USAID Impact Evaluation No.__

Urban and Industrial Pollution Programs

INDIA CASE STUDY

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TABLE OF CONTENTS

Page 2

SUMMARY

1. BACKGROUND

    A. Urban and Industrial Pollution in India
    B. USAID's Urban and Industrial Pollution Program

2. PROGRAM ELEMENTS

    A. Economic Policies
    B. Government Regulations and Standards
    C. Education and Awareness
    D. Institution Building
    E. Technological Change

3. IMPACT

    A. Economic, Financial, and Trade Impacts
    B. Environmental Impact
    C. Health Impact

4. PROGRAM PERFORMANCE

    A. Effectiveness
    B. Sustainability
    C. Replication

5. CONCLUSIONS AND LESSONS LEARNED

ANNEXES

A. Evaluation Methodology
B. Persons Consulted
C. The U.S.-Asia Environmental Partnership in India
D. Survey of U.S. Companies
E. TEST: Status as of May 29, 2000

BIBLIOGRAPHY

2

SUMMARY

In May/June 2000, USAID's Center for Development Information and Evaluation (CDIE) fielded a four-person team to assess the impact of USAID/India's urban and industrial pollution program. The assessment focused primarily on the industrial component of the program, the Trade in Environmental Services and Technologies (TEST) project (1992-97) and its follow-on, the Clean Technology Initiative (CTI) project (on-going). But it also touched in the urban component of the program, the Financial Institutions Reform and Expansion (FIRE) project (also on-going).

The five-year TEST project had two objectives: (a) to develop U.S.-Indo business linkages that would lead to increased trade opportunities for U.S. companies supplying pollution control equipment and services; and (b) to improve environmental conditions in India. By the end of the project, TEST had provided technical assistance to 92 Indian firms, 12 of which had entered into a partnership with a U.S. firm and received loans from the Industrial Credit and Investment Corporation of India (ICICI), the Indian collaborating partner for the project. The 12 U.S. firms were located throughout the United States, including California, Florida, Georgia, Illinois, Kansas, Kentucky, Michigan, Minnesota, New Jersey, New York, North Carolina, and Texas. Likewise, the Indian firms were located throughout India: Haryana, Himichal Pradesh, Karnataka, Maharastra, Punjab, Tamil Nadu, and West Bengal. At the time of the assessment, eight of the 14 loans made to the 12 companies had been repaid in full or were in the process of being repaid, two had been restructured, and four had been cancelled or were in litigation.

The U.S. Foreign Commercial Service (FCS) estimates that U.S. suppliers were exporting $6 million worth of environmental equipment to India annually in 1991, or about 4 percent of the total market estimated at $135 million. Nine years later, in 2000, FCS estimated Indian firms imported $150 million worth of environmental services and technologies from the United States, which is 6 percent of the much larger $2.5 billion market.

It is difficult to know how much, if any, of this success can be attributed to the TEST project. In fact, the assessment found that U.S.-India trade in environmental services and technologies was hampered by both supply-side and demand-side barriers. On the supply side, U.S. companies had legitimate concerns about the time, effort, and risk involved in tapping the Indian market. On the demand side, Indian firms were hesitant to buy U.S. pollution technologies or process techniques unless demonstrations had shown they were suitable for local conditions. Even then, U.S. pollution technologies were often too expensive to find widespread acceptance in the Indian market.

U.S. companies that have been most successful in India generally have formed joint ventures or licensed their technology for local production. U.S. companies relying on the outright sale of pollution equipment have been less successful. Three of the Indian firms that obtained TEST financing entered into a joint venture, purchasing equipment directly from U.S. companies for installation in their own factories; nine firms entered into license agreements with U.S. companies, and then manufactured pollution reducing products in India to sell to other Indian

companies; and two firms provided environmental services to other Indian companies based on technical expertise obtained from U.S. companies.

Sustainability was generally achieved by those U.S.-Indo partnerships that are still in business and continue to produce and successfully market pollution control equipment and services to an expanded Indian market. The expansion of the Indian market for such services and technologies, however, hinges mainly on the extent to which the government enforces its environmental standards and regulations. This means that for most companies, the incentive to invest in pollution control measures is the "stick," not the "carrot." They want to avoid being shut down or paying fines for non-compliance. However, India's compliance and enforcement institutions are not well developed, and political will and public pressure are weak. This makes the cost of non-compliance small relative to the cost of investment in end-of-pipe controls.

Purchasing and operating pollution control technologies is expensive. Substantial capital and labor costs must be recovered, either in the selling price of the company's products or by recovering raw materials or intermediate products during the production process. To invest in pollution control equipment, companies must perceive it to be in their business interest to do so. For large Indian firms that have made this determination, lack of financing is typically not a constraint. After four years, TEST had drawn down only $10.45 million of the $20 million financing component of the project; the World Bank had a similar experience with a similar pollution prevention project. By contrast, individual small and medium firms often do require financing; also, municipalities require financing for urban environmental infrastructure.

Program performance can be assessed not only in terms of sustainability, but also replication. TEST used the "retail" approach to introduce pollution technologies to India whereby any company of any size from any industrial sector located in any part of the country was eligible to apply for a loan from ICICI. By contrast, CTI used the "wholesale" approach, which strategically targeted export-oriented companies from only three industrial sectors (automobiles, cement, and textiles). CTI also worked with industry associations (which are often able to facilitate the sharing of information among companies within the same industry) and it introduced the concept of "greening the supply chain" which can be a powerful force in replicating experience among many supplier companies. Another way to encourage replication of successful pollution control approaches is to publicize success stories widely among Indian industries. CTI and U.S.-AEP are both well positioned to boost Indian awareness of successful approaches as well as U.S. awareness of opportunities to market environmental services and technologies in India.

Replication is already taking place under the on-going FIRE-D project. Following the example of Ahmedabad, 13 other Indian municipalities have sought fiscal review so they too can be certified as credit-worthy and can issue commercial bonds to fund urban environmental infrastructure development. However, success in Ahmedabad depended first on changing the mind-set of a wide range of business and government leaders concerning private sector financing of public sector environmental infrastructure—a process that delayed the project by more than half a decade.

1. BACKGROUND

According to the World Bank, India is among the ten most industrialized countries in the world and has the world's eighth largest economy. Stimulated in large part by a program of economic liberalization beginning in 1991, India's economy grew by 5 percent per year, on average, during 1992-97. However, rapid economic and industrial growth is causing severe urban and industrial pollution. A 1995 World Bank study (cited in U.S.-AEP, p. 2; i.e., Carter Brandon and Kirsten Hommen) conservatively estimated India's annual environmental damage at $9.7 billion or 4.5 percent of gross domestic product (in 1992 prices); of this, $7 billion was due to air and water pollution.

A. Urban and Industrial Pollution in India

Data from India's National Ambient Air Quality Measuring Network indicate that 14 of the country's 20 largest cities have an air quality index of "dangerous" (Way and Worden 2000, p. 7). Moreover, Delhi, Bombay, and Madras are among the ten most polluted cities in the world (USAID/India Website, p. 1). In these and three other large Indian cities (Ahmedabad, Kanpur, and Nagpur), annual average total suspended particulates in the atmosphere are at least three times World Health Organization (WHO) standards. An estimated 37,000 lives would be saved annually if WHO standards were met in these six cities. Urban air pollution is exacerbated by increased motor vehicle use and industrial growth. In Delhi, for example, 2,000 tons of pollutants are emitted into the air each day, 63 percent of which come from vehicles, 29 percent from industry, and 8 percent from other sources (Way and Worden 2000, p. 8).

In the case of industrial water pollution, the main source is the nearly 3 million small- and medium-size firms scattered throughout the country, particularly firms that produce paper, sugar, leather, textiles, dyes, and chemicals. (Although about half the medium- to large-scale industries have at least partial effluent treatment, this is not the case with most small industries.) Toxic waste is especially serious. During 1963-91, toxic waste grew six-fold, much faster than India's four-fold industrial growth during that period. Producers of iron and steel and industrial chemicals contribute nearly 70 percent of the toxic material, but only 20 percent of industrial output. Facilities for disposal of non-hazardous industrial waste (110 million tons a year) and *safe* disposal of hazardous waste (600,000 tons a year) are minimal. Some companies are able to recycle or incinerate these wastes effectively; however, most lack wastewater treatment systems or environmentally safe means of disposal. Instead, they dispose of their polluted industrial effluent into streams and reservoirs via open drains.

State pollution control boards are India's primary pollution control enforcers. They prescribe emission and effluent standards; inspect equipment, industrial plants, and manufacturing processes; and grant permits for specified emissions levels from industries. However, they must rely on time-consuming judicial remedies to close down polluting industries; they also must bear the burden of proof in demonstrating pollution violations. Their effectiveness has been limited by the large number of small industries, lack of technical capacity to monitor hazardous waste

streams, and slow response from the courts. Poor enforcement is also due to political interference: as with other enforcement activities in India, corruption is pervasive.

B. USAID's Urban and Industrial Pollution Program

In 1992, the Government of India formulated a policy statement on pollution abatement. Consistent with the country's shift to economic liberalization, the policy statement sought to support pollution prevention not only through stronger regulations but also through market-based instruments. In that same year, USAID designed a major industrial pollution project, Trade in Environmental Services and Technologies (TEST). This project was succeeded in 1997 by the Clean Technology Initiative (CTI). A third USAID project, Financial Institutions Reform and Expansion (FIRE), supports environmental infrastructure development in urban areas and, like CTI, is an on-going activity.

Trade in Environmental Services and Technologies (TEST)

TEST was designed to "assist Indian industries to adopt environmentally sound practices while promoting sustainable linkages between U.S. and Indian firms" (Project Paper 1992). Thus, TEST was not just an environmental project; trade promotion was an equally important objective. The project authorized $25 million over five years (1992-97). After four years of implementation (September 30, 1996), USAID obligations totaled $15.450 million and disbursements totaled $8.409 million (FY 1998 Congressional Presentation, Statistical Annex, p. 105). Four months later (January 31, 1997), an external, "mid-term" evaluation of TEST was completed. Based on the evaluation's findings, TEST was redesigned to become the Clean Technology Initiative (CTI). At the same time, $4.950 million was added to the project making the total authorization $29.950 million. The project was also extended for an additional five years, until 2002.

The Industrial Credit and Investment Corporation of India (ICICI) represented the Government of India during project implementation and was responsible for the financing component of TEST. ICICI had been established by the World Bank and representatives of Indian financial institutions and private industry in 1955 as a development financing institution. Today it is listed on the New York Stock Exchange and operates on a commercial basis. Since 1985, it has been a key implementing agency for USAID programs. Of the original $25 million of USAID funds authorized under TEST, $20 million was to be loaned by ICICI to Indian companies that needed financing to procure environmental services or pollution prevention technologies from U.S. companies; the host country provided an additional $10.8 million for financing. The remaining $5 million of USAID funds was provided to a U.S. contractor (Sanders International, Inc, which is no longer in business) to identify U.S. suppliers of environmental technology and facilitate commercial transactions between U.S. and Indian firms.

ICICI established a technical unit to identify technological gaps and environmental needs of Indian companies. At the same time, the U.S. technical assistance contractor, based in the United States, helped make U.S. companies aware of market opportunities in India for environmental technologies and helped match potential partners for joint ventures and licensing

agreements. ICICI, however, played the primary role of proactive investment banker by identifying and vetting project opportunities, guiding potential partners on the final investment proposals, approving projects, and providing financial support.

The TEST project was based on five key assumptions:

- Strong regulatory and market incentives were needed for Indian industries to upgrade their environmental management.
- There was growing Indian market demand for environmental services and technologies that were not available in India.
- The United States had technically and economically competitive know-how and technologies, at least in several environmental areas.
- A severe shortage of financing options hindered commercial environmental technology transfer between India and the United States.
- A "demand driven" approach was needed because the environmental market in India was too dynamic and varied to permit targeting by sector or region.

As indicated in Part 3, many of these assumptions, critical to project success, proved invalid.

Clean Technology Initiative (CTI)

Following the 1997 mid-term evaluation, TEST was redirected to become the Clean Technology Initiative (CTI) project. Characterized as the second phase of TEST, CTI increased total funding from $25 million to $29.95 million and extended the project assistance completion date (PACD) an additional five years from September 30, 1997, to September 30, 2002. ICICI remained the primary Indian counterpart agency for CTI. However, International Resources Group (IRG) replaced Sanders International as the U.S. technical assistance contractor for CTI for two years, June 1997-September 1999. Tetra Tech won the contract for the last three years of the project. CTI was about half completed when the CDIE team visited India in May 2000.

CTI began at a time when public environmental regulation around the world was shifting away from command-and-control approaches to market-incentive and information-based strategies. The regulatory paradigm based on emissions limits that industry had to meet (by installing scrubbers, filters, and other end-of-pipe devices) was important, but inadequate. Moreover, its success relied on government enforcement of regulations, and India's enforcement capabilities were notoriously weak. The shift toward pollution-prevention and polluter-pays paradigms under CTI was grounded on business self-interest. It has two main components: promoting industrial environmental management; and promoting adaptation and transfer of cleaner industrial technologies.

The first component is targeted on specific, highly polluting industries: automobiles, cement, and textiles. It provides U.S. technical assistance to promote improved environmental management through four market-based initiatives: (a) ISO 14000 certification, (b) greening the supply chain, (c) benchmarking and rating environmental performance, and (d) industrial extension services (similar to agricultural extension services) to deliver information on environmental technologies and best practices. The success of these four initiatives is grounded on the belief that environmental performance has become a competitive factor globally and that profitability depends increasingly on how well businesses integrate sound environmental management into their business practices.

The second, trade-oriented component of CTI is untargeted. It is basically a continuation of the TEST project and, like TEST, operates through ICICI. Building on the fact that the United States is India's largest trading partner for both imports and exports, it provides financing for procuring pollution prevention and control technology from the United States. To achieve this objective, it helps identify U.S. sources of environmental services and clean technologies by supporting business exchanges and information networks.

Financial Institutions Reform and Expansion (FIRE)

Unlike the TEST and CTI projects, which were designed to address industrial pollution problems, the FIRE project addresses urban pollution problems. It has two components: FIRE-R for "regulatory" which covers government regulation of the stock market; and FIRE-D for "debt" which covers the debt market. The original project was implemented from 1994-98. It was then extended for five years which end September 30, 2003.

FIRE-D addresses two issues. The first concerns mechanisms to finance urban environmental infrastructure. The second concerns actual construction of the infrastructure so as to benefit the poor. The Project Paper (1993) identifies six expected outputs: five concern financial development and only one ("increase the number of households below the median income benefiting from infrastructure projects financed by the debt and equity markets") concerns construction. Thus, financing is the overarching concern of the project. Financing was also the primary focus of CDIE's Impact Evaluation on "Developing the Capital Market in India" (April 1999). By contrast, this assessment focuses primarily on the second issue concerning infrastructure construction.

The FIRE-D program is supported by up to $125 million in USAID Housing Guaranty (HG) loans. These loans are supplemented with development assistance funds provided to participating institutions for technical assistance and training. As of the end of FY 1997, $7.123 million had been obligated under the urban environmental infrastructure objective of FIRE, of which $4.705 million had been expended. (Comparable figures for the financial development objective of FIRE are $11.777 million in obligations and $8.361 million in expenditures.) (FY 1999 Congressional Presentation, Statistical Annex, p. 108; the CP does not disaggregate these data in terms of FIRE-D and FIRE-R).

The purpose of the HG funds is to finance urban environmental infrastructure projects. Projects eligible for funding include water supply, sanitation, solid waste management, and shelter schemes. The HG loan funds must be matched with capital raised through the Indian capital market; that is, the HG loan can provide no more than 50 percent of the costs of a project. In addition, household income of at least half of the project beneficiaries must be below the median. Perhaps the largest impact of the program to date has been in changing the mind set of planners, urban managers, and policy makers—especially their perception of the commercial viability of infrastructure and services like water supply, sewerage, and solid waste management. Traditionally these have been regarded as social welfare services, the costs of which could not be recovered.

2. PROGRAM ELEMENTS

Many USAID-funded urban and industrial pollution programs support interventions in one or more of five areas: economic policy reform; environmental regulations and standards; education and awareness campaigns; institution building; and technological change. In India, U.S. technology (and financing U.S. technology) was key.

A. Economic Policies

After almost five decades of pursuing socialist-oriented economic and protectionist industrial policies, India in 1991 began a slow shift toward economic reform and liberalization. Since then, successive policies have been introduced to encourage foreign investment and greater private sector participation in areas previously reserved for the public sector. The Government of India (GOI) has also recognized that pricing, trade, fiscal (taxes and subsidies), and monetary (interest and exchange rate) policies that had been adopted to promote rapid industrialization have had an adverse environmental impact. Inappropriate economic policies influenced both the pattern and rate of industrialization. For example, they skewed industrialization towards capital-intensive sectors, often at sub-optimal plant size, despite the fact India was a net importer of both energy and capital. They also supported expansion of industries such as cement, chemicals and petrochemicals, pulp and paper, refineries, and steel, among others, which often have significant adverse environmental effects.

Pricing and Trade Policies

Prior to 1991, the government subsidized prices of raw materials, energy, and water. This encouraged over-utilization and wasteful practices and discouraged conservation, efficiency, and recycling. When material inputs are priced artificially low, industries tend to use them intensively and expand capacity beyond what is economically justified. Tariff and non-tariff barriers to trade combined with cost-plus pricing of outputs provided little incentive for industries to maximize efficiency or utilize resources consistent with the country's resource base. Trade protection also resulted in increased pollution levels that might have been avoided if costs had been internalized. In addition, the government's emphasis on decentralized industrial development encouraged sub-optimal scales of production. Concentrating production in small- and medium-size plants in industries such as leather tanning, pulp and paper, sugar processing, and textiles, not only increases the cost of production, but also makes it difficult for companies to adopt process changes and effluent treatment measures to meet emission standards.

Since 1991, the government has begun to address some of these problems by encouraging competition through deregulation, reducing subsidies and tariffs, and instituting minimum scales of production as part of the licensing process for new industrial plants.

Market-based Instruments

The government has also introduced various market-based instruments to encourage industries to implement pollution control measures. In 1992, the Ministry of Environment and Forests

(MOEF), which is responsible for pollution prevention and control, increased effluent charges levied against industries by five to six times in an effort to reduce industrial pollution. In addition, to encourage private provision of common effluent treatment plants and toxic and hazardous waste treatment and disposal sites, the government has established a system of charges to be levied against the generators of waste. If these charges reflect the social and economic costs of pollution, they will be high enough so that waste treatment and disposal become the least-cost alternative.

In 1994, the ministry commissioned the National Institute for Public Finance and Policy to review various fiscal and regulatory incentives for pollution control. Subsequently, it adopted the use of several market-based instruments to encourage industrial pollution abatement. It also introduced an accelerated depreciation allowance on all pollution abatement equipment so that investments to acquire such equipment could be written off in one year. These and other market-based instruments, including capital grants, soft-loan financing, exemptions from duties on imported equipment, and tax holidays, are summarized below.

- **Subsidies on pollution control equipment**

  1. Excise taxes reduced from 25 percent to 15 percent
  2. Accelerated depreciation allowance increased from 30 percent to 50 percent
  3. Maximum customs duty reduced from 85 percent to 40 percent
  4. Soft loans and grants provided by government to companies to purchase pollution equipment

- **Charges**

  1. Charges on water consumption increased
  2. Consent fees for environmental clearances introduced, with lower fees for operating units that have pollution prevention or control systems
  3. Monitoring fees to review water samples for environmental compliance: the greater the pollution, the more often reviews (paid for by the company) take place

- **Enforcement incentives**

  1. Failure to comply with the Water Act: fines up to Rs. 5,000 (about US$120) and/or imprisonment
  2. Failure to comply with the Air Act: fines up to Rs. 10,000 (about US$240) and/or imprisonment
  3. Failure to comply with the Environment Act: fines up to Rs. 100,000 (about US$2,400) and/or imprisonment

Financing

Lack of financing for pollution prevention and control equipment--especially for the foreign exchange component--was seen as a major constraint to Indo-U.S. business linkages. This

included financing for (a) purchasing such equipment, (b) licensing for distribution and manufacture, and (c) formation of joint ventures. However, during implementation of the TEST project, it became clear that access to concessional financing, though important, was not critical, at least for larger industrial companies. They already had access to both the domestic capital market and external sources of funding. Smaller firms, on the other hand, often did need concessional financing but typically could not meet the lending criteria of ICICI.

ICICI lending criteria under TEST may have favored these larger firms, those that were already amenable to change and where management was keenly aware of global competition and was already undertaking pollution prevention actions to reduce resource costs, increase operational efficiency, reduce waste, enhance productivity, and increase profits. Of course, these larger Indian firms with greater managerial commitment tended to be strong financially, and thus had less need for financing. Moreover, it was primarily the large "champion" industries, often those that were export oriented or those where investments in cleaner technologies and waste minimization offered the real prospect of achieving operational and process efficiencies that made such investments. These champions also often adopted the concept of "greening the supply chain;" that is, their suppliers, which previously had generated a significantly large portion of pollution in the manufacture of components for the champion industry, agreed to reduce their pollution.

B. Government Regulations and Standards

The history of India's environmental consciousness, as expressed in law, extends well into the colonial era. For example, a law was enacted in 1860 prohibiting the pollution of water. India was the first nation to provide for environmental protection explicitly in its Constitution (Way and Worden 2000, p. 22). In 1948, a law was enacted prohibiting factories, in particular, from discharging effluents into the water. Since the early 1970s, the Indian government has enacted 16 legislative measures that provide guidelines for protecting and improving the environment. These include legislation on water pollution (in 1974 and 1977) and on air pollution (in 1981).

In 1992, the government issued a Policy Statement on Abatement of Pollution which was intended to integrate environmental considerations with decision-making at all levels. One of the key approaches used to achieve this objective was based on the "polluter pays" principle. Pollution would be prevented through cleaner manufacturing processes, pollution abatement (where effective), and end-of-pipe measures (as necessary). Successful application of this principle would require the government to establish discharge standards for industry, and here the government's intent was to shift from concentration-based to load-based standards. It would also be necessary to charge for the consumption of resources. Increased water charges would increase polluter costs, remove the incentive for polluters to dilute effluents, and strengthen measures to adopt cleaner technologies. In follow-up to the 1992 policy, the Central Pollution Control Board identified 17 highly-polluting industry sectors that needed priority action. These included cement, sugar, thermal power plants, distilleries, fertilizer plants, oil refineries, caustic soda production, petrochemicals, aluminum/copper/zinc smelting, sulphuric acid, pulp and paper, tanneries, pharmaceuticals, textiles, pesticides, metal finishing, and food processing.

Although India has made considerable progress in developing environmental protection legislation, the government's capacity and willingness to enforce environmental laws, regulations, and standards, which is critical in preventing pollution, has often been wanting. Some laws—especially those dealing with factories and the air and water pollution they cause—have been criticized for relying too heavily on self-regulation without appropriate police powers. India's Central Pollution Control Board establishes national environmental standards and is the main enforcement agency of the Ministry of Environment and Forestry; state pollution control boards may enact stricter standards. However, enforcement at both the national and state levels has been very weak according to companies interviewed by the CDIE team. As a result, judicial activism has been the key driver since 1995 in forcing companies and industries to adopt pollution prevention and control measures. The courts have a huge backlog of environmental enforcement cases, many brought before judges unqualified to understand the technical arguments. Nevertheless, such activism has led to closure of company operating units or entire industrial segments until mitigation and remediation measures were implemented.

Since the 1992 Earth Summit, India has elected four governments, and not surprisingly all have depended on fragile coalitions of political friends and enemies. However, the fundamental goal of all four governments, regardless of party composition, has been and remains economic growth, not environmental responsibility. Given the fractiousness of Indian politics, this means India is likely to concentrate resources on economic development and poverty alleviation and discount the environmental costs of its development plans. This is particularly true if there is a clear trade-off between a sound economy and good environmental practices. Confronted with this choice, India's politicians and industrial leaders are likely to opt for fewer environmental controls and less environmental enforcement (Way and Worden 2000, pp. 26-28).

C. Education and Awareness

TEST, CTI, FIRE, and the United States-Asia Environmental Partnership (U.S.-AEP) have each relied heavily on informal training programs such as seminars, case studies, and international study tours to introduce new approaches and technologies to improve environmental management and reduce urban and industrial pollution in India. Much of this educational work has been conducted through major industrial associations, including the two leading business associations in the country, the Congress of Indian Industries (CII) and the Federation of Indian Chambers of Commerce and Industry (FICCI). With support from TEST, both organizations disseminated information about the project to their members. In addition, CII prepared a comprehensive overview of "Environmental Business Opportunities in India" which was made available to both U.S. and Indian industry. CTI supplemented the original TEST agenda by promoting U.S.-based and other international voluntary business initiatives for environmental management, especially among business leaders and factory managers. Again, CII and FICCI played central roles.

CTI has benefited from a powerful new educational tool--the Internet. Indian industry's rapidly expanding access to the World Wide Web and to e-mail, coupled with rapid growth in the availability of environmental information of all kinds and from all countries on the web, is revolutionizing international technology transfer. Internet resources were in their infancy when

TEST was designed in 1991-92. At that time, FICCI began to compile information concerning relevant environmental technology for computer CD-ROM access; toward the end of TEST, in 1997, this information base was being reestablished onto a web site. FICCI's efforts have been continued under CTI, with creation of a world-class web portal devoted to clean technology and industrial efficiency. The FICCI site is sure to play a significant and continuing role in developing the Indian environmental services and technology sector as well as in promoting U.S. (and other international) business linkages.

The FIRE project has skillfully, patiently, and persistently worked with a variety of target audiences in several Indian cities to introduce innovative concepts of private sector financing of public infrastructure. As a result, municipal bonds, the first in South Asia, were issued successfully. Respondents from both public and private sectors remarked on the management changes that are sweeping the nation's major cities–giving high marks to the contributions made by USAID's educational campaign. In addition, FIRE's contractor team has compiled a series of concise summaries of the project's experience. These will help to ensure that the lessons are shared throughout India and beyond.

Each of these bilateral projects has been augmented by international travel fellowships and exchange programs available through U.S.-AEP. Most of these exchanges have been for Indian nationals going to the United States, but some were for U.S. experts and entrepreneurs to visit India. Since 1992, well over 200 U.S.-AEP exchanges have been conducted, several of which were of critical strategic importance to TEST. Drawing on that experience, CTI included a separate line for fellowships and exchanges to parallel those provided under the on-going U.S.-AEP program.

D. Institution Building

Strong public and private institutions are indispensable to ensuring clean air and water in any country. When TEST was designed, the World Bank was already active in strengthening key public sector environmental agencies. Partly because of the Bank's focus on public institutions, USAID has focused primarily on the private sector. Both TEST and CTI have done so by working with ICICI and (through ICICI) with several national-level industry associations–primarily CII and FICCI.

Under TEST, and continuing under CTI, ICICI has developed a small but capable in-house capacity to assess the financial capability of Indian companies to produce and market a range of environmental technologies in India. Investments made by these Indian companies have for the most part been successful. ICICI has become a well-established and competently managed financial intermediary, well recognized for its continuing involvement with lending to the industrial sector. With economic liberalization in the early 1990s, the entire commercial banking sector has opened up and become highly competitive. However, neither TEST nor CTI has attempted to develop the general capacity of the banking sector for environmental lending to business, nor have they attempted to stimulate access to commercial capital for environmental investments by small and medium enterprises.

As noted above, USAID has helped strengthen both CII and FICCI. CII began to establish a unit of environmental staff just as TEST was being designed, and with donor assistance has played an increasingly important role in developing the environmental agenda and commitment of its members. CII has also taken a strong and apparently effective lead in promoting adoption of ISO 14000 certification by Indian factories. Similarly, FICCI has developed a highly sophisticated information center responsive to its members' needs. The CTI project has also helped strengthen several diverse environmental NGOs. For example, it has supported efforts of the Consumer Education and Research Society (CERS) to test and measure the energy efficiency of electric appliances. The Center for Science and Environment (CSE) and the Tata Energy Research Institute (TERI) have conducted modest CTI-supported research and public education projects concerning India's greenhouse gas emissions.

One arm of the Indian government has received institution-building support from CTI: the judicial branch. Over the past decade, the Indian Supreme Court and the country's state courts have become active in pollution control cases, generally without any formal training or professional experience in environmental technology or direct familiarity with precedents from environmental law in other countries. Through a grant to the U.S.-based Environmental Law Institute (ELI), CTI has exposed a number of court justices and state lawyers to modern judicial environmental management strategies and basic information on a range of environmental issues.

The FIRE project has worked with an expanding group of municipal governments and several key national level urban agencies–the Housing and Urban Development Corporation (HUDCO), the National Institute of Urban Affairs (NIUA), and Infrastructure Leasing and Financial Services, Ltd. (IL&FS). However, India's civil service, like that of other developing countries, works at a significantly lower pay scale than the private sector, and it consistently lags the private sector in facilities and administrative technology. To help redress this problem, services that traditionally have been the domain of government officials have sometimes been privatized or contracted out. One example, just beginning to gain acceptance with support from FIRE, involves using professional architects and planners to prepare municipal development plans. FIRE has also supported the work of EXNORA International, an NGO committed to working with slum communities, and with the Ahmedabad Municipal Counsel, which is carrying out an impressive program of environmental infrastructure development to transform the city's slum communities.

E. Technological Change

A primary objective of TEST and, to a lesser extent, CTI was to promote U.S. exports of environmental technology and services to India. A USAID-funded study, "Market Survey of Proposed Trade in Environmental Services and Technology Project in India, Final Report" (November, 1991), identified technology gaps in both air and water pollution control. TEST assumed that U.S. technologies, both end-of-pipe (EOP) and process-related, would be attractive to Indian industry and that such technologies, once introduced, would be replicated through free market supply and demand mechanisms throughout the country. All that was needed, at least initially, was to match U.S. suppliers with Indian customers.

Environmental technologies could be introduced in any of three ways:

- process changes and controls that reduce waste and discharges into the environment
- EOP and process hardware, imported from U.S. suppliers or licensed for local production either in part or completely in India
- feasibility and environmental management studies

In all instances USAID assistance was intended to accelerate conversion of need to demand, demand to identification of technology, and identification of technology to commercialization that would be profitable to the U.S. supplier as well as the Indian user.

It soon became clear that the Indian market could not and would not pay U.S. prices for finished products or services having high U.S. content. (The exception was GE Turbines which required air intake filters manufactured by Donaldson--and only by Donaldson. This was driven by GE's desire to protect the turbine machinery during the warranty period.) The capability to produce most products and provide most services was and still is resident in or can be easily developed in India. Therefore, successful U.S. counterparts adjusted accordingly: they engaged in joint ventures and licensing agreements with Indian partners, though this resulted in much lower margins than they likely had hoped for. Under these agreements, most U.S. content consisted of critical components such as filter and adsorption media, design engineering, and technology transfer.

In contrast to the TEST project, the CTI project adopted a targeted, demand-driven approach. Demand for reducing pollutant discharges was identified in small, medium, and large companies of three target industries (automotive, textile, and cement). The expectation was that demonstrations of successful approaches would be replicated at other companies in the same industry. However, the range of approaches and technologies that could be considered for USAID support under CTI was limited in May 1998 as a result of U.S. sanctions imposed against India: the technologies had to demonstrate potential for reducing greenhouse gas emissions or be humanitarian in nature. Approaches that met those criteria and which were approved for USAID assistance included benchmarking techniques appropriate for the targeted industries, rating environmental performance by industry, "Greening Supply Chain Management" (GSCM), life cycle analysis of products, carbon emissions accounting, and business exchanges. Among these, GSCM holds particular promise for a positive "ripple effect," since major manufacturers require their suppliers to employ environmentally sound practices in the production of components.

In addition to applying process changes and end-of-pipe technologies at existing industries, significant opportunities exist for applying new and more efficient technologies in new industrial projects. In 1996, it was estimated that up to 80 percent of India's industrial capacity in the year 2010 will not have existed in 1996. If this estimate is even remotely accurate there is indeed a unique opportunity to incorporate new and cleaner technologies in India's new and retooled manufacturing base. Moreover, India has over 100,000 industrial enterprises with output in excess of $US 100 billion per year, and is ranked 52nd out of 59 countries by World Economic Forum in its "Global Competitiveness Report." Thus, there is much room for forward-looking investment in pollution control and process efficiency technology in India.

Given a choice between end-of-pipe technology and process changes, the latter is more desirable from a financial perspective because it costs less to reduce pollutant discharges. However, given the size and distribution of India's industry, the magnitude of environmental degradation, and the need to improve human health, end-of-pipe measures must also be considered in the short term. In many instances, an integration of both approaches will be required to demonstrate regulatory compliance and achieve near-term reductions in negative environmental impacts.

Future commercialization of U.S. technologies and services in India will depend primarily on joint ventures and licensing agreements. In the past, concerns over contract law, intellectual property rights, and legal recourse have impeded development of joint ventures. However, FICCI is currently encouraging the Indian government to amend Section 9 of the federal Companies Act in an effort to increase trust and raise confidence levels between partners. This should ease concerns over licensing and production of critical components in India and enable Indian businesses (a) to reap the benefits of India's relatively low labor costs for the manufacture of labor-intensive components, assembly, and distribution, while (b) retaining, initially, the higher margins on U.S.-supplied critical components. U.S. suppliers that partner with reliable Indian counterparts will realize profits primarily from low margins on high volumes rather than from outright sale of U.S. labor and equipment. Over time India may become an established base for fabrication and distribution of licensed U.S. technologies both in India and the entire region.

3. IMPACT

Urban and industrial pollution prevention programs can have at least three effects: economic, environmental, and health. How were these effects manifested under the TEST, CTI, and FIRE-D projects?

A. Economic, Financial, and Trade Impacts

In 1990, the Indian market for environmental technologies (air pollution control equipment, waste-water treatment systems, and toxic and hazardous waste disposal technology) and environmental management services was only $220 million. By 1994, demand for ten specific types of environmental equipment was estimated at US$ 1.9 billion (Confederation of Indian Industry, *Environmental Business Opportunities in India*, 1996, p. 36). By the year 2000, the Indian market for various types of pollution control equipment and services had increased to about US$ 2.5 billion, according to the Commercial Service of the U.S. Embassy in India--and demand is growing at 15 percent annually.

U.S. exports of environmental equipment to India increased by about 29 percent per year from 1992-95 (Halter 1997, p. 6). And as of early 1996, the United States had the largest share of environmental joint ventures with Indian firms (40 percent). According to the Commercial Service, U.S. firms are expected to meet approximately 6 percent of the $2.5 billion demand projected for 2000, or about US$ 150 million (U.S. Embassy, *India 2000 Guide for U.S. Exporters*).

Did the technical assistance and financing provided to Indian industries under TEST contribute to this increased Indo-U.S. trade?

Technical Assistance

ICICI's Technology Products and Services Division was charged with converting business linkages between U.S. and Indian firms into actual trade deals. To this end, ICICI sent letters to over 900 Indian firms (environmental service providers, engineering companies, and major industries) explaining the TEST program. It sponsored four seminars in 1993-94 targeted to potential TEST clients and hosted a booth at four different promotional events. It responded to 781 Indian companies which had requested information about the TEST program. Of 212 companies that were considered serious, ICICI prepared a preliminary list of potential U.S. environmental technologies or services for 60-65 of them. Finally, ICICI prepared special, internal reports for 17 or 18 companies, each of which had demonstrated its commitment to pollution control by paying 25 percent of the cost of the report.

At the same time, Sanders International aggressively marketed TEST in the United States. Initially, it sponsored four investment tours to the United States for 27 Indian delegates, and subsequently, in collaboration with U.S.-AEP, it sponsored 16 additional tours for 33 Indian delegates. Altogether, 33 Indian companies participated in these tours. Sanders prepared 23

research reports for individual U.S. firms assessing the strength if the Indian market for U.S. pollution control equipment and services. These U.S. firms each paid a portion of the cost of the report, estimated at $5,000 each. Sanders also sponsored nine technical assistance tours under TEST that brought U.S. advisors to India.

By 1997, TEST had provided technical assistance of one sort or another to 92 Indian companies, and of these, 25 were identified for potential trade deals (MSI 1997, p. 13, 28n). Of the 25 companies, ICICI ultimately approved 14 loans for 12 different Indian companies that entered into a trade agreement with a U.S. firm. (Two of the 12 companies, Kirloskar American Air Filter and TTG Industries, each received two loans; in other words, two Indian companies accounted for four of the 14 "deals" with U.S. companies.) Two of the 14 loans were approved in 1993; four in 1994; three in 1995; four in 1996; and one in 1997. Subsequently, ICICI approved two additional loans: one in March 2000 and another in May 2000. These loans are too recent to include in this assessment.

In addition to financing provided under the 14 "deals" between Indian and U.S. firms, which are listed below, TEST provided a grant to a trade association, the Ahmedabad Textile Industry's Research Association (ATIRA). Annex E provides a comprehensive summary of the TEST project from 1992 through May 29, 2000.

1. Kirloskar American Air Filter, Limited (KAAF); Bangalore, Karnataka
   Snyder General Corporation; Kentucky
2. Kirloskar American Air Filter, Limited (KAAF); Bangalore, Karnataka
   Engineering Mechanics Research Corporation; Michigan
3. TTG Industries, Limited; Chennai, Tamil Nadu
   Davy McKee Corporation; California
4. TTG Industries, Limited; Chennai, Tamil Nadu
   Joy Environmental Technical, Inc.; Texas, and SWEMCO, Inc.; New York
5. The Associated Cement Companies, Limited; Thane, Maharastra
   Research Cottrell, Inc.; New Jersey
6. Shreyons Industries/Agro Pulping Machinery Private, Limited; Ahmedgarh, Punjab
   Enders Process Equipment Corporation; Illinois
7. Ignifluid Boilers India, Lmited; Chennai, Tamil Nadu
   Tampella Power Corporation; Georgia
8. D. I. Filter Systems Private, Limited; Gurgaon, Haryana
   Donaldson, Inc.; Minnesota
9. Gabriel India Limited; Parwanoo, Himachal Pradesh
   Pfaulder Corporation; New York
10. Varun Flair Filtration Private, Limited;
    Pneumafil Corporation; North Carolina
11. Kothari Sugars and Chemicals, Limited; Kattur, Tamil Nadu
    Amcane International, Inc.; Minnesota
12. Batliboi Environmental Engineering, Limited; Mumbai, Maharashtra
    UEM, Inc.; Florida
13. Madhya Bharat Papers, Limited; Calcutta, West Bengal

Purification Industries International; Kansas, and Power Marketing International, Inc.; California

14. Advanced Waste Management Technologies, Limited; Andhra Pradesh
    Larsen Engineers; New York

Financing

According to ICICI, financing was provided for one of four types of industrial pollution control: (a) pollution treatment and abatement (eight loans); (b) pollution prevention (three loans); (c) clean technology (one loan); and (d) pollution services (two loans); see Annex E. Depending on the type of equipment or service, financing was provided for foreign exchange only (three companies); Indian rupees only (seven companies); or both foreign exchange and rupees (four companies). Of total financing provided by the TEST project (as distinct from other financing sources), Rs.82.0 million (27 percent) was in dollars and Rs.221.5 million (73 percent) was in rupees. The financial analyses on which loan approvals were based were carried out by ICICI as part of the due diligence process. The results of the financial analyses were confidential and not made available to USAID or the CDIE team.

The 14 U.S.-Indo linkages were of three types: (a) licensing agreements with U.S. companies under which pollution control equipment was manufactured in India to sell to Indian companies (nine loans); (b) joint ventures between U.S. companies and Indian companies (three loans); and (c) direct purchase of equipment or environmental services by Indian companies from U.S. companies (two loans). The 14 Indo-U.S. business deals completed by the end of 1997 under TEST were valued at Rs. 1,168.6 million (US$ 35.0 million). TEST financed Rs.303.5 million (US$ 9.4 million), or 26 percent of total project costs, and ICICI and the individual firms financed the remainder; see Annex E. Interest rates were subsidized at 1.5 to 3.0 percentage points below the market rate in order to encourage Indian companies to risk investing with U.S. partners in the manufacture of new pollution control technologies, untried in India. The follow-on CTI project was designed to reduce risk further by funding demonstration activities for new, clean technologies that firms wanted to adopt.

As of September 30, 1996, all borrowers were repaying their loans on schedule (Halter 1997). As of May 29, 2000, however, this was no longer the case. Of the14 ICICI loans, two had been repaid in full, six were in the process of being repaid, two had been restructured, and four had been cancelled or were in litigation; see Annex E.

A major conclusion of the mid-term evaluation was that, contrary to project assumptions, financing to procure environmental technology was not a constraint in India. As a result, the financing component of TEST was not critical in "making the transaction happen" (Halter 1997, p. 14, 18). In fact, TEST technical assistance generated several commercial transactions with U.S. companies even without TEST financing (Halter 1997, pp. 13, 28n). In addition, every borrower interviewed during the mid-term evaluation said that acceptable financing would have been available from sources other than TEST, though perhaps not as quickly, or on terms as favorable, as TEST. The CDIE team interviewed representatives of three firms: Kirloskar American Air Filter (KAAF), Agro Pulping Machinery, and D. I. Filter Systems. All three

indicated that TEST financing was helpful because it accelerated business transactions, but that it was not essential. The World Bank drew the same conclusion—that financing was not a key constraint--and for that reason canceled the credit component of its Pollution Prevention Project. However, both ICICI and Sanders International, Inc. question this finding, believing that the Indian firms underestimated the importance of obtaining TEST financing.

Sales of Pollution Control Equipment

The overall financial effects of the TEST project are unknown. This is because ICICI tracked sales of pollution control equipment and services by only two of the 12 Indian companies that received loans under TEST (KAAF and TTG Industries). KAAF, one of companies visited by the CDIE team, is a joint venture formed by the Kirloskar Group of India and American Air Filter International (AAF) of Louisville, Kentucky. The relationship began in 1988 when Mr. Snyder, then owner of AAF, met Mr. Kirloskar, founder of the Kirloskar Group. At the time, neither was prepared to make the initial capital investment to start a joint venture. But in 1992, TEST provided the seed assets need to seal the joint venture agreement. KAAF received approximately US$1.8 million in loans to manufacture pollution control equipment under license from Snyder General Corporation, the U.S. company that owns American Air Filter. Fabrication of filter frames and supports, housings, and ancillary ductwork for air pollution products is carried out at the KAAF facility in India. However, certain materials (filter media, absorption media, and process controllers) are imported from the United States. Certain materials for wastewater treatment facilities (reverse osmosis and other filter media) are also imported from the United States.

KAAF has successfully marketed pollution control services and products to large, world-class industrial facilities in India. Table 1 summarizes total sales of both air and water pollution control equipment during 1992-99 as reported by the company. For air pollution equipment, total sales were Rs. 2,285 million (US$ 66.2 million) spread over some 710 individual orders from Indian companies. Major industrial clients included the iron and steel industry (six companies), the cement industry (five companies), and one company in both the pulp and paper industry and the acrylics industry. Though not reported in Table 1, KAAF's air pollution control business declined by 44 percent between 1992-95 and 1996-99 (from Rs. 1,465 million to Rs. 820 million), primarily because of the downturn in the iron and steel and pulp and paper businesses in India.

For water pollution equipment, KAAF sales were Rs. 1,150 million (US$ 33.3 million) spread over 50 individual orders from companies in ten industrial sectors. KAAF sold water pollution control equipment to five companies in the iron and steel industry, three companies in the automobile industry, and one company in each of eight other industries: dairy, food and beverage, copper, oil and gas, detergent, petrochemicals, aluminum, and power. Water quantity and quality have become major concerns in India in recent years. As a result, KAAF's sales of water pollution control equipment have more than doubled from Rs. 355 million during 1992-95 to Rs. 795 million during 1996-99.

Table 1. Estimated Value of Kirloskar AAF Sales, 1992-99

Type of Equipment	Number of Orders	Value (Millions of Rupees)	Value (Millions of US$*)
Air Pollution Control Equipment			
1. Baghouse, Bag Filters, and Scrubbers	70	1,075	31.16
2. Electrostatic Precipitators	25	735	21.30
3. Machinery Filtration and Acoustic Systems and Standard Products	615	475	13.77
Total	710	2,285	66.23
Water Pollution Control Equipment			
1. Effluents and Waste Water Treatment Plants	39	830	24.06
2. Sewage Treatment Plants	2	10	0.29
3. Raw Water Treatment and Demineralization Plants	9	310	8.98
Total	50	1,150	33.33

* Average exchange rate during 1992-99 was US$ 1.00 = Rs. 34.5.

Source: Kirloskar AAF Limited, "A Report on Environmental Impact through KAAF," May 25, 2000.

Regulatory requirements, particularly those affecting major industries that burn dirty coal and foundries, have been the primary market driver of KAAF sales. Corporate strategy has been of lesser importance, and then only to multinational corporations and companies that rely on export markets. Increased profitability of the client firm has not been an important factor driving KAAF sales. In fact, increased profitability is the exception rather than the rule, since the costs of regulatory noncompliance have not been fully internalized by industry. However, companies in coal-burning industries that burn lower quality (cheaper) fuel that still satisfies emission limits have realized some savings. Savings have also been realized in the cement industry through recovery and reintroduction of fine particles collected in the baghouses.

The CDIE evaluation team also visited other TEST participants including Agro Pulping Machinery Private, Limited (APMPL). APMPL is part of the Chellam group of companies of Chennai in Tamil Nadu. ICICI made an initial US$3 million loan to APMPL, of which US$1 million was provided under TEST; loans covered by TEST eventually totaled US$2.0 million; see Annex E. After setting up a demonstration unit at the agro-based manufacturing plant of Shreyans Industries Limited in Punjab, APMPL showed that imported U.S. technology for fluid bed chemical recovery provided a promising solution for small agro-based paper pulping units throughout India. Approximately 200 agro-based paper mills in India could benefit from this technology. Under its 10-year license from Enders Process Equipment Corporation of the United States, APMPL agreed to pay the U.S. company a 12 percent royalty fee for every system sold during the ten years. Savings achieved through use of the Enders equipment were estimated at Rs. 517,000 (about US$ 14,000) per month.

D. I. Filter Systems in Gurgaon, Haryana, received a $500,000 loan under TEST in 1994; see Annex E. This enabled the company to manufacture filters for gas turbine engines under a joint venture between Mundratech of New Delhi (a United Kingdom-based group of non-resident Indians) and Donaldson, Inc. of Minnesota. In 1999, Donaldson bought out the Mundratech group, and D. I. Filter Systems now operates as a wholly owned subsidiary of Donaldson. Taking advantage of the close working relationship between Donaldson and G.E. Power Systems, one of the main suppliers of gas turbine systems for power generation in India, D. I. Filter provides air filtration systems to 97 gas turbine projects throughout India with annual sales valued at about US$ 7 million. The company also sells air filtration systems to the automobile market (valued at about US$ 10 million annually) and to the industrial dust collection market (valued at about US$ 3 million annually). About 40 percent of the value of an air filter system is imported directly from the parent company, Donaldson, in the United States and then assembled by D. I. Filter. Because D. I. Filter has relatively low production costs, Donaldson expects it will become the hub for much of the company's air filtration business throughout Asia and the Far East. This means that operations currently located in Australia, Japan, and Korea will need to relocate to India.

The market for clean technology equipment and services in the dyestuffs and textiles industry is substantial. The Ahmedabad Textile Industry's Research Association (ATIRA), which is supported by CTI, estimates that the market at six factories alone was over US$ 800 million over a 3 to 5 year period. Of this, over US$ 450 million represents market potential for U.S. suppliers. Paybacks through cost savings were typically less than one year, which is the sort of return on investment that will promote and accelerate technological change in key industrial sectors. Indian Dyestuffs Industries Limited (IDI) is a case in point. It also is an example of a company that invested in air pollution control and prevention equipment valued at Rs. 30 million (approximately US$ 700,000) without ICICI funding. These investments helped the company reduce water consumption from 8 million gallons per day to 6 million gallons per day during 1995, and to 4 million gallons per day by 1999. Savings amounted to about Rs. 19.5 million per year (about US$ 460,000). IDI has also undertaken measures to reduce waste and recycle resources such as nitrobenzene and pyridine. This has resulted in savings of approximately Rs. 7.5 million per year (about US$ 175,000).

While not necessarily representative, the collective experience of these companies—KAAF, Agro Pulping Machinery, D. I. Filter Systems, and Indian Dyestuffs Industries—provides at least anecdotal evidence of the financial benefits of investing in industrial pollution control measures in India.

B. Environmental Impact

Pollution control devices or process changes, once installed or implemented under USAID programs, no doubt resulted in reduced emissions into the atmosphere and effluents into the water. However, it is not possible to quantify these changes in environmental quality over time, because initial air and water quality are not known. Contemporaneous increases or decreases in discharges from sources unrelated to the USAID projects are also unknown, as are changes in the transport of pollutants from non-project to project areas. Without baseline data, continuous

sampling of air and water quality, and source attribution studies, it is impossible to quantify changes in net air and water quality resulting from implementation of new technologies. As indicated in the final report for the TEST project, insufficient resources had been allocated for monitoring program impact. According to the Ministry of Environment and Forestry, there are over 290 air quality monitoring stations in over 90 towns and cities throughout India, but the data are unreliable and of poor quality. Water quality data, collected at over 480 stations, suffer from the same deficiencies, though to a lesser extent than air quality data.

Notwithstanding the positive effects of USAID interventions, air quality in India continues to decline. This is due to the increased number of vehicles on the road and resultant vehicular emissions. Between 1980 and 1995, the population of Delhi grew by 67 percent, while the number of vehicles increased by over 300 percent. Poorer air quality is also due to industrial growth, whereby increased industrial output results in increased pollutant discharges (though pollutant discharges per unit of output may be less). The relative importance of industrial, vehicular, and domestic emissions of air pollutants has changed over time. Delhi is a case in point. Table 2 indicates that industry caused 56 percent of Delhi's air pollution in 1970-71; but 30 years later, in 2000-01, industry was causing only 20 percent of the city's air pollution. By contrast, vehicles caused only 23 percent of Delhi's air pollution in 1970-71; they now are the biggest polluters, causing 72 percent of Delhi's air pollution. Air quality continues to deteriorate in Delhi in spite of vehicle emissions testing requirements and relocating industries further from the city.

Table 2. Air Pollution in Delhi, by Source, Percent, 1970-71 to 2000-01

Source	1970-71	1980-81	1990-91	2000-01
Industrial	56	40	29	20
Vehicular	23	42	63	72
Domestic	21	18	8	8
Total	100	100	100	100

Source: World Environment Federation (WEF), 1995.

As noted above, Kirloskar American Air Filter (KAAF) supplies air and water pollution control equipment to major industries in India. Table 3 shows that substantial reductions in emissions of particulate matter (6,312 tons per day) were realized during 1992-99 through installation of KAAF systems and technologies at four industries: ferrous metal, cement, pulp and paper, and acrylics. However, most reductions in particulate matter, 78 percent, occurred at cement factories. Table 4 shows equally impressive reductions of water pollutants (BOD, COD, suspended solids, oil and grease, metals, fluorides and acidic or basic effluents) achieved through the treatment of industrial effluents using technology supplied by KAAF.

Table 3. Reductions in Air Pollution from Industries Served by KAAF, 1992-99

Industry	Emission Reductions (tons of particulate matter per day)
Iron and Steel	1,212
Cement	4,944
Pulp and Paper	60
Acrylics	96
Total	6,312

Source: Kirloskar AAF Limited, "A Report on Environmental Impact through KAAF," May 25, 2000.

Table 4. Reductions in Water Pollution from Industries Served by KAAF, 1992-99, Parts per Million

Industry	BOD	COD	SS	O&G	TSS	Zn	Ni	Cu	Pb	Poh	PH
Dairy	1170	1950	400	390	-	-	-	-	-	-	-
Food/Beverage	1970	3750	450	-	-	-	-	-	-	-	-
Copper	-	-	2400	-	-	10	2	7	-	-	-
Oil & Gas	1585	3900	-	3490	-	-	-	-	-	-	-
Detergent	220	150	-	990	-	-	-	-	-	-	-
Petrochemical	550	800	-	490	-	-	-	-	-	-	-
Aluminum	-	-	-	-	49	-	-	-	-	-	-
Power	-	-	400	45	-	-	-	-	-	-	-
Iron & Steel	-	-	13500	480	-	-	-	-	-	-	101
Automobile	570	950	450	6480	-	95	65	-	29.9	1645	-

Source: Kirloskar AAF Limited, "A Report on Environmental Impact through KAAF," May 25, 2000.

Sales at KAAF and other companies that manufacture environmental pollution control equipment are likely to grow due to continued high levels of air and water pollution, increased public awareness of poor environmental quality, public demands for action, and judiciary actions. On the other hand, the apparent inability of the government to monitor and enforce environmental compliance will hinder further success at KAAF.

The FIRE-D project has considerable potential for improving water quality in India's low-income communities (its primary target area) through development of basic municipal services including water supply, sewerage removal and treatment, trash collection, and electric utilities. Although it is too early to quantify the project's environmental impacts, there is no doubt that overall water quality and to a lesser extent air quality will improve.

C. Health Impact

Approximately two percent of Delhi residents age 15-44 die prematurely due to respiratory or cardiovascular disorders directly attributable to or exacerbated by air pollution. Judging from ratios of emissions to total population, it is likely that the incidence of premature death due to chronic exposure to air pollutants is similar in other major urban centers of India. Poor water quality is also detrimental to human health. The country's inadequate capacity to produce and deliver potable water result in diarrheal disease, dehydration, and related complications which, in turn, are reflected in high death rates among infants, children, and the elderly. The poor are disproportionately affected by air and water pollution due to where they work and reside–and as a group they are least likely to seek (or be able to afford) medical care.

No baseline or ongoing surveillance data were generated under TEST, CTI, or FIRE-D to permit an analysis of the relationship between changes in environmental quality and in human morbidity or mortality. This problem is compounded by the fact that autopsies to determine cause of death are generally not performed in the case of non-violent death. Although adequate data do not exist to estimate the incremental health effects of USAID activities, provision of basic services such as potable water and trash pickup and support of environmental infrastructure including sewer systems and electric power in low-income areas where FIRE-D is being implemented are bound to improve human health.

USAID's "slum networking" project in Ahmedabad is a case in point. Ahmedabad is the seventh largest city in India with a population of 3.2 million. Forty percent, 1.25 million people, live in 2,412 slums or near-slums. The slum networking project is designed to provide physical infrastructure (individual piped water supply, underground sewerage, individual toilets, drainage, etc.) to families living in these areas. The cost is about Rs. 14,600 ($365) per family. Most costs ($255 per family) are covered by the Ahmedabad Municipal Council, using funds raised on the bond market with support from FIRE-D and USAID's Housing Guarantee program. Remaining costs are covered by private industries and NGOs ($60) and each beneficiary family ($50). Since most slum-dweller families do not have $50 readily available, they must secure a commercial loan. The interest rate on such loans was 18 percent in May 2000, and the repayment period was generally less than two years. Physical infrastructure has been built in eight slums; it is currently being built in nine slums; and it is in the planning stage in three slums. About 93 families (of 5-6 persons each) live in each slum, on average, but this varies considerably from one slum to another.

Unfortunately, systematic monitoring procedures are not in place and no "before" and "after" surveys have been undertaken. However, it's worth reporting that beneficiaries interviewed by the CDIE evaluation team said there has been considerable improvement in the health standards in the slum areas affected. Individual toilets, in particular, have reduced water stagnation and the menace of mosquitoes and flies. Beneficiaries also reported fewer visits to doctors and hospitals, but hard data to substantiate these claims are not available.

Thus, efforts to assess the financial, environmental, and health impacts of these USAID-funded urban and industrial pollution projects were seriously hampered by lack of basic data. According to the mid-term evaluation of TEST, the most critical lesson learned may be the need to strengthen design, monitoring, and reporting for project indicators. Not only is it necessary to

monitor short-term outputs (number of organizations assisted, number of tours, volume of sales) to satisfy reporting requirements; it is also important to gather data for appropriate indicators to permit evaluation of long-term impact. The evaluation states: "TEST certainly contributes to achieving SO_5—'improved air and water quality at selected industrial sites and municipalities'--, but there is presently no way to measure specific impact" (Halter 1997, p. 11). To make the claim, for example, that there was a 97 percent reduction of air pollutants at 11 plants using equipment manufactured by one of TEST's borrowers would have required baseline data in the affected area at each plant (Halter 1997, pp. 12, n23). No such data had been collected.

4. PROGRAM PERFORMANCE

Program performance is normally assessed in terms of (a) its effectiveness, (b) whether benefits were sustained after donor funding ended, and (c) the extent to which activities were replicated beyond the project.

A. Effectiveness

Effectiveness is a measure of how appropriate an intervention is in achieving program objectives. Were benefits significant? Were they generated through a strategy that worked with the right people? Was the approach the best way to use USAID resources to get the job done? The job in the case of TEST was to accelerate the development of India's environmental services and technology sector while promoting business opportunities for U.S. companies. The on-going CTI project has similar goals, but concentrates on helping the leaders of Indian industry become more competitive in international markets through environmental initiatives. FIRE-D, also on-going, has two goals: (a) promoting innovations in *financing* urban environmental infrastructure, and (b) actually *constructing* urban environmental infrastructure to benefit the poor. The overall effectiveness of the three projects, particularly of TEST, is not clear-cut.

The pre-project market survey conducted for TEST in 1991 identified several environmental technologies and services in which the United States apparently had clear superiority over Indian technologies and services. These included environmental auditing, hazardous waste management, clean production, groundwater remediation, and technology for common effluent treatment plants. However, demonstration projects supported under TEST and CTI included few of these technologies. Instead, they tended to focus on technologies that could be manufactured by both Indian and U.S. companies such as air filters and wastewater treatment systems. However, there were exceptions. For example, the process for treating black liquor developed by Agro Pulping Machinery Private Limited (APMPL) drew upon a superior U.S. technology from Enders Process Equipment Corporation, then adapted it to the Indian situation where agricultural residues rather than timber are the primary raw materials for producing pulp and paper.

Nevertheless, it was clear early on that India did not lack the capability to manufacture pollution control equipment and that importing finished equipment from the United States would be unattractive. This explains why 12 of the 14 ICICI loans under TEST were for Indo-U.S. joint ventures or licensed production arrangements; only two loans were to import services or products directly from the United States. Hundreds of Indian firms had been approached during project design and the early implementation stages of TEST to determine their interest in acquiring U.S. environmental technologies and services. Five years later in 1997, only 14 "deals" had been completed with 12 Indian companies (since two Indian companies received two loans each). Of the $25 million authorized in 1992 to provide technical assistance and financing for Indian companies, only $15.450 million had been obligated by 1997. The remaining $9.550 million was subsequently rolled into the follow-on CTI project. These findings raise questions about the effectiveness of the approach used by TEST.

TEST's environmental benefits will be multiplied many times over as the 12 companies that received loans sell environmental equipment and services to various Indian industries. Nevertheless, the question lingers: was it necessary to subsidize loans for these environmental investments, especially when the subsidy was only a few percentage points below market rates of interest? According to the mid-term evaluation (Halter 1997), only two of the business collaborations were originally fostered by ICICI or Sanders International. The others were already in process and almost certainly would have proceeded even without the TEST project. The question arises with CTI as well. CTI has adopted a "wholesale" approach to building better environmental management systems and practices among Indian industry by stimulating demand for environmental services and technologies. Still, it continues the financing program initiated under TEST, even though financing may not be essential to achieving CTI project objectives.

USAID efforts to improve industrial pollution control in India would likely have been more effective if the state pollution control boards had improved their capability to enforce regulations and standards, as anticipated. In 1991, the public was voicing its demand for better enforcement, and the World Bank began supporting activities designed to improve enforcement. The World Bank now indicates that its efforts have had very limited success, and much of the funding for its pollution prevention and control projects has been reprogrammed. Corruption and lack of political will remain severe constraints to enforcing industrial compliance with environmental standards. Acting in response to an increasing number of public interest lawsuits, India's Supreme Court and several state courts (rather than the state pollution control boards) have become the primary source of enforcement actions.

TEST and CTI have been closely associated with activities supported under the U.S.-Asia Environmental Partnership (U.S.-AEP); see annex C. Viewed collectively, these three activities provide a program of comprehensive support to improving India's industrial environmental management practices–at least among larger, export-oriented (or supply chain) firms–while at the same time promoting U.S.-Indo environmental business collaborations. FIRE-D has also benefited from working with U.S.-AEP and has met many of its basic objectives, although at a much slower pace than originally anticipated. As a result, construction of urban environmental infrastructure has been completed in only a few areas of a few municipalities and only recently.

B. Sustainability

Sustainability concerns the extent to which a program continues to deliver benefits after development assistance ends. TEST will prove sustainable if the 12 companies that received loans from ICICI to invest in pollution control equipment and services are able to meet an expanded market demand for their products and services; in other words, if they remain in business. This depends in part on the expansion of the Indian market for such services and technologies, which in turn hinges mainly on the extent to which the government enforces its environmental standards and regulations. Pollution problems are worsening in India, judicial determinations are continuing, and public awareness is growing. This suggests that pressure for enforcement will increase. In addition, international market demand may spur forward-looking businesses to take their own "voluntary" initiatives.

Development assistance for TEST ended in 1997. But CTI and FIRE-D are on-going activities, making it is too early to assess sustainability for these two programs. In the case of FIRE-D, however, one thing is clear. Considerable time has been required—more than was anticipated during project design--to achieve the intangible change in mind-set that was a precondition to achieving the more tangible infrastructure objectives. This was because the idea of using the private capital market to raise funds to construct urban environmental infrastructure was an entirely new concept for business and government leaders. Acceptance of municipal bonds as a means of financing public projects, though time-consuming, has now been overcome. This aspect of FIRE-D was recently assessed by CDIE (Fox 1999).

Infrastructure projects have been initiated in only two municipalities, but construction is likely to proceed smoothly elsewhere. Yet to come is a new set of formidable challenges--establishing economically sound yet politically acceptable water charges, effective collection of user fees, and timely repayment of the municipal bonds guaranteed by FIRE-D. Only then will it be possible to assess the sustainability of FIRE-D.

C. Replication

As indicated above, sustainability was generally achieved for those U.S.-Indo partnerships that are still in business and continue to produce and successfully market pollution equipment and services to Indian companies. Replication, in contrast to sustainability, concerns the extent to which the TEST project model was adapted or duplicated by others outside the project area, thereby bringing about widespread change. Two indicators can, perhaps, help assess replication. First, to what extent has the Indian market for U.S. environmental services and technologies grown? Second, to what extent have Indian companies turned to commercial lenders, especially lenders other than ICICI, to secure financing for environmental services, pollution control equipment, or clean production technologies?

The market for commercial U.S.-Indian pollution control ventures clearly has expanded since TEST began in 1992. The U.S. Foreign Commercial Service (FCS) estimated that in 1991 U.S. suppliers were exporting $6 million of environmental equipment to India annually, or about 4 per cent of the estimated total market of $135 million (Tropical Research and Development 1991). Nine years later, in the year 2000, FCS estimates the Indian market for pollution control equipment at $2.5 billion, and that Indian firms will import $150 million worth of environmental services and technologies from the United States–6 percent of total market share (U.S. Embassy 2000). This may be a conservative estimate, since FCS estimates do not appear to capture joint venture sales such as those represented by 3 of the 14 "deals" under TEST. Thus, the U.S. *share* of the Indian market for environmental equipment and services increased rather modestly, from 4 percent in 1991 to 6 percent in 2000. Yet, the overall Indian market increased substantially, from $135 million to $2.5 billion, so that the volume of U.S. exports to that market is 25 times larger today than it was in 1991. Moreover, the market is expected to grow at 15 per cent annually.

It is difficult to determine how much of this increase in U.S. market share and in total U.S. exports might be attributed to TEST and CTI. Although information on market opportunities in

India was developed under TEST and disseminated widely in the United States, it remains unclear how this information might have been used. There are no specific examples of U.S. companies that increased their exports of environmental equipment or services to India because of the experience of the companies that participated under TEST and CTI.

Regarding the second potential indicator of replication, it is unknown how many, if any, Indian companies have turned to commercial lenders to secure financing for pollution control equipment because data are not available. ICICI staff was not aware of any other commercial banks that had begun to lend for investments in such equipment. It is likely that efforts made under TEST and CTI, complemented by those under U.S.-AEP, have boosted both U.S. and Indian awareness of market opportunities in India for environmental services and technologies. However, the extent to which this improved awareness and market information has stimulated other ventures—not to mention the commercial financing of other ventures—cannot be determined.

The credit fund created by USAID at ICICI may be an alternative to commercial lending in the short run. As long as the fund remains solvent and as long as ICICI continues to lend to industries to manufacture pollution control technologies, benefits will be replicated. Of course, for the fund to remain solvent, borrowers must not default. According to ICICI, eight firms were repaying (or had repaid) their loans on schedule as of May 2000. Two firms were having difficulty repaying, and their loans were restructured, and ICICI had cancelled the loans for four other firms; see annex E.

One way to encourage replication of successful pollution control approaches is to publicize success stories widely among Indian industries. This has proved effective in similar USAID environmental demonstration projects elsewhere in Asia. U.S.-AEP, for example, has used this approach, and U.S.-AEP experience is relatively well known. By contrast, TEST's experience is relatively unknown. Both CTI and U.S.-AEP might usefully assist in publicizing TEST's successful experience. CTI supports international market-oriented business management initiatives as well as information and communication services. U.S.-AEP has established a small, hardworking team of field-based technical representatives in major Indian cities. Both programs, especially U.S.-AEP's "tech reps," have worked synergistically to boost U.S. awareness of and responsiveness to Indian environmental business opportunities.

Although FIRE-D is an on-going activity, it appears that replication is already occurring. Following the example of Ahmedabad, the first municipality in India certified as credit-worthy for the purpose of issuing unsecured commercial bonds, 13 other municipalities have sought fiscal review.

5. CONCLUSIONS AND LESSONS LEARNED

During the 1990s, USAID supported three environmental programs in urban and industrial pollution reduction in India. The TEST project was completed in 1997; the CTI and FIRE-D projects (as well as U.S.-AEP) are still being implemented. What lessons emerge from this experience?

1. "Changing the Mind-set." *Changing the mind-set of key business and government leaders with respect to environmental management is staff intensive and takes considerable time, but is essential if pollution control technologies, environmental management systems, and urban development are to be widely adopted.*

In India, the FIRE-D project has brought about significant changes in urban development by introducing the concept of private sector financing of public sector environmental infrastructure. Professional urban planning is another new concept introduced and supported by FIRE-D. USAID is widely praised by Indian counterparts for carefully nurturing these ideas. However, this process of changing the mind-set of a wide array of Indian stakeholders has delayed the FIRE-D project considerably—by more than half a decade—insofar as establishing on-the-ground environmental infrastructure is concerned. Now that local champions are bringing credibility, continuity, and public support to urban development, tangible accomplishments have begun to emerge, and there is some ground for hope that they will become widespread.

The situation is similar though not as dramatic with the CTI project and U.S.-AEP. With USAID support, new international standards of voluntary business practices are being introduced and cultivated through extensive seminars and information exchange. This has contributed to improved industrial awareness of various environmental management techniques including benchmarking, greening the supply chain, and ISO 14000 certification.

2. Financial Benefits. *Companies will not invest in pollution control technologies or environmental management systems unless they perceive it to be in their business interest to do so.*

Purchasing and operating pollution control technology, especially end-of-pipe systems such as waste-water treatment plants and systems to control air or water pollution, is expensive. To justify the investment, companies need to recover the substantial capital and labor costs, either in the selling price of their products or by recovering raw materials or intermediate products. When environmental performance is a competitive factor in the global market, companies may adopt environmental management initiatives that reduce industrial pollution in order to gain access to international markets. CTI's emphasis on ISO 14000 certification and the concept of greening the supply chain are grounded on the principle that environmental performance can help a company compete globally. In 1999, 150 Indian firms were ISO 14001 certified compared to only 25 in 1997—and many of these firms learned about the certification process through CTI. By 1999, a major Indian company had adopted a program to green the supply chain, again with CTI assistance. CTI also introduced benchmarking techniques to India, which help companies

understand how to optimize financial returns by reducing both production costs and pollution emissions. By 1999, CTI had supported 12 demonstration projects in the use of benchmarking.

3. Regulation. *Companies are likely to acquire pollution control technologies only if there is strict enforcement of environmental standards.*

Financial benefits alone are rarely sufficient to justify investments in pollution control technologies and environmental management systems. Companies that invest generally do so to avoid being shut down or paying fines for non-compliance with environmental standards and regulations. For most companies, the incentive to invest is the stick, not the carrot. Although environmental standards and regulations are well-established in India, enforcement by state pollution control boards generally remains lax because India's institutions are poorly developed, and political will and public pressure are weak. As a result, companies often decide not to comply with pollution standards, and instead take remedial action only in response to litigation and judicial rulings (which can take years). Since the cost of non-compliance is typically small relative to the cost of investing in end-of-pipe controls, this makes financial sense. Environmental compliance is likely to be more widespread when companies adopt pollution prevention technologies that focus on process and management changes. These technologies, emphasized by CTI, often have greater financial as well as environmental benefits.

4. Trade. *U.S. companies may not be interested in exporting environmental services and technologies to India. Nor are Indian companies necessarily interested in buying U.S. services and technologies.*

Both supply-side and demand-side barriers hamper U.S./India trade in environmental services and technologies. On the supply side, U.S. companies often have legitimate concerns about the time, effort, and risk involved in tapping the Indian market for such services and technologies. On the demand side, Indian firms are unlikely to buy U.S. pollution technologies or process techniques unless demonstrations have shown they are suitable for local conditions—and Indian financial institutions are unlikely to loan funds for the purchase of untested technologies. In addition, U.S. pollution technologies are typically too expensive to find widespread acceptance in the Indian market. U.S. companies that have been most successful in India generally have formed joint ventures or licensed their technology for local production, in both cases reducing the delivery price. U.S. companies relying on the outright sale of pollution equipment have been less successful.

5. Credit. *Lack of financing is typically not a constraint for large Indian firms that want to procure pollution reduction technology. However, it often is a constraint for individual small and medium firms and for municipalities that want to finance environmental infrastructure.*

The TEST project assumed Indian companies would be unable to purchase pollution reduction technology from U. S. suppliers due to lack of financing. Therefore, it provided a $20 million credit component with loans subsidized at 1.5 to 3.0 percentage points below the market rate of interest. After four years, Indian companies had borrowed only $10.450 million. The World Bank also provided a line of credit under its industrial pollution prevention project, but there was

little demand for financing, so the Bank cancelled the credit component of its project. Thus, lack of financing is not a serious constraint for large Indian companies (or clusters of small- and medium-size companies) that want to procure pollution technology. These companies are able to secure such financing, and they are willing to pay market rates of interest.

By contrast, individual small- and medium-size companies often do require financing. However, TEST did not expressly focus on these companies, perhaps because they were unlikely to satisfy lending criteria established by ICICI or because of high transactions costs. Municipalities in India also require financing, not for industrial pollution control but for urban environmental infrastructure. FIRE-D has assisted Ahmedabad and several other Indian municipalities tackle this problem, so far successfully.

6. Replication. *A key to replicating technology transfer projects is careful targeting with an eye to sharing and spreading successful results.*

TEST used the "retail" approach to introduce pollution control technologies in India. Companies were not targeted. Instead, any company of any size from any industrial sector located in any part of the country was eligible to apply for a loan from ICICI. By contrast, CTI used the "wholesale" approach. Companies were strategically targeted. Export-oriented companies from three industrial sectors received priority, including a small, medium, and large company from each sector. Unlike TEST, CTI is also working with industry associations, which are often able to facilitate the sharing of information among companies within the same industry. CTI is also introducing the concept of "greening the supply chain" which can be a powerful force in replicating environmental management systems from one company to numerous supplier companies. Both approaches, though, can encourage replication as long as the initial firms receiving assistance are explicitly expected to help spread successful results.

7. Baseline Data. *Baseline data are needed to assess program impact.*

Baseline data were typically not gathered under the TEST, CTI, or FIRE-D projects prior to project implementation. Data on environmental quality in Indian cities, discharge rates from industrial sectors, and epidemiological and other health data for populations located near industrial zones or participating companies were not available to the evaluation team. Lack of baseline data greatly reduces the ability to conduct an accurate assessment of environmental and health impacts.

ANNEX A

Evaluation Methodology

A four-person CDIE team visited India during a three-week period, May 18-June 9, 2000, to gather data needed to assess the impact of USAID-supported projects in urban and industrial pollution control and prevention. Three projects fell within this mandate: Trade in Environmental Services and Technologies, TEST (1992-97); Clean Technology Initiative, CTI (1997-2002); and Financial Institutions Reform and Expansion, FIRE (1994-2003). The team relied primarily on three sources of data: documents not available in the United States, key informant interviews, and site visits. The team had already reviewed project documentation available in Washington and had interviewed persons based in Washington who were knowledgeable about urban and industrial pollution programs implemented by USAID/India during the 1990s—a former USAID mission director, a former environmental project officer, and two U.S. based contractors, among others.

Interviews in India were carried out with a broad range of people. In addition to USAID staff, the team interviewed U.S.-AEP officers (in both Delhi and Chennai), one other donor (the World Bank), and USAID contractors for all three projects (both former contractors and in the case of on-going projects, present contractors). The team met with Government of India officials at the state and local levels in Tamil Nadu (Chennai), Mysore (Bangalore), and Gujarat (Ahmedabad). The team interviewed representatives from the Industrial Credit and Investment Corporation of India (ICICI), which was USAID's main counterpart agency for the TEST and CTI projects as well as representatives from the National Institute of Urban Affairs, the counterpart agency for the FIRE project. Among the other private sector organizations with whom the team met were the financial intermediary companies in Delhi associated with the FIRE project and several environmental and urban planning consulting firms in Bangalore and Ahmedabad. Finally, the team interviewed several non-governmental organizations, which were implementing urban environmental infrastructure projects on the ground in Chennai and Ahmedabad (under FIRE) as well as several industry-oriented associations that had received USAID assistance under TEST and CTI.

The team visited four Indian companies that had been assisted either by the TEST or CTI project. One company was the largest automobile manufacturer in India, two companies designed and manufactured pollution control equipment, and one designed and supplied pulping and wastewater treatment equipment to the agro-pulping industry. A key consideration in selecting these four companies, rather than others assisted under TEST and CTI, was the fact that they were located in areas where USAID has also supported urban environmental infrastructure development under the FIRE project. Two companies located near Chennai declined a request for a CDIE interview because they were under litigation for not having repaid their loans from ICICI.

The team commissioned a telephone survey of U.S. firms that had been identified early on under the TEST project as possible candidates for exporting pollution control technology or

environmental services to Indian industries; see Annex D. The purpose of the survey was to determine why the firms had or had not participated under the project. A 10 percent sample was drawn from the universe of 1,060 U.S. firms for this purpose.

These various sources of information, taken together, gave the CDIE evaluation team a reasonable basis for assessing the impacts of the urban and industrial pollution projects under consideration.

ANNEX B

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ANNEX C

The U.S.-Asia Environmental Partnership in India

The U.S.-Asia Environmental Partnership (U.S.-AEP) is a public-private, interagency program led by the U.S. Agency for International Development. Since 1992, when it was established, U.S.-AEP has addressed environmental degradation in Asia by mobilizing U.S. environmental experience, technology, and services. As an interagency program, U.S.-AEP relies on the U.S. Department of Commerce (DOC) for assistance in commercial strategy and for financial support; it relies on the U.S. Environmental Protection Agency (EPA) for environmental expertise. As a public-private program, U.S.-AEP helps to build long-term, mutually beneficial relationships among American and Asian private businesses, government agencies, and nonprofit organizations.

The TEST project came into being at the same time as U.S.-AEP, both with essentially similar objectives. The most important distinction between TEST and U.S.-AEP was that TEST relied on a significant line of concessional financing to meet its objectives, while U.S.-AEP had no capital fund. Rather, it used an evolving and diverse array of networking tools to promote relationships between people and organizations and to share information about U.S. experience and technologies.

From the beginning TEST and U.S.-AEP have been synergistic and complementary. Although other USAID country missions in Asia frequently regarded U.S.-AEP as an autonomous and competing program, USAID/India established and maintained a generally cordial and mutually reinforcing collaboration with U.S.-AEP early on. In early 1993, U.S.-AEP recognized that the mission program constitutes the foundation upon which linkages with U.S.-AEP are to be built. During 1996, U.S.-AEP staff and consultants played a major role in working with the mission to reformulate the TEST program into CTI. CTI maintained the financing facility that had been initiated under TEST, but also adopted much of U.S.-AEP's program initiatives to promote "best environmental practices" among leading Indian businessmen and business associations.

Perhaps the most distinctive feature of the U.S.-AEP program in India has been its creation of a network of Technology Representatives in four major urban-industrial regions: Delhi, Bombay, Calcutta, and Ahmedabad--and an Urban Environmental Infrastructure Representative in Ahmedabad. The four "tech reps" provide business counseling to both Indian and American companies, linking prospective business partners and identifying trade leads and opportunities to share experience and technology. The "urban rep" provides similar services, except they are focused on urban water and sanitation, including management of solid wastes.

Literally hundreds of business transactions between U.S. and Indian companies and government agencies have now been supported in one way or another through U.S.-AEP and/or TEST and CTI programs. The synergy of the USAID and U.S.-AEP programs has established a momentum that will help sustain and replicate the successful results of TEST and CTI.

ANNEX D

Survey of U.S. Companies

Early on, the TEST project identified 1,060 U.S. firms as potential exporters of pollution control technologies and services to Indian companies. When the project ended in 1997, only 14 "deals" between U.S. and Indian firms had taken place. A telephone survey was undertaken as part of this assessment to determine why relatively few U.S. companies ended up doing business in India under the TEST program after they had been contacted by USAID.

A 10 percent sample was drawn from the universe of 1,060 firms by selecting every tenth firm. If the tenth entity was an organization that did not manufacture pollution control technologies or provide pollution control services, then the 11th entity was selected instead. This process resulted in the selection of 106 firms.

Each firm was contacted by telephone and asked the following questions:

1. Are you familiar with the USAID project called TEST (Trade in Environmental Services and Technologies) which was designed to assist U.S. companies break into the growing Indian market for U.S. environmental services and pollution control equipment?

2. If yes, why did your company not use the TEST program as a way to open the Indian market to your services and products?

3. Is your company actively doing business in India at this time?

   - If yes, what mechanism did your company use to penetrate the Indian market?

   - If no, is your company actively seeking business in India?

4. If your company did not participate under TEST, what, if anything, could USAID do to help you develop markets for your products and services in India or other countries?

The results of the telephone survey were as follows:

- In most cases (40 percent), the telephone number had been disconnected or was no longer in service.

- In other cases (25 percent), those who might have been familiar with TEST had left the company and/or no one currently at the company had heard of TEST.

- In fewer cases (10 percent), the interviewee had heard about a USAID project, but could not comment because he: (a) was not sure the USAID project was TEST; (b) was not part of the

decision-making process when TEST was implemented; or (c) was located in a different department when TEST was implemented.

- For unanswered calls (20 percent), a voice mail message was left requesting the potential interviewee to return the call, but only one did so. He was currently doing business in India, but was not familiar with TEST. Follow-up phone calls were made one week later, but these resulted in no additional interviews.

- Only six U.S. companies (5 percent of the sample) were familiar with TEST. Interviews were conducted with these six.

When asked why their company did not participate under TEST, responses were as follows:

1. USAID's description of the program was limited to table top presentations, and there was insufficient USAID follow-up after the initial contact.

2. At the time TEST was being implemented, India did not respect international intellectual property rights. The U.S. company decided not to participate to avoid financial risk associated with this issue.

3. Two companies preferred to work with large self-financed projects whereby they could supply parts and equipment and not have to adhere to bureaucratic procedures associated with TEST.

4. Some companies preferred doing business through European subsidiaries because EU countries imposed fewer restrictions on foreign trade.

The poor response rate (that is, the fact that only five percent of the U.S. companies in the sample had heard of TEST) probably reflects the fact that the survey was carried out in 2000, three years after the project ended and eight years after USAID made initial contacts. It is not surprising that few contacts could recollect many, if any, project specifics.

ANNEX E

Trade in Environmental Services and Technologies (TEST): Status as of May 29, 2000

Indian Company (Location)	U.S. Collaborator (Location)	Type of Collaboration	Type of Pollution Activity	Date of Loan Approval	Total Project Cost (Rs. mil.)	TEST Financing (Rs. mil.)	TEST Financing as % of Total Cost	Status of Loan	Value of Commercial Sales Generated to Date (Rs. mil.)
1.Kirloskar AAF Ltd. (Karnataka)	Snyder General Corp. (Kentucky)	Joint Venture	Pollution Treatment	9/1/93	89.0	55.0	62%	Repayment on Schedule	2,285
2. TTG Industries Ltd. (Tamil Nadu)	Davy McKee Corp. (California)	Licensing Agreement	Pollution Treatment	9/1/93	15.5	9.2	59%	Loan Refinanced	180
3. Shreyans Industries Ltd. (Punjab)	Enders Process Equipment (Illinois)	Licensing Agreement	Pollution Treatment	6/10/94	179.0	61.5	34%	Repayment on Schedule	180
4. The Associated Cement Companies Ltd. (Maharashtra)	Research Cottrell Inc. (New Jersey)	Licensing Agreement	Pollution Services	8/16/94	17.9	11.6	65%	Loan Repaid	300
5. Ignifluid Boilers India Ltd. (Tamil Nadu)	Tampella Power Corp. (Georgia)	Licensing Agreement	Pollution Prevention	9/27/94	44.5	28.8	65%	Loan Cancelled or in Litigation	0
6. D.I. Filter Systems Private Ltd. (Haryana)	Donaldson Inc. (Minnesota)	Joint Venture	Pollution Prevention	9/27/94	33.0	15.0	45%	Repayment on Schedule	731
7. Gabriel India Ltd. (Himachel Pradesh)	Pfaudler Corp. (New York)	Direct Purchase	Pollution Treatment	3/28/95	10.3	6.6	64%	Loan Repaid	Unknown
8. Varun Flair Filtration Private Ltd.	Pneumafil Corp. (North Carolina)	Licensing Agreement	Pollution Prevention	6/21/95	19.1	12.4	65%	Repayment on Schedule	67
9. TTG Industries Ltd. (Tamil Nadu)	Joy Environmental Technical Inc. (Texas)/ SWEMCO Inc. (New York)	Licensing Agreement	Pollution Treatment	6/21/95	169.4	17.0	10%	Loan Refinanced	169.4
10. Kothari Sugars and Chemicals Ltd. (Tamil Nadu)	Amcane International Inc. (Minnesota)	Joint Venture	Clean Technology	2/22/96	221.6	17.0	8%	Loan Cancelled or in Litigation	0
11. Kirloskar AAF Ltd. (Karnataka)	Engineering Mechanics Research	Licensing Agreement	Pollution Services	9/10/96	3.3	2.9	88%	Repayment on Schedule	Included in #1 above

	Corp. (Michigan)								
12. Batliboi Environmental Engineering Ltd. (Maharashtra)	UEM Inc. (Florida)	Direct Purchase	Pollution Treatment	9/10/96	290.0	22.5	8%	Repayment on Schedule	290
13. Madhya Bharat Papers Ltd. (West Bengal)	Purification Industries Int'l (Kansas)/Power Marketing Int'l Inc. (California)	Licensing Agreement	Pollution Treatment	10/29/96	14.0	9.0	64%	Loan Cancelled or in Litigation	0
14. Advanced Waste Management Technologies Ltd. (Andhra Pradesh)	Larsen Engineers (New York)	Licensing Agreement	Pollution Treatment	6/27/97	62.0	35.0	56%	Loan Cancelled or in Litigation	0
Sub-total (Rs.)					**Rs. 1,168.6**	**Rs. 303.5**	**26%**		
Sub-total (US$)					**US$ 35.0**	**US$ 9.4**	**26%**		
15. The Morajee Goculdas Spinning & Weaving Co. Ltd.	Energy Performance Services, Inc.	Joint Venture	Pollution Prevention	3/3/2000	42.7	27.7	65%	Unknown	In Progress
16. Caldyn Thermowir Private Ltd. (Andhra Pradesh)	Caldyn Inc. (New York)	Joint Venture	Pollution Prevention	5/12/2000	49.6	29.3	59%	Unknown	In Progress
Total (Rs.)					**Rs. 1,260.9**	**Rs. 360.5**	**29%**		
Total (US$)					**US$ 37.2**	**US$ 10.9**	**29%**		

Source: ICICI, 2000.

Note: Dollar conversions based on following foreign exchange rates: 1992 ($1.00 = Rs. 25.9); 1993 ($1.00 = Rs 30.5); 1994 ($1.00 = Rs. 31.4); 1995 ($1.00 = Rs. 32.4); 1996 ($1.00 = Rs. 35.4); 1997 ($1.00 = Rs. 36.3); 1998 ($1.00 = Rs. 41.3); 1999 ($1.00 = Rs. 42.5); 2000 ($1.00 = Rs. 42.5).

49

BIBLIOGRAPHY

Ahmedabad Municipal Corporation. 2000. "Slum Networking Project." May 29.

Confederation of Indian Industry. 1996. *Environmental Business Opportunities in India*, January 1996.

Fox, James W., et al. 1999. "Developing the Capital Market in India." CDIE Impact Evaluation. April 1999. Washington, D.C.

Government of India. 1999. "State of the Environment Report – India, 1999." Ministry of Environment and Forests. New Delhi.

Halter, Faith, Robert Spongberg, and Paritosh Tyagi. 1997. "Mid-term Evaluation of the Trade in Environmental Services and Technologies (TEST) Project." January 1997. Washington, D.C.

International Resources Group, Ltd. 1999. "USAID/India Clean Technology Initiative (CTI): Final Report." October 22, 1999. Washington, D.C.: IRG.

Kirloskar AAF, Limited. 2000. "A Report on Environmental Impact through KAAF." May 25. Bangalore, India.

Lintz, Randolph S. 1996. "Annual Evaluation of the Financial Institutions Reform and Expansion Project (Debt Component)." Washington, D.C.: Gardiner, Kamya International, Inc.

National Institute of Urban Affairs. 1998. "Financial Institutions Reform and Expansion (Debt Market Component: Status Report (1994-1998)." July 1998. New Delhi.

Sanders International, Inc. 1997. "Trade in Environmental Services and Technologies: Final Report." January 31, 1997. Washington, D.C.

Tropical Research and Development, Inc. (in collaboration with Nathan Associates, Inc. and Groundwater Technology, Inc.). 1991. "Market Survey of Proposed Trade in Environmental Services and Technology Project in India." Final Report. November 1991.

U.S.-AEP. N.d. "U.S.-AEP Country Assessment: Republic of India."

USAID. "Congressional Presentation." FY 1996-FY 1999. Washington.

USAID/India. 1992. "India: Trade in Environmental Services and Technologies: Project Paper." Washington, D.C.

USAID/India. 1993. "Financial Institutions Reform and Expansion Project: Project Paper." October 1, 1993. Washington, D.C.

USAID/India. 1997. "A.I.D. Evaluation Summary—Part I." April 10, 1997. New Delhi.

USAID/India. 2000. "USAID/India Environment Activities." WebSite. January 31.

U.S. Embassy. 2000. *India 2000 Guide for U.S. Exporters.* Commercial Service. New Delhi, India.

Way, Douglas S. and Robert L. Worden. 2000. *India's Environmental Challenges.* DCI Environmental Center.

World Environment Federation. 1995. India Environmental Report.

India2000:1/22/01