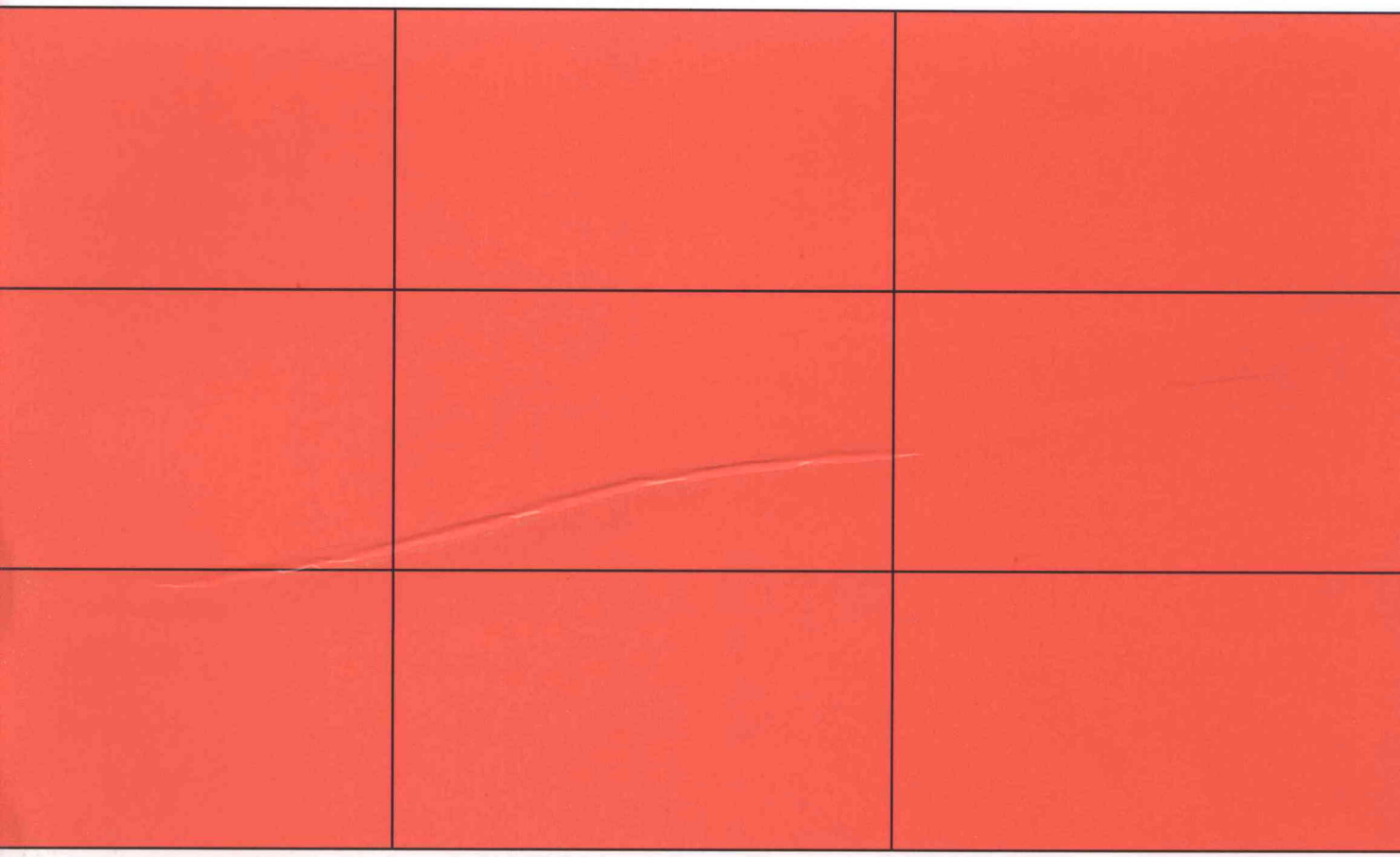
The Development of Infrastructure and Supporting Facilities and Prevention Control for Pollution and Environment: Executive Summary



Executive Summary

The Development of Infrastructure and Supporting Facilities and Prevention Control for Pollution and Environment

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Executive Summary

In the third quarter of 1986, the Thai economy made a sharp recovery from recession resulting in the dramatic economic growth over the past four years. The industrial sector grew at a rate of more than 10 percent during this period, compared to the 6.6 percent targeted in the Sixth Economic and Social Development Plan. Such an unexpected growth rate has made the existing infrastructure, transportation communication, utilities and manpower inadequate. Unless urgent attention is given to, this increasingly serious problem the recent high growth rate will not be sustainable in the long run. At the same time, long term planning for investing in improved infrastructure and facilities should be carried out to cope with future demand. This study is aimed at forecasting what the demand for infrastructure and facilities in the industrial and trade sectors is likely to be. It should also provide policy guidelines for infrastructure and facilities provision and management during the Seventh Economic and Social Development Plan (1992-1996).

Demand for infrastructure and supporting facilities depend heavily, of course, on the extent of the Thai economy's expansion and the industrial and trade sector, in particular. This study projects that economic growth during the Seventh plan should be about 6-8 percent per annum. The industrial sector should grow at a rate ranging from 8-9 percent, the service sector at about 6-8 percent, and the agricultural sector at 3 percent, thus implying that the Thai economy will grow, during the Seventh plan, at a favorably high rate. In addition, structural changes in the Thai economy should continue,

in that the industrial and trade sector should become increasingly more important than the agricultural sector.

It is also projected that the conuntry's industrial structure will change from assembling activities toward more sophisticated activities. Traditional industries such as food processing will become less important, while others become increasingly more important. These include the chemical and engineering sectors, and especially the industrial machinery and electronic machinery sectors. Industries which should grow at a relatively rapid rate are the textile, fabricated metal and basic chemical industries.

Such restructuring would, of course, greatly a effect infrastructure and supporting facilities such as in technology requirements and manpower needed for the industrial sector.

It has been estimated that the electricity demand for businesses in the Bangkok Metropolitan Area (BMA) will increase from 4,797 Gwh in 1989 to 8,625 Gwh in 1996 or at the rate of 8.7 percent per year. If the economy grows at a rate higher than that projected, however, electricity demand for the business sector of the BMA will increase by 10.0 percent. For industrial firms in the BMA, it is projected that the electricity demand will increase from 5,957 Gwh in 1989 to 11,478-12,522 Gwh in 1996, representing a growth rate of 9.8-11.2 percent per year.

The increase in electricity demand in the BMA, however, is forecasted to be lower than that of the provincial areas since it is predicted that the business sector in provincial areas will increase their electricity consumption from 2,480 Gwh in 1989 to 4,969-5,138 Gwh in 1996 or at a rate ranging from 10.4-11.0 percent. Demand for

electricity by manufacturing firms in the provincial areas should rise from 6,977 Gwh in 1989 to 16,982-17,958 Gwh in 1996 or at the rate of 13.6-14.5 percent per year. Such projection is based on the fact that there has been an increasing trend in rural industrialization especially in industrial core provinces. In addition, industrial firms established in the rural areas recently are engaging in more electricity-consuming activities such as basic metal, chemical, paper and cement processing. As a consequence, it has been projected that the electricity demand of the business and manufacturing sectors in the provincial areas will grow at a faster rate than that of the metropolitan area.

Policies recommended to respond to this increasing demand for electricity should take into account both supply and demand management. On the supply side, major policies should focus on

1) implementing investment plans to increase the present supply by EGAT;

2) ensuring stability electricity supply, especially in the rural areas;

3) encouraging the private sector to engage in electricity production.

On the demand side, electricity conservation should be seriously and continuously encouraged by several means ranging from time-of-day rates, fiscal incentives for imported energy-saving devices and preparation of manpower involved in this activity.

With regard to water supply, from a macro perspective there is no shortage at present, since water consumption is still less than the available supply. The total water consumption of the whole country should be approximately 22 percent of the total renewable amount in

1990 perhaps increasing to 43 percent by 2000. However, from a micro point of view, water shortage could be a problem in certain areas, especially in some of the industrial areas such as the BMA, Samut Prakan, Nonthaburi, the Eastern Seaboard and industrial core provinces.

In the BMA, Samut Prakan and Nonthaburi, it is estimated that water consumption will increase from 1,072 million m^3 per year in 1989 to 1,482 million m^3 in 1992 and 1,860 million m^3 in 1997, representing a growth rate of 11.6 percent per year during 1989-1992 and 4.6 percent during 1992-1997. The major problem area for water shortage is forecasted to be Western Bangkok. It is also expected that this problem will become increasingly serious since this area has been rapidly urbanized and industrialized. At present, groundwater is its major source of supply. It has been estimated that the quantity groundwater pumped up in the BMA is over 1.2 million m^3/day, but the quantity permissable without causing land subsidence is said to be 600,000 - 800,000 m^3/day. One should, therfore, aim at reducing groundwater use by 400,000 - 600,000 m^3/day.

It is estimated that raw water needed to supply the increasing water demand in the BMA will be 1,854 million m^3/year by 1997. This implies that raw water from the Chao Praya River at the rate of 1,290 million m^3 will be insufficient and will have to be supplemented by alternative sources, for instance, by water from the Mae Klong River. In addition, water from Eastern Bangkok should be chanelled to the Western area to match its increasing demand.

In the Eastern Seaboard area, water demand should be about 575 million m^3/year in 1991, 63.7 million m^3 in 1996 reaching 101.7

million m^3 in 2001. Comparing these figures with the existing water supply in reservoirs, water supply shortages could emerge in the very near future, especially in Lam Chabang, Mab Ta Pud, Pattaya and Chachoengsao. Manufacturing firms in Chachoengsao, in particular, have recently experienced water shortages mainly because it has a total number of 137 firms needing 5 million m^3 of water per day but the supply is limited to 1.8 million m^3. Groundwater can not be used as a substitute because of its salt content. As a consequence, manufacturing firms have to pay high prices for transporting water supply.

The problem of water shortage also likely to emerge in many core industrial provinces. Samuth Prakan, Nakhon Rajchasima, Nakhon Pathom, Phathum Thani, Surat Thani are examples.

Policies dealing with water shortages should focus on pricing, reflecting the real social cost, especially that of groundwater. The higher price for government water supply results in more groundwater being pumped up, either legally or illegally, which leads to land subsidence causing floods. In addition, a pricing system reflecting the real social cost should encourage better demand management and especially water conservation which has not been given sufficient attention.

Communication facilities are also urgently needed, especially if Thailand aims at becoming one of the financial centers for Southeast Asia, promoting rural industrialization and becoming more internationalized in terms of trade and investment. With these objectives in mind, adequate communications equipment and efficient communications systems are very important prerequisites. These range from basic equipment such as telephones to more sophisticated

equipment and systems. It has been projected that, to satisfy basic needs, the number of telephones should be increased to 2.4 million by 1993 from the present about 1 million. And if the per capita income of the Thai people is $2,000 by the end of the Seventh plan, the ratio of telephones per 100 people should be 7. This implies that 3 million additional telephone lines should be installed during 1992-1996 and 1.5 million more during 1996-1998. To make Thailand an attractive site for foreign investment and also a business and financial center, more sophisticated, efficient and low cost telecommunications equipment and systems are needed, especially data transmission services, nation-wide paging services, nation-wide data services, and videotex.

With regard to the land transportation facilities needed to encourage rural industrialization in core industrial provinces, government policy should focus on

1) constructing and improving road transportation networks
2) improving the efficiency of the present transportation systems
3) promoting alternatives to road transportation especially transport by train.

For sea transportation, because of the increasing number of both incoming and outgoing cargo vessels using Bangkok Sea Port as a result of the recent trade and investment boom, present facilities and infrastructure at the port are insufficient and over utilized. Other sea ports in Thailand are underutilized because of technical and marketing problems. Bangkok Sea Port, as a consequence, is overcrowded. According to this study, if exports and imports expand at a rate of 15 and 17 percent per year, respectively, during the

Seventh plan, incoming and outgoing cargo at Bangkok Sea Port will reach 100 million tons by 1996 or at an approximate rate of 9 percent per year. This cargo is mainly from container vessels instead of from traditional general cargo. The study implies that government policy dealing with this problem should mainly aim at preventing crowding at the Sea Port by 1) improving and expanding Bangkok Sea Port's capability through investing in infrastructure and facilities; and through improving the efficiency of its services 2) encouraging utilization of other sea ports or deep sea ports, especially Lam Chabang.

Air transportation facilities are also becoming more overcrowded. Bangkok (Don Mueng) International Airport, in fact, has as much traffic as important regional airports such as Singapore or Hong Kong. Infrastructure and facilities, however, at Bangkok Airport are less adequate. These problems will become more obvious unless government policies to resolve them are implemented. This study found that the capacity of the international passenger building at Bangkok Airport should be, however, sufficient up to 1996, provided that the growth rate of incoming and outgoing passengers is no more than 9 percent per year. If the growth rate becomes as high as 15 percent, the present capacity will only be sufficient up to 1992. In term of cargo space, the airport's capacity is sufficient up to 1992. But if cargo passing increases at a rate of 10 percent, by the end of this year, this capacity will no longer be sufficient. These demand projections lead to both short and long term policy recommendations. In the short term, expanding and improving the existing facilities at both Bangkok Airport and the provincial airports (as an alternative source) should be pursued. In the long term, building a second

international airport near Bangkok should be taken into serious consideration.

The manufacturing sector also requires more industrial estates. In fact, industrial estates are a very efficient way of promoting industrialization in rural areas and providing infrastructure and facilities needed by the manufacturing sector at a lower cost. In addition, when manufacturing firms are concentrated in one area, measures and regulations for environmental control are more easily enforced and at lower costs. There is no doubt that the government should encourage the private sector to participate in developing industrial estates. This study implies that the Industrial Estate Act and the role of Industrial Estate Authority of Thailand should be taken into consideration when to promoting private sector participation.

Apart from the infrastructure and utilities needed by the industrial sector, as mentioned above, two important supporting facilities, also key factors in industrial development, are technology and manpower. These two important factors ,that sustain long term economic growth, have been neglected since Thailand started industrial development in the early sixties.

Until recently, Thailand has not laid too much importance on technological development. A study on the technological capability of Thai industry reveals that although Thailand imports foreign technology at a considerable amount of money each year for the past three decades, the technological capabilities, including acquisitive, operative, adaptive and innovative, of Thai industries is still very low. This is party due to the fact that, because of insufficient

recognition of technology's role in economic development, both the public and private sectors spend an insignificant amount of money on the providing infrastructure and training manpower in science and technology compared to other countries, the NICs, in particular. Leapfrogging from the present situation to a future awareness of science and technology's role, policy guidelines for technological development during the Seventh plan should be focused on:

1) Providing a basis for science and technology development. This includes infrastructure, manpower and information.

2) Promoting targetted technology to targetted industries. This includes computer-aided technology, metal-working technology, and management technology.

3) Decreasing the country's disadvantage in having to import technology by developing strategies for acquiring and absorbing technology.

4) sustaining the country's comparative advantage through technological development, especially in improving labor efficiency to compensate for a rising wage rate.

With regard to manpower, an important issue discussed nowadays is the shortage of scientifically and technologically-skilled manpower. This study estimates that the demand for manpower in these areas by using a manpower requirement approach. The estimations lead to policy guidelines for manpower planning. In response to increasing demand, 780 graduates at the higher education level and 3,100 at the lower level in the biotechnology area are needed. In the area of electronic technology, 1,020 graduates at the higher education level and 4,680 graduates at the lower level are required. This study also projects

that 1,430 graduates at the higher education level and 14,700 graduates at the lower level are required in the field of material technology. In other area of related technology, 2,170 graduates at the higher education level and 5,740 graduates at the lower level are needed. It should be noted that these figures are only estimates of the manpower needed and subject to change if actual economic growth during the Seventh plan does not conform with the forecast carried out in this study.

Apart from manpower planning in response to the rising demand for science and technology trained people, policies to develop and upgrade semi-skilled or unskilled labor by both the public and private sectors should be emphasized. Measures promoting human resource development include training by the government's National Institute for Skill Development, and issuing a Skill Development Act to promote private participation in human capital development, as has been done by Singapore, increasing and improving the short training courses and curriculum of the government agencies to match the demand for training, especially general training type.

INDUSTRIAL DEVELOPMENT AND ENVIRONMENTAL QUALITY

Even though industrial development has contributed to rapid economic growth, it has impinged on the environment. Inadequate pollution control and protection provokes the wide spread of pollution, deteriorates water and air quality, and hence poses health hazards.

The number of factories (excluding rice mills) registered with the Department of Industrial Work (DIW) has rapidly increased from 600 in 1969 to 51,500 factories in 1989. Fifty-two percent of these factories are located in the Bangkok Metropolitan and the Greater Bangkok Areas (BMR). Twelve out of twenty-three industrial estates are also located in the region whereas the remaining seven are located in the central region including the Eastern Seaboard. Value added derived from these factories has accounted for 76 percent of the country's value added in the industrial sector and thus reflects a high concentration of medium and large scale industries in the region.

Industrial wastes consisting of various kinds of hazardous materials, such as heavy metal sludges and solids, chemical wastes, oil and solvents, are harmful to living organisms and human beings, therefore controlling these wastes should be one of the country's primary concerns. The first five hazardous waste generators including the Basic

Metal Industry, Manufacture of Fabricated Metal Products, Manufacture of Transport and Equipment, Manufacture of Electrical Machinery, apparatus, appliances and supplies, and Manufacture of Chemicals, encompassed 15,126 factories in 1989. Sixty-seven percent of these factories are located in the BMR.

The value added share of non-hazardous-waste-producing industries has decreased from 71 percent in 1979 to 42 percent in 1989, whereas the share of hazardous waste producing industries has increased from 29 to 58 percent for the same period. Currently, the country's only hazardous waste treatment plant is located in Bangkhuntein district and has the capability of treating 200,000 tons of waste per annum.

Industrial expansion coupled with rapid growth in urbanization has deteriorated water and air quality. Discharge of wastewater containing high biochemical oxygen demand (BOD) into the Chao Phraya and Tachin rivers has polluted these two rivers. The dissolved oxygen (DO) in some areas has been below the standard set by the office of National Environment Board (ONEB).

With regard to air quality, 0.14 million tons of sulfur dioxide (SO_2), accounting for 26 percent of total SO_2 emission, were released from the industrial sector in 1988. Fifty- eight percent of the industrial emission was in the

BMR. Total emission for the BMR and central region including the Eastern Seaboard added to 80 percent. It is obvious that the environmental impact of industrialization on air quality was especially high in areas with high industrial concentration such as Samut Prakarn. Recent studies indicate that the ambient level of nitrogen oxide and sulfur dioxide in this area will exceed the national air quality standard set forth by the ONEB in 1992 and 2001 respectively (JICA 1990) unless adequate controls are implemented.

Factors Presently Influencing the Environment

Despite the attempts to control pollution and manage environmental quality through various legislation such as the Factory Act B.E. 2512 (FAC 1969), The Public Health Act B.E. 2484 (PHA 1941), and the National Environmental Quality Act B.E. 2518 (NEQA 1975), the agencies involved in control and environmental management still lack proper and effective mechanisms to enforce these provisions. For instance, according to NEQA, a factory requesting permission to be in operation is required to submit an Environmental Impact Assessment (EIA) report, describing potential impacts of its operations on the environment and prevention guidelines, to the ONEB for review prior to obtaining approval from the appropriate agencies (DIW and Industrial Estates Authority of Thailand (IEAT)). However, ONEB's authority is limited to evaluating the EIA report, recommending proper procedures to

minimize environmental impacts and giving recommendations for approval or disapproval of the project. Implementation and enforcement are, in fact, the responsibility of other agencies who generally lack sufficient manpower to effectively monitor and enforce the EIA findings and recommendations.

The DIW has no authority to monitor or enforce the FAC for factories under the jurisdiction of the IEAT. The IEAT is therefore responsible for not only establishing factories within the estate, but also for controlling and treating industrial waste released by those factories. Even though environmental quality is one of the IEAT's primary objectives, it lacks an environmental unit to treat any industrial hazardous waste other than wastewater. This makes the pollution problem more critical and complicated.

With regard to DIW, its budget for monitoring and enforcement of environmental quality is inadequate; as low as 1,900 baht per factory per annum in 1989. The ratio of staff to factories (excluding rice mills) was approximately 1:74 (i.e., 699 staff per 51,500 factories). These resources are undoubtedly insufficient for the enforcement of effluent standards and other pollution control regulations.

The Board of Investment (BOI) statistics indicate that the proportion of approved investment for hazardous-waste-generating industries have increased from 25 percent in 1987

to 55 percent in 1989. The current capacity for properly handling hazardous waste is still far below the amount being generated. Expansion of hazardous waste treatment capabilities to sufficiently handle present and future waste is certainly a slow process and a time-consuming task which requires substantial financial support. The BOI promotion policy should therefore be restructured to take into consideration these limitations and their environmental implications.

In addition, factors such as the change in industrial structure (shifts from small scale industries generating organic waste to large scale industries with sophisticated production processes and technologies which generate waste that is more difficult to treat), rapid industrial growth at the rate of 10 percent per annum in the past decade, and the cumbersome procedures required to change laws and regulations, have made environmental management less efficient and effective.

Future Trends

Hazardous wastes

It is projected that the production of hazardous wastes will reach 1.99 million tons per annum in 1991. Ninety-six and a half percent of these wastes are attributable to the manufacturing sector, with the remaining portion

attributable to urban, hospital and lignite usage. The country's hazardous waste is projected to grow to 3.5 million tons by the year 1996 and will continue growing to 6 million tons by the year 2001.

Wastewater

Industrial wastewater in the form of BOD was estimated to be 0.5 million tons per annum in 1991, the equivalent of wastewater generated by an urban population of 27.2 million. About 29.3 percent of the wastewater is generated by sugar-related industries with 17.4 and 19.6 percent being generated by beverage and pulp and paper industries. Under current economic and industrial growth, it is projected that wastewater in BOD form will grow to 0.68 million tons per annum in 1996. This figure would be equivalent to the wastewater generated by an urban population of 35.3 million.

Air Pollution

The four significant industry generated pollutants deserving special attention are sulfur dioxide (SO_2), nitrogen oxide (NO_x), carbon Dioxide (CO_2), and suspended Particulate Matter (SPM)

Electricity generating plants were the primary source of SO_2 emission in the year 1991 (56.4 percent) followed by the industrial sector (21.5 percent). Total industrial SO_2 emission is projected to increase from 0.21 million tons

per annum in 1991 to 0.28 and 0.85 million tons per annum by the years 1996 and 2010 respectively.

NO_X will be released predominantly from the transportation sector (60 percent) followed by electricity generating plants (16 percent) and the industrial sector (13 percent). The industrial sector is projected to generate 0.09 million tons by the year 1996 which is slightly higher than 0.07 million tons, the amount expected to be emitted in 1991. It is also anticipated that the NO_X emission will almost triple the 1991 figure, rising to 0.2 million tons by the year 2010.

Likewise, the major source of CO_2 emission is from the transportation sector, which accounts for 32 percent of the total CO_2 emissions. Electricity generating plants and the industrial sector contributed 26 and 23 percent in 1991. The latter is projected to emit 34 and 70 million tons by the years 1996 and 2010 respectively. However, electricity generating plants will become the leading source of CO_2 emission, followed by the transportation and industrial sectors by the year 2010.

The industrial sector contributed the greatest amount of SPM emissions into the environment in 1991, followed by the transportation and residential sectors. The industrial sector generated 0.35 million tons of particulate matter in

1991, and is projected to generate 0.47 and 1.07 million tons by the years 1996 and 2010 respectively.

Economic Measures

Industrialization in Thailand has resulted in increased pollution. Laws and regulations have not yet been fully enforced to control industrial pollution due to firms' lack of incentives to improve their production processes and use raw materials that are less harmful to the environment. Economic measures have been widely adopted as part of pollution control strategies by many industrialized countries such as Japan, USA and the EC, and even one of our neighbor countries, Malaysia. Such measures have made industrial waste and environment clean-up programs economically feasible to industrial groups. Cooperation within industries to accept and enforce such economic measures can be cultivated through understanding of environmental impacts resulting from industrialization which, if left unsolved, would significantly hinder economic growth in the long run.

The Polluter-Pays-Principle is a policy instrument that is self-financing. All environmental clean-up costs would be incurred by those who generate industrial waste. Firms have the option to pay for pollution or to control and hence minimize their waste by employing less-polluted production

processes and technologies. Firms will choose to control their pollution if the pollution charges exceed the control costs.

The establishment of an environment fund aims at searching for technical treatment strategies and encouraging polluters to minimize their waste through provision of economic incentives. The fund would be used not only to establish and operate central waste treatment centers, but also to provide low-cost borrowing funds to small and medium scale industries unable to gain access to central treatment facilities.

Pollution charges should reflect clean-up costs which are estimated to be 1,000 baht per ton of industrial hazardous waste. To ensure waste delivery, a rebate system should be applied. In this case 2,000 baht per ton should be collected (one thousand for clean-up an additional thousand as a deposit). The industry's deposit would be returned when the full amount of contracted waste was delivered for treatment. Hence, 1.2 billion baht would be collected from the 1991 level of industrial hazardous waste of 600,000 tons, estimated by Engineering Science (1989). This amount is only 0.2 percent of the hazardous- waste-generating industries' value added, or only 1 percent of the industries' profit assuming a conservative profit rate of 20 percent. Of this, 50 percent would constitute an environment fund for hazardous waste clean-up and the rest would be

deposited into an escrow account earning interest on behalf of hazardous waste generators.

For industrial wastewater, the charge of 1,000 baht per ton of BOD industrial wastewater (treatment through a Waste Stabilization Pond Treatment System) would raise and contribute 525.2 million baht to the environment fund in 1991. This would account for only 1.43 percent of the wastewater-generating-industries' value added.

It can be seen that due to the small share of treatment cost in the industries' value added and profit, industries generating hazardous wastes would be able to finance their own treatment costs. The concept of an environment fund would therefore not only be the solution to the treatment problem, but would also create a good public image of industries themselves contributing to the improvement of society's quality of life.

By comparison, natural gas, which is also a domestic energy source, produces no SO_2, only 12 percent of lignite's NO_x output, and virtually no SPM. Natural gas is also lowest in terms of CO_2 emission, thus its potential impact on the environment is lower than that of other fuels. Lignite is preferred to natural gas by the manufacturing industry, however, because its cost advantage is directly beneficial to the firm, while its pollution disadvantage is a social cost that is not paid by the users, but by the

society at large. A pricing system incorporating social (external) costs into the price of lignite would certainly curtail lignite consumption and hence reduce its potential impact on the environment and improve quality of life.

THE FIVE PRINCIPLES OF COST-EFFECTIVE ENVIRONMENTAL MANAGEMENT

In designing effective policy instruments for environmental management, the following principles need to be observed:

1. An Ambient Quality Target

The goal should be to achieve a desired environmental quality (ambient standard), not a uniform effluent or emission standard or level of waste treatment. Ambient quality is the ultimate objective, and can be achieved through various means; uniform effluent standards is only one instrument, and rarely the most efficient. The target ambient quality standard should be specific, monitorable, and verifiable.

2. The Minimum Cost Principle

The desired ambient quality standard must be attained through the most cost-effective means, that is, at the lowest possible cost to the economy. This includes both the costs to the regulatory agency, such as monitoring and

enforcement costs, and the costs to industry, such as a reduction in output and an increase in compliance cost. This implies that the chosen policy instrument must be enforceable in the Thai context at a relatively low cost, and with minimal leakage.

3. The Polluter-Pays-Principle

The chosen policy instrument must be self-financing, and perceived as equitable. The polluter-pays-principle is now widely accepted around the world. While the payment is collected from the industrial producer or land developer, the ultimate burden (incidence of the pollution or congestion charge) is shared between the producer and the consumer in a proportion determined by the elasticity of demand for the product or service in question. In the case of an exported commodity sold in competitive world markets (and therefore facing infinitely elastic demand), the full burden is assumed by the producer; therefore, his competitive position may be affected.

4. The Competitiveness Imperative

The policy instrument chosen should not significantly reduce the overall competitiveness of Thai industry, though it would unavoidably change the industrial and energy mix in the medium to long run if it were to be effective at all. Maintaining competitiveness while controlling pollution

implies the existence of inefficiencies that the chosen instrument should seek to reduce.

5. Policy Transition

Changing the industrial mix from high- to low-pollution industries, and the energy mix from high-to low-polluting fuels, is one of the desirable outcomes of an effective pollution control policy. However, structural change takes time because investments which have already been made, under "pollution haven" conditions, will take time to depreciate. Therefore, in the interest of both fairness and efficiency, allowance for adjustment during the transition period must be made. The new policy is also likely to be more acceptable to industry if it is gradually phased in over an appropriate period. The stability and predictability of the policy is critical if industrial investment is to be gradually shifted from high-to low- polluting industries.

Policy Recommendations

The structural changes in industry and changes in production materials in the past decade have led to the emergence of new types of pollution problems. The heavy concentration of industry, especially in the BMR, has accelerated and intensified the pollution problem. Presently, air pollution generated by the industrial sector has become more prominent. The following environmentally viable policy measures are recommended, based on both the

economic and other factors currently influencing the environment.

- Establish an independent, autonomous " Environment Fund" as an entity to administer pollution charge collection. The fund could be used to construct and operate the central waste treatment center and to provide soft loans to small and medium scale industries to manage their wastes.

- Create an environmental auditing system as part of the environment fund operation in order to monitor industrial waste and gather basic data to be used as a baseline for determining pollution charges. The implementation of environmental auditing can be operated bypp a private consulting firm under the control of an appropriate agency.

- Enact a law to charge polluters at progressive rates for the amount of waste produced which exceeds a certain specified level, and vice versa. Charges should reflect total clean-up costs including construction of treatment facilities, waste collection treatment and disposal costs.

- Encourage industries, both existing and newly entering industries, to adopt waste minimizing production technologies.

- Encourage industrial estates to take more active roles in controlling pollution within their vicinity, taking advantage of proximity, homogeneity and economies of scale in monitoring and enforcing the treatment. Consolidation of small scale industries to estates will therefore minimize environmental management cost.

- Government policies to decentralize industry into the rural areas, to reduce congestion in the BMR and to spread benefits of industrialization, should also take into account the environmental pros and cons of such policies. A preferable alternative might be to promote a clusters of industries with support from the government in identifying potential locations, and, wherever possible, in developing the necessary infrastructure for the industrial groups in a systematic way (an industrial complex).

- The fuel pricing structure should be revised so as to minimize the pollution problems caused by those fuels having major environmental impacts, especially lignite. Moreover, the quality of fuel oil should be improved by reducing the percentage of sulfur content from 3.5 to 2.0 in the short run, and to 1.0 in the long run.

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