gas desulfurization equipment or shifted to petroleum. New coal-fired power stations were built far from the Tokyo, Osaka, and Nagoya bay areas. Also, nuclear power stations were steadily expanded to supply electricity to the bay areas. These developments were the result of the pollution control agreements between local governments and electric power stations after 1965. Table 1.20 presents the trends in and structure of primary energy supply.

In 1973, at the time of the first energy crisis, Japan was more than dependent on foreign sources for petroleum. The jump in the price of oil induced a shift in Japan's desulfurization program, from using expensive, low-sulfur residual oil to installing stack-gas desulfurization equipment and using inexpensive, high-sulfur residual oil. At the same time, diesel fuel for automobiles became more popular because of better fuel efficiency and lower fuel price and fuel tax, compared with gasoline. The use of diesel trucks for commodity transport increased as the use of railways decreased. By 1978, the government implemented strict emission control on passenger cars (except diesel cars). The government introduced emission controls for heavy-duty cars, trucks, and trailers gradually, but with longer vehicle life (about 10 years), the shift to the new cars slowed. Thus, there has been little evidence of improvement in air quality in this area. At least, air quality was not getting worse even though the volume of diesel truck and trailer traffic as well as the size of diesel trucks and trailers were increasing. The government did not revise the emission standards because of the oil crisis.

TABLE 1.20
Trends of primary energy supply structure (Share; %)

	1962FY	1965FY	1967FY	1969FY	1970FY	1973FY	1979FY	1983FY
	%	%	%	%	%	%	%	%
Hydropower	13.4	11.3	8.3	7.0	6.3	4.6	5.1	5.7
Nuclear Power	-	0.0	0.1	0.1	0.4	0.6	4.2	7.4
Coal	36.0	27.3	24.6	20.7	20.7	15.6	14.0	18.2
Petroleum	46.1	58.4	64.6	68.3	70.8	77.6	71.1	60.9
Natural Gas	1.3	1.2	1.1	0.0	0.9	0.7	0.6	0.6
LNG	-	-	-	0.1	0.4	0.8	4.9	7.2
Charcol	0.6	0.2	0.1	0.1	0.0	0.0	0.0	0.0
Woodenfire	2.2	1.5	1.0	0.6	0.5	0.2	0.1	
Domestic	47.4%	33.8%	25.5%	19.6%	16.5%	10.1%	13.8%	16.7%
Imported	52.6%	66.2%	74.5%	80.4%	83.5%	89.9%	87.0%	83.3%
Total Amount of Energy Supply; 10^{10} Kcal	113,895	165,614	205,521	270,687	310,468	382,345	408,880	380,741

Source: Comprehensive Energy Statistics; Resource & Energy Agency, MITI, In 1973, the Diet passed the Pollution-Related Health Damage Compensation Law, and implemented it the next year. The law provided a pollution-load levy, which was calculated based on the total amount of SO_x emission per year. The levy was not a device to control emissions; it was meant merely to provide funds for compensation. Nevertheless, the levy had the unintended effect of encouraging large pollutors to cut their emissions. For example, electric power stations accelerated the shift in fuel in order to minimize the pollution-load levy.

The government began total mass emission regulation for SO_x in 1974 and completed it in 1978. It instituted NO_x control for stationary sources in 1973, and has since instituted the second, third, and fourth enforcement schedules. The government started total mass emission regulation for NO_x in 1982 and ended it in 1985. In 1978, the Environment Agency revised the NO_2 AAQS from the unreasonably stringent standard of 0.02 ppm/24hr to the reasonable and appropriate standard of 0.04-0.06 ppm/24hr.

Beginning in 1973, during the first energy crisis, MITI formulated and implemented an energy-conservation program. Japanese industry commenced research programs to develop energy-conservation technology actively. Specifically, the research centered on improving fuel efficiency and recovering waste heat and waste gases as new energy sources. Also, scientists greatly improved the air pollution control of the coke oven. Nippon Kokan installed equipment for the dry quenching of generator gas in the coke oven at its new iron and steel mill in Oogishima. As a result of these research efforts, the mining and manufacturing sector has experienced a clear reduction in the energy demand per unit of GNP and per unit of production since 1973. See Table 1.21.

TABLE 1.21

Energy demand per unit of GNP and per unit of production in the mining and manufacturing sector

FY	Total Energy Demand 10^{10}Kcal	Population 10^4	GNP 1975 Price 10^8 Yen	Energy Demand per Unit GNP	Mining & Manufacturing Index 1980=100	Energy Demand per Unit of Mining & Manufacturing Index
1973	354,053	10,871	1,449,698	0.244	85.7	1965.9
1975	341,073	11,193	1,498,074	0.228	73.9	2108.1
1978	379,825	11,517	1,741,464	0.218	90.4	1780.3
1980	373,001	11,706	1,916,997	0.195	99.7	1611.6
1983	368,192	11,932	2,128,146	0.173	107.6	1336.4

Source: Comprehensive Energy Satistics; 1984 FY Edition; MITI; December 1984

Between FYs 1973 and 1983, total energy demand hardly grew despite growth in GNP. During that period, energy demand per unit of mining and manufacturing index dropped about 31%. In other words, energy savings, induced by the energy crisis, affected air pollution control favorably.

In 1983, MITI conducted an analysis of the factors which contributed to changes in energy demand during FYs 1981 and 1982. It concluded that 49% was due to energy saving, 29% to production decreases, and 22% to changes in industrial structure. Between FYs 1979 and 1981, production dropped in industries with high inputs of raw materials and energy, and production increased in industries with low inputs of raw materials and energy.[82]

A typical case which illustrates this phenomenon is the electrolytic-process aluminum smelter.

In June 1979, the Tokyo Summit was held to devise strategies to deal with the second energy crisis. Participating countries set upper limits to the amount of petroleum they would consume. This, of course, had a favorable effect on air pollution. MITI's Comprehensive Energy Study Committee started a provisional long-term forecast of energy demand. The forecast took into account the ceiling values on consumption set at the 1979 Tokyo Summit and the introduction of alternative energy sources. The Study Committee recommended that Japan decrease her 99.9% dependence on foreign petroleum for national

TABLE 1.22

Long term prediction of energy demand & supply

Energy Classification / Fiscal Year	1982	1990		1995
	Real Data	1983 Prediction	1982 Pre.	1983 Prediction
Petroleum 10^8 Kl Substitute Energy	1.49	ca2.2 ~ ca2.3	3	ca2.7 ~ ca3.0
Coal 10^6 Kl	72	81 ~ 86	115	86 ~ 102
Nuclear Power	27	48 ~ 51	67	74 ~ 79
Natural Gas	27	56 ~ 60	68	65 ~ 63
Hydropower	22	28 ~ 27	30	ca28
Geothermal	0.4	1.5 ~ 2	6	3.5 ~ 4
New Fuel, New Energy, etc.	0.9	7 ~ 12	15	15 ~ 26
Petrolium 10^4 Kl	2.4	ca2.4 ~ ca2.5	2.8	ca2.4 ~ ca2.5
Grand Total Energy Supply 10^8 Kl	3.88	4.5 ~ 4.8	5.8	5.0 ~ 5.5

Ministry of International Trade & Industry, Resource & Energy Agency, 1983.

security purposes.

In August 1979, the Diet passed the Law for the Acceleration of Alternative Energy Sources. Article 3-2 announced the principle of environmental conservation in setting alternative energy policy, and article 5-1 reiterated the principle when introducing alternative energy programs at factories or business enterprises. Under the law, the Cabinet sets the targets in alternative energy supply planning. The Environmental Agency's role in the target setting process

TABLE 1.23

A comparison of the environmental impact and the pollution potential of a petroleum power station and a coal power station

Item	Sub-item	Coal Power Station	Petroleum Power Station
Necessary Space Area. 10^6 kw x 2	Plant Area	90 ha	60 ha
	Depth of Harbour	14m ~ 19m	7.5m
	Length of Bath	750m	Dolphin
Quantity of Fuel 10^6 kw x 2	Annual Quantity (70% operation)	2.3×10^6 t	1.3×10^6 t
	Hourly Maximum	370 t	210 t
Nature of Fuel	Calorific Value	6,200Kcal/kg	10,000Kcal/kg
	Sulfur Content	0.3% ~ 1.6%	Crude Oil 0.14% Residual Oil 0.87%
	Nitrogen Content	1.2% ~ 1.8%	0.05% ~ 0.5%
	Ash Content	15% ~ 20%	0.01%
Effluent Gas etc. 10^6 kw x 2	Quantity of Effluent Gas (Max. Load, Dry)	3.1×10^6 Nm^3/h	2.6×10^6 Nm^3/h
	SO_x Emission Concentration	250ppm 1,300ppm	Crude Oil 80ppm Residual Oil 500ppm
	Emission Quantity of SO_x (Max. Load)	780 Nm^3/h 4,100 Nm^3/h	Crude Oil 200 Nm^3/h Residual Oil 1,300 Nm^3/h
	NO_x Emission Concentration	170ppm ~ 300ppm	130 ppm
	Emission Quantity of NO_x (Max Load)	530 Nm^3/h 930 Nm^3/h	340 Nm^3/h
	Emission Quantity of Smoke & Dust (Max. Load)	6.2t/h ~ 7.8t/h	260 kg/h
	Emission Concentration of Smoke & Dust	$20g/Nm^3$ ~ $25g/Nm^3$	$0.1g/Nm^3$

Source: Environment Agency; Planning & Co-ordination Bureau; 1980 is one of prior consultation. The Cabinet set the first target in November 1980.

In the spring of 1955, the Environment Agency established the Council for the Examination of Energy and Environmental Problems. The Council noted that the expansion of coal consumption could lead to greater concentration of air pollutants such as suspended particulates, SO_x, and NO_x. It recommended stricter emission control, especially for electric power stations. In addition, it noted that the increased consumption of heavy crude oil could lead to more pollution, and therefore recommended the expansion of refineries to produce light quality residual oil from the crude oil. The Cabinet took these recommendations into account when implementing the alternative energy supply plan. See Table 1.22.

In March 1956, the Council for the Examination of Energy and Environmental Problems published a report which included a comparison of the pollution potentials of petroleum-powered and coal-powered electricity generating stations.[83] See Table 1.23.

The report made the following main points: (i) Coal combustion has a greater emission potential than petroleum combustion. (ii) Industry should control dust pollution occurring during transport, storage, and loading operations. (iii) Scientists should make a study of secondary pollutants, which are pollutants generated by primary pollutants. Examples of secondary pollutants are sulfate, nitrate, and acid rain generated by transformation during the course of long-range transport. (iv) Scientists should study the trace elements in coal and their effect on combustion, emission, and deposits and residues in combustion wastes. In addition, the effect of trace elements and small particles on the efficiency of dust collection should be studied. (v) Scientists should study polycyclic hydrocarbon and fluorine compounds, which are generated during combustion.

The council's report also addressed nuclear power. It classifies nuclear power generation as a clean, alternative energy from the standpoint of air

TABLE 1.24

Electricity generation cost (Yen/Kwhr) classified by energy source; 1984FY

Hydropower	21
Nuclear Power	13
Coal	14
Petroleum	17
LNG	17

Source: Resource, Energy Agency, MITI 1984
Note : Decommission Cost is included for nuclear power case.

pollution control. However, the report also noted the special risks of nuclear power generation. These included the accidental release of radioactive pollutants, the storage of wastes, and the management of nuclear cycle facilities. Finally, the council's report superficially reviewed geothermal power generation. Among other issues, it discussed the release of H_2S and the need for total energy balance.

In response to the recommendations of the council's report, the Environment Agency organized the Study Group of Methods and Criteria in Environmental Impact Assessment of Coal-Fired Power Stations. In addition, the agency established a comprehensive study group with subgroups for coal analysis, combustion, control technology, environmental monitoring, and integration of the various study results. Both study groups completed their deliberations by the end of FY 1984.

In 1982, the Air Pollution Control Law strengthened the emission standard for particulates, which made the revised standards for new, coal-fired power stations more stringent than the emission standards in the U.S. and Europe. In 1983, the Air Pollution Control Law tightened the emission standards for NO_x. At present, the emission standards for pollutants discharged by coal-fired power stations are almost equivalent to the emission standards for petroleum-fired power stations.

The Environment Agency established these strict emission standards for coal combustion boilers primarily to control pollution from small coal boilers in

Table 1.25
International comparison of electricity charge (July 1981)

Name of Country		U.S.A.			U.K.	France	W.Germany	Japan
Name of Electric Power Co.		Consolidated Edison	Common Wealth Edison	Detroit Edison	London Power Bureau	France Electricity Corp.	Rhein West Fahren	Tokyo Electric Co.
Date of Charge Renewal		'81/2	'81/2	'81/7	'81/4	'81/7	'81/6	'80/4
Yen Conversion Based on Currency Exchange Rate July '81	Domestic Use: 190KwH/M.	34.88	18.44	14.74	27.47	18.17	18.73	26.36
	Industrial Use Contract: 2,000Kw: Unit 300KwH	28.66	13.66	14.48	17.19	12.26	12.66	17.89

Source: Japan Iron & Steel Federation, Division of Raw Materials
Iron & Steel Journal, Vol.31, No.10, October 1981

TABLE 1.26

Structural plan for electric power generation

	1984FY	1989FY	1994FY
Hydropower	19%	18%	17%
LNG	23%	27%	26%
Coal	3%	5%	7%
Petroleum	39%	32%	25%
Nuclear Power	16%	18%	25%
Total Power Generation Kwhr	$12,249 \times 10^8$	$14,634 \times 10^8$	$18,010 \times 10^8$

Source: Japan Electric Power Study Committee
Long Term Demand Forecast; April 1985

air pollution control system for coal-fired power stations to meet the tough, new standards.[84]

Dengen Kaihatsu spent ¥8 billion between 1978 and 1982 for research and development. It has developed several coal centers after conducting careful environmental impact assessments and formulating strict air pollution control plans.

Japanese electric companies charge the highest rates in the world for electricity. This is due to the high price of fuel and the cost of complying with stringent anti-pollution measures. Table 1.24 presents the costs of electricity generation, classified by energy source. Table 1.25 presents an international comparison of electricity charges.[85]

Japan's energy structure for electric power generation has been undergoing a change. It relies less on petroleum and more on LNG, nuclear power, and coal. See Table 1.26. Table 1.26 is based on the assumption that electricity demand will increase by 2.8% annually.

1.13 SPECIFIC AIR POLLUTANTS

Accidental releases. The Smoke and Soot Regulation Law of 1962 set forth measures to be taken in the case of an accident occurring during a company's manufacturing process which results in the release of specified noxious substances. The law permitted the prefectural governor to order an investigation, conduct an on-site inspection, and take enforcement measures, if necessary. These provisions were included as a result of a number of instances of accidental air pollution.

The 1970 amendments. The Air Pollution Control Law of 1968 had the same provisions, but it was extensively amended in 1970. The amendments provided definitions for two new categories of smoke subject to emission control. One category defined specific noxious substances, such as Cd, C_{12}, and Pb and their compounds, NO_x, F, HF, silicon fluoride, and other noxious substances not yet designated. The other category specified substances subject to special measures in the case of accident. These included NH_3, H_2S, HCN, and others. In addition, the law controlled the primary air pollutants which were transformed by photochemical reaction to photochemical oxidant.

During 1972-73, the Environment Agency developed control guides for mercury compounds and PCBs. In 1973, the Chemical Assessment Law designated alkylmercury and PCB as chemicals specially toxic to the environment.

Acid rain. Around 1975, the air pollution problem grew worse. In July 1974 and July 1975, officials reported widespread eye irritation and plant damage in the Kanto region. It was assumed that the cause was acid rain. Since then, national and prefectural research institutes and universities have conducted joint regional study projects on acid rain. The incidence of acid rain has declined with the progress of total mass emission control of SO_x and NO_x. According to a study conducted by M. Tamaki in 1985, there were 11 episodes of acid rain with a pH of less than 3 between June 1973 and June 1981. During these 11 episodes, taking place in the summer, Tamaki observed high electroconductivity and a high concentration of nitrate. From 1973-80, scientists observed rain in urban areas with a pH of between 4.3 and 4.8. The pH levels have not been declining.[86]

Spiked tires. Another problem was the use of spiked tires on automobiles during the snow season from October to March. Spiked tires destroyed the road surface, which generated a marked increase in the amount of suspended particulates and heavy deposited matter. In Sendai, scientists recorded 14 tons/km^2/month of deposit matter in October, 92.2 tons/km^2/month in January, and 133 tons/km^2/month in March.[87]

Asbestos. In January 1985, the Environment Agency conducted a survey in which it found the ambient concentration of asbestos to be in the range of 10^{-2} to 10^{-4} times the occupational exposure limit.[88]

Hg. In FY 1975 and FY 1982, the Environment Agency conducted a nationwide survey of the concentration of ambient Hg. The FY 1975 data indicated that the concentration differences between the different areas. The Hg ambient concentration was 10^{-2} to 10^{-3} times the WHO guide of 15 μg/m^3.[89]

In 1983, the government issued a report on the status of Hg emissions from urban incinerator plants. The report stated that the source of Hg emissions from urban incinerators was Hg contained in dry cells. According to K. Hishida, in April and May 1984, Hg emissions from 12 metropolitan incinerators ranged between 0.12 and 0.34 mg/Nm^3.[90]

MHW and MITI proposed the Hg content in dry cells be cut. Accordingly, the government has conducted research and development programs on emission control for Hg and Hg-free dry cells.

Dioxin. Since FY 1982, the government has been conducting a national comprehensive research project on dioxin. People became alarmed when dioxin was discovered in the residual ash of urban incinerators. This has led to concern about the risk of pollution from 2, 3, 7, 8, TCDD. In May 1984, a MHW Expert Study Group calculated the maximum ground-level concentration of dioxin at 0.25 ng/m^3 and the maximum daily intake at 1.58×10^{-3} ng/kg/day. MHW set the provisional ADI at 0.1 ng/kg/day after reviewing data regarding the non-observable adverse effect level (NOAEL), the non-observable effect level, and ADI reports abroad. The Expert Study Group stressed the need for further research on this and other points.[91]

Carcinogenic and mutagenic pollutants. The public has become increasingly concerned about the problem of carcinogenic and mutagenic pollutants. In 1984, during the 25th Annual Assembly of the Japan Society of Air Pollution, several papers discussed the declining trend of benzo(a)pyrene in Sapporo, Sendai, Tokyo, Kawasaki, Yokohama, and Kita Kyushu.[92]

The papers theorized that the decline was due to the stringent air pollution control of SO_x, NO_x, and particulate emissions from stationary sources and strict automobile emission control. At the same time, the increasing use of large trucks and trailers to transport cargo has caused polycyclic hydrocarbon pollution along heavily travelled roads, particularly 1-nitropyrene and 3-nitrofluoranthene.[93]

The Environment Agency has been studying diesel exhaust continuously.

Fluorocarbon and CO_2. Finally, Japan has become increasingly concerned by some of the global environmental pollution problems, such as fluorocarbon and CO_2. In recent years, the Environment Agency, the Ministry of Transportation, and the Ministry of Education have conducted research projects on CO_2.

1.14 EVOLUTION OF AIR QUALITY MANAGEMENT

Local initiative. In almost every case in Japan, the government undertook to reduce air pollution only after it had become a serious problem. Moreover, it was local government which usually took the initiative to deal with pollution problems. The Ube city government was the first to implement an effective emission control program with the active assistance of local industry and the university. Ube also conducted epidemiological studies and monitored air pollution levels.

National legislation. The Smoke and Soot Regulation Law of 1962 was the beginning of modern air quality management in Japan. It established emission standards, air monitoring programs, and measures to alert the public when pollution reached levels dangerous to health. In FY 1963, MHW subsidized a program to build automatic air monitoring stations which measured the level of suspended particulates and SO_2. The issue of alerts to warn the public of dangerous pollution levels served to heighten the awareness of people to the growing pollution problem in Japan.

Pollution measurement and health effect studies. The National Institute of Public Health conducted studies on the impact of air pollution on health. In addition, MHW conducted community health effect studies in Yokkaichi and Osaka from 1964-69. MHW published the results of the Yokkaichi study in 1965.[94] See Table 1.27. After 1965, MHW expanded its research projects to include clinical, pathological, and animal experiments.

The Expert Committee of the Central Advisory Council for Pollution Control Measures consulted the MHW reports and foreign studies as it developed criteria, guides, and standards for SO_2. The Cabinet established the first AAQS for SO_2 in 1969. Then, MITI formulated a low-sulfur fuel-supply program designed to achieve the SO_2 AAQS within ten years. During this time, MHW subsidized the installation of a telemeter system in each designated area. Also, it installed a regional telemeter system in the Osaka Bay and Tokyo Bay areas from 1970. In addition, prefectural governments obtained the voluntary cooperation of industry to build a source telemeter system.

Pre-siting studies and pollution control agreements. In 1961, the Osaka prefectural government and the city of Nishinomiya were the first to conduct air pollution impact assessments. In 1964, in response to the anti-pollution and anti-development movements in Mishima-Numazu, MHW and MITI conducted large-scale environmental impact assessments of the regional industrial development project at Mishima-Numazu. This became the model for later environmental

TABLE 1.27

Prevalence rate of chronic bronchitis symptoms through interview questionaire survey of the British Medical Research Council in Osaka & Yokkaichi

			Osaka	Yokkaichi
Non-smoker	Male	Polluted Area	4.3%	11.1%
		Non-polluted Area	2.1%	3.9%
	Female	Polluted Area	2.6%	12.3%
		Non-polluted Area	0.8%	1.6%
Smoker	Male	Polluted Area	7.8%	16.2%
		Non-polluted Area	5.0%	5.7%
	Female	Polluted Area	4.0%	16.9%
		Non-polluted Area	7.2%	10.3%

Source: Ministry of Health & Welfare; 1965 impact assessments. In 1965, MITI began to conduct factory pre-siting studies in cooperation with local governments. These studies consisted of a detailed source inventory, a wind tunnel experiment, a meteorological study, and a computer simulation. Also, MHW conducted background studies, short-term air pollution studies during the worst meteorological season for air pollution, and field diffusion experiments using tracers. Between FY 1965 and FY 1969, MITI and MHW surveyed 25 and 37 areas, respectively.

MHW and MITI cooperated with local governments in their efforts to develop effective air pollution control programs and to negotiate pollution-control agreements with private companies. In most cases, the pollution-control agreements set terms more stringent and individualized than those required by law. The first such agreement was between Yokohama and Dengen Kaihatsu, an electric power company, in 1964. Yokohama first conducted an environmental impact assessment, and then developed the pollution-control requirements from the results of the assessments. This procedure followed that used in Mishima-Numazu. Yokohama published the data obtained from the environmental impact assessment, but it did not hold a public hearing on the matter.

In 1965, the Electricity Source Development Coordination Council made environmental impact assessments and pollution-control agreements standard parts of the approval process for the siting and expansion of fuel power stations. MITI and the Economic Planning Agency also adopted such procedures.

Criteria, guides, and standards. The government established an AAQS for SO_2 in 1969, for CO in 1970, for suspended particulates in 1977, and for NO_2 and photochemical oxidant in 1973. The government raised the AAQS for SO_2 in 1973, and lowered the AAQS for NO_2 to a more appropriate level in 1978. In addition, it set a provisional air quality guide for hydrocarbon in 1976, in order to control photochemical oxidant. These AAQSs are summarized in Table 1.27.

In 1976, the Environment Agency established an air quality criteria for Pb. However, the agency did not convert the criteria to a guide and then a standard because the lead-free gasoline program had succeeded in reducing the ambient concentration of Pb.

The Expert Committee of the Central Advisory Council developed all of these criteria, guides, and standards based in part on health effect studies conducted by MHW, the environment agencies, and local governments. Also, it relied on expert committee reports issued by WHO. Scientists from the U.S. and Japan cooperated in developing a methodology for the health effect studies.

Area Environmental Pollution Control Plan. The 1967 Basic Law for Environmental Pollution Control Measures authorized the government to institute a pollution-control plan in a designated area if the area already has a high pollution level or if there is a danger of the area developing a high pollution level due to trends in population and industry. The Prime Minister directs the planning and policy-making for this medium-term comprehensive plan for environmental pollution control with the prior consultation of the relevant prefectural governor. The Council of Environmental Pollution Control Measures, chaired by the Prime Minister, must approve the planning and policy. Air pollution control is an integral part of this overall pollution program. In the planning process, the council consults estimates of growth and future pollution levels and data collected by MHW and MITI on emission sources, air pollution monitoring, source inventory, and pre-siting studies. The ambient air quality standards provide the overall goals for the air pollution programs.

The government provides subsidies and other financing measures for several of the pollution control programs, such as the air monitoring network system, the mobile survey unit, and the buffer zone facility development project. In addition, the Environmental Pollution Abatement Corporation provides loans for pollution abatement programs at existing factories. The Law for Cost Bearing

Table 1.28

Progress of aerial environmental pollution control plan

Year	'72 '74 '76 '78 '80 '82 '84 '86 '88	Area
Area 1	----------------- ------------- xxxxxxxxxxxxx	Yokkaichi, Mizushima
Area 2	------------ ------------xxxxxxxxxxxxxxxx	Tokyo, Kanagawa, Osaka, Saitama, Kyoto, etc.
Area 3	------------ ------------xxxxxxxxxxxxxxxx	Kashima, Nagoya, Hyogo, Ooita, Kitakyushu
Area 4	------------ -------------- xxxxxxxxxxxxx	Fuji, Harima south, Ootake, Iwakuni, Oomuta
Area 5	----------- ---------------- xxxxxxxxxxxxxx	Sendai, Chiba, Toyama, Takaoka, Kobe, etc.
Area 6	--------------xxxxxxxxxxxxxxx	Muroran, Niigata, Shizuoka, Okayama, Hiroshima, etc.
Area 7	------------- xxxxxxxxxxxxxx	Sapporo, Hitachi, Akita, Suwa, Gifu, Matsumoto, etc.

Note: ---- old plan, xxxx present plan
Source: Annual Report of Environmental Quality for 1984 FY. Presented to 102nd Congress; 1985 May

by Polluting Industries requires pollutors to pay for pollution abatement programs undertaken by the government. The prefectural level Local Council for Environmental Pollution Control Measures determines the amount which industry must pay.

The government implemented the first environmental pollution control plan in FY 1971. The Council for Environmental Pollution Control Measures approved the seventh pollution control plan in May 1986. By May 1985, the government had adopted polllution control plans covering 9% of the national area, 55% of the population, and 68% of manufacturing production. Table 1.28 presents a summary of the coverage of the plans.

Total emission regulation and automatic monitoring networks. Total mass emission regulation is a kind of medium term air pollution control plan. It is developed from monitoring data, emission source data, the outlook for energy supply, meteorological background studies, tracer experiments, and computer simulation.

In 1983, there were 1613 automatic SO_2 monitoring stations, and 1284 area

TABLE 1.29

Trends of monitering station expansion & compliance - rate to ambient air quality standard (Osaka Prefecture)

Fiscal Year	On-line Station		Off-line Station		Compliance Rate (%) to AAQS of SO_2
	Total Number	SO_x Autometer	Total Number	SO_x Autometer	
1964FY	-	-	7	7	-
1965FY	-	-	10	10	-
1966FY	-	-	15	15	-
1967FY	-	-	19	19	-
1968FY	15	15	10	10	-
1969FY	22	21	10	4	-
1970FY	28	24	21	10	-
1971FY	29	25	25	18	-
1972FY	34	30	30	21	-
1973FY	38	34	83	65	8.5%
1974FY	40	37	97	70	47.6%
1975FY	42	39	95	67	61.8%
1976FY	42	39	96	68	66.2%
1977FY	42	39	83	56	75.4%
1978FY	42	39	83	57	62.0%
1979FY	42	39	79	57	81.7%
1980FY	42	39	82	56	97.2%
1981FY	42	39	77	51	100.0%
1982FY	42	39	77	46	100.0%
1983FY	42	39	77	46	100.0%

Source: Tatsuya Yamamoto; Thesis Paper, Tsukuba University 1985
Osaka Prefectural Government

and 274 roadside monitoring stations for NO_2. 99.4% of the SO_2 monitoring stations meet the SO_2 AAQS, and 98.7% of the NO_2 area stations and 75.9% of the NO_2 roadside stations meet the NO_2 AAQS. SO_2 management has advanced to the point where it is concerned with maintaining the AAQS, but NO_2 management is still concerned with abatement.

Air pollution monitoring using telemeters is expensive. The government is considering revising the budgets for this. However, it is recognized in some circles that this is the cost for obtaining the information which forms the basis for air pollution management.

In Osaka prefecture, SO_2 abatement programs cost a total of between 4550 billion to achieve the AAQS. Table 1.29 traces the progress of compliance with the SO_2 AAQS and the expansion of the SO_2 air monitoring system. Total mass emission regulation for SO_x was implemented in 1976.

Table 1.30 presents the cost of the administration of SO_x pollution control. A study of the cost effectiveness of air pollution monitoring systems showed that, in the case of a 10-station monitoring system, one additional air monitoring station can save 0.1 billion in abatement costs. For a 30-station monitoring system, one additional air monitoring station can save 0.1 billion in abatement costs. The study also showed that a 40-station system provides the optimum quantity of information, with a 90% probability of achieving the SO_2 AAQS.

Regional pollution. Photochemical oxidant and acid rain became pollution

Table 1.30

Cost of air pollution control administration (Osaka Prefecture)

1968FY - 1976FY 10^6Yen

Fiscal Year	Information Cost				Policy & Planning Decision Cost	Control Programme Impremen-tation Cost	Total
	Collection			Analysis			
	Monitering						
	Facility Cost	Maintenance Cost	Surevy Cost	Analysis Cost			
1968FY	84	-	-	-	-	-	84
1969FY	108	-	28	8	-	17	161
1970FY	112	23	132	7	3	34	308
1971FY	68	37	157	8	4	50	281
1972FY	134	38	186	7	14	68	439
1973FY	135	57	132	7	5	67	389
1974FY	95	69	167	8	23	122	471
1975FY	110	84	94	3	5	68	360
1976FY	30	107	64	63	6	36	239

Source: Tatsuya Yamamoto; Thesis Paper; Tsukuba University 1985
Osaka Prefectural Government

problems in the mid-1970s. Because of this, air monitoring had to be conducted on a regional, rather than a local, scale. The government provided a subsidy to expand the regional telemeter systems in the Tokyo and Osaka Bay areas. In 1974, the National Institute of Environmental Studies initiated a research project conducted by universities and teams from several prefectures. Reports from the U.S. and Europe on acid rain damage have accelerated progress in these research projects. In FY 1986, the government began a nationwide acid rain study project, which also examined pollution from China. The FY 1986 budget allocated funds to the Meteorological Agency to conduct continuous monitoring of CO_2 in order to cooperate with the World Meteorological Organization's global CO_2 monitoring program.

Environmental impact assessments. The government began environmental impact assessments in 1964 as a routine, technical administrative program. Then, the Cabinet issued a regulation requiring such assessments for all public works projects. In 1974, the Industrial Siting Law required environmental impact assessments for designated industrial development projects. Also, total mass emission regulation was applied to such projects. The Industrial Pollution Abatement Manager Law of 1971 established the foundation for the implementation of the Siting Law.

The government broadened the scope of air pollution impact assessments to include road construction projects, airport development projects, and the large bridge project in the Seto Island Sea. In 1980, the Environment Agency submitted a bill to the Diet which would establish a common procedure for environmental impact assessments for public works projects. Although the legislation was not passed, in 1984 the Cabinet issued a resolution based on the bill. The Cabinet resolution made such assessments a standard part of the planning and implementation of public works projects. It also provided for public hearings and disclosure. During 1980-84, when the bill was pending in the Diet, each ministry had developed detailed technical guidelines for environmental impact assessments for electric power stations, highways, and airports. However, the government has not yet established procedures for regional-scale environmental impact assessments for building a coastal highway in the Tokyo Bay area and the cross-bay bridge project.

Econometric Assessment. The government conducted econometric assessments to assist in the evaluation of pollution-control programs. The Environment Agency's econometric assessments of air pollution control programs were an integral part of the formulation of policy options for the Long-Term Environment Conservation Plan. In 1977, the Economic Planning Agency conducted econometric assessments of the Economic and Social Development Plan. In 1978, the Environment Agency conducted an econometric assessment of NO_x control plan options. Between 1975 and 1986, during the agency's reviews of emission-control technology, it examined fuel efficiency data and cost increases resulting from the plan options.

The Third Comprehensive National Development Plan emphasized regional human settlements over huge industrial projects. One of the goals of the development plan was to blend with local culture and community traditions. The Environment Agency stressed environmental management which anticipated and prevented pollution problems. For example, with the shift from petroleum to alternative energy sources, in 1979 the Environment Agency developed a plan to deal with the increase in coal consumption. Today, environmental management in Japan is the product of 25 years of experience by the central and local governments in dealing with pollution control.

1.15 INTERNATIONAL PERSPECTIVES IN JAPANESE POLLUTION CONTROL

In many instances, Japan looked to the U.S. and Europe to learn from their experiences in formulating its own pollution-control policies. In Great Britain, local governments implemented traditional smoke abatement methods using the Ringelman chart to control black smoke. Drawing on this experience, the Tokyo municipal government enacted the Smoke Abatement Ordinance in 1955. The ordinance contained a provision for black smoke control using the Ringelman chart. In 1954, Kanichi Nakayasu, president of the steel manufacturing company Ube Kosan, revisited the United States and was deeply impressed with how the city of Pittsburgh had managed to control the air pollution caused by its iron and steel mills. This experience motivated him to propose an air pollution abatement program in Ube.

Japan has also looked to the west for legal doctrine to be used in the fight against pollution. For example, local governments in Japan borrowed the concept of nuisance as used in British and U.S. law. In 1949, when the Tokyo municipal government drafted its Industrial Pollution Control Ordinance, it was strongly influenced by the German concept of Imission. Around 1960, Japan gained further insight on pollution control by studying reports on smog in London, Donora, and the Muse Valley; photochemical oxidant in Los Angeles; and the Poza Rica incident. In addition, the Los Angeles Pollution Control District's Air Pollution Control Regulation served as the model for the Japanese program of continuous pollutant monitoring and the issue of alerts when pollutant concentrations reached levels dangerous to health. In 1961, WHO arranged fellowships in Great Britain, West Germany, France, and Belgium for MHW officials who were preparing the Smoke and Soot Regulation Law of 1962. These fellowships allowed Japan to learn from the accumulated knowledge and experience of these countries. The MHW officials studies the similarities and differences in the air pollution control programs of these countries.

At about the same time, the United States Public Health Service began an environmental health project in Japan. It sent Dr. V. Newill to the medical laboratory of the U.S. Army in Camp Zama to head the project. MHW sought the advice of Dr. Newill on the problems it was facing in Yokkaichi concerning air pollution and health. This exchange in 1959 was the beginning of U.S.-Japan cooperation in studies on air pollution and health. Dr. T. Suzuki of the National Institute of Public Health and the executive-secretary of the Japan Society of Air Pollution led the Japanese team. Japan had a lot to learn from the United States on scientific and technological issues in the field of air pollution measurement and health effect studies.

Learning to manage pollution from the new petrochemical complexes, such as Yokkaichi, presented different problems, however. The West did not have the knowledge and experience to assist Japan in this field. From the fellowships to Europe sponsored by WHO, Japan realized that it would have to solve the problem of SO_x control by itself. Japan came to the conclusion that land use and factory siting were important considerations in preventing air pollution in newly developing areas. But this was an area where Japan had made mistakes--companies had located large industrial complexes with huge emission potentials near residential areas. Japan devised a three-part approach to air pollution control for industrial complexes. It consisted of pre-siting surveys, pollution-control agreements between the local government and the pollutor, and MITI's desulfurization plan. This approach was different from that taken in the United States, Great Britain, and West Germany.

In the later-1960s, WHO expert committee programs assisted Japan in the development of air quality criteria, guides, and standards. For example, Japan received scientific information from WHO and the U.S. Public Health Service when it formed the AAQSs for SO_2 in 1969 and CO in 1970. In 1968, the OECD Science Policy Committee's air management program gave Japan an insight into the problem of acid rain. In return, the OECD sought information from MITI on its desulfurization plan and from MHW and MTI on their pre-siting surveys.

The United Nation's Report on the Human Environment treated air pollution as a global problem, and the report was widely circulated in Japan. Also, the OECD's report on "The Problems of Modern Society" gave Japan insight into the economic aspects of air pollution control. In response to automobile regulations of the European Economic Commission, the Ministry of Transportation instituted CO control in 1966. In addition, U.S. federal and California automobile emission control legislation forced Japanese automobile makers to develop and install hydrocarbon control devices in their export models to the United States.

Other developments in the United States also helped to shape Japanese pollution-control policy. In 1970, the Japanese press reported and evaluated the U.S. National Environmental Policy Act with great interest. President Nixon criticized Japan implicitly for taking an unfair advantage in international trade by not incurring the costs of pollution control. Christian Harter came to Japan as a special envoy of President Nixon to gain the cooperation of Japan in environmental-pollution control.

In March 1970, the International Social Science Council held the International Symposium on Environmental Disruption in Tokyo. The symposium provided an opportunity for other countries to review Japan's pollution problems at their worst stage. Also, in 1970, the OECD established the Environment Committee, which formulated the pollutor-pays-principle. It also started the Air Management Sector Group, which issued the report on "Fuel Combustion and Stationary Sources." The report provided useful information on the prediction of future pollution levels in OECD member countries. In September 1972, the Air Management Sector Group held a special session. During the session, Japan reported to the OECD member countries that it had undertaken drastic environmental policy changes. Also, it advised that Mazda and Honda had met the U.S. automobile exhaust emission standards for 1975 of the Clean Air Act.

When Mr. Ruckelshaus of the U.S. Environmental Protection Agency addressed the U.S. Congress to introduce the Clean Air Act of 1970, he spoke about the worst air pollution in Tokyo, where policemen had to use masks to protect themselves. A number of provisions of the Clean Air Act were studied with interest in Japan. This included the automobile emission standard and the requirements for environmental impact assessments and environmental impact statements. In 1975 and 1976, Japan adopted the U.S. automobile exhaust emission standards of 1975 and 1976, respectively, the so-called Muskie standards. However, when the U.S. changed its pollution policy in mid-course due to the devaluation of the dollar and the energy crisis, Japan maintained a strict pro-environment policy. The stringent U.S. AAQS for NO_2 (0.02 ppm/24hr) in 1973 was the subject of an intense debate in Congress. Consumers demanded an even stricter NO_2 AAQS and the institution of the original NO_2 emission standards for 1975 and 1976.

In 1971, the Environment Agency and other ministries began to participate actively in the international programs of the OECD and the UNEP. In 1972, the director-general of the Environment Agency, Minister Ohishi, addressed the Human Environment Conference in Stockholm, and explained frankly Japan's past negligence in pollution control. At the Nairobi Conference of the UNEP, the director-general of the Environment Agency, Mr. Hara, noted the importance of environmental conservation on a global scale. He proposed that the United Nations establish a special committee to study and make recommendations concerning this topic. Accordingly, in the fall of 1984, the UN General Assembly organized the World Commission on Environment and Development.

In 1976, the WHO-UNEP joint expert committee published its report on air quality guides and criteria for NO_2. The report served as an important scientific contribution to Japan's revision of its NO_x AAQS. In May 1979, the OECD Council issued recommendations on the use of coal as a substitute for petroleum. The recommendations helped Japan to formulate an environmental policy as it shifted its primary energy source from petroleum to coal.

Japanese corporations doing business abroad have been criticized for engaging in environmentally destructive practices. In response to the complaints, the Keidanren issued a "Code of Conduct for Japanese Enterprises in Developing Countries." The Keidanren organized the Japan Overseas Enterprise Association to encourage the implementation of the Code of Conduct. The Association's 1982 annual report stated that pollution-control investments constituted 6.7% of the total investments of Japanese overseas enterprises during the past ten years. Of this, investments for water-pollution control constituted the largest category, and investments for air-pollution control constituted the third largest category.

In 1975, a Japanese consortium and the Indonesian government signed a master agreement for a development project in Asahan. The agreement contained express terms on environmental preservation. The participants spent 20% of their total investment cost for an aluminum smelter on pollution-control equipment. A dry adsorption process with a recycling system has eliminated 98% of HF emissions. Monitoring equipment has recorded ambient HF concentrations of under 1 ppb. In addition, Japan has provided technical assistance for a community health project since 1977. The arrangement is based on an agreement between Japan and Indonesia.

During the 1980s, Japan's experience with environmental pollution control has attracted international interest. Specifically, Canada, the United States, West Germany, and the Scandinavian countries have looked to Japan to find ways to deal with the degradation of their forests due to acid rain. They are interested in Japanese technology and know-how concerning desulfurization, denitrification, and automobile emission control. In addition, Japan has executed bilateral cooperation agreements with West Germany, Turkey, Austria, Greece, China, and other countries, and has cooperated with ASEAN countries.

Since 1974, there have been more and more international seminars and training courses on pollution control. A course on air pollution control was added in 1985. The Environment Agency's Council for Global Environmental Problems has been working to promote international cooperation. It is concerned with the yellow sand in wind from the Chinese continent in the spring, radioactive fallout of nuclear testing on Bikini Island, and large volcanic eruptions. It is also studying the increase of CO_2 leading to the depletion of the ozone layer in the upper atmosphere. These will be the main challenges for humankind in the 21st Century. Japan's role and responsibility in solving these problems are entering a new stage.

1.16 HOW JAPAN CONQUERED AIR POLLUTION: A HISTORICAL SUMMARY

At the end of World War II, Japan had a few statutes dealing with pollution control but it lacked an effective, comprehensive approach. Emissions from plants in the mining and manufacturing industries caused serious damage to farmers and residents in the vicinity. In response to strong demands for pollution control measures, some companies built higher stacks for better diffusion. Also, mining smelters installed sulfuric acid recovery equipment and cement manufacturers installed Cottrell devices.

Between 1945 and 1969, local government initiatives played an important role in the development of modern, industrial pollution programs. For example, in Ube, the municipal government, university, and local industry cooperated to implement an effective pollution-control program. The Ube programs were not mandated by legislation; city ordinances merely created a committee where the parties concerned could meet and exchange views. Committee members included a university professor, an industry manager, a city official, and a city assembly representative. The Ube program was remarkably successful. Pollution levels declined to one-seventh of their previous levels.

In the early 1960s, air pollution from the petrochemical complex at Yokkaichi incensed local residents. The strength of their opposition spawned an anti-development and anti-pollution movement which attacked other planned development projects. In 1964, the movement succeeded in cancelling the planned industrial complex at Mishima-Numazu. The Smoke and Soot Regulation Law of 1962 was effective for controlling black smoke and heavy deposited matter, but not for the SO_2 emissions discharged by the petrochemical complexes. This era of pollution activism started the shift in the weight given to pollution control policy and industrial development policy.

In this period, MHW and MITI began to conduct joint environmental impact assessments of proposed industrial developments. When the Yokohama municipal government demanded that an electric power company consent to a strict pollution-control agreement, MITI urged the power company to sign. MITI feared that, otherwise, the project would be cancelled, as happened in Mishima-Numazu. From this time, municipalities expected electric power companies and other polluting industries to use the best available technology to reduce emissions. This served as an incentive for companies to develop desulfurization and denitrification technology. In 1966, MITI commenced a large project to develop desulfurization technology. Also in 1966, Idemitsu Kosan became the first company to install desulfurization equipment in the refinery process.

The 1967 Basic Law for Environmental Pollution Control Measures required the government to develop AAQSs. The first AAQS, for SO_2, was established in 1969,

Table 1.31

Chronology of national air quality management policy development and relevant issues

				'62	'63	'64	'65	'66	'67	'68	'69
Ambient Air Quality Standard											SO_2
Enforcement for Emission Control	Stationary Source Control	Suspended Particulates		X							
		Concentration; Vol. %		X		X					
		SOx K-Value								X	X
		Total Mass Regulation									
		Concentration ppm									
		NOx									
		Total Mass Regulation									
		Hazardrous Substance; Pb, HF, F, Cd & Their Compounds, NO_2, HCl, Cl_2		(X)							
		(HC)									
	Automobile Exhaust Control	Passenger Vehicle	CO					X	X		
			HC								
			NOx								
			Pb								
		Truck & Bus Gasoline Diesel	Black Smoke								
			CO								
			HC								
			NOx								
		Diesel Passenger Vehicle	Black Smoke								
			CO								
			HG								
			NOx								
Dust from Mechanical Process (Structure, Management, Operation)											
Air Pollution Control Legislation & Important Relevant Legislation				Smoke etc. Control Law '62					Air Pollution Basic Law '67 '70		
Energy Policy Issue				Liberarization of Petroleum Boiler '62						Low Sulfur Crisis plan	
National Development Issue				Regional Industrial Development; '62 '64 Yokkaichi, Mishima-Numazu, Yokohama '63 '64				Archipelago Reform '69			

'70	'71	'72	'73	'74	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85
CO		SP	SO_2				(HC)								
			Ox				(Pb)								
			NO_2					NO_2							
	X											X			
X	X	X	X	X	X	X									
				X	X	X									
			X		X		X		X				X		
												X			
	X						X								
							(X)					(X)			
X	X		X		X										
X	X		X		X										
			X		X	X		X							
	X	X	X		X										
		X			X										
				X	X										
				X	X										
							X	X	X	X	X	X	X	X	X
		X													
				X	X										
				X	X										
				X	X						X				
	(X)														

Control Law
'70 '72 '74
Compensation Law
'73

Energy Saving Law
'79
Alternative Energy Supply Law
'80

1st Oil Fuel Supply
'69 '73

2nd Oil Alternative Crisis
Energy '79 Coal, Nuclear

Human Settlement Zone Development
'77

Techno-police
'83

M. Hashimoto '85

and MITI developed a desulfurization plan designed to meet the standard in ten years. The Economic Planning Agency conducted an econometric impact assessment of the desulfurization plan. In 1969, the government integrated its energy supply program and air pollution control program. The Air Pollution Control Law of 1968 employed the K-value formula to regulate SO_2 emissions. This encouraged the construction of higher stacks. Each year, the government tightened the K-value, in accordance with the expansion of desulfurization capacity.

In 1970, Prime Minister Sato reacted to the political and social crisis created by past governmental neglect by establishing the pollution control headquarters directly under his leadership. The Diet passed 14 environmental laws and strengthened the Air Pollution Control Law. Events abroad quickened the pace of change in Japan. The OECD described Japan's implementation of anti-pollution measures as non-economic, moral, and emotional.

The courts issued decisions in favor of the victims in the four pollution trials, and this prompted the government to tighten pollution standards and enforcement. In 1972, the Diet passed strict liability legislation, and the Cabinet issued a resolution requiring environmental impact assessments for public works projects. Also in 1972, the government adopted the automobile exhaust emission standards of the U.S. Clean Air Act and incorporated them into the Air Pollution Control Law.

In 1973, Japan began a program of NO_x control with the extremely strict NO_2 AAQS of 0.02 ppm/24hr. In 1974, the Diet amended the Air Pollution Control Law to provide for total mass emission regulation. The regulations were based on similar statutes enacted by Mie prefecture in 1972 and Osaka prefecture in 1973. In 1974, the Environment Agency postponed until 1978 the implementation of the NO_x automobile exhaust emission standards scheduled for 1976. The postponement evoked strong objections from many quarters. Seven large cities organized a team to assess the state of NO_x emission control technology for automobiles. In 1975, the Environment Agency also established a committee to conduct annual assessments of NO_x control technology for automobiles and stationary sources. The agency released a report describing each automobile maker's (non-confidential) pollution control technology. These reports encouraged automobile makers to compete to be the first to develop the most advanced, pollution control technology. In May 1976, all automobile makers had met the stringent NO_x emission standards, and mass production began in October 1976. It turned out that the new, cleaner cars had better fuel efficiency than the old cars which did not meet the emission standards.

The devaluation of the dollar in 1971 and the oil crisis in 1973 did not deter Japan from its anti-pollution campaign. It maintained strict pollution control laws, rationalized industry, and developed energy saving methods to cope with the crises. In 1978, the Environment Agency revised the overly strict 1973 NO_2 AAQS based on scientific information provided by the Central Advisory Council expert committee.

The Energy Saving Law of 1978 and the Alternative Energy Promotion Law of 1980 both took environmental considerations into account. The Diet passed the two laws just after the Tokyo Summit of 1979, which dealt with the second energy crisis. In 1981, the Environment Agency published a report entitled "Environmental Policy During a Stage of Changing Energy Policy." From 1981-84, Japan shifted from petroleum to coal for its energy supply. Accordingly, the government tightened emission standards for particulates and NO_x from coal-fired boilers in 1982 and 1983.

Between 1982 and 1985, the government implemented total mass emission regulation for NO_x. It implemented emission controls for trucks, trailers, and buses between 1978-85. However, due to the extension of the useful life of these vehicles, the changeover to the newer, cleaner vehicles took longer than expected. For this reason, in the summer of 1985, some roadside monitoring stations recorded NO_2 concentrations above the NO_2 AAQSs. Pollution control in transportation presents a challenge in the coming decades.

Table 1.31 presents a chronology of Japan's pollution-control programs beginning in 1962.

1.17 CONCLUSION

Air pollution levels in Japan reached their worst in the mid-1960s, and were very much improved by the late-1970s. A number of factors contributed to the reduction of pollution. Industry invested in expensive pollution control equipment to meet the stringent ambient and emission standards that made pollution abatement possible. Also, nine automobile manufacturers conducted research and development on automobile exhaust emission control technology and succeeded in meeting Japan's strict emission standards. In addition, the government integrated its national energy policy with air pollution control policy in the desulfurization program. Finally, despite the devaluation of the dollar and the oil crisis, Japan maintained its basic environmental policies. It expanded coal consumption after 1979, and put more effort into pollution control after 1980.

The success of Japan's air pollution control efforts can be attributed to the social and political dynamics of change that took place from 1970-74. The process was helped by the government's comprehensive and integrated planning to achieve the SO_2 AAQS. But the key to the entire effort was the public's awareness and persistent demand for change. Farmers and residents first turned to local government for action, and then demanded that the central government take action as well. The public's influence was felt as voters in local and national elections, and as consumers purchasing clean, fuel-efficient cars. Also, the mass media's nationwide anti-pollution campaign served as a catalyst for change.

Local government played an important role in Japan's anti-pollution drive. The Tokyo Metropolitan Government enacted the first industrial pollution control ordinance in 1949. In the 1950s, Ube instituted a successful air pollution control program with the cooperation of municipal officials, industry managers, and university scholars. The Yokohama city government pioneered the idea of pollution control agreements. After making an air pollution assessment, it used the results to gain favorable terms on pollution-control agreements from the Tokyo Electric Power Company. In many local governments, the public health service and laboratories developed the new scientific and technical methods of analyzing the pollution problem. Finally, the confrontation between the conservatives and socialists in local government kept the subject of pollution control on the top of political agendas.

Despite meager budgets during the early days, a small number of scholars and researchers at universities and research institutes at the local and national level participated in study projects for air pollution control. Also, the Japan Society of Air Pollution, established in 1959, made an invaluable contribution.

The cancellation of the Mishima-Numazu petrochemical project in 1964 shocked economic and industrial organizations. The possibility of a similar cancellation encouraged MITI to lend its support to the pollution-control agreement which the Yokohama municipal government demanded from the Tokyo Electric Power Company in 1964. This soon became standard practice all over Japan. Local governments conducted pre-siting environmental impact assessments and negotiated pollution-control agreements based on the findings of the assessment. The terms of many of the agreements required companies to use the best available pollution-control technology. Companies found it in their interests to negotiate the pollution-control agreements in good faith for two reasons. First, they wanted good relations with the communities in which their factories were located, and, second, they wanted to increase market share.

MHW expanded the scope of its pollution monitoring and health-effect studies. As a result, the government established criteria, guides, and an AAQS for SO_2 in 1969. In the same year, MITI developed a desulfurization program. This was the most successful example of MITI-MHW cooperation. In addition, MITI adjusted the charges for electricity to cover the costs of pollution control incurred by electric power companies.

In 1970, Prime Minister Sato responded quickly to a serious social and political crisis by establishing the pollution control headquarters directly under his supervision. The pollution headquarters succeeded in guiding the preparation and passage of 14 pieces of anti-pollution legislation. All political parties supported the efforts to adopt the new environmental laws.

The court's decision in the Yokkaichi case served as an important catalyst in the government's receptivity to the need for change in environmental policy. The Yokkaichi court made new doctrine in its treatment of negligence, causation, and damages in a pollution context. Also, it faulted the administration for its handling of pollution control at the Yokkaichi industrial complex. Prompted by the Yokkaichi case, the government quickly prepared the Pollution-Related Health Damage Compensation Law, total mass emission regulation, and the Industrial Siting Law. The Diet passed these bills during 1973 and 1974.

The fact that automobile makers met the stringent emission standards of 1975, 1976, and 1978 is attributable to the intense competition among the nine automobile manufacturers. Consumers disliked air pollution in their cities and demanded clean and fuel-efficient cars, which forced automobile makers to work quickly to meet the standards. At first, automobile makers rushed to install pollution-control devices without regard to cost effectiveness. But after the devaluation of the dollar, the automobile makers rationalized production costs to lower prices and gain a greater market share. After the oil crisis in 1973, government and industry worked to conserve energy. It took an accelerated program of research and development to achieve pollution-control, cost rationalization, and energy conservation.

In 1971, the Diet passed the Industrial Pollution Abatement Factory Manager Law. This law required each factory to designate an individual to be responsible for pollution control. Also, the Yokkaichi decision in 1972 gave notice to companies that the courts would apply the concepts of negligence and joint tort very strictly in pollution cases. These factors created an awareness among companies of their responsibilities for pollution control.

Scientific uncertainty is an ever-present problem in the management of pollution control issues. Consequently, even experts disagreed on related scientific and technological issues. Even where there is a degree of certainty on these factual matters, administrators differed in what policies to pursue, in what judgments to make. The OECD characterized Japan's environmental policies as non-economic, moral, and emotional. But Japan faced a dire need for a quick, dramatic reverse of the environmental degradation of its air and water. In any event, the government implemented pollution-control laws in a gradual manner, with annual reviews of the state of pollution-control technology and studies of their econometric impact. Moreover, the government publicly disclosed much of the information gained from the technology reviews and econometric assessments despite the controversy over the wisdom of such a disclosure. This provided the foundation for the most important determinant of Japanese environmental policy--the public's awareness, criticism, and active participation. But this has been the story of the past. Japan will face new challenges in air pollution control in the 21st Century.

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