PITO

PRIVATE INVESTMENT AND TRADE OPPORTUNITIES

ECONOMIC BRIEF
NO. 11

PRIVATE INVESTMENT AND TRADE OPPORTUNITIES IN AIR AND WATER POLLUTION CONTROL

East-West Center

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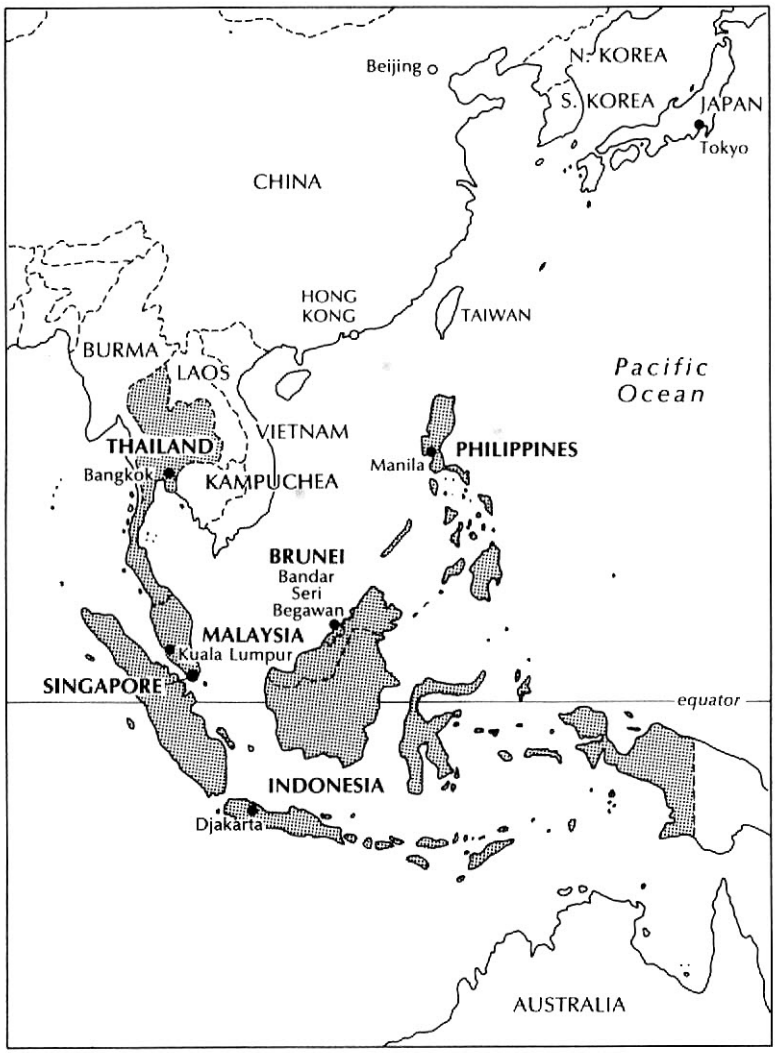
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PRIVATE INVESTMENT AND TRADE OPPORTUNITIES IN AIR AND WATER POLLUTION CONTROL

Richard A. Carpenter*

INTRODUCTION

The Association of Southeast Asian Nations (ASEAN) member states of Indonesia, Malaysia, the Philippines, and Thailand present trade and investment opportunities for foreign investors. At the same time, the investor may be frustrated by the conflicts between economic development and regulations in these countries which serve to protect and restore the quality of air and water. Each ASEAN country continues to grow industrially, creating both increased discharges of pollutants and an increased economic ability to pay for a cleaner environment. Although the worldwide awareness of threats to public health and ecosystems from environmental degradation is also apparent in the attitudes of citizens and government officials in ASEAN, the desire for rapid economic development is still a dominant concern. New and existing regulations for pollution control are not always accompanied by credible enforcement capabilities and actions. Primitive, small-scale manufacturing and processing factories with little

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The views expressed in this paper are those of the author and not necessarily those of the U.S. Agency for International Development (USAID), the East-West Center, or other organizations.

pollution control continue to exist side-by-side with high-tech installations of multinational corporations equipped with the latest waste treatment technologies.

For American private sector concerns entering the region, these contrasts characterize the setting for trade and investment opportunities in environmental pollution control. Generalities among the four larger ASEAN countries can be found, but it is important to keep in mind their individual stages of development and environmental management practices. Hence, this overview of private investment and trade opportunities in ASEAN assesses each country separately according to major environmental problems, pollution control policies, regulations, and business opportunities.

During his recent trip to Asia, President Bush announced the U.S.-Asian Environmental Partnership which was established to develop markets for the U.S. environmental industry through activities in training, the building of environmental management capabilities, and technology transfer in 30 Asian nations including ASEAN. This effort is led by USAID's Asia Bureau and the Department of Commerce in collaboration with 19 other federal agencies, nongovernment organizations, and businesses.

A related new private sector organization with the purpose of helping U.S. firms capture a larger share of the growing market for pollution control technologies is the Environmental Technology Export Council (ETEC). Member organizations will be aided by U.S. government agencies in gathering and sharing market research and export promotion ideas.

This PITO informational brief is prepared with the recognition that a major six-year USAID project called ASEAN Environmental Improvement is about to get under way. As is stated in the request for proposals:

> The pace of development in the ASEAN region makes it an involuntary laboratory illustrating the interactions between economic growth and the environment.... The Project's purposes are to promote private sector initiatives, to address urban and industrial pollution, and to strengthen local, national, and regional capabilities in environmental management.

INDONESIA

The long-awaited establishment of Bapedal, the Environmental Impact Management Agency, occurred in 1990. A number of government regulations and ministerial decrees have been passed for implementation by Bapedal, which is organized as part of the Ministry of Population and Environment (KLH). Amdal, or environmental impact assessment, reports are required in granting permits and licenses for new industrial installations. These reports are available from the permit-granting departments and in offices of the provincial governments.

Bapedal has the following programs pertinent to air and water pollution:

- Surface water pollution (PROKASIH)
- Air pollution - mobile sources
- Sanitation and municipal waste control in urban areas (ADIPURA)

- Coastal water/sea water pollution control
- Hazardous waste management

Air Pollution

There are few data in Indonesia on air pollution emissions, air quality, or meteorology related to dispersion, but the seriousness of the level of air pollution in large cities is obvious. Monitoring in Jakarta has shown that sulfur oxides (from fuel combustion), dust, and nitrogen oxides (from vehicles) regularly exceed ambient air quality standards (see Figure 1 for general location of industry, roads, rivers, and monitoring stations in Jabotabek, which is the area comprising Jakarta, Bogor, Tangerang, and Bekasi). Ten cement plants are in operation, but few have adequate dust control and have been the target of frequent complaints from nearby residents. An inventory of air pollution sources is maintained by the Jakarta Environmental Research Laboratory (DKI). Monitoring is performed by the Department of Meteorology and Geophysics. Road tests of automobile emissions are scheduled to begin in 1992.

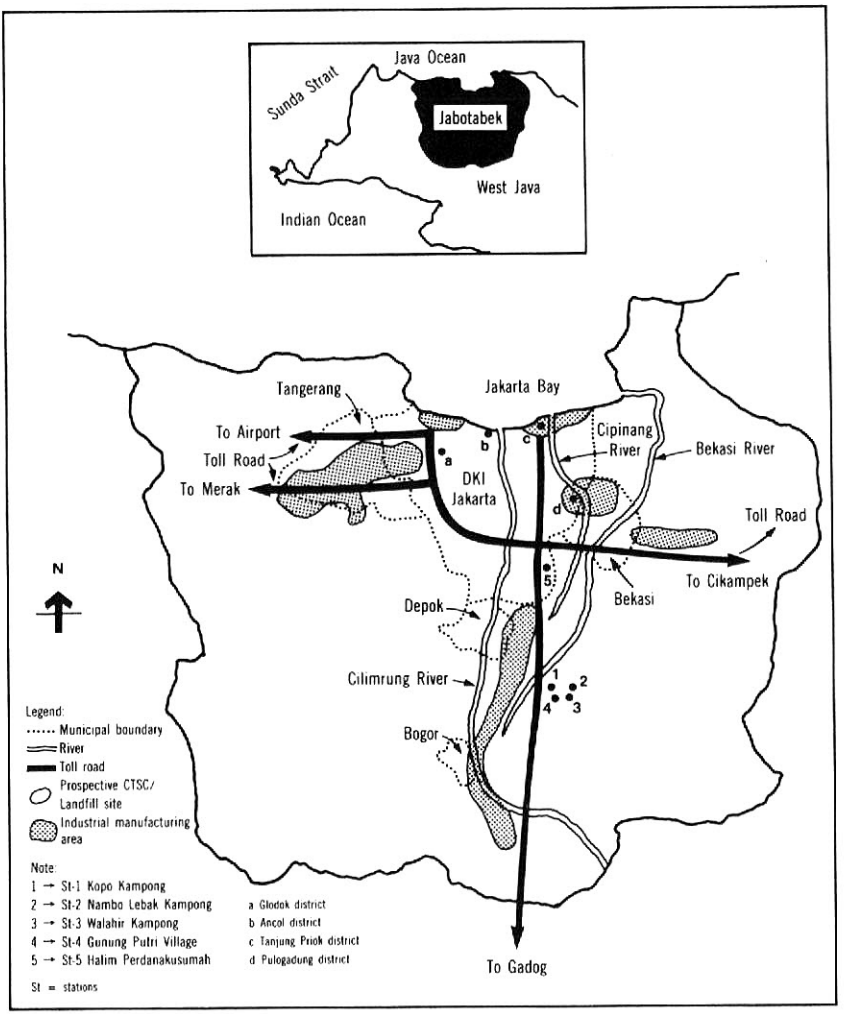
Management of air quality in Indonesia is just beginning. Ambient standards and some emission standards for stationary sources have been decreed. Nevertheless, few enforcement actions have been taken so far.

Water Pollution

PROKASIH is a program to improve the quality of 24 major rivers by identifying all factories discharging wastes and then

Figure 1

Monitoring Stations in Jabotabek



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selecting significant waste generators for priority action to enforce installation of treatment facilities. Domestic waste waters, however, are not yet included in this inventory. Each discharge source is categorized as to the status of waste treatment, ranging from compliance with the standards to no existing treatment. In a recent survey of the three rivers in Jakarta, less than 10 percent of the factories had waste treatment units that complied with standards for aqueous discharges, which are set for each particular industry. The pollutants monitored are biological oxygen demand (BOD), chemical oxygen demand (COD), and suspended solids (SS).

Hazardous waste inventories have been conducted for Jakarta and the East Java GKS region (Surabaya, Gresik, Sidoarjo, Mojokerto, Lamongan, and Bangkalan). These reports were sponsored by the U.S. Trade and Development Program and are available for inspection at that office.

In terms of amounts discharged, a World Bank study, "Industrial Efficiency and Pollution Abatement," has identified the most polluting industries: the thousands of food processing plants, and pulp/paper factories (BOD); textile manufacturing and tanning (COD); and metal finishing (heavy metals and acidic wastes). PROKASIH data are compiled using Standard Industrial Classification codes. The continued monitoring of factories discharging wastes into major rivers shows that end-of-pipe treatment technology for BOD is now being installed. Enforcement has been slow, due in part to unfamiliarity of the judiciary with

environmental laws. Most of the abatement task lies ahead and should generate substantial purchases of equipment.

A different approach to siting industries is found in the growing number of industrial estates, about 50 of which are privately operated and 7 are government-owned. All newly developed industrial estates must have central treatment works. Some older estates do not have this feature and may be required to install treatment and disposal facilities.

The highly capitalized, large installations such as refineries, petrochemical complexes, and electric power plants are usually well equipped to meet international emission standards for discharges to both air and water and are usually operated to do so.

Business Opportunities

1. Waste treatment equipment, instruments and chemicals. Vendors acting as agents, dealers, or distributors are active in supplying filters, ion exchange equipment, activated carbon, sedimentation/coagulation tanks, pH meters, chemical dosing devices, special purpose pumps, and laboratory equipment. One entry point for a U.S. firm is to sell to American manufacturing firms already operating in Indonesia. Subsequently, the firm can seek to widen the market.

Price competition and cost-effectiveness of equipment are strong selling points because most industries are only willing (or financially able) to comply with regulations to the minimum extent necessary to avoid sanctions. Enforcement of regulations is improving but the level of fines may not be high enough in some

instances to motivate purchase of treatment facilities. This economic incentive must be established with experience which is just beginning.

2. Engineering design, construction and maintenance. A few firms now offer packaged waste treatment facilities and limited engineering and architectural services.

3. Environmental consulting and management. With the advent of Bapedal and Amdal, services are a growing business. The government of Indonesia has instituted a system of prequalification and registration of firms for work on government projects. It is estimated that 200 projects will require Amdal each year and this volume of work cannot be handled by domestic Indonesian consulting capabilities. Joint ventures and other collaborative arrangements with local firms are common.

Indonesia continues to industrialize and the government shows some commitment to setting and enforcing pollution regulations. Control of water pollution is receiving more attention than control of emissions into the air. The Bapedal organization and the Amdal information are sources for locating business opportunities. Investment procedures, foreign ownership requirements, and protection of intellectual property are being improved. One possible drawback is the lack of English language versions of technical reports and regulations which can be frustrating.

Foreign (i.e., non-U.S.) private companies are well supported by their governments and development aid programs. The high quality of U.S. technology and goods is widely accepted, but price

and suitability of U.S. technology and goods for many of the relatively unsophisticated Indonesian industries are questioned.

MALAYSIA

Peninsular Malaysia is separated from the states of Sabah and Sarawak by the South China Sea. Thus far, most industrialization in Malaysia has been in the peninsula near Kuala Lumpur and Penang. A rising standard of living (per capita GNP in 1991 was US$2,305) and improvement in the quality of life have resulted from rapid economic development.[1] The environment, however, has been degraded. For example, rapid urbanization has increased loads to sewage and solid waste disposal services faster than new capacity can be installed. Only 5 percent of the urban population is served by sewerage and central treatment plants. Industries based on mining, agriculture, and forestry are being augmented by manufacture of electrical and electronic equipment, chemicals, and petroleum products. A record 906 approvals of new manufacturing projects were granted in 1990. These installations usually include some pollution control equipment so that the continuing growth of industry, as well as the retrofitting of older factories, provide a market.

Malaysian political power is divided between the federal and state levels. While the states control the basic resources of land,

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[1]See "Malaysia, the Next NIE?" PITO Economic Brief, No. 4, and "Country Report: The Malaysian Economy and Business Opportunities for Foreign Enterprises," Business Environment in ASEAN, No. 4.

water, agriculture, and forestry, the Federal government deals with pollution to protect health and welfare. Thus, there are continuing conflicts between these jurisdictions in the siting of industries and land use planning. The Department of the Environment (DOE) within the Ministry of Science, Technology and the Environment administers a comprehensive Environmental Quality Act. Other agencies have related responsibilities:

- Sewage - Ministry of Housing and Local Government
- Solid waste - Ministry of Housing and Local Government
- Public health - Ministry of Health
- Pesticides - Ministry of Agriculture

The Sixth Malaysia Plan for 1991–1995 (SMP) stresses the enforcement of pollution regulations and the encouragement of clean technologies. An environmental impact assessment is required for 19 specified types of projects covering virtually all technological development. The reports are available for inspection at the Department of the Environment.

Air Pollution

The heavily industrialized and populated area of Kuala Lumpur and the Klang Valley of Selangor are the most polluted. The number of motor vehicles in these areas is increasing rapidly. Open burning of municipal solid wastes, a practice that is difficult to control, contributes a steady load of particulates. Haze is a widely recognized characteristic of air quality in these tropical countries and is exacerbated by light winds, high insolation, and

multiple sources of dust and particulate matter. At the air quality monitoring stations (see Figure 2), only total suspended particulates, lead, and dustfall are measured. Moreover, monitoring instruments vary greatly by brand and year of manufacture so that maintenance servicing has been difficult and reliability is low.

Malaysia does not have legally binding ambient air quality standards but recommends "guidelines" aimed at protecting human health. The guideline values are similar to internationally accepted standards (see Appendix I).

Water Pollution

Agricultural industries, particularly the oil palm and rubber processing industries , are major sources of BOD in inland waters although progressively tightened treatment requirements are being enforced (Table 1). Sediment from many years of dredging in tin mining clogs long reaches of most rivers. Domestic sewage, however, contributes to a BOD equivalent of three times the total of all industrial discharges. The rivers of the west coast of peninsular Malaysia are the most polluted because of the concentration of tin mining, agriculture, industry, and population in the region.

A river water quality monitoring program is underway to judge whether use classifications of water bodies are being achieved. The number of sampling stations is being increased with more staff and equipment provided in response to growing public complaints.

Figure 2

Distribution of Air Monitoring Stations for Total Suspended Particulates and Respirable Particles in Peninsular Malaysia

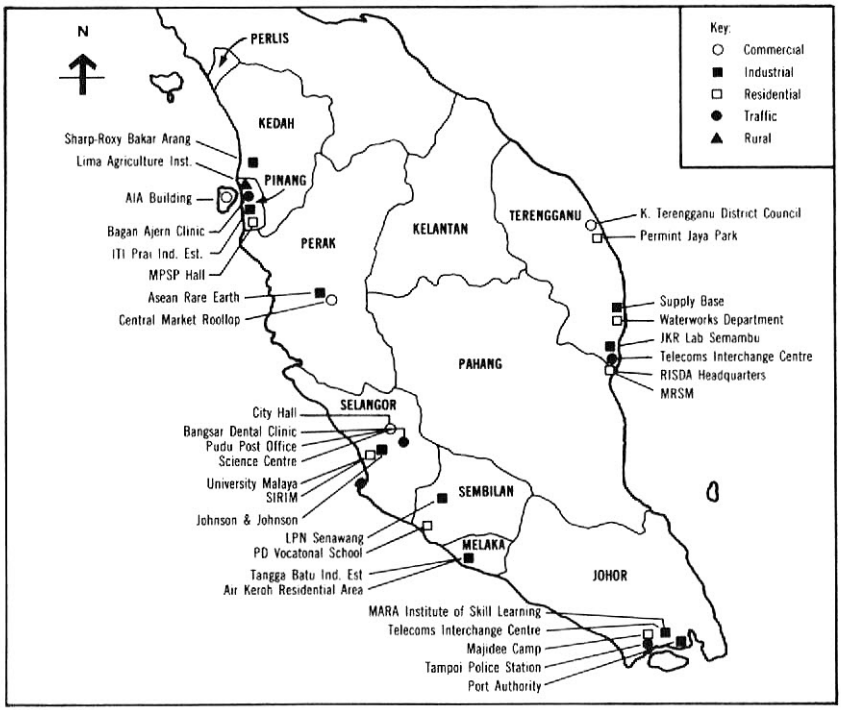

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Table 1 Distribution of Major Stationary Sources of Water Pollution in Malaysia, 1990

State	Major Sources of Water Pollution							
	Palm Oil Mill	Raw Natural Rubber	Rubber Product	Food and Beverage	Textile and Leather	Paper	Chemical Product	Total
Perlis	–	–	1	14	1	–	–	16
Kedah	3	29	22	98	8	2	8	170
Pulau Pinang	5	9	33	162	58	11	43	321
Perak	37	31	28	132	13	5	11	257
Selangor	29	13	122	92	22	15	107	400
Wilayah Persekutuan		4	22	21	10	13	31	101
Negan Sembilan	12	22	12	15	2	22	9	94
Melaka	3	12	17	21	7	3	11	74
Johor	65	49	34	130	46	7	32	363
Pahang	56	20	3	33	–	1	1	114
Terengganu	11	3	6	84	16		–	120
Kelantan	8	11	1	28	4	1	3	56
Sabah	25	4	3	48	5	11	4	100
Sarawak	6	4	1	38	–	3	4	56
Total	260	211	305	916	192	94	264	2,240
Percentage	11.6	9.3	13.6	40.8	8.5	4.1	11.7	–

Note:
– = Zero or near zero.

Business Opportunities

Privatization is increasing under government policy in Malaysia. A large hazardous chemical waste treatment and disposal facility is being built by a private Dutch/Malaysian consortium under an agreement with the government, which would require all waste generators to use these services for a fee. Ironically, the study leading to this facility was funded by the U.S. Trade and Development Program in 1987. Sewage treatment plants, where they exist, are difficult to maintain in continuous operation and the government is seeking private operators who will undertake to guarantee more reliable service. A haze episode in September-October 1991 brought demands for more continuous air quality monitoring, and since government manpower is limited, this task may be offered to private firms.

There is a receptivity in the Department of the Environment for so-called cleaner technology and waste minimization, but their cost effectiveness is uncertain. In particular, the quality of specialty products, such as electronic parts, must not be degraded by any changes made to reduce pollution.

The growing data base of environmental information should benefit from computer processing for effective accessibility and use by government agencies, industry, and consulting engineering firms. American software in this area is viewed as being of high quality.

Training programs in occupational safety and health tailored to Malaysian cultural and working situations will be in demand as

more complex manufacturing and processing technology is introduced.

ENSEARCH, which is located in Kuala Lumpur, is a government-sanctioned organization with the purpose of linking business and environmental interests in Malaysia.

Public concern about environmental health is rising and some observers believe that Malaysia will soon begin to deal with more complex risks such as PCBs, asbestos, and leaking underground storage tanks. The continued strong emphasis on economic growth (motivated, in part, to address the wealth imbalance among races) may, however, limit the attention and resources deployed for environmental pollution control.

THE PHILIPPINES

In the Philippines, the central environmental authority since 1987 is the Environmental Management Bureau (EMB) which is within the Department of Environment and Natural Resources. Decentralization to regional offices and the creation of environmental units in other operating agencies have been largely ineffective due to lack of money and manpower. An environmental impact assessment (EIA) is required of all major projects but the latest figures (for 1990) show that few detailed EIAs are completed. Over 80 percent of the applications for Environmental Compliance Certificates are still pending processing by the government, but the projects proceed. EIA reports are not generally available. Enforcement of pollution regulations is not effective and there is no apparent political will to improve enforcement by properly staffing

and funding the EMB to do so. Most of the limited amount of money actually spent for environmental management, rehabilitation, training, and equipment comes from foreign development assistance agencies which pursue their own agendas. New privately-financed factories have little incentive to install waste treatment technologies.

In the Manila area, the Laguna Lake Development Authority has overlapping and sometimes conflicting jurisdiction and authority with EMB. Large agencies such as the Philippine National Oil Corporation and the National Power Corporation have competent environmental departments but these are poorly coordinated with EMB.

Air Pollution

Forty-two percent of all motor vehicles in the Philippines and most of the pulp and paper mills, iron and steel factories, and paint and plastics manufacturers are located in Metro Manila. Cebu City is the second-largest industrial concentration. There are few air quality monitoring data but the particulate matter in Manila air is obvious; the perpetual traffic jam of many poorly maintained buses, jeepneys, trucks, and automobiles is one source of the city's air pollution. None of the electric power plants in the Philippines has sulfur oxides control equipment and only one has an electrostatic precipitator. Cement and steel plants are cited frequently in citizens' complaints about dust emissions.

Water Pollution

As of 1990, only one-fifth of the streams and water bodies have been classified as to their best expected use. Most of those classified do not meet the water quality criteria of the classification because of excessive total dissolved solids (TDS), total suspended solids (TSS), BOD, and low dissolved oxygen (DO), especially in the lower reaches of rivers. Only 15 percent of Metro Manila is served by a sanitary sewerage system; the major wastes are discharged directly into septic tanks, storm drains, or rivers. A more realistic reclassification of water bodies is underway based only on DO, BOD, pH, and total coliform organisms. The EMB does not believe it is possible to enforce standards for other pollutants within the next 5–10 years. One reason for this is a lack of analytical capability.

Priority for cleanup has been given to the following Water Revival and Management Projects:

- Navotas-Malabou-Tullahau-Tinajeros River pollution and flood control
- Pasig River rehabilitation
- Laguna Lake Development Authority
- Manila Bay monitoring
- Hydraulic control structure
- METROSS I-V
- Calancan Bay rehabilitation

Where treatment units exist (nationally, only 31 percent of all firms had treatment equipment and a permit to operate in 1990), the most common methods are sedimentation basins or tanks

(Tables 2 and 3). There have been some BOD reduction as a result of the activated sludge process or aeration which is used in large installations. There is little evidence of chemical treatment.

A law calling for regulation of hazardous chemical wastes was passed in 1990, but formation of these regulations and an inventory of waste generators have not been completed. It is apparent that many factories are storing these wastes (especially sludges) on-site or illegally dumping them because of a lack of treatment and disposal facilities.

Business Opportunities

A noteworthy advantage for Americans doing business in the Philippines is the similarity of laws, regulations, and business practices, and especially the use of the English language. Despite recent conflicts over the military base closings, there is a continuing receptivity for American products and services.

Monitoring efforts in Metro Manila and the 13 regional offices are likely to increase. Portable and laboratory equipment will be needed. Organic wastes and heavy metals in water, and particulates and sulfur dioxide in the air, are priority pollutants that will need to be addressed. Data management systems for making regular use of improved monitoring efforts will also be required.

In Metro Manila, efforts to reduce motor vehicle emissions may take the form of add-on devices and improved maintenance to reduce smoke, volatile organics, and carbon monoxide. Emission measurement equipment may also be required if the political will to attack the problem is achieved. Improving the

Table 2 Physical Treatment Methods Used by Industries (DENR, 1990) - Discharge Point: Pasig River

Physical Treatment Used	Food	Textile	Beverage	Paper	Livestock	Metal	Chemical	Others	Total
Bar screen	1	0	0	0	0	0	0	0	1
Catch basin	1	0	0	0	0	0	0	0	1
Clarifier	3	0	0	0	0	0	0	1	4
Collection tank	2	0	0	0	0	0	0	0	2
Filter	1	1	1	0	1	1	1	0	6
Filter press	0	0	0	0	0	2	1	0	3
Incline screen sieve	1	0	0	0	0	0	0	0	1
Inclined plate settler	1	0	0	0	0	0	0	0	1
Liquid-gas-grease separation	0	0	0	0	0	0	2	0	2
Oil-grease trap	0	0	0	0	0	0	0	0	0
Oil-water separation	1	0	0	0	0	0	5	1	7
Sedimentation tank	6	3	0	0	0	2	2	5	18
Separator	0	0	0	0	0	0	2	0	2
Septic tank	1	0	1	0	0	0	0	0	2
Square-based tank	0	0	0	0	0	0	0	0	0
Total	18	4	2	0	1	5	13	7	50

Table 3 Biological Wastewater Treatment Methods Employed by Industries along Pasig River

Biological Treatment Used	Food	Textile	Beverage	Paper	Livestock	Metal	Chemical	Others	Total
Activated sludge	3	1	0	0	0	0	0	2	6
Aeration	4	2	0	2	0	0	0	1	9
Aeration-dilution	0	0	0	0	3	0	0	0	3
Lagoon	2	0	0	0	0	0	0	0	2
Anaerobic digestion	0	0	0	0	0	0	0	0	0
Trickling filter	0	0	0	0	0	0	0	1	1
Total	9	3	0	2	3	0	0	4	21

existing fleet of vehicles is the only affordable immediate approach to cleaner air in Manila.

Rehabilitation of "dead" rivers by dredging of bottom sediments may be undertaken. Included with this cleanup should be much wider installation of BOD treatment technology in factories discharging to the rehabilitated rivers.

The consulting capability in the Philippines is generally adequate but specialists in hazardous waste treatment and systems engineering are often secured from abroad. Competent technicians for operating and servicing equipment are available locally.

The chronic shortage of electricity in Manila means that power for pollution control equipment and instruments is unreliable. Diesel generators are the rule for new installations if they are not to experience frequent shutdowns. Although pollution control may be the least of the worries for these industrial managers, equipment that can fail safely may have a comparative advantage.

THAILAND

A new government organization for the environment—the Ministry of Science Technology and the Environment—was recently established (May 1992) in Thailand. The former National Environment Board (NEB) will continue as the major environmental unit within the new ministry. Under the reconstituted NEB will be an Office for Environmental Policy Planning, a Department of Environmental Pollution Control, and a Department for Environmental Promotion (public education and information). This new

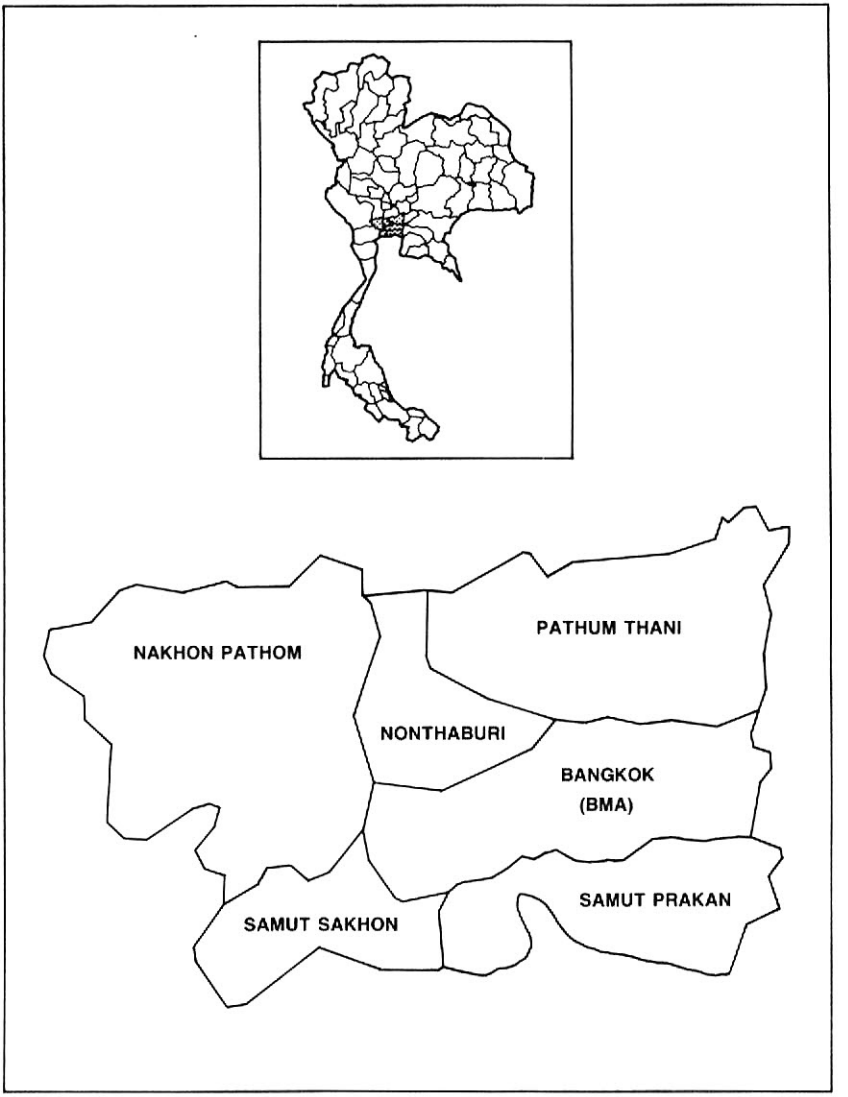
ministerial level for environmental affairs should help to gain greater recognition of the problems of industrial pollution which have resulted from the rapid economic expansion in the recent past. Tension between government agencies such as the Industrial Works Department (IWD), the Electric Generating Authority of Thailand (EGAT), and NEB over environmental/development issues has been obvious and is frequently cited in the press. A new Environmental Act is also coming into force that will give the NEB power to fine polluting businesses up to four times the damage costs, an attempt to implement a "polluter-pays principle." Enforcement may continue to lag because the Thai culture and society do not favor litigation, and going to court is usually considered only as a last resort. Although EIAs are required for most large-scale development projects, they are considered confidential for government use and are not generally available.

Most industry is in the Bangkok Metropolitan Region (BMR) and the adjacent Eastern Seaboard Development Area (ESDA) to the south. The government is active in directing new industrial growth away from the BMR through investment incentives, infrastructure location, and industrial estates. It is likely, however, that the major market for air and water pollution control technology will continue to be in the BMR, ESDA, the upper south, and the Songkhla Lake areas (Figure 3).

The Federation of Thai Industries, a nongovernment organization, is active in improving pollution control. Its members

Figure 3

The Bangkok Metropolitan Region (BMR)



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have visited the United States to learn about American regulations and technologies.

A study of hazardous wastes in Thailand was completed in 1988 under the U.S. Trade and Development Program and is a useful guide to industrial pollution problems. Documents generated for the 1990 Conference on Industrializing Thailand and its Impact on the Environment, which was sponsored by the Thailand Development Research Institute, also provide valuable background information for foreign businessmen.

The Board of Investment (BOI) promotes both domestic and foreign industry but has not used environmental impact assessment in its selection criteria. Perhaps in part due to this oversight, the proportion of promoted industries which generate hazardous wastes has grown to over 50 percent of the total. The absence of treatment and disposal facilities adds to the problem of toxic chemical wastes.

An interesting government response has been the central collection and treatment plant for electroplating wastes at Bang Khuntien. Built by the Ministry of Industry and leased for operation by a private company, the center sends trucks to waste generators who pay a fee based on the type and amount of waste. The generators are motivated to use the system in order to avoid having to install their own treatment facilities, which would be required under government regulations. So far, this waste management scheme appears technically and economically successful and is likely to be replicated in other BMR sectors.

Air Pollution

Bangkok air quality is typical of tropical cities located on estuaries, i.e., smog and haze derived from pollutants are cooked by high insolation and kept from dispersing by light winds. A pronounced "heat-island effect" occurs daily in Bangkok and the vertical rise of air helps to dilute street-level pollution. The legendary continuous traffic jam throughout the BMR is a source of carbon monoxide and hydrocarbons. Ambient standards for particulate matter, carbon monoxide, and oxidants are exceeded regularly. An action plan to enforce vehicle emission standards for smoke and CO is underway and includes an increase in manpower and resources for monitoring. Certified private companies inspect vehicles. The import tax for monitoring equipment has been reduced. Lead-free gasoline is now available and its price is subsidized to make its use attractive. Compressed natural gas is being used in fleet vehicles.

Large industrial installations must be licensed for operation by the IWD. The license is granted, and operating conditions imposed, based on the findings of EIAs required by the NEB. The EIA evaluates emissions to the atmosphere and recommends equipment for their control to meet emission standards. Stack sampling is done for smoke, dust, and sulfur dioxide (SO_2) in the cement, steel, and electric power plants. Enforcement for large installations is credible and compliance is good.

Ambient air quality is monitored for suspended particulates, CO, oxides of nitrogen, SO_2, and lead.

Water Pollution

The Chao Phraya river and its tributaries in the BMR are virtually devoid of dissolved oxygen and aquatic life due to the heavy load of organic matter from industry and municipal sewage. (Water quality in major rivers is shown in Table 4.) Biological oxygen demand loads are high throughout the country and can be disastrous to fish in impacted streams during dry seasons. Aside from domestic wastes, the main source of BOD is the large and dispersed number of food and beverage plants and the pulp and paper industry. The BOD load is expected to double from 1991 to 2001.

The newer industries (i.e., steel, electroplating, textiles, electronics, chemicals, and petrochemicals) are being heavily promoted and are growing rapidly. Their wastes are more difficult to treat than BOD from traditional industries. Projected amounts and sources for 1996 are shown in Table 5. Total treatment costs for that year are estimated at about 1 billion baht (US$40 million). A proposal has been made to the government by the Thailand Development Research Institute to create an environment fund to build treatment and disposal plants; the money for the fund is to be raised by a charge to waste generators.

The Industrial Estate Authority of Thailand is a public enterprise under the Ministry of Industry, but the estates are outside the jurisdiction of the IWD. Waste water treatment facilities were installed at all 23 estates as of 1989, but the type and level of treatment efficiency are not reported.

Table 4 Water Quality of the Major Rivers, 1987–1989

River	Standard			1987			1988			1989		
	Dissolved Oxygen (mg/l)	Biological Oxygen Demand (mg/l)	Total Coliform (MPN/100ml)	Dissolved Oxygen (mg/l)	Biological Oxygen Demand (mg/l)	Total Coliform (MPN/100ml)	Dissolved Oxygen (mg/l)	Biological Oxygen Demand (mg/l)	Total Coliform (MPN/100ml)	Dissolved Oxygen (mg/l)	Biological Oxygen Demand (mg/l)	Total Coliform (MPN/100ml)
Chao Phraya												
Upper	6	1.5	5,000	5.7	1.6	8,000	5.2	1.7	8,200	5.8	1.0	18,666
Middle	4	2	20,000	3.0	1.8	29,000	3.4	1.8	13,000	2.4	2.4	35,000
Lower	2	4	na	0.3	4.0	71,000	0.8	3.8	242,000	0.2	2.8	705,000
Thachin												
Upper	6	1.5	5,000	5.1	2.7	91,666	5.0	2.0	24,000	5.0	2.9	24,000
Middle	4	2	20,000	1.0	2.4	93,500	1.6	2.8	160,500	1.6	2.6	240,000
Lower	2	4	na	0.6	4.0	92,400	0.5	3.6	164,000	0.8	2.7	161,000
Mae Klong	4	2	20,000	5.0	2.2	53,300	5.1	1.8	23,100	5.3	2.0	25,800
Bang Pakong	4	2	20,000	3.7	1.3	9,680	3.6	1.7	9,314	4.1	1.2	9,800

Note:
na = Not available.

Table 5 Projected Hazardous Waste Quantities for 1996 (tons)

TSIC[a]	Industry	Oils	Liquid Organic	Organic Sludge	Inorganic Sludge	Heavy Metal Sludge	Solvent	Acid Waste	Alkaline Waste	Off Spec. Produce	PCB	Aqueous Organic Residues	Photo Waste	Total
371–372	Basic metal industry	0	0	0	0	2,298,095	0	0	0	0	0	0	0	2,298,095
381	Fabricated products	2,937	0	0	9,955	126,474	1,167	115,801	29,451	0	0	0	0	285,785
384	Transport equipment	175,362	0	0	3,827	0	9,197	1,152	1,155	0	0	0	0	190,693
383	Electrical machinery	2,234	0	0	5,671	70,923	1,225	66,268	16,633	0	0	0	0	162,954
351–352	Chemical products	55,906	522	8,456	2,270	34,057	6,473	10,397	5,700	52	0	499	0	124,333
382	Machinery	77,005	0	0	504	0	11,112	10	500	0	0	0	0	89,131
321	Textiles	53,784	0	0	0	0	0	0	0	0	0	0	0	53,784
342	Printing, publishing, allied	0	0	2,761	0	0	17,708	0	0	0	0	0	30,398	50,867
356	Rubber and rubber products	14,792	0	0	0	0	14,096	0	0	0	0	0	0	28,889
341	Paper and paper products	4,123	0	132	0	0	4,951	0	0	0	0	0	0	9,207
353–354	Petroleum products	1,696	0	602	2,242	2,074	581	0	0	0	0	0	0	7,195
385–390	Miscellaneous nes.	51	0	0	207	2,553	22	2,881	585	0	0	0	0	6,300
332	Furniture and fixtures	0	0	0	5,474	0	0	0	0	0	0	0	0	5,474
331	Wood and cork	0	0	0	1,893	0	0	0	0	0	0	0	0	1,893
313	Beverage	0	0	0	0	0	0	0	0	0	0	0	0	0
311–312	Food	0	0	0	0	0	0	0	0	0	0	0	0	0
322	Wearing apparel	0	0	0	0	0	0	0	0	0	0	0	0	0
361–369	Nonmetallic mineral	0	0	0	0	0	0	0	0	0	0	0	0	0
314	Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0
323–324	Leather products and footwear	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	387,893	522	11,951	32,043	2,534,176	66,532	196,510	54,024	52	0	499	30,398	3,314,600

Note:
a. Thailand Standard Industrial Classification.

Business Opportunities

Some observors argue that Thailand appears cautious about accepting new technologies from abroad, giving as a reason the lack of "readiness" of their industry in terms of trained personnel, sophisticated chemical laboratory analysis, and maintenance and repair services. This may or may not be true but it presents the possibility of American help in providing the means to make Thailand ready, i.e., building the indigenous pollution control service industry. The current concern with air quality monitoring mentioned above is a case in point. Thailand has so far spent only one-fifth the proportional amount (as a percentage of GNP) annually on environmental protection compared with the OECD country average.

As noted previously, privatization is a popular policy trend in ASEAN countries and Thailand is no exception. Innovative proposals are actively solicited. The lack of coordination among NEB, IWD, and other agencies has led to frustrations for business firms in getting actual agreements to proceed. For example, hazardous waste management to provide central treatment and disposal facilities in the ESDA has not yet been implemented, although proposals from Japanese and American interests have been submitted. Successful privatization may follow the scheme described above for electroplating waste treatment in Bang Khuntien, BMR.

The anticipated conversion of large-scale industrial boilers to readily available and cheap lignite coal will increase SO_2 and particulate emissions and should result in a market for control

equipment for these pollutants. On the other hand, small-scale industries are being encouraged to shift to natural gas for fuel with consequent lower emissions.

Industrial estates can achieve economies of scale in pollution control and will likely be required to install, monitor, and enforce the use of appropriate technology within their boundaries.

The large number of small- and medium-scale factories in electroplating, textiles and tanning, and motor vehicle repair shops present an opportunity for down-sized and simplified end-of-pipe treatment technology or for waste minimizing changes in processes. Many of these shops are so dispersed that collection and central treatment of wastes will not be feasible. Yet, if these wastes are improperly managed, the environment, particularly surface waters, will continue to be degraded. Whether such small-scale pollution control equipment can be inexpensive enough to be required by regulations is a challenging question.

SUMMARY

Business opportunities seem promising in air and water pollution control in ASEAN. American firms should be alert to the following specific markets:

- Waste water treatment technologies for organic pollutants (lowering BOD)
- Cleanup of contaminated river beds polluted with sludges and silt

- Hazardous waste treatment to avoid discharge of heavy metals, chlorinated solvents, and other toxic materials
- Monitoring and chemical analysis equipment related to water quality management
- Ambient air quality monitoring equipment
- Motor vehicle exhaust testing equipment
- Technologies for controlling particulate emissions to air
- Environmental data management systems

APPENDIX I

Ambient Air Quality Standards

Pollutant	Indonesia	Malaysia[a]	Philippines	Thailand	United States
Particulate matter	0.26 (dust)	0.26	0.18	0.26	0.26
Sulfur dioxide	0.26	0.105	0.369	0.365	0.365
Nitrogen oxides	0.9 (1 hour)	0.32 (1 hour)	0.1 (annual)	0.282	0.1
Carbon monoxide (8 hours)	2.26	10	10	10	10
Oxidants (1 hour)	na	0.1	0.12	0.16	0.235
Lead (3 months)	0.06	0.0015	na	0.01	0.0015

Note:
a. Guidelines only, not legally enforceable standards.

APPENDIX II

Contacts for U.S. Businesses

Indonesia

Ministry of Population and Environment
J1. Merdeka Barat 15
Jakarta

Malaysia

Department of the Environment
13th Floor, Wisma Sime Darby
Jalan Raja Lant
50662 Kuala Lumpur

ENSEARCH
36B, Jalan 20/16A
Paramount Garden
46 300 Petaling Jaya
Telephone: (03) 775-1564
Telex: KTAMA 36244

Philippines

Environmental Management Bureau (EMB)
Philippine Heart Center Bldg., 6th Floor
East Avenue
Diliman, Quezon City
3008 Metro Manila

Thailand

National Environment Board (NEB)
60/1 Soi Pracha-sumpun 4
Rama VI Road
Bangkok 10400

Thailand Development Research Institute (TDRI)
163 Asoke, Sukhumsit Road
Bangkok 10110
Fax: (662) 258-9046

USAID Representative to ASEAN
U.S. Embassy
Bangkok
Telephone: (662) 255-3650
Fax: (662) 255-3730

United States

Environmental Technology Export Council (ETEC)
1825 Eye Street, NW, Suite 975
Washington, D.C. 20006
Telephone: (202) 408-0660

U.S. Trade and Development Program
1621 N. Kent Street, Room 309
Rosslyn, Virginia 22209
Telephone: (203) 875-4357

SOURCES

Table 1: Malaysia, Department of Environment, 1990. Environmental Quality Report.

Table 2: Statistics from the Department of Environment and Natural Resources, Philippines, 1990.

Table 3: Statistics from the Department of Environment and Natural Resources, Philippines, 1990.

Table 4: Statistics from National Environment Board, Bangkok, Thailand, 1990.

Table 5: Engineering Sciences, Inc., 1989. Hazardous Wastes in Thailand. A report prepared for the U.S. Trade and Development Program.

Appendix I: Statistics from the Environment and Policy Institute, East-West Center, Honolulu, Hawaii.

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