Chapter VIII

Drivers of Environmental Industry in Asia: Bilateral and Multilateral Cooperation and Multinational Corporations

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Summary and Recommendations

Summary

1. Exogenous and endogenous factors, which include policy, institutional and economic variables, drive the market for Environmental Industries ('EI") in the Asia Pacific region."

2. International agencies and multinational corporations (MNCs) are affected by the exogenous and endogenous conditions, which also include national and international norms and standards and influential environmentally sensitive consumer movements and non-governmental organizations (NGOs).

3. Multinational corporations and local businesses are increasingly motivated by the "triple bottom line of value added: economic (profits), ecological and social," which includes combating poverty through and with the market. Social and environmental responsibility is increasingly considered as good business.

4. Most recent data indicate that thousands of Asian companies (including in China, India, Indonesia and Korea) have adopted the ISO 14001,a standard that assesses the ability of companies to comply with environmental law and to manage environmental effects and risks of their operations.

5. More than 1000 Chinese companies have the ISO certification, many of which are joint ventures. This compares with 199 in Indonesia, 9,467 in Japan, 552 in Thailand, 333 in Singapore, 367 in Malaysia and 120 in the Philippines[1].

6. Socially and environmentally responsible Investment Funds could be a significant source to help finance the tens of billions of dollars required per year to grow EI in the Asia-Pacific Region. Korea is actively engaged in attracting and developing socially responsible investment in Asia (outside Japan), including development of a socially responsible investing index. Moreover, major Korean companies are making special efforts to be "first movers" in their industries to attract foreign investment.

7. Overall, however, in Asia socially responsible investment is still at an incipient stage, with only about US 1 billion committed for this purpose while globally the industry has US$2.4 trillion in assets. Australia and Japan are the most advanced in the region, with US$8.9 billion and US$599 million, respectively. On the other hand, in addition to the Islamic funds of Malaysia and Indonesia, Singapore, Hong Kong, Malaysia and India have one or two registered domestic funds while Thailand, Indonesia, the Philippines and China have none.

8. International agencies have been impacted by the Multilateral Environmental Agreements (MEAs) and have contributed to disseminating energy efficient standards and technologies, including energy efficient light bulbs for public and private lighting, low emission engines, and to a more limited extent renewable energy. Energy efficient standards for refrigeration (compressors) and the electronic industry, and capacity development have also benefited from interventions by international agencies.

9. The contributions of MNCs have been significant, and their role is expanding because of the growing demand for increasingly sophisticated and advanced environmental technology and engineering/consultancy services not yet available

[1] This data and related information about socially responsible investing and managed investment funds is revealed in a recent report prepared by the Hong Kong based Association for Sustainable and Responsible Investment in Asia (ASRIA), with the support from the IFC (Wall Street Journal October 29th, 2003.)

in the four countries, as well as the need to mobilize significant direct foreign investment for the EI industry.

10. MNCs, especially Shell and BP in China, have focused on transforming “dirty coal” into synthetic gas and to support development of hydrogen-based industries.

11. MNCs contribute to EI through wholly owned companies, joint ventures (including public-private partnerships), and through subcontracting and licensing of transfer of technology to national conglomerates or large public enterprises

12. More efficient conditions for MNCs to enter the EI market will be facilitated through filling gaps in regulatory frameworks and performance - based standards and through economic and fiscal incentives and streamlined institutional arrangements.

13. Developing countries, especially in Latin America, could benefit from the experience of the rapid growth of E I in the Asia Pacific region. It seems that opportunities exist for joint ventures between Asian and Latin American entrepreneurs and public-private partnership from countries such as Brazil, Chile, Costa Rica and Mexico.

14. Within the framework of the North East Asia environmental collaboration, trilateral (China, Korea and Japan), ministerial meetings take place annually to address issues of common interest. Working teams meet between the ministerial sessions to study specific topics for consideration by the ministers.

Recommendations [2]

Recommendations that require national action include:

[2] The recommendations listed in this section require immediate action. However, such as R&D, capacity development, and establishment of credible databases and information systems will require longer time frames.

15. Consistent and focused policy in negotiating with international agencies and MNCs in order to optimize their contributions to growing EI. Minimal, simple guidelines, reflecting national policy and international conditions, might be useful..

16. Expand awareness among influential consumer movements and NGOs about EI, and mobilize their support for its development.

17. Motivate national companies to become ISO certified and provide rewards to them.

18. Adopt policies to promote the establishment of national socially and environmentally responsible investment funds, as an instrument to attract financing for EI. Asian, especially Korean, and other experiences could be drawn upon. A system of incentives should be consolidated to enable major national companies to attract DFI.

19. Islamic funds, where they exist, should be encouraged to expand their support to EI.

20. Directed R&D should be actively pursued, especially in areas such as: synthetic gas, renewable energy, low emission vehicles and engines, fuel cells and hydrogen-based industries.

21. Create more efficient conditions to facilitate entry by MNCs into the EI market.

Recommendations that require international actions include:

22. International agencies and major bilateral donors should adopt explicit policies in support of EI through their funded programs and lending activities.

23. MNCs, including corporate financial institutions, should promote investment in Asia by global socially and environmentally responsible investment funds. They should also participate with capital and technical know-how to develop and manage national similar investment funds.

24. MNCs should expand active participation in directed R&D.

25. Promote international environmental standards for major industrial sectors and corporate environmental management systems for MNCs.

26. Standardize consistent and comparable internal reporting by MNCs and national corporations about their sustainability performance. (About 50 WBCSD members do it already).

27. Expand ratings of MNCs and national companies based on their sustainability performance.

28. Working teams of the Trilateral Ministerial arrangements could, with support of IGES, explore specific follow-up to recommendations derived from this study with regard to E I implications for developing countries outside the region. The initial focus could be on select countries in Latin America and in the Asia Pacific region.

29. Similar follow-up explorations could be made through arrangements within ASEAN and SARC (South Asian Association for Regional Cooperation) framework.

1. Introduction

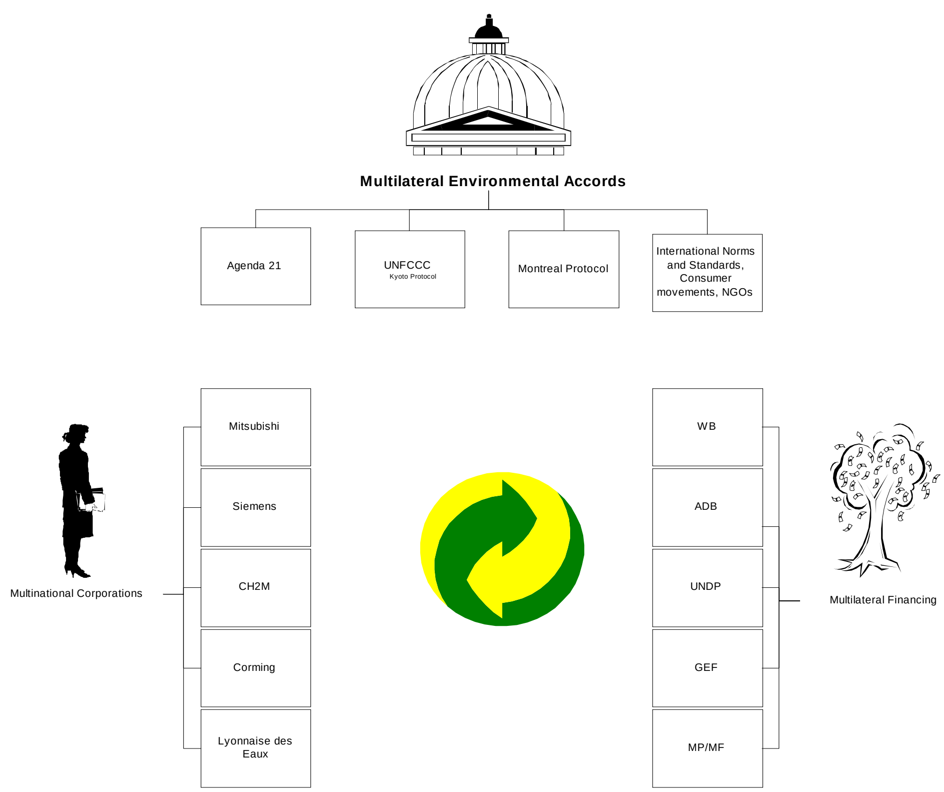
1. The paper focuses on the Environmental Industry (EI) in four selected countries of the Asia Pacific Region. The countries selected by IGES are: China, India, Indonesia and Korea
2. As defined by IGES, the paper outlines and assesses the contributions to EI by international organizations and major donors and by multinational corporations (MNCs). EI refers to:
   -Environmental management systems and reporting at corporate level,
   -Environmental technology and processes (software), and
   -Environmental products, equipment and instruments (hardware).

3. All the above-mentioned three categories are applied to three environmental market segments: air, water, and soil pollution, including industrial waste processing and disposal.
4. EI in the Asia Pacific region, and especially in the four pilot countries, which represent a wide range of social, political, economic and ecological conditions, is critical to sustainable development and to enabling nations to attain the Millennium Development Goals (MDGs) and to realize the Johannesburg Plan of Implementation by 2015
5. How the external factors-international agencies and MNCs-drive the EI markets is the focus of the paper, which concludes that their contributions are and will continue to be strategically significant. However, their role is assessed in the context of domestic policies and institutions that facilitate or impede the effective contribution by international agencies and MNCs to growing EI.
6. Structurally, the paper consists of an Introduction, Major Findings and Recommendations, a chapter on What Drives the Markets for Environmental Industry, four country chapters, Bibliography, and an Annex.
7. The information and data used are derived from hard cover publications, electronic/website reports and data available at no cost, and personal communications. Proprietary reports and information have also been identified during the research but have not been accessed and/or obtained due to significant costs involved.
8. Methodological issues exist with respect to projected investment and/or market value of EI in the four pilot countries based on the data examined. Classification and definition of environmental market segments and of the environmental technologies and services differ from country to country and even within countries. Likewise, the base years for which data is available vary. However, these elements do not affect the thrust of the analysis and the major conclusions and recommendations.
9. Lastly, the paper has benefited from the discussion at IGES on 14 and 15 of June 2003, especially the specific suggestions by Professor R. Hirono, and has been informed by the individual country papers.

2. What Drives the Markets for Environmental Industry

1) Basic Conditions and Analytical Framework

10. The market for Environmental Industries ("EI") is driven by exogenous and endogenous factors, which include policy, institutional and economic variables. They also include expanding national and international norms and standards and increasingly influential environmentally sensitive consumer movements and non-governmental organizations. International agencies and multinational corporations are affected by these exogenous and endogenous conditions. International agencies and multinational corporations, as well as smaller companies, are critical and strategic contributors to the development of EI in the Asia Pacific region for the domestic and export markets.



Exogenous Factors

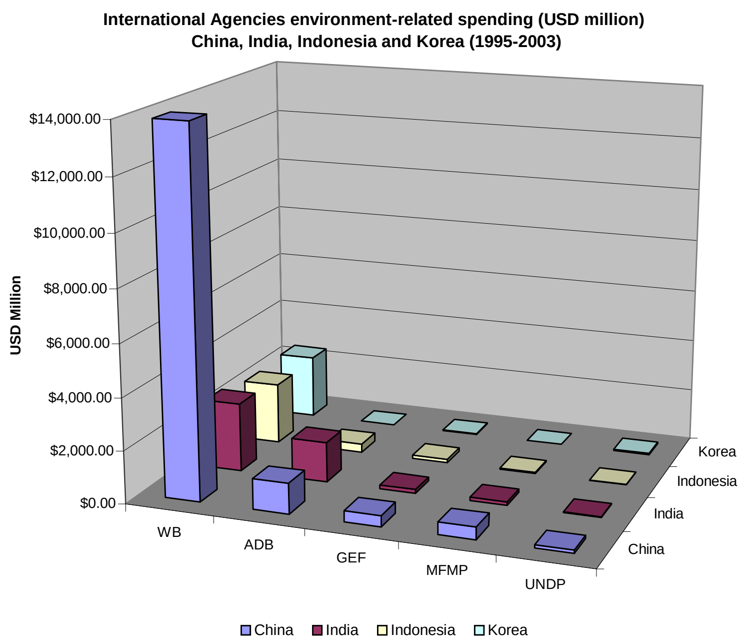
11. As the analysis of the four pilot countries indicates, there is a substantial but differentiated market for EI to address the growing needs of air pollution prevention and control, water pollution prevention and control, water conservation and agriculture, solid waste treatment and management, and environmental technology and management systems and services at the enterprise and corporate levels. More emphasis will be placed in the future on pollution prevention or reduction, waste minimization, including waste to energy reuse and biofuel, recycling and energy and raw materials recovery, technology and environmental engineering, and management systems rather than on end of pipeline processes and products.
12. "Early movers" gain comparative advantage by anticipating demand for environmental engineering and management services, including certification, eco-labeling, environmental audit, environmental impact assessment, environmental technology and processes, as well as products and instruments for cleaner and more efficient production and monitoring of performance. It also enables them to create a new market niche that is profitable and responsive to a "value driven demand" by consumer movements for green products, and to national policies that aim to develop the environmental industry as a strategic export industry by supporting environmental start-ups.

2) International Agencies

13. Multilateral Environmental Agreements ("MEAs) such as the United Nations Framework Convention on Climate Change (UNFCCC), including Clean Development Mechanism (CDM) of the Kyoto Protocol, the Montreal Protocol to Phase Out Ozone Depleting Substances (CFCs) and Agenda 21 adopted at the Earth Summit, constitute international policy instruments that have impacted positively on environmental lending (including soft loans and grants) and technical cooperation activities of the WB/IFC Group, the Asian Development Bank and UNDP. EI will be promoted through the potential financial and technological benefits offered by CDM. However, to optimize this potential, it is necessary to understand CDM "deal-making" among investors, entrepreneurs and government authorities. Moreover, it would be facilitated by governments creating a "one-stop-shop" for the CDM deal-

making process.[3] The Environmental Engineering and Technology Development Program of the G-7 has also contributed in some of the countries. Chart 1 reveals the direct financial contributions, which are only a partial indication of the total strategic and catalytic impact on EI, by these international funding instruments and agencies.

Chart 1: International Agencies environment-related spending (USD million) in China, India, Indonesia and Korea in 1995-2003



Charts 2, 3, 4, 5, and 6 (in the Annex) provide a detailed breakdown of funding by the WB, ADB, UNDP, GEF, and MFMP.

14. The GEF and MFMP are two multilateral environmental finding instruments contributing directly to EI, especially in the area related to climate change. Likewise, the MEAs establish the principle for transfer of environmental technologies to developing countries. More recently, the Millennium Development Goals (MDGs), and especially the World Summit on Sustainable Development (WSSD), established

[3] The scale of the business opportunities for EI and sustainable development is suggested by the World Bank's estimates of a carbon market of up to USD4.5 billion per year during the first commitment period in 2008-2012 (Lecocq and Crassous, 2003)

targets for water supply and sanitation and for expanded use of renewable energy and energy efficiency, which will have a significant impact on EI. Increasingly, multilateral trade agreements (WTO) and bilateral (Singapore-U.S.) or regional commercial agreements address environmental issues related to the products traded within the framework of such accords and affect market access. Korea's membership in the OECD has also contributed to EI development in the country.

15. Industrial and population growth, expanded urbanization and increased influence of civil society, and NGOs and consumer organizations in the four countries, combined with the impact of the exogenous policy and the multilateral environmental financing instruments, are creating an ever-expanding set of national environmental policies and performance-based standards and norms. Economic and fiscal incentives (especially in China, India and Korea) and opening of environmental infrastructure to private initiatives and public-private partnerships (PPP) are increasingly complementing the regulatory framework and the command and control systems. These endogenous factors affect the demand for environmental technologies and services, thus contribute to expansion of EI for both the domestic and external markets. Effective application, enforcement and monitoring of the environmental policies and regulations by state and local agencies also impacts on the EI since it transforms potential demand into effective, real demand.

16. National commitment to environmental performance–based standards is also reinforced by sub-regional cooperation. For example, since September 1992, Korea and others have championed environmental cooperation in Northeast Asia. This sub-regional cooperation focuses on monitoring and combating acid rain, which in turn creates effective demand for relevant equipment and technology. The need to meet European Union environmental standards for vehicles, (Euro I and II), and other products, also provides incentives to produce products for the European markets compatible with such standards. OECD environmental requirements regarding toxic substances have caused Korea to establish specialized databases such as the Toxics Release Inventory (TRI) Program.

17. Conditions for EI growth and for an expanded role by multilateral agencies, major donors and especially multinational corporations are created by:

   - Interaction between the mandates of international agencies and international norms and standards, corporate international standards of MNCs and the imperatives of access to markets and avoiding barriers related to the environment, on the one hand, and

- Greater awareness by the population of environmental problems and growing influence of “green consumer” movements, the commitments assumed by the countries within the framework of MEAs and other relevant accords, and the economic and fiscal incentives, on the other hand.

18. Moreover, national authorities are increasingly aware of the damage to the economy due to environmental degradation ranging between two to four percent of annual losses in GDP. Expansion of EI is accelerated by a realization by governments of the need to avoid trade barriers related to environmental issues and a potential loss of export markets for manufactured and agricultural goods and commodities, and of environmental products and services. This also creates conditions for gaining comparative advantage and profitability for EI.

3) Multinational Corporations (MNCs)

19. Turning now to the role of multinational corporations and smaller and medium size foreign companies, the evidence suggests that their contributions are significant. In fact, their role is expanding because of the growing demand for increasingly sophisticated and advanced environmental technology and engineering/consultancy services not available yet in the four countries.
20. The contributions to EI of the MNCs come through wholly owned companies, joint ventures (including public-private partnerships), and through sub-contracting and transfer of technology (licensing) to national conglomerates or large public enterprises. Subcontracting and licensing are especially prevalent in Korea, while China and India are encouraging joint ventures (see Table 1). MNCs and large corporations from Japan, the US, Germany, France and the UK are the major actors, with Denmark (wind energy), the Netherlands and Israel (irrigation and water conservation) also active. MNCs with international corporate policies and standards who are also active members of trade and related associations such as, for example, the World Business Council for Sustainable Development (WBCSD), impact on the growth of EI. Such corporations with plants and companies in the four pilot countries include, for example, BP, Shell, Rio Tinto, Corning, Nestle and CH2MHill. Three cases from China, India and Korea presented below are illustrative of the above.

21. Applying NEMS[4] to a specific factory in Nanjangud, India has reduced, over a three year period, water consumption per ton of product by 29 percent and waste water generation by 46 percent, with all the treated waste water used for irrigation. Similarly, plants located in areas with limited water supply of low quality (and in some cases salty), the raw water is treated and some of it is reused and recycled. The sophisticated technology process to treat the raw water includes: silica removal, flocculation and coagulation, cold lime softening, clarification, sand filtering, reverse osmosis with high recovery and demineralization.
22. CH2MHill through its operations in China, India and Korea contributes to promoting environmental management systems consistent with ISO standards at the corporate level of multinationals such as GE, General Motors, ICI, Elf Atochem, IBM, Motorola, Dole and others through a wide range of engineering/consultancy environmental services. It also impacts domestic large corporations such as Shanghai Electricity Meter Works involved in joint ventures with multinationals or by providing direct services to, for example, a ceramic insulation production facility and coal gasification plant in Shandong Province.
23. Moreover, it serves as a conduit to transfer technology and processes related to air quality and emission inventory assessment, energy management, transformation of organic waste to energy through bioreactor technology for managing organic solid waste, pollution prevention including reuse, recycling and material substitution, industrial water supply and treatment, and solid and hazardous waste management. More broadly, companies such as CH2MHill contribute to the development of the environmental engineering consulting industry, which is given high priority in the four pilot countries. Environmental engineering consulting companies need to be able to provide services in the various areas for which high market demand is anticipated. (see Table 2)
24. Corning (Shanghai) is a wholly owned foreign company in China, which belongs to the Environmental Products Division of Corning Incorporated (the multinational

[4] The Nestle Environmental Management System (NEMS) is an example of corporate policy that relies on action programs at global and local levels. Consequently, all manufacturing sites are required to report performance results annually on the basis of a series of environmental performance indicators (EPIs), which are consistent with the international standard of ISO 14031. EPIs cover internal manufacturing operations worldwide and measure both process inputs and outputs, including water consumption and wastewater generation.

corporation). Corning (Shanghai) illustrates what drives the markets for EI and how exogenous (international) and endogenous (national) economic and policy/institutional factors combine to develop and grow the environmental technology industry, especially products (hardware).. Corning supplies advanced materials and technologies, including clean air products such as catalytic converters, which require cellular ceramic substrates[5].

25. Corning anticipates growing demand for catalytic converters because China already adopted the EURO I standard for vehicle emissions, which is the driving force in creating a market for catalytic converters in the country. Ultimately, Corning expects that at least 20 percent of its Shanghai production will be for the national market, compared to only 5 percent currently, and 80 percent for export. Eighty five percent of the total export from Corning Shanghai now goes to Korea, which previously received its products from Corning plants in Germany and the US, with the remainder targeted for Japan, India and Malaysia. Effective demand for catalytic converters in China will also be affected by a significant increase in vehicles and by more effective enforcement of compliance in the rural areas.
26. Overall, the exports of environmental equipment to the Asia Pacific countries (excluding China) indicate the contributions to EI by MNCs and their countries of origin. Recent reports reveal that Japan and the U.S. control over 60% of the environmental equipment exports to the countries of the U.S-Asia Environmental Partnership, with Japan being the dominant player (US-AEP)[6]. Japan, U.S. and Germany account for US$87 billion of the total exports in the U.S.-AEP countries for the period 1995 - 1999. Currently, only U.S., Korea and Austria show growth of exports to the US-AEP countries.

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[5] Catalytic converters convert noxious exhaust gases to water vapor and harmless gasses. Other environmental products include particulate filters for diesel engines, industrial control systems and ceramic membrane liquid filters.

[6] U.S.-AEP countries are: Hong Kong, Indonesia, India, Korea, Sri Lanka, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam and the U.S.

3. China

1) An Overview

27. China constitutes one of the largest markets for EI, as well as the fastest growing. Contributions by the international agencies and by the MNCs have been significant and are expanding. The World Bank, the Asian Development Bank (ADB), GEF, MFMP and UNDP are active contributors. However, in China it is especially important to distinguish between effective, real demand and the enormous magnitude of the potential demand, which is linked directly to the economic and financial capacity of the business enterprises and the local governments. Furthermore, the ability of China to produce advanced environmental products, technologies and engineering/consulting services will also impact on the real domestic and export demand which are to some extent interdependent.
28. The 10th Five-Year Plan (2001-2005) establishes for the first time a plan for the environment technology industry (ETI) in order to reverse the severe environmental degradation that has taken place during the accelerated economic and industrial growth in recent decades. Accordingly, the government estimates that to meet the environmental objectives of the 10th Five-Year Plan will require a total investment of US$85 billion (RMB 700 billion) which amounts to 1.3 percent of the GDP, assuming annual growth of 7.5% for the five-year period. China is giving high priority to EI and considers it a strategic component required to sustain high exports and 7.5 percent of overall economic growth annually.
29. According to the Chinese Research Academy for Environmental Sciences (CRAES), the three main domestic sources that will fund the required investment are: business enterprises (55 percent), provincial and local governments (34 percent), and the central government (11 percent). US$4 billion (RMB33 billion) will be mobilized from international financial institutions and major bilateral donors. It is assumed that MNCs will make significant contributions to projects undertaken by business enterprises and provincial and local governments through direct foreign investment, joint ventures, and public-private partnerships.
30. Because of a public shift in the late 1990s to “greener” economic growth policy, including substantial improvement of indoor air quality, the market for environmental products, technology and services outperformed other industries. EI has grown between 15 and 20 percent annually during the 9th Five-Year Plan (1996-

2000). A target of the 10th Five-Year Plan is to reduce overall pollution levels by 10 percent by 2005 as compared to 2000. Furthermore, a larger number of environmental national laws, standards and regulations have been issued in recent years, which are complemented by more than 900 environmental regulations that exist at the local level as of early 2002.

31. The magnitude of the anticipated growth of EI is also illustrated by the major financing allocated in the 10th Five-Year Plan, and by some of the projects related to the 2008 Olympics, which offer unique opportunities for contributions by MNCs.

2) Selected areas of EI future Business Opportunities for MNCs in China

32. According to the Chinese Research Academy for Environmental Sciences (CRAES) report**,** under the 10th Five-Year Plan (2001-2005), major projects are being financed (see Table 3). The following is the list of projects that will be carried out in preparation for the 2008 Beijing Olympic Games: Increase of natural gas consumption to 1.8 billion m^3 by the end of 2002; build twelve sewage plants; within the 10th Five-Year Plan, the Beijing Municipality expects to spend RMB 45 billion in the environmental sector; by 2007, 8,000 buses and 40,000 cabs in Beijing will be fuelled by green energy, respectively 90% and 70% of the total number of vehicles· *(Source: People's Daily 22/02/2002)*

33. Based on China's environmental priorities of water and air quality and waste management, the Tenth Five Year Plan specifies11 programs, which should be completed. (Table 4)

34. To facilitate implementation of the ETI, the State Economic and Trade Commission and State Taxation Administration jointly issued in March 2000 the Directory of Environmental Industry Products Being Encouraged at the Current Stage by the State. The Directory includes 8 categories of environmental industrial products.[7] (see also Table 5)

[7] 1) Water pollution treatment; 2) Air pollution control; 3) Solid waste recycling and disposal; 4) Noise pollution control; 5) Environmental monitoring instruments; 6) Energy saving and renewable energy resources; 7) Cleaner production and comprehensive resource utilization; and 8) Environmentally sound materials and environmental chemicals.

35. The Directory established the following financial and fiscal incentives with a view to promote the production and use of the environmental technologies and products:

- Enterprises, which install the 62 types of environmental protection products listed in the Directory can benefit from the national policy to reduce their corporate income tax by up to the amount of the investment in the products.
- Enterprises, which utilize the environmental protection products named in the Directory, can also request their accelerated depreciation.
- Any enterprise engaged in the production of any type of environmental products listed in the Directory can be exempted from income tax up to an annual profit of RMB300, 000.
- The State Economic and Trade Commission (SETC) will provide, through the existing technological renovation programs, interest free loans and grants towards some of the investment projects or technology development projects, which are aimed at producing the environmental products listed in the Directory.
- Government-funded construction projects or government procurement should give preference to the environmental products listed in the Directory.

36. According to both national environmental targets and major environmental projects planned in the 10th Five-Year Plan (2001-2005), China's environmental market will focus on the following areas (Han 2002):

- sewage (large scale, medium and small scale) treatment, and industrial wastewater treatment (high-density organic waste, heavy metal, oil and chemical containing effluents, pharmaceutical effluents, recycling and resources retrieval);
- air pollution control, such as dust removal, desulphurization, vehicle emission control;
- municipal solid waste collection, transportation, incineration, landfilling, and management;
- monitoring equipment for all types of pollution, automation control systems for all treatment facilities, and environmental materials and chemicals;
- resources utilization, including value-added reuse of industrial wastes, cleaner production technology and equipment, comprehensive utilization of agricultural wastes, waste recycling;
- environmental services for all above areas

3) International Agencies

37. In the last two decades, the **World Bank** has concentrated its lending in areas such as environmental technical assistance, water pollution and watershed management, and phasing out ozone depleting substances (see Table 6).
38. Cumulative **ADB** lending to China as of 31 December 2000 was US$10.3billion, targeting six areas for environment protection and natural resource management: 1) improving air and water quality in urban areas; 2) increasing efficiency and greater diversification to cleaner sources in the energy sector; 3) increasing energy conservation and using clean technology processes in the industry sector; 4) promoting comprehensive basin planning and pollution cleanup in rivers and lakes; 5) protecting watersheds, conserving bio-diversity, and preserving unique ecosystems; and 6) strengthening institutional capacity in sectoral agencies involved in environmental management.
39. From 1996 to 2000, **UNDP** provided core resources of approximately US$100 million, with supplementary cost-sharing and other anticipated financial resources amounting to about US$121 million (see Table 7). The focus of this funding has been in areas such as fuel cells in public transport, biomass energy modernization, capacity development for managing reforms in the energy sector, phasing out ozone depleting substances, and energy efficiency (including the household appliances).
40. The total amount of **GEF** assistance to China has reached US$357 million. Eighty percent has been allocated to climate change, 15% to biodiversity protection, and 5% to international waters and ozone layer protection. More recently, in 2002, the GEF approved two large projects (GEF 2002) (see Table 8).
41. The **MFMP** has allocated a total of US$471 million of which US$276 million has already been disbursed (see Table 9).

4) Major Bilateral Donors

42. The development cooperation between the **U.S.** and China relies on the US Trade Development Agency (US TDA). The TDA reopened its grant assistance program for China in early 2001. The renewed cooperation between TDA and China's private and public sectors benefits both nations. During TDA's previous program in China, almost $1.4 billion in US exports resulted from nearly $24 million of overall TDA obligations for feasibility studies, orientation visits and training programs

43. **Sino-German** environmental cooperation is provided through three major agencies: the German Agency for Technical Cooperation (GTZ), the German Investment Development Agency (DEG) and the German Development Bank KfW (Kreditanstalt fuer Wiederaufbau).
44. **Canada's** bilateral cooperation in China focuses on: global environmental issues (reducing greenhouse gas emissions by targeting the energy, transportation, and industry sectors); economic cooperation, focusing on the water, urban management, GIS, energy, and waste management sectors; environmental impact assessment, including policy frameworks, technology transfer, and public consultation mechanism.
45. The **European Union** provides assistance designed to encourage China to adopt environmental policies, and to help China realize the objectives proposed in the Government's National Agenda 21 strategy.
46. From 1993 to 2000, **Spain** has supported 13 projects, amounting to 49 million EUR. These projects are mainly in the areas of wastewater pollution control, drinking water supply and solid waste treatment.

5) Air Pollution

47. Air pollution in China is recognized as the most critical threat to public health and economic development of the country. The level of pollutants in the air is among the highest ever recorded worldwide. It reaches up to ten times higher than WHO standards. No less than 30 percent(USDC-USAEP 2002) of China's total territory is affected by acid rain (mostly in the southern part of the country). China's recent CO_2 and SO_2 discharges are lower than expected due to decrease in energy demand after its peak in 1996. However, oil demand is anticipated to double in the next 20 years.
48. The state also recognizes the urgency to resolve two other major problems in air quality improvement: 1) Indoor air pollution and 2) Auto emissions. As China becomes more focused on the problems of poor air quality in residential and office buildings, there are emerging opportunities for air quality monitoring and air purification and filtration equipment, as well as coating and chemical absorbers. China's government plans to invest a minimum 12 billion dollars in disulfurization technology, described in Table 10 (USDC-USAEP 2002). Additionally, the state plans to invest approximately $ 6.6 billion in fuel gas desulfurization equipment for

thermal plants as summarized in Tables 11 and 12. (Han, Dietmar, and Methling 2002)

6) Water Pollution

49. Over half of the Chinese population does not have access to drinking water. Moreover, the government confirmed that no exploitable clean fresh water resources are left in the country. Overexploitation and mishandling of groundwater in the North have decreased the water table dramatically. Pesticides and heavy metal from the agriculture and leaking septic tanks and sewers contributed to water quality degradation. Due to strong focus on water supply, water and wastewater treatment, and water pollution problems, the state may realize significant investments in the next few years (USDC-USAEP 2002; Han 2002).
50. Water supply shortage and deteriorating water quality have led the government to consider a water diversion scheme, which assumes water pumping from the Yangtze River to the drought afflicted cities, such as Beijing and Tianjin. The World Bank estimates that Chinese industries discharged over 20 billion tons of wastewater in 1999.It is also stated that discharge rates declined through 1999 due to the economic slowdown, restructuring, increased regulatory effectiveness, and new measures for protection. However, little progress was achieved. Due to expected increase of the urban populations from 36% to 45%, the state strengthened its control over the construction of large-scale municipal wastewater treatment facilities (WWT), which began in 1980s (USDC-USAEP 2002). The government intends to increase the number of WWT to 1000 by 2010. This will require an investment of $1.8 billion, in order to improve the effluent quality to a minimum 50% (see Tables 13 and 14).

7) Solid Waste Management

51. Three components of Chinese solid waste management sector have been developed with a varied rate of success. Municipal Solid Waste (MSW) collection systems are relatively reliable, despite the obsolete equipment. On the contrary, transfer and disposal systems are inefficient and harmful for the public health and the environment. The following factors are recognized as barriers to an adequate response to the explosive growth of solid waste produced in China: funds scarcity; obsolete infrastructure; lack of enforcement of disposal; low treatment standards;

lack of professional waste facilities operators, unavailability of reliable, locally produced waste treatment equipment (USDC-USAEP 2002).

52. It is reported, that in 1999 Chinese urban areas generated 940 pounds per person. Solid waste generation per capita has a potential to increase by 8-10 percent annually. Food wastes, plastic, and polystyrene comprise the majority of the MSW. Most metals are extracted and reused for different purposes. In 1999, China generated over 700 million tons of industrial solid waste. Various statistical sources estimate the amount of hazardous waste between five to 30 million tons annually (USDC-USAEP 2002).

53. Composting, incineration, controlling emissions and ash management are the priorities to address the solid waste problems in the future (USDC-USAEP 2002). This creates a potential market for monitoring equipment, ash management and emission technologies, and management and consulting services. Moreover, foreign investors facilitate urban/municipal landfills, which limits access to the domestic market for local products such as compactors and compacting equipment, liner materials and leachate collecting materials (Table 15). Improving standards and quality of local supplies would enhance use of domestic equipment and technologies to manage landfills.

4. India

1) An Overview

54. India's EI market has taken off, although it is still in a developmental phase. It grew at an average annual rate of 15 – 20 percent through 1996, stimulated by the dawning of the age of economic liberalization in 1991 and more rigorous enforcement of regulations, including a more active role by the judiciary. Subsequently in 1997-98, the EI market experienced short-term fluctuation that affected primarily the environmental products and technology market segments, except for the engineering consulting segment that registered a growth rate of 27 percent. The total environmental products, technologies and engineering/consulting services market is estimated to be US$4.85 billion in 1999/2000, distributed roughly: US$2.5 billion, US$1.24 billion, and US$1.1 billion for air pollution, water pollution, and land and solid waste management, respectively. Overall, it is anticipated that EI market in the coming years could grow at 10-15 percent, provided economic performance is sustained and that market forces continue to operate effectively, including availability of direct foreign investment (DFI).

55. International agencies, major donors, national companies, and MNCs have and will continue to be significant contributors to growing EI in India for the domestic and export markets. The US, Japan, Germany, UK, France, Canada, Denmark and the Netherlands are major actors. Already in 1998, partnerships between Indian and foreign companies totaled about 350 covering the various segments of the EI market. Such partnerships, including public-private partnerships and joint ventures, are expected to increase and contribute to channeling the required investment and transfer of technology to grow the environmental industry. Likewise, national large and medium size companies are beginning to invest in environmental prevention and control since they discovered it is good business and essential in order to be able to access the OECD export markets. Consequently, Indian EI is increasingly diversified and it has strengthened its technological capabilities in conventional environmental management in areas such as: water and wastewater treatment (except for reverse osmosis membranes), air pollution control, and non-hazardous solid waste management.

56. A seven to eight percent annual growth of GDP through 2005-2006, targeted by the Government of India, requires substantial expansion in the urban environmental

infrastructure. It is also linked to the government's commitment to raise the level of foreign direct investment (FDI) to US$10 billion per year. Since FDI has consistently grown in the environmentally sensitive manufacturing and energy sectors, the demand for environmental products, technologies and services should also continue to expand. This is also applicable to environmental management systems, which has resulted in 175 industrial enterprises to be ISO 14001 certified in late 1999. Industrial enterprises seeking ISO 14001 certification are growing as corporations target increased exports to OECD markets. Central and state governments are promoting public-private partnerships, including BOOs and BOTs, in water supply and treatment, sanitation, solid waste management, including toxic, hazardous and hospital waste, and transportation that reduces the rate of Green House Gas emissions.

57. Over the next four to five years the public and private sectors will emphasize the following areas for EI development: energy efficiency, including renewable energy systems and clean coal technologies, urban water supply and sanitation systems, industrial wastewater treatment (particularly in SMEs through integrated solutions), urban air pollution control through stricter emission norms for automobiles, hospital waste management, and afforestation programs. Table 16 provides additional indications of investment and potential growth in select market segments of EI. India's diversified industrial base includes the following sectors related to EI: Infrastructure; heavy machinery, basic metals, mining, oil and gas, petrochemicals and other chemicals, pharmaceuticals, automobiles, food and agricultural products processing, pulp, paper, and textiles, electronics and computer software.

58. Three million of small and medium-sized enterprises (SMEs) are considered the backbone of the economy. Their share of the GDP is estimated to be around 40%, and 60% of the total pollution load (ETI 2000).

59. The high rate of population growth and economic development in India has resulted in significant degradation of the environmental quality. In 1996, the World Bank estimated that in order to mitigate the effects of degradation, US$9.7 billion should be devoted to the process of the environmental improvements. This corresponds to 3.2% of India's 1998-1999 GDP. Increasing demand for environmental services (Table 17), such as water supply and wastewater treatment, air quality, and solid waste management largely depends on the rapid urbanization rate. It is expected that 23 large cities with population greater than one million will account for over 40% of total Indian population in the 21st century (ETI 2000).

60. Recently, the U.S. government recognized India as one of 10 “Big Emerging Markets”. It is also considered as a priority target for U.S. trade and investment promotion efforts. It is also important to note that the private sector has increased its activity in India since the national economic liberalization in 1991(ETI 2000).

2) International Agencies

61. The **World Bank’s** principal objective in India is to support private sector, governmental institutions, and multilateral organizations to explore broad opportunities for investments in order to enhance ongoing processes of poverty reduction. India is the World Bank’s largest single borrower. The Bank has loaned more than US$45 billion to India in order to address diverse developmental problems. It is a major financial source for environmental and energy projects in India. Integrating environmental concerns into the economic mainstream is the major priority of the World Bank in the field of environment. Projects in energy and the environment constitute 26 percent of the Bank portfolio, including most of the external funding of water supply and sanitation projects. Recently, the International Development Association (IDA) has established credit line to support the program of industrial pollution minimization. Moreover, the WB implements a large portion of GEF and MFMP funded projects.
62. The **ADB** provides loans and market equity investments to enhance India’s economic and social development. A major portion of the ADB loans and technical assistance is devoted to the energy sector and social infrastructure development. Moreover, the ADB is also committed to promote environmentally sound development. Currently, the ADB supports fourteen programs, which directly address environmental aspects of social and technical development (see Table 18).
63. In addition to its GEF and MFMP funded projects, which **UNDP** implements, it provides developmental assistance through its own resources and synergies with other U.N. system resources and funds. UNDP facilitates “small grants” projects and programs in cooperation with grass-roots organizations and NGOs. The following are two major programs facilitated by UNDP:
    - UNDP Environment Program I. This program aims to improve natural resources management, management of databases and environmental advocacy. The Program also strives to address issues of capacity building for decision-making and participation. Non-governmental organizations (NGOs), non-profit

organizations and State Pollution Control Boards (SPCBs) serve as main implementing agencies[8].

- UNDP Environment Program II. Within this program, UNDP supports the government's ongoing activities in environment protection in forested areas. Most projects developed within this program's framework deal with conducting research, developing demonstration projects, and promoting environmental awareness. The following are the recent projects that are administered by this Program: "A Green Rating" of Indian Industries, coal-bed methane and its commercial utilization, eco-textiles and use of natural dyes in textiles. UNDP also focused on rural electrification and poverty reduction through introduction of solar energy.

64. In India **GEF** programs are implemented through the World Bank, UNDP and UNEP providing co-financing for activities that address climate change, loss of biodiversity, ozone layer depletion, and international waters degradation. GEF also directly finances projects that focus on the problem of reducing the long-term costs of low greenhouse gas-emitting technologies. Tables 19 and 20 present major projects that were initiated and approved by GEF during 1998-2003.

65. As of April 2003, **MFMP** has allocated over US$125 million aimed at phasing out ozone depleting substances in areas such as refrigeration, production of CFCs and aerosols. (Table 21)

3) Major Bilateral Donors

66. **United States** Agency for International Development (USAID) through its. E3 – Environment, Energy, and Enterprise – is the coordinator for U.S. bilateral and sub-regional contributions to EI. The U.S.-Asia Environmental Partnership (USAEP) is designed to promote an Asian "clean revolution", based on sustained development and adoption of environmental benign and resource efficient products, processes and services in the Asian region. USAEP activities can be characterized as follows: Promoting clean technology and environmental management (CTEM), "Greening the Supply Chain", developing urban environmental infrastructure, and establishing a policy framework to sustain a clean revolution.

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[8] A typical example is a common effluent treatment plant in West Bengal.

67. USAEP works in close cooperation with USAID, US Department of Commerce, USEPA, industrial environmental associations in India (regional scale), Pollution Control Boards, and others. USAEP has established Offices of Technology Cooperation in 12 Asian cities. These offices provide commercial counsel for local environmental markets (Venkateswaran 1998).

68. **Canada** has an extensive development cooperation program in India. A key element of the program is environmental consulting. One of Canada's primary goals is to assist India in establishing its own capacities to produce environmental technology adapted to the country's needs through long-term cooperation with Canadian producers of environmental technologies (Venkateswaran 1998). The Canadian private sector is collaborating with the Industrial Cooperation Programme (INC). The INC supports long-term business relations with developing countries, in particular with India, by promoting sustainable socio-economic development. CIDA does not invest in projects through a capital contribution and its support is limited to establishing joint ventures or other types of business[9].

69. Environment and engineering consulting is a focal area of **the Netherlands** in India. The program focuses on: Integrated Urban Water Management (includes wastewater treatment management practices, and technology transfer); energy efficiency and solid and hazardous waste; Environmental Management Systems; and Institutional strengthening and capacity building (Venkateswaran 1998).

4) MNCs in Air Pollution

70. Air pollution prevention, control and management are restricted to stationary and mobile sources, which includes primarily suspended particulate matter from industrial and thermal power plants and vehicular emissions. The annual market for products, technology and monitoring systems for air pollution as defined above is estimated at more than US$400 million per year. However, the energy efficiency and renewable energy market segments, which are linked to air pollution, were valued at US$2.5 billion in 1999-2000.

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[9] However, CIDA direct financial contribution is limited to Cdn$500,000 to support projects dealing with testing, adaptation and/or demonstration of environmental technology

71. Transportation and manufacturing are the major contributors to the deterioration of air quality in metropolitan cities. Transportation accounts for 52 to 67 percent and the industrial sector for 25 to 46 percent of air quality deterioration, with household activities contributing the remainder. Euro I and Euro II emission standards for vehicles will take effect by the year 2005. This will create demand for cleaner/alternative fuels, multipoint fuel injection systems, exhaust analyzers/testing equipment, and catalytic converters for tailpipe emission control. In 1998, there were more than 40 million vehicles in India.

72. Energy intensive industries, particularly in the form of combustion, such as coal-based utilities, cement plants, and petroleum refineries account for about two thirds of the demand for products and technologies to control and prevent air pollution. The technologies that are in demand for particulate matter reduction include electrostatic precipitators (60%), bag filters (20%), dust collection systems (15%), and wet scrubbers (5%).

73. India’s EI has developed capabilities for manufacturing a wide range of equipment for dust collection and for some suspended particulate matter pollution control equipment. However, it requires collaboration from foreign firms to manufacture more sophisticated and high performance electrostatic precipitators and bag filters, as well as for special gaseous pollutants. Likewise, it requires external technology for catalytic converters. Table 22 indicates the external technology required from abroad for the industrial sector.

74. MNCs have established 25-30 joint ventures and collaborations with Indian firms to produce equipment and air pollution control systems. Currently, Japan and Korea account for most of the imported equipment for the mobile air pollution control sub-sector, with the US having about 15 percent. Fuel-efficient and emission control technologies are offered by those foreign firms as part of a comprehensive package. With respect to catalytic convertors, foreign MNCs which have shown interest in establishing collaboration with national enterprises are: Engelhardt Corporation (US), Friedrich Boyson GmbH (Germany) and Mathey Finance B.V. (the Netherlands).

5) MNCs in Energy Efficiency and Renewable Energy Sub-sector

75. The Energy efficiency and renewable energy sub-sector of EI in India requires special attention because of its magnitude and its direct links to the power, manufacturing, mining and agriculture sectors. It, therefore, influences the entire

economy. Although the energy efficiency is now valued at about US$500 million, its potential is estimated at US$3.5-US$5.0 billion. Consequently, its potential impact on EI is extremely important. ESCOs (energy service companies) will play a critical role in this area. With the inclusion of renewable energy in development, the impact of EI is even greater.

76. International agencies, MNCs and principal bilateral donors are major contributors to supplying and developing equipment, strategic technologies and engineering/consulting management services and systems to this market segment of EI. Likewise, they provide a significant portion of the investment required for this purpose.

77. Only a limited number of national and foreign firms are active in the incipient renewable energy (solar, wind, and small hydro). These are: Central Electric Limited, Tata Energy Research Institute (TERI), TATA, BP Solar, NEPC MICON, and BHEL, and some from Japan, U.S. and Denmark (wind power). However, there are numerous domestic and foreign firms active in the supply of equipment and technology for biomass generation. In the future, it is assumed, that R&D may focus on developing a hydrogen energy economy and fuel cell production for both the energy (stationary fuel cells) and public and private transportation sectors.

6) MNCs in Water and Wastewater Treatment

78. The water and wastewater treatment sector is technologically sophisticated and has a high level of participation by MNSs and international agencies. It is the largest market segment of EI, estimated to be US$1.24 billion. Growing water scarcity and water pollution is one of the critical environmental problems in India.

79. Since 1997, external funding for the urban environmental sector, of which water and sanitation is a large proportion, totals US$2.593 billion. The World Bank alone has provided US$853 million for urban water supply and sanitation, which has been the main source of external funding for this sub-segment of the EI market. Private-public partnerships (PPP), including BOOs and BOTs, are expected to increase in the future their contribution to channeling investment and technology to this sub-segment with the consolidation of the economic liberalization policies (Table 23).

80. A total of 240 foreign firms have established a variety of partnering arrangements with Indian enterprises in the water and wastewater sector. The U.S. accounts for about 65 of these partnerships, with the remainder being European firms, especially

from the UK, Germany, the Netherlands and France, and Japan. Government funding agencies from these countries provide credit and financing facilities to their MNCs in gaining market share.

7) MNCs in Solid and Hazardous Waste Management

81. As the Solid and Hazardous Waste Management sub-segment of EI develops, the scope for MNCs and major bilateral donors increases. Rather than using pure privatization to expand substantially the capacity to manage various sub-segments of this market, increasingly progressive municipalities are opting for joint ventures, and PPPs to mobilize funding and the required technology. The growth rate in this sub-segment is anticipated to be 10 to 20 percent.
82. Transfer of certain sophisticated technologies will be required to grow this segment of EI. These technologies relate to the areas of composting and waste-to-energy (biomethanation), coal ash utilization from thermal power stations, and hazardous waste management. Sources of solid waste generation are: residential (54%), industrial and commercial (44%), and medical (2%). Generally, 80-85% of waste is organic, which can be used to produce methane gas, and 13-20% is recyclable. Annual coal ash generation has increased from two million tons in 1947 to 70 million tons in 1999.
83. About 15% of major hazardous wastes can be disposed by incineration, which requires advanced technology not yet available in the country. Large and medium-size private sector firms in petrochemicals, refineries, chemicals, pharmaceuticals, and automobile industries prefer incineration. More than 100 incinerators are already installed, and the potential demand is significant, which presents opportunities for collaboration by MNCs.
84. Major technologies and products for which expanded cooperation is required include: flexible membrane liners; plasma and hydrogenation; solidification and stabilization of hazardous wastes; waste-to-energy (including co-generation); bioremediation
85. In the area of coal fly ash utilization, advanced technologies and substantial investment is required for: extraction and/or production of minerals, aluminum, magnetite, cino-sphere, fire-resistant tile and bricks, acid resistant tile and bricks, and light aggregates. Firms from Australia, Canada, Denmark, France, Japan, the UK, and the U.S. are involved in supplying incineration systems for resource recovery and environmental impact assessment studies. Nitettu Chemical Corporation from

Japan and Vicarb from France have supplied incineration systems. Most of the only eight domestic firms active in the municipal solid waste management market provide either composting or waste-to-energy equipment and services (Table 24).

5. Indonesia

1) An Overview

86. Indonesia's EI is the least developed of the four pilot countries, yet it faces the most severe challenges of environmental degradation and pollution that have accumulated over the years as a result of rapid industrialization and economic growth. Slow recognition by the public and by the government of the substantial health and economic damage afflicted upon the population has resulted in lack of required standards, regulatory frameworks, minimal monitoring and enforcement, and inadequate human and financial resources to meet the environmental challenges of a country with unique geographic and ecological characteristics.

87. A multiplicity of agencies and institutions responsible for environmental management, combined with incompatible and at times even conflicting laws, as well as absence of required data and information, has further aggravated the country's ability to generate effective real demand for environmental products, technology and services. More recently, however, with increased domestic (including NGOs) and external, political and market-based pressure, Indonesia has embarked on a process to "green" the economy and to improve health and overall quality of life for the population.

88. In Indonesia, in contrast with some of the other countries, the international agencies and financial institutions along with the major donors have so far contributed significantly more than the MNCs, including the national corporations, to the development of EI and more generally to sustainable management of natural resources. Overall, Japan, the US and Germany are the major donors active in the country. They are also the major exporters of pollution control products and technology, with a market share in 2001 of 26 percent, 21 percent, and 12 percent, respectively.

89. Five examples of international funding are provided below:

- The MFMP is providing a total of US$50 million (US$17 million in loans and US$33 million in grants) for a project involving the public and private sectors focused on replacing ozone-depleting substances in mobile air conditioners, refrigerators, solvents, and air resolvents.

- GEF is funding two projects:
  - -To introduce solar home systems, with a total of US$36.8 million (US$20 million in loans and US$16.8 million in grants).
  - -Renewable small energy power facilities, with a total of US$69.4 million (US$66.4 in loans and US$3 million in grants).
- An ADB loan of US$66 million for a project focused on capacity building for water loss reduction of water supply. A project was concluded in 1996 with a US$7.4 million loan for water pollution control.
- Cleaner Production Fund of the Japanese OECF project was launched in 1995 for US$115 million, and a second part was expected to be launched valued at US$500 million.
- The German Federal State co-financing institution (KfW) provided DM15.6 to co-finance a project for industrial efficiency and pollution control.

2) Air pollution

90. Severe air pollution in Indonesia, which also affects neighboring countries, is driven by increasing urbanization, motorization,[10] industrialization (including mining), and forest fires. Between 1985 and 1987, over 20 million hectares of forest cover were lost. During 1997 and 1998, 10 million hectares were burned (including 3.8 million of agricultural land), exposing 20 million people across Southeast Asia to air pollution. Total economic losses from these fires are estimated at US$9-10 billion. It is estimated that air pollution related health costs amount to US$ 400 million annually.

3) Water

91. Access to piped-water and disposal and treatment of sewage in Indonesia are among the lowest in Asia. The size of the population without piped water at the end of 1994, is estimated at 43 million people of which 30 million were in Java. Water pollution is aggravated by the fact that the majority of the population is not covered by

10 The number of vehicles increased by 6 million between 1995 and 2000, reaching a total of 19 million.

managed networks of sewage and sanitation but rather relies on on-site sanitation. Few cities have even rudimentary sewage systems. Mining and unregulated effluent run-off also contribute to surface and ground water pollution.

4) Soils-Solid Waste Management

92. Land degradation is severely affected by the existence of only minimal, modern management of solid municipal/industrial solid and hazardous waste. Likewise, air and water pollution and health are also adversely affected. EI development in the future would benefit form the creation of conditions for converting potential demand for environmental products, technology and management services into effective, real demand. Furthermore, market-based incentives, combined with effective management of streamlined and strengthened regulatory and monitoring frameworks and standards, will also contribute to the above endeavor. It will also facilitate participation by MNCs and national companies that are beginning, slowly and belatedly, to discover that investment in environmental protection and control is also good business.

5) International Agencies

93. Major activities of the **WB** are focused on: collaboration with the Indonesian Environmental Impact Pollution Board; research on industrial emissions; establishing and supporting environmental trust funds. Moreover, the WB has invested US$80 million into a project designed to improve potable water quality, and access to the water supply and sanitation services. (Unternehmensberatung 1998) In addition, this investment aims to implement a program that will increase people's awareness in health and hygiene.
94. The **ADB** provides financing for development projects that support various environmental areas (Schmidt 1999; ADB 2003). Major projects include: Capacity building of water supply for Water loss reduction (US$66 million); Water pollution control project (US$7.4 million); Participatory Irrigation Sector Project (US$90 million); Coral Reef Rehabilitation and Management (US$40 million); Central Sulawesi Integrated Area Development and Conservation (US$32 million); Marine and Coastal Resources Management Project (US$50 million); Clean Vehicle Fuel for Blue Skies (US$0.6 million). About 90% of the loans are targeted to the public

sector. If private projects are considered, they are mostly being implemented by large national enterprises.

6) Major Bilateral Donors

95. The Cleaner Production Fund of the Japanese Overseas Cooperation Fund (OECF) was started in 1995 with a total allocation of US$115 million. A second stage started in 1998 with a planned allocation of US$500 million. This is a revolving fund with a perspective of 30 years. Investments were made for promotion of the following: pollution control equipment; wastewater treatment and reuse for agricultural needs; air pollution protection; noise protection; CO_2 reduction; consulting services for designing pollution control or prevention equipment.
96. Kreditanstalt fuer Wiederaufbau (KfW) German Bank for Reconstruction and Development is the design to co-finance and to promote private, and public, investments. KfW allocated DM15.6million to the Bank of Indonesia as a part of financial cooperation within the industrial efficiency and pollution control program. German Investment and Development Company (DEG) provides an Integrated Advisory service for the Private Sector in Indonesia. The DEG also serves as the financing institution for direct private investments. Main activities include: consulting and advisory services to joint ventures and technical projects; investment cooperation opportunities and information; analysis and identification of qualified partner companies; facilitation of investment seminars (Schmidt 1999).

7) Multinational Corporations

97. The relative importance of multinational corporations from major countries is summarized below in terms of the market share of environmental equipment and services exported to Indonesia.

Air Protection Equipment (APC)

98. From 1995 through 1999 Indonesia imported APC for the total value of US$0.276 million. Japanese companies lead the sector for three of five years, with market share of 31%. The third major investor was Germany, with 13% of market share. The five-year cumulative major competitors market share is as follows: Japan-26%, U.S.-21%, Germany-12% (US-AEP 2001).

Monitoring & Analysis Equipment (M&A)

99. The total market size of the M&A in Indonesia reached US$0.108 million in 1999 (Total for five years is US$1.134 million). In this sector, Japan is the leader in Indonesia, followed by U.S. and German competitors. The five-year cumulative major competitors market share is as follows: Japan-46%, U.S.-13%, Germany-11% (US-AEP 2001).

Solid & Hazardous Waste, Other Recycling Systems and Remediation and Cleanup (SWM/ORS/RC)

100. This is the largest import sector in Indonesia. It accounts for US$0.168 million in 1999 (Total for five years - US$1.738 million). For the period from 1995 through 1999, the total SWM import has dropped by 58%. Two major competitors are still the U.S. and Japan. In this sector the Italian companies replaced German competitors. The five-year cumulative major competitors market share is as follows: Japan-42%, Italy-16%, U.S.-13% (US-AEP 2001).

Wastewater Management Equipment (WWM)

101. In the Indonesian WWM equipment sector the leader is Korea, followed by Japan and Germany. Total size of the WWM equipment market in Indonesia reached US$0.129 million in 1999, and for the period from 1995 through 1999, the total was US$1.1million. The five-year cumulative major competitors market share is as follows: Korea-33%, Japan-32%, Germany-8% (US-AEP 2001).

6. Korea

1) An Overview

102. Development and growth of EI in Korea has accelerated in recent years due to its overall economic performance, which is sustained in large part by exports, especially to the OECD countries, by designating EI as a strategic export industry, and by the growing influence of civil society and NGOs who are pressing for improved air and water quality. Moreover, Korea's joining of the OECD in 1997 and of co-hosting the World Cup Soccer Games in 2002 has also been a contributor to a growing demand

for environmental products and services and enforcement of stricter performance based environmental standards.

103. Several decades of rapid industrialization and urbanization have resulted in a significant deterioration of environmental quality, which the government had decided to reverse, as articulated in "Green Vision 21," a ten-year (1996-2005) environmental master plan, "1999 Environmental White Paper" and in numerous Acts and Laws. Consequently, Korea appears to be among the largest markets for environmental products, technology and environmental management services in the Asia Pacific region with a projected average annual growth of 10 percent. The total value of the environmental market in Korea in 1999/2000 is estimated at US$7.1 billion.

104. Three basic national environmental policy documents – "Green Visions 21" (1996-2005), the second mid-term comprehensive plan (the business plan for "Green Vision 21"), and the"1999 Environmental White Paper" shape the development of EI in Korea through the articulation of five strategic principles (including the "polluter pays principle") and six policy priorities. These priorities are: clean water and sufficient water supply, clean air, recycling and reuse of waste, managing safety with chemical pollutants, preservation of the natural environment, and strengthening international cooperation. Furthermore, currently the Ministry of Environment is responsible for 30 environmental laws. Other sectoral ministries are responsible for administering regulations of more than 50 other laws related to the environment.

2) International agencies

105. Overall, international agencies and international finance instruments will have a limited impact in coming years, except for catalytic importance related to the MEAs and the GEF providing some funding for cleaner production and related climate change advanced technologies. On the other hand, national corporations and MNCs will account for about 50 percent of total expenditures in the environmental market. As privatization and public private partnerships (PPPs) of major segments of environmental infrastructure expand, the role of domestic and international corporations is likely to increase with the MNCs making significant and strategic contributions to sophisticated environmental technologies.

106. Korean companies will continue to focus on traditional end-of the pipe areas as they position themselves to upgrade their technological capabilities; these include wastewater treatment, hazardous waste treatment, and more recently technologies for

dust filtration and sulfurization. Since the Korean Institute of Science and Technology (KIST) assesses Korea's overall level of environmental technology in the range of 30-70 percent relative to most advanced nations, the scope for MNC contributions to EI in the country in the coming years continues to be significant and of strategic importance, especially in advanced fields such as clean up, recovery, recycling and abatement of emissions from fixed and mobile sources. Korean companies will also continue to focus on developing technology related to engineering and construction of environmental infrastructure such as wastewater treatment plants and incinerators.

107. In view of the above, expanded future R&D by the government and industry will give priority to clean and renewable energy, energy efficiency, abatement of global warming, low GHG emission by automobiles and trucks, environmental bio-engineering, hazardous fine chemicals, waste minimization, and electronic monitoring/measuring instrumentation. While MNCs could be partners in such R&D, international agencies and, for example, the G-7 Environmental Engineering and Technology Development Program, would make catalytic and strategic contributions, which should not be measured in terms of the volume of financing

108. To accelerate R&D in priority areas and development of state of the art EI, tax incentives and low-interest loans are offered by the government. The tax incentives include customs duty reduction or exemption on imports of pollution control equipment in selected environmental and alternative energy technologies classified as "high level technologies." [11] Long-term, low-interest loans are offered to environmental investors and technology developers, in addition to the support to start-ups.

3) MNCs in Air Pollution

109. Although 52 items are defined as air pollutants, only 26 substances are affected by air pollution control standards, including Sulfur Dioxide (SO_2), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), total suspended particulates (TSP), particulate matters (PM-10), ozone (O_3), and lead (Pb). Industrial pollution, including waste minimization through cleaner production, vehicle emissions, and energy efficiency

[11] It may include a hydrogen energy economy and fuel cell production for the energy (stationary fuel cells) and transportation sectors.

(including renewable energy technologies), are the primary focus of the government's prevention control and monitoring (including telemetering systems).

110. Of the 31,000 air pollutants emitting businesses, the regulatory authority over 24,000of these businesses is managed by regional governments, and the regulatory authority on the remaining 7,000 is managed by the environmental offices of the MOE, which classifies the businesses in five classes depending on the volume of annual fuel consumption. With registered motor vehicles approaching 12 million, they have become the main source of emissions amounting in 1999 to 41 percent of total volume of air pollutants generated, while industry accounts for 27 percent, power generation 17 percent, and heating 6 percent.

111. In Seoul, motor vehicles are responsible for 85 percent of total emissions, while commercial vehicles (buses and trucks), which account for only 4 percent of all vehicles, generate 47 percent of emissions. To combat emissions from motor vehicles, the government had planned to have 5,000 CNG buses operating in eight cities for the World Cup Soccer games in 2002, and 20,000 CNG buses and 210 CNG stations operating by 2007.

112. Korea's automotive industry is an illustration of the convergence of domestic demand for clean air, the need to meet international commitments under the UNFCCC, the Montreal Protocol, and the imperatives of maintaining and expanding export market share in the European and US markets which increasingly demand zero emission vehicles and trucks as the Euro I & II standard become fully operational. Advanced environmental technology (software) and products (hardware) are, therefore, critical to the sustainability and growth of the Korean automotive industry. Likewise, at the corporate level, the automotive industry needs to adopt state of the art environmental management systems and reporting procedures, and be rated internationally regarding its environmental and social responsibilities.

113. To expand, update and operate the monitoring and control system presents the EI industry with major challenges and opportunities with respect to equipment, electronic instrumentation technology and integrated/advanced management systems. Government and industry currently operate four air quality-monitoring systems: air pollution monitoring stations (telemetering); air pollution monitoring vehicles where telemetering is not installed; acid rain monitoring stations; and smokestack telemetering systems.

114. The Bank of Korea estimates that in 1999, the total market for air pollution prevention and control products and services was US$1.13 billion and it was

anticipated to reach US$1.2 billion in the year 2000. According to the same source, the market is driven by the private sector, unlike the water supply, wastewater and solid waste sub-sectors, with industries accounting in 1999 for 91.8 percent of the country's total environmental spending, households 5.0 percent and the government 3.2 percent.

115. The Korean Environmental Industry Association estimates that 570 companies are active in this market, of which 169 specialize only in the air pollution prevention and control field. Since KIST rates Korean environmental technological capability at 30 to 70 percent compared to leading OECD countries, local manufacturers can now manufacture low-tech equipment such as bag filters and cyclone collectors. An exception is Korea Cottrell that has been in this business since the 1960's and produces electrostatic precipitators and other equipment and technology related to crude oil and other industrial desulfurization, and exhaust gas treatment required by national industries.

116. Consequently, Korean industry continues to rely on MNCs and foreign companies for advanced technology and equipment, which includes the following areas: flue, gas and fuel desulfurization/denitrification; high efficiency dust collectors, motor vehicle emission reduction; and air quality automated measuring instruments.

117. Major industries that require advanced air pollution prevention and control equipment and management systems technologies include: petrochemicals, cement, power generation (new and renewable energy), automotive, electronics and steel. Japanese, US and German companies have been the predominant actors among about 30 foreign companies that have transferred, primarily under licensing agreements, air pollution control technology to Korean enterprises in the 1990's.

118. In the future, MNCs affiliated with major Korean conglomerates (Hyunday, Samsung, LG, SK, and the Korean Electric Power Corporation), will be able to continue and even expand their contributions to EI in the country; joint ventures and possibly PPPs may also become feasible due to the policy of privatization and decentralization. Likewise, multinational engineering consultancy companies will continue to do business under licensing agreements and/or joint ventures with major Korean general and specialized environmental firms.

4) MNCs in Water Pollution

119. In 1999, the market for the water and wastewater sub-sector was estimated at US$3.3 billion accounting for 46 percent of the total environmental market valued at US$7.1 billion. During the same year, the government spent US$2.2. billion (about 70 percent of total) to manage water quality and wastewater while industry spent US$0.9 billion (about 30 percent) in the same sub-sector. Unlike the air pollution sector, the water and wastewater sector continues to be largely dominated by the government. However, the government has recently opened the area of local sewage treatment to the private sector, with 16 sewage treatment projects selected for privatization, including public-private partnerships (PPP).

120. According to the "1999 Environment White Paper," the major goals of the comprehensive measures for water management for the period 1996-2005 are:

Indicator	**1996**	**2005**
Ratio of municipal wastewater treatment (%)	50	80
Ratio of livestock waste water treatment (%)	42	74
Ratio of industrial wastewater treatment (%)	73	90

To achieve these goals the government plans to invest US$25 billion on infrastructure projects for water quality improvement. This will enable the government to build 165 new **municipal** wastewater treatment plants, and construct 14 new **industrial** wastewater treatment plants bringing the total to 53 in 2005.

121. With respect to drinking water, there are more than 3 million purifiers installed in homes. The annual market for home water purifiers has been growing from US$188 million (US$21 million from imports) in 1998 to US$250 million in 1999.

122. The contributions of MNCs and foreign firms to the water pollution control segment of EI has been to provide technology and/or equipment for purification and sludge treatment, including of membranes for reverse osmosis processes. In 1996, there were 76 license agreements reported for transfer of technology in the water pollution control field. Since licensing agreements were deregulated after 1996, no data is available for subsequent years.

123. In the past, Japanese firms dominated the market for advanced pollution control technologies, including water and waste treatment, commanding around 50 percent

of the market share, with the US commanding 20-25 percent and European companies 20 percent. Major Japanese companies include: Daiki, Daiwa, NCE, Tayobo, Denka Engineering, Nitto, Denko, Suirei and Nittetsu Chemical Engineering. Major US environmental corporations are: CH2MHill (Water treatment), Romm Hasy (filtering machines), Hydranautics (membrane products), Filterk corp. (backwashable micro filter products), VMT (pure water treatment), and Aeromix Systems (Surface aerator). European companies include: Led Italia (Italy), Danish Hydraulic Institute (Denmark), Rochem (Germany), TIA and Trailigas (France), Biothane Systems (Netherlands) and NYT (Finland).

124. More recently MNCs are entering the water and wastewater market by establishing partnerships-joint ventures- with major Korean companies. Samsung had signed in 2000 a joint venture agreement with Operation Management International, Inc. (OMI), a subsidiary of CH2MHill, to construct sewage treatment projects under the privatization arrangements whereby OMI will transfer advanced technologies and provide financing. Hyunday Engineering ad Construction has been pursuing a joint venture with Generale Desaux of France for the construction of a wastewater project in Kyongsangbuk-do. LG Engineering & Construction has recently introduced technologies from Japanese and US companies for sewage treatment and solid waste incineration.

5) MNCs in Soil Pollution and Industrial and Solid Waste Management

125. Waste minimization, progressive reduction of use of landfills and reuse of methane gas of existing landfills for power generation, (waste to energy), hazardous waste management and expanded recycling characterize the challenges faced by the soil pollution and solid waste management sector. The comprehensive plan for National Waste Treatment is based on three principles: encourage recycling and discourage landfill; prevent or reduce waste generation and expand recycling capacity; and expand incineration capacity for the waste that cannot be recycled. Consequently, waste management policy prioritizes actions as follows: reduction, reuse, recycling, energy recovery, incineration and landfill.

126. Generally, the Korean industry is able to manufacture medium to low tech components and parts for incinerators and other aspects of solid and hazardous waste management. However, advanced foreign technology and equipment is required for incineration, recycling, waste to energy, and hazardous toxic waste management.

Specifically, these needs include: heat treatment technology for manufacturing the furnace stall parts of an incinerator and the ash treatment technology to abate hazardous materials such as heavy metals, and of controlling dioxin emissions and other toxic substances (volatile organic compounds) from incinerators. Advanced technology is also required to reuse or recycle industrial waste, scrapped cars, computers and home appliances.

127. The magnitude of the market for solid waste treatment (see Table 25) products and services was estimated by the Bank of Korea to be US$2.5 billion in 1999, with US$0.5 billion for the private sector. The government is providing low interest loans to encourage private firms to expand substantially the number of private recycling plants. It is planned to expand the proportion of recycling industrial waste to 75 percent by 2005 compared to 67 percent at present. At the same time, the government is considering a model project of the Eco-Industrial complex aiming at zero discharge of solid waste, where cleaner production systems, technologies and equipment will be used.

128. Foreign companies active in Korea's market for municipal incinerators include five Japanese, two German and one each form Denmark, Belgium, France and Switzerland (Table 26).

129. MNCs will continue to be an important contributor to hazardous solid waste and toxic chemicals treatment and management, with an expected substantial growth in the market for technology and equipment. Revision of regulatory and administrative requirements to comply with European standards and the TRI of the OECD, which is already being applied by the oil refining industries, offers expanded opportunities by international environmental companies specializing in hazardous waste management. The main categories of hazardous waste discharge by industries are: acid waste, alkaline waste, non-halogen solvent waste, oil waste, and wastewater sludge. Technologies to treat and manage these wastes include: dust treatment using the plasma incinerator technology, recovery of oil-spilled soils and land fills, and extrusion of incinerated waste using plasma for large-scale municipal waste incinerators.

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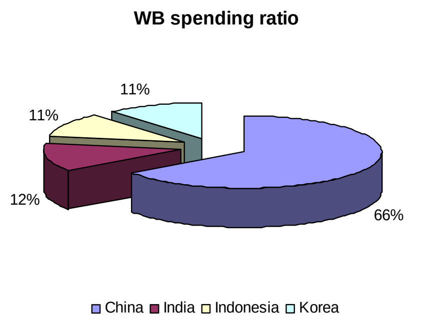

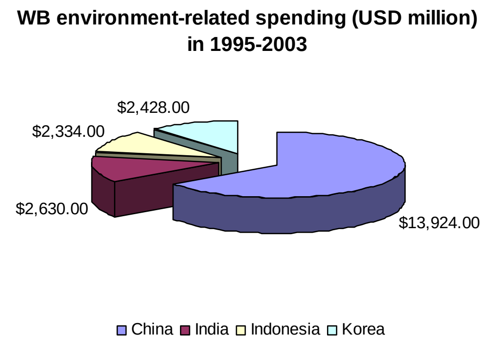

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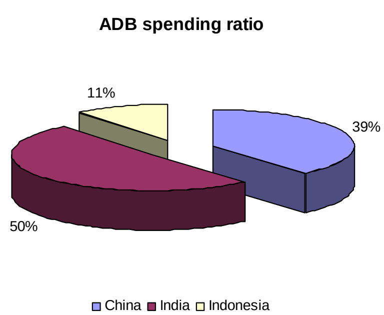

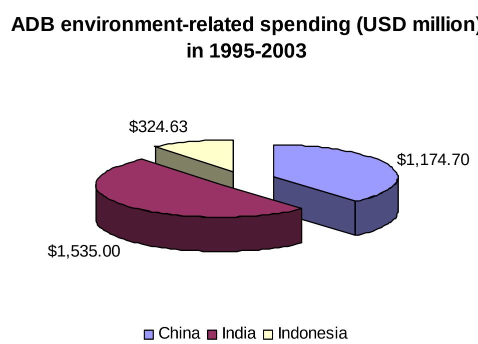

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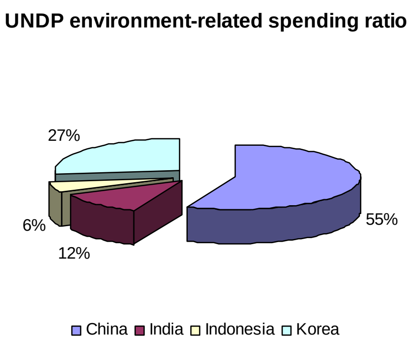

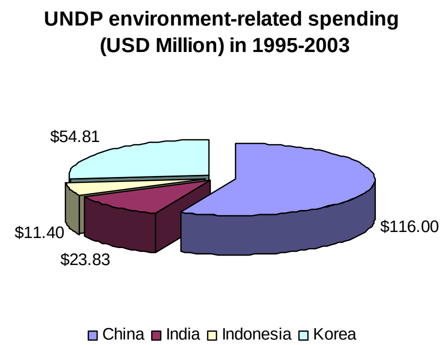

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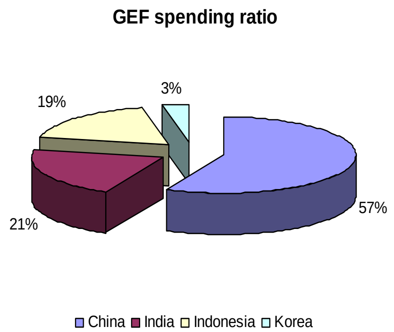

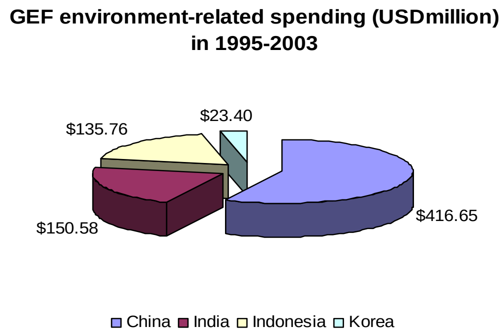

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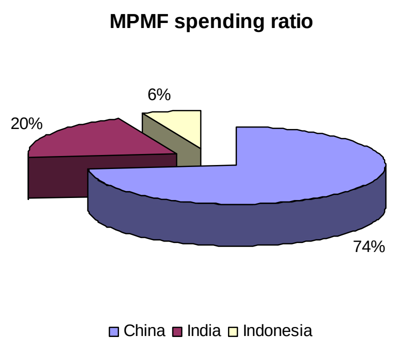

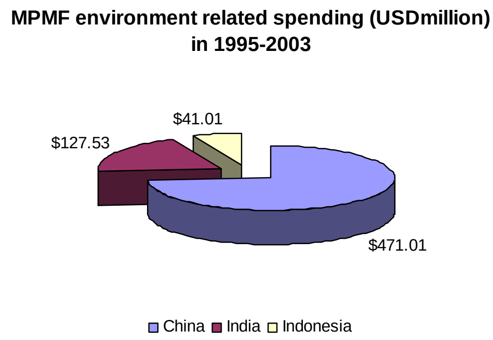

Source: The Multilateral Fund Secretariat

Tables

Table 1: Forms of contribution by MNCs to EI in selected coutries

Country	Form of contribution
South Korea	Subcontracting
China, India	Joint ventures
	Private Public Partnerships
China, India, Indonesia, Korea	Built-Own-Operate – BOO
China, India, Indonesia, Korea	Built-Own-Operate and Transfer – BOT

Table 2: Environmental consulting services demand in Asia

Anticipated demand	Marked demand areas
High	Clean process design, construction and operation
High	Sophisticated environmental management systems (includes “greening the supply chain”).
High	Energy efficiency (demand-site management).
High	ISO 1401 Certification consulting services.
High	CDM related certification services.
High	Environmental impact assessments and audits.
High	Product life span assessment.
High	Resource utilization, including value added integrated reuse of industrial and agricultural waste.
High	Waste resources recycling and disposal for plastic, paper, wood, chemical products and metals.

Table 3: Finance allocation under the 10th Five-Year Plan (2001-2005) in China

Project	Amount allocated
To build or expand 145 urban wastewater treatment plants in the basins of the Huai, Hai and Liao rivers and the Tai, Chai and Dianchi lakes;	RMB27.1 billion
To build 22 hazardous waste facilities;	RMB20 billion
To install desulphurization equipment on 51 coal-fired power plants in the acid rain control areas;	RMB16.4 billion
To build four sewage plants and four other environmental facilities in Beijing;	RMB12.4 billion
To build 30 plants to treat sewage entering the Bohai Bay;	RMB9.3 billion
To build 37 urban sewage treatment plants and nine urban waste management plants in the Three Gorges Reservoir.	RMB7.3 billion

(Source: People’s Daily 22/02/2002)

Table 4: First priority environmental programs specified by the Tenth Five Year Plan in China

Area	Project description
Water and wastewater	The water pollution control engineering of the Three Gorges Project
Water and wastewater	The water pollution control engineering of the Divert Water from the South to the North Project
Water and wastewater	Huai River Wastewater Control and Treatment
Water and wastewater	Liao River Wastewater Control and Treatment
Water and wastewater	Hai River Wastewater Control and Treatment
Water and wastewater	Taihu Lake Pollution Control and Treatment
Water and wastewater	Chaohu Lake Pollution Control and Treatment
Water and wastewater	Dianchi Lake Pollution Control and Treatment
Air	Two Controlling Areas — Reducing SO2 Emission and Controlling Acid Rain
Water and wastewater	Bohai Sea water pollution control engineering
Water, air, waste treatment	Beijing Environmental Programme

Table 5: Development of China's Environmental Protection Industry: 1993-2000

Sector for development	1993	1997	2000
Company/institution (number)	8,651	9,090	18,144
Employee (million)	1.882	1.699	3.176
Total annual income (RMB100 million)	311.5	459.2	1689.9
Envir. Protection products (RMB100 million)	104.0	182.1	236.9
Clean products (RMB100 million)	-	21.6	281.1
Environmental service (RMB100 million)	11.1	57.8	129.4
Waste recycling (RMB100 million)	169.3	181.4	757.1
Natural conservation (RMB 100 million)	27.1	16.3	285.4
Total annual profit (RMB100 million)	40.9	58.1	166.7
Average profit per capita (RMB)	2200	3400	5200
Average income per capita (RMB)	16600	30700	53200

Table 6: Environmental projects in China approved by the World Bank in 1991 through 2003

Project	Amount (USD million)
Environmental Technical Assistance Project	76.0
Montreal Protocol Ozone Depleting Substances Phase Out Project (04)	100.0
Montreal Protocol Ozone Depleting Substances Phase Out Project (03)	90.1
Xiaolangdi Resettlement Project	571.3
Loess Plateau Watershed Rehabilitation Project (02)	150.0
Natural Forest Biodiversity Project	16.0
Taihu Basin Flood Control Project	497.3
Lake Dianchi Aquatic Biodiversity Restoration Project	0.75
Beijing Environmental Project	298.7
Sustainable Forestry Development Project	214.58
Southern Jiangsu Environmental Protection Project	250.0
Second Beijing Environment Project - GEF Component	1200.0
Montreal Protocol Ozone Depleting Substances Phase Out Project (02)	6.0
Montreal Protocol Ozone Depleting Substances Phase Out Project	18.8
Huai River Basin Pollution Control Project	78.5
Beijing Environment Project (02)	1255

Table 7: UNDP contribution in China's environmental improvement

Project	**Amount (USD million)**
Demonstration of Fuel Cell Bus Commercialization in China	15.9
Modernized Biomass Energy in China: Jilin	1.24
Development of the Capacity to Manage China's Electricity Power Supply Reform	23.22
Demonstration of Fuel Cell Bus Commercialization in China	40.91
China: Promoting Methane Recovery and Utilization from Mixed Municipal Refuse	14.3
Building Capacity for the Clean Development Mechanism in China	0.078
Capacity Building for Environmental Education in Primary and Middle Schools through the Production of Interactive Teaching Materials	0.825
Capacity Building of Women Mayors and TVE Managers for Sustainable Development in China	0.96
Development of Coal-Bed Methane Resource	10.0
Modernized Biomass Energy in China: Jilin	1.240
Peanut Improvement in Poor Areas	-
Poverty Alleviation and Women in Development in Inner Mongolia	-
Prevention and Management of Marine Pollution in East Asian Seas	11.4
Seabuckthorn Development in China	1.04
Study on wind resources concession	0.13

Table 8: Major recent GEF projects in China

Project	**Implementing Agency**	**GEF allocation**	**Total cost**
Energy Conservation, Phase II	The World Bank	US$26 million	US$281.2 million
Efficient Utilization of Agricultural Waste	The World Bank/ ADB	US$6.4 million	US$77.3 million

Table 9: MFMP allocation in China

Sector	**Amount US$ million**
Aerosol	7.0
Foam	112.0
Fumigant	1.08
Halon	51.0
Process agent	22.22
Production	72.85
Refrigeration	159.03
Solvent	29.73
Several	9.21
Other	6.32

Table 10: Investment in China's disulfurization technology

Disulfurization technology for thermal power plants	$6.6 billion
Control and monitoring of domestic SO2 emissions	$3.6 billion
Desulfurization technology for industrial furnaces	$1.8 billion

Table 11: Air Pollution related Environmental Technology Development in China

Category	**Encouraged Development and Investment of Environmental Equipment and Technology (issued by SETC in 2000) To be commercialized**	**Environmental Equipment and Technology that need Development in the 10th Five Year Plan (issued by SETC in 2001) To be developed**
Air pollution control equipment technology	Limestone (lime)-gypsum gas hydro-desulfurization integrated equipment; Half-drier method gas desulfurization equipment; Gas recycle fluid-bed desulfurization equipment; High temperature and filtrate speed bag filter; Bag filter high-efficiency dust-out equipment; High-efficiency electrostatic separator;	Technology and equipment of choosing, washing, and desulfurization of coal; Wet desulfrization technology and equipment of large electricity station fueled by coal; Industrial boiler flu gas desulfurization equipment;

Source 1) The 10th Five-Year Plan for Environmental Protection Industrial Development in China (issued by SETC)

2) Encouraged Development of Environmental Equipment and Technology at Present (issued by SETC)

Table 12: Selected Large-Scale Foreign Investors in Chinese Air-Related Technologies Market

Country	**Company**	**Investment amount and Project Locations**
U.S.A.	Thermo Instrument Systems	Holds a 70% share in the environmental air quality monitoring market in China
	Hewlett-Packard	Gas-chromatography, air control and monitoring equipment
	Dasibi Environmental Corporation	Installed air monitoring equipment in 33 key cities in China for amount of $13.4 million
	Corning (Shanghai) Co., Ltd	Wholly owned foreign company; it produces ceramic substrates, used in catalytic converters.
Austria	W & Partner Group - Dipl.Ing.Michael Wachsmann GmbH	air measuring systems, air and treatment technology

Table 13: Water and Wastewater related Environmental Technology Development in China

Category	Encouraged Development and Investment of Environmental Equipment and Technology (issued by SETC in 2000) To be commercialized	Environmental Equipment and Technology that need Development in the 10th Five Year Plan (issued by SETC in 2001) To be developed
Municipal wastewater treatment technology and equipment	Revolving ladder grid; High-efficiency air-floating equipment; Suspending chain impulse wave aerator; Pneninatic aerator; Strip type spin-drier machine and sludge condense integrative equipment; Clean up algae machine; SBR sequential activated sludge reactor; Film-biological reactor; Sludge fast compost integrated equipment;	Whole sets of municipal waste water treatment equipment using activated sludge (200-500 thousand tones per day); Whole sets of municipal waste water treatment equipment using methods of oxidation ditch, SBR, and AB (100-200 thousand tons per day); Technology and whole sets of equipment of waste water treatment methods of A/O, A/AO, bio-filter, and aerobic hydrolyzation (below 100-200thousand tonnes per day); 10-50 thousand tonnes waste water treatment equipment for small towns; - Municipal waster reusing equipment;
Industrial wastewater treatment technology and equipment	Floating oil recycled machine; High-concentration bio-degradation organic wastewater treatment integrated equipment; Internal triphase recycle bio-fluid bed reactor; Neotype ozone generator; SBR method large-scale revolving	Technology and equipment of aerobic and anaerobic treatment for high-load industry organic waste water; Antibiotic production waste water treatment equipment technology; Pulp and paper waste water treatment equipment technology; Industrialization of middle water reuse technology and equipment; Industrialization of industrial wastewater reuse equipment;

Source 1) The 10th Five-Year Plan for Environmental Protection Industrial Development in China (issued by SETC)

2) Encouraged Development of Environmental Equipment and Technology at Present (issued by SETC)

Table 14: Selected large-scale foreign investors in Chinese water management

Country	Company	Investment amount and Project Locations
France	Suez-Lyonnaise des Eaux	Total investments: $120 million, including $28 million for Shanghai Huangpu River project
	CGE	Total investment: $780 million for project in Huizhou (Guandong Province), Xi'an, Shanghai, Tionjin, Chengdu, and other areas
	Degremont	Invested in 50 water treatment systems in Beijing, Guandong, Hangzhou, and other areas
Germany	Siemens	Total investment: $300 million (capitalized on aid finances)
UK	Thames Water and Bovis	$68 Million for Shanghai water treatment project $25 million for Guiyang water supply system
	Anglian Water	Total investment:$16 million
U.S.A.	Nalco Chemicals	$3 million for Suzhou project
	Lemma International	$120 million for Guangzhou Xilang project

Table 15: Solid and Hazardous Waste related Environmental Technology development in China

Category	**Encouraged Development and Investment of Environmental Equipment and Technology (issued by SETC in 2000) To be commercialized**	**Environmental Equipment and Technology that need Development in the 10th Five Year Plan (issued by SETC in 2001) To be developed**
Solid waste treatment equipment technology	Waste assort equipment; Urban living garbage incinerator; Small solid waste incinerator; Garbage ferment roller; Compost mix round machine; Back-load compress garbage gather trunk; Vacuum suck feces vehicle;	Municipal waste solid stoker- type incinerating boiler (150-1000 tonnes per day); Circulating- fluidized-bed type incinerating boiler system of waste solid (75-1000 tonnes per day); Municipal waste solid screening and crushing equipment technology; Waste heat utilization technology of incineration; Disposal automobile treatment and recycling equipment (5000 per year); Recycling equipment of waste battery; Waste plastic high purity sorting and washing equipment with capacity below 2000 tonnes per year; Manufacturing equipment of building materials from recycling of coal fly ash; Sorting equipment of fly coal ash; Whole sets of equipment of fertilizer made of sludge;
Hazardous waste treatment	Poisonous and harmful and solid waste incinerator;	Radioactive solid waste management and disposal engineering; Industrial hazardous and toxic solid waste incinerator; Industrial hazardous and toxic solid waste package and composting equipment;

Table 16: Required Investment for urban Infrastructure Services (at 1995 prices, US$ billions) in India

Services	Low	High
Water Supply	2.12	5.0
Sewerage	2.0	4.5
Solid Waste	0.23	1.0
Total	4.35	10.5

Source: Environmental Technologies Industries – Market Plans

Table 17: Potential growth estimates of the environment related business sectors in India

Business Segment	Short-term potential	Long-term potential
Water and Wastewater Treatment	Medium	High
Air Pollution	High	High
Municipal Solid Waste	Medium	Medium
Hazardous Waste	Medium	High
Hospital Waste	Medium	Medium
Environmental Consulting	High	Medium
Monitoring Equipment	Medium	High
Energy Efficiency	High	High
Renewable Energy	Medium	High
Clean Coal	Medium	High

Source: Environmental Technologies Industries – Market Plans

Table 18: ADB investment in India's EI

Progect	Ammount US$ million	Year
Renewable Energy Development	200	20003
Gujarat Power Sector Development Program (Policy Loan)	350	1996-2000
Urban Clean Fuel Project	1	2003
Chhattisgarh Irrigation Development Sector Project	0.7	20003
Energy Efficiency Enhancement	0.6	2002-2003
JFPR-Rainwater Harvesting and Slum Development In Rajasthan	1.9	2002-2004
Urban Water Supply and Environmental Improvement in Madhya Pradesh	213	2003
Calcutta Environmental Improvement	250	2000-2007
Rajasthan Urban Infrastructure Development	250	1998-2004
Urban and Environmental Infrastructure Facility	90	1999-2004
Karnataka Urban Development and Coastal Environmental Management Project	175	1999-2004
Kerala Sustainable Urban Development	1	2003
Integrated Urban Development in Madhya Pradesh	1	2002-2003
Calcutta Environmental Improvement US$1mln (1998-1999)	1	1998-1999

Table 19: GEF Regional and Global Projects - Carried out in various countries, including India

Country	Project Name	Focal Area	Agency	GEF Grant (US$M)	Project Stage
Global	Conservation and Sustainable Management of Below Ground Biodiversity, Phase I	Biodiversity	UNEP	5.296	CEO Endorsed
Global	Assessment of Soil Organic Carbon Stocks and Change at National Scales	Multiple Focal Areas	UNEP	0.978	CEO Approved
Global	Promoting Industrial Energy Efficiency through a Cleaner Production/Environmental Management System Framework	Climate Change	UNEP	0.950	CEO Approved
	Total Spending			7.224	

Source GEF Projects profiles: India (1998-2003)

Table 20: GEF Single Country Projects - India

Country	Project Name	Focal Area	Agency	GEF Grant (US$M)	Project Stage
India	First National Report to the CBD	Biodiversity	UNDP	0.025	CEO Approved
India	National Biodiversity Strategy and Action Plan Asia	Biodiversity	UNDP	0.968	CEO Endorsed
India	Conservation and Sustainable Use of the Gulf of Mannar Biosphere Reserve's Coastal Biodiversity	Biodiversity	UNDP	7.868	CEO Endorsed
India	Conservation and Sustainable Management of Dryland Biodiversity, Phase 1	Biodiversity	UNDP	2.040	Council Approved
India	Energy Efficiency	Climate Change	IBRD	5.000	CEO Endorsed
India	Coal Bed Methane Capture and Commercial Utilization	Climate Change	UNDP	9.190	Council Approved
India	Enabling Activity for the Preparation of India's Initial Communication to the UNFCCC	Climate Change	UNDP	2.000	CEO Endorsed
India	Biomass Energy for Rural India	Climate Change	UNDP	4.213	CEO Endorsed
India	Fuel Cell Bus Development in India (Phase II - Part 1)	Climate Change	UNDP	6.280	Council Approved
India	Removal of Barriers to Biomass Power Generation, Part I	Climate Change	UNDP	5.650	Council Approved
	Total Spendings			43.234	

Source GEF Projects profiles: India (1998-2003)

Table 21: MFMP investments in India's EI (1995-2003)

Segment	Allocated (US$M)	Support (US$M)	Disbursed (US$M)
Aerosol	3.096	0.369	2.261
Foam	33.099	3.545	26.692
Fumigant	0.035	0.002	
Halon	5.098	0.519	1.515
Process Agent	4.907	0.596	0.523
Production	46.115	3.665	32.501
Refrigeration	26.197	2.854	10.515
Solvent	4.675	0.545	2.839

Table 22: Business Opportunities in Industrial Air Pollution in India

Industrial Sector	Technology Required
Thermal power stations and iron and still plants	Energy efficient equipment High temperature filter bags
Dyes and dye intermediates, small boilers (up to 15t/hours), electroplating	Package scrubbers High efficiency cyclones
Thermal power stations, pharmaceuticals, and cement	NOx removal
Dyes and dye intermediates, chemicals	High efficiency scrubbers
Petrochemicals, distilleries, pharmaceuticals, and metallurgical industries	Monitoring equipment Odor control systems Fugitive emission control systems
Petrochemicals, pesticides, iron and steel, nitrogenous fertilizer, thermal power stations	Monitoring equipment
Fertilizers, iron and steel; sugar; pulp and paper; caustic soda; petroleum refining desulfurization of systems	Specialized air pollution treatment equipment; equipment for recovery units; smokeless flares, rapper recovery crude oil; sulfur

Source: EQMS India Pvt., Ltd.

Table 23: Generic Technology Needs/Business Opportunities in the Industrial & Municipal Water/Wastewater Treatment Sector in India..

Sector	Technology Required
Industrial Sector	
Process water treatment filtration systems	Advance reverse osmosis membranes
Dyes and dye intermediates, tanneries, nitrogen fertilizers, pesticides, pulp and paper	Total dissolved solids removal/reduction
Man-made fiber, pesticides, coke-oven electroplating, pharmaceuticals	Heavy metals removal/reduction
Dyes and dye intermediates, petrochemicals	Biological and chemical oxygen
Man-made fibers, textiles	Demand reduction, advanced oxidation process (wet oxidation, ultraviolet oxidation)
Sugar, distilleries, pulp and paper	Fixed film anaerobic bio-methanation systems, energy efficient biological treatment systems, energy recovery
Systems, sludge handling systems	
Dyes and dye intermediates, food processing, electroplating	Small and energy efficient package treatment systems
Pulp and paper, nitrogen fertilizers	Nitrification/denitrification systems
Pesticides, phosphatic fertilizers, nitrogenous fertilizers, distilleries	Special pollutant treatment
Pulp and paper	Caustic recovery/color removal systems
Nitrogenous fertilizers	Fluidized-bed biological treatment/trickling filter
Pesticides	Toxicity reduction
Coal mines	Coal beneficiation plants
Galvanizing industries	Acid recovery systems
Electroplating industries	Cyanide treatment, metal ion recovery systems
Tanneries	Chromium recovery systems
Industries located in coastal areas	Desalination plants
Small and medium-sized enterprises	Compact and prefabricated packaged systems
All industries	Rotary bio disc systems, sequencing batch reactor systems, reciprocating ion exchange and automated chemical dosing systems, systems for oil removal from sludge
Municipal sector	
Water treatment	Ultraviolet disinfection
Wastewater	Advanced oxidation systems, energy efficient aerators, sewerage farming, up-flow anaerobic sludge blanket (UASB) process
Analytical/Monitoring Equipment for Industrial and Municipal Sector	Auto analyzers for phosphate and nitrogen, thermo and municipal sector hydrograph, total organic carbon analyzer, electronic flow meters, ultra centrifuge micro-pure filtration units, ion electrodes for fluoride, cyanides, NO_3 and NH_3, Spectrophotometers, continuous pH meters.

Source: EQMS India Pvt., Ltd.

Table 24: Major Waste Projects in India Financed by Housing and Urban Development Corporation, 1997-1999

Project	Cost (US$M)	Loan (US$M)	Component Financed	Year of Approval
Bagasse-based co-generation project at Satara, Maharashta	18.6	8.31	Boiler, turbine, pollution control equipment	1998
Power production from waste at Nagpur	11.26	2.78	Pre-processing equipment, manure production equipment, digestors, dual-fuel engines	1999
Bagasse-based co-generation project at Satara, Maharashta	9.53	3.92	Boiler, turbine, pollution control equipment	1999
Solid waste management for the twin cities of Hyderabad and Secunderabad	3.45	2.47	Equipment for storage, collection and transportation	1997
Solid waste management project for Cochin	2.45	1.42	Development of sanitary landfills, incinerators for medical waste	1997
Solid waste management project for Calicut	1.50	0.58	Equipment for storage, collection and transportation, Compost plant (owned by the O&M corp.)	1997
Solid waste management project for Imphal, Manipur	1.07	0.66	Equipment for collection and transportation, Compost plant	1999
Solid waste management project for Shillong	1.01	0.61	Equipment for collection and transportation, Compost plant	1998

Source: Housing and Urban Development Corporation, Ltd., and EQMS India Pvt., Ltd

Table 25: Municipal Solid Waste Disposal in Selected Countries, 1997

Country	Land filling	Op. Dumping	Composting	Incineration	Other
China	30	50	10	2	8
India	15	60	10	10	
Indonesia	10	60	15	2	13
Korea	60	20	5	5	5

Table 26: Foreign Companies Active in Korea's Market for Municipal Incinerators

Country	**Foreign Company**	**Korean Partner**
Japan	Hitachi Zosen	Daewoo Corp
	Kawasaki Heavy Industry	LG Construction
	Mitsubishi Heavy Industry	Samsung Heavy Industry
	Sanki	Kolon Engineering & Construction
	NKK	Jindo Construction
Germany	Deutsche Babcock	Hyundai Heavy Industry
	Steinmuller	Dongbu Corp
Denmark	Volund	Halla Industry Development
Belgium	Seghers	SK Engineering & Construction
France	Stein Industry	Samsung Corp
Switzerland	ABB	SK Engineering & Construction
		Hyundai Precision & Industry

Source: Adapted from: Ministry of Environment, Status of Municipal Incinerators (June 2000).

p. 285 Section II (Nakaune's Report) Table 2 Export of Environmental Equipment from Japan

(Unit: Million Yen)

	East Asia										West Asia		Others		Total	
	Korea		China		Thailand		Others		Total		Total					
	FY2000	FY2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Air pollution control equipment	336	346	2,363	993	4,953	265	7,504	3,958	15,156	5,562	2,912	5,852	3,185	5,345	21,253	16,759
1.Dust collectors	57	192	1,397	268	176	27	498	677	2,128	1,164	0	0	26	146	2,154	1,310
2.Flue gas desulfurization equipment	189	101	892	647	4,630	0	4,703	1,680	10,414	2,428	2,690	5,806	122	1,420	13,226	9,654
3.Others	90	53	74	78	147	238	2,303	1,601	2,614	1,970	222	46	3,037	3,779	5,873	5,795
Water pollution control equipment	514	618	8,497	3,408	196	171	8,125	4,291	17,332	8,488	1,813	7,903	3,818	923	22,963	17,314
1.Industrial wastewater treatment equip	420	425	3,737	754	80	46	4,630	2,715	8,867	3,940	709	1,206	696	148	10,272	5,294
2.Sewage treatment equip.	0	0	0	0	43	0	1,899	53	1,942	53	0	4,752	2,312	455	4,254	5,260
3.Others	94	193	4,760	2,654	73	125	1,596	1,523	6,523	4,495	1,104	1,945	810	320	8,437	6,760
Waste treatment equipment	1,126	129	1,761	702	20	13	6,790	4,946	9,697	5,790	55	41	946	739	10,698	6,570
1.Urban waste treatment equipment	906	94	916	125	9	5	5,274	3,825	7,105	4,049	52	20	0	20	7,157	4,089
2.Industrial waste treatment equip	10	28	474	3	0	0	184	636	668	667	0	0	696	653	1,364	1,320
3.Others	210	7	371	574	11	8	1,332	485	1,924	1,074	3	21	250	66	2,177	1,161
Noise and vibration control equipment	48	205	2	0	2	0	83	165	135	370	2	79	7	7	144	456
1.Noise control equipment	3	86	2	0	1	0	83	25	89	111	2	0	7	7	98	118
2.Vibration control equipment	45	29	0	0	1	0	0	75	46	104	0	44	0	0	46	148
3.Others	0	90	0	0	0	0	0	65	0	155	0	35	0	0	0	190
total	2,024	1,298	12,623	5,103	5,171	449	22,502	13,360	42,320	20,210	4,782	13,875	7,956	7,014	55,058	41,099