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URBAN AND INDUSTRIAL POLLUTION PROGRAMS

A SYNTHESIS OF FIVE COUNTRY CASE STUDIES

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Urban and Industrial Pollution Programs

A Synthesis of Five Country Case Studies

By

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Abbreviations and Acronyms

BOD	biochemical oxygen-demanding
Btu	British thermal unit
CDIE	Center for Development Information and Evaluation
CIP	Commodity Import Program
CTI	Clean Technology Initiative (India)
EAPS	Environmental Action Program Support project
EP3	Environmental Pollution Prevention Project (Chile)
EPT	Environmental Policy and Technology project (Russia)
FIRE	Financial Institutions Reform and Expansion project (India)
GDP	gross domestic product
ICICI	Industrial Credit and Investment Corporation of India
IEMP	Industrial Environmental Management Project (Philippines)
NGO	nongovernmental organization
NO_X	nitrous oxides
SO_X	sulfur oxides
TEST	Trade in Environmental Services and Technologies (India)
UNDP	United Nations Development Programme
U.S.-AEP	United States-Asia Environmental Partnership
U.S. EPA	U.S. Environmental Protection Agency
WHO	World Health Organization

Preface

USAID supports environmental programs in five principal areas (often characterized as strategic objectives):

- ❑ Reducing the threat of global climate change;
- ❑ Conserving biological diversity;
- ❑ Preventing urban and industrial pollution;
- ❑ Promoting energy conservation; and
- ❑ Improving natural resources management (USAID 1997).

The Agency's Center for Development Information and Evaluation (CDIE) has completed four environmental assessments in three of these areas: biological diversity (1995), energy conservation (1996), forestry (1996), and sustainable agriculture (1996). This fifth program assessment covers urban and industrial pollution. An experience review and country case study on global climate change (forthcoming) will complete the CDIE series of environmental assessments.

Like its predecessors, this assessment is based on country case studies. Fieldwork was carried out in five countries: the Philippines, Chile, the Czech Republic, India, and Russia. CDIE teams spent three weeks in each country during 1999-2000 interviewing representatives of donor agencies, nongovernmental organizations (NGOs), government officials, factory managers, and other beneficiaries of USAID-supported programs designed to prevent and control urban and industrial pollution. The studies were conducted with the assistance of economists, engineers, and environmentalists provided by Nexant, a Bechtel Technology and Consulting Company. Annex A describes the evaluation methodology. Annex B lists members of the CDIE teams and provides ordering information for the five country reports.

This synthesis of the five country case studies describes the economic, environmental, and health impacts of programs in each country and identifies factors affecting program performance (effectiveness, sustainability, and replication). It is designed to help managers learn from the experience of USAID-funded projects that have been completed. These lessons will help guide the development of future urban and industrial pollution programs.

1 Summary and Lessons Learned

USAID has supported various programs to reduce the adverse health effects of air and water pollution in developing countries. This assessment examines the impact and performance of USAID's urban and industrial pollution prevention programs based on case studies of the Philippines, Chile, the Czech Republic, India, and Russia.

The five programs encompass a broad perspective. Some stress industrial pollution, while others emphasize urban pollution. Some focus on preventing pollution at its source, while others focus on end-of-pipe treatments. Some use financial benefits (the carrot) as the main incentive for industries to adopt pollution control and prevention technologies, while others focus on their desire to avoid penalties and financial costs (the stick). Programs in some countries emphasize air pollution, with programs in other countries mainly targeting water pollution. Based on this broad experience, one can identify key lessons applicable to most urban and industrial pollution programs.

Most USAID-funded projects in urban and industrial pollution prevention supported interventions in one or more of five areas: economic policy reform, government regulations and standards, institution building, education and awareness, and technological change. The impact of these interventions was mixed. The Philippines, Chile, and India studies all reported positive financial benefits. This was not the case, however, in the Czech Republic and Russia, where USAID-funded activities focused more on urban pollution than on industrial pollution.

Although the environmental impact was positive in all five countries, the availability and reliability of emissions and effluent data needed to reach this conclusion varied among countries. Data were far more thorough and credible in the Philippines and the Czech Republic than they were in Chile, India, and Russia. Unfortunately, health surveillance data, needed to measure changes in human morbidity and mortality in response to changes in environmental quality, were not collected in any of the five countries. It is reasonable to assume, though, that the health impact of the USAID projects was positive.

Each of the five programs was at least partially effective. This was certainly the case in Chile, the Philippines, and the Czech Republic (at the national level). By contrast, most components of the programs in Russia, India, and the Czech Republic (at the municipal level) were generally less effective. Program benefits were sustained after USAID funding ended in Chile, the Czech Republic (at the national level), and Russia (under the Moscow Water Quality project). This was generally not the case in the Philippines, the Czech Republic (at the municipal level), Russia (under the Air Management project), or India (except for the Financial Institutions Reform and Expansion [FIRE] project). Finally, the benefits were not replicated beyond the original target areas, participants, or industries in any of the countries. The exception to this generalization is India's FIRE-D project, the debt component of the FIRE project.

Six key lessons emerged from this synthesis of the five country case studies analyzed for this assessment. The lessons address financial benefits, regulation, sustainability, replication, credit/financing, and data measurement.

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

Companies are not altruistic. They are in business to make a profit, either by increasing revenues or reducing costs. In both the **Philippines** and **Chile**, pollution audits were used to identify opportunities for businesses to (1) increase revenues (by producing less waste or by recovering waste and selling it); (2) reduce costs (by reducing energy and input use, such as water); and (3) use cleaner technologies. Companies were motivated to adopt audit recommendations by the prospect of saving money, increasing revenues, and expanding profits—more so than by reducing pollution. However, reducing pollution was a motivating factor if that resulted in reduced pollution fees and fines. Pollution audits demonstrated how a company could benefit from increased profits and how a country could benefit from lower pollution levels.

In the case of **India**, environmental performance was seen as a competitive factor in gaining access to the international market. It was primarily for this reason that companies adopted environmental management initiatives, such as ISO 14001 certification, greening the supply chain, and benchmarking techniques. Environmental benefits were seen as a by-product.

In **Russia**, cash-strapped industries were more likely to use limited financial resources to pay staff rather than adopt environmental upgrades. This was the case even for low-cost and no-cost improvements with short payback periods. Even these involved a financial cost without a commensurate benefit.

Conclusion: Financial benefits (or other business-related benefits) are invariably needed to encourage companies to adopt pollution prevention and control measures. Pollution audits are useful tools that can be used to identify such measures. If conducted by industry specialists, rather than by generalists, such audits are likely to have greater credibility with senior managers. It is more cost effective to conduct audits for companies in a few selected industries rather than in many industries. Audit recommendations, including what they can and cannot do, must be carefully explained to company managers. In some cases, financial benefits, though necessary, are insufficient to induce companies to implement pollution prevention measures.

2. **Regulation.** *Environmental regulations—and their strict enforcement—are important in motivating companies to acquire pollution control technologies.*

Chile had no environmental regulations when the USAID project was implemented. There was little concern about pollution, and many companies viewed pollution prevention as a cost that might not generate any return on investment. It was therefore difficult to persuade firms to adopt clean production measures. They became interested only when they faced the threat of fines, government sanctions, penalties imposed by the wastewater authority, or restricted access to export markets.

Command-and-control measures—environmental regulations and standards—are effective only if they are strictly enforced and penalties are severe. In the **Philippines**, the government did not routinely monitor compliance with environmental standards, so the probability of a business getting caught was slim. Even then, orders to shut down a factory were issued only for the most egregious, obvious offenses, and penalties and fines were relatively low. In **India,** companies invested in pollution control technologies primarily to avoid being shut down or paying fines for noncompliance with environmental regulations. As in the Philippines, however, enforcement in India was generally lax, partly because political will and public pressure were weak. Therefore, companies often did not comply, deciding instead to take remedial action only in response to litigation and judicial rulings, which could take years, or to pay fines, which was sometimes the least-cost option. This seemed sensible, since the cost of noncompliance was typically small relative to the cost of investing in end-of-pipe or process-based controls.

In the **Czech Republic**, by contrast, failure to comply with the Clean Air Act meant swift and harsh penalties, fees, and ultimately orders to shut down a factory. Observing many polluting industries being shut down, polluting municipalities were prompted to take action. Asked why they undertook environmental upgrades, an overwhelming number of city managers pointed to the Clean Air Act. (They also identified citizen complaints and the high costs associated with inefficient district heating operations.) In the absence of regulations that were enforced, the effectiveness of the USAID project would have been seriously compromised.

Conclusion: The threat of environmental fines is a critically important tool. In fact, both cost savings and regulation are important in motivating companies to take action. If pollution laws and regulations are not already in place, they should be developed before trying to persuade industry to adopt pollution prevention measures. Market-based instruments can complement command-and-control approaches. They use economic incentives to influence a company's behavior by encouraging the company to act in its own self-interest. Imposing pollution charges, for example, on companies that discharge effluents into the environment effectively internalizes the costs of their pollution.

3. **Sustainability.** *A pilot effort is an excellent way to demonstrate the benefits of pollution prevention methods, but it should include a plan to ensure that benefits are sustained after donor funding ends.*

The **Philippines** project assumed that waste minimization techniques, once adopted, would generate substantial benefits, and that companies would sustain those techniques over time. The same was true in **Chile**, where it was assumed that companies would recognize the value of pollution audits and continue implementing pollution prevention recommendations. However, that was not always the case, especially when companies did not realize the financial benefits estimated in the audits. When sustainability took root, it occurred most often in large multinational companies, where corporate image counts and managers reinforce the goal of clean production and pollution prevention. This suggests that constant support and vigilance from top company management may be the key to sustainability.

In **Russia**, program sustainability depended heavily on the availability of operating funds after donor assistance ended. And in the **Czech Republic**, program sustainability was not only contingent on a source of operating funds, but also on well-functioning environmental institutions. These take time to mature. Occasional visits by short-term consultants may not be suitable for long-term institutional strengthening. The technical assistance provided to the 22 municipalities is unlikely to have any long-term effect, partly because project staff and municipal staff did not work together to develop needed skills. By contrast, the State Environmental Fund is financially sustainable, partly because of the sound technical advice provided under the USAID project. Finally, in **India**, considerable time was required to gain the acceptance of its business and government leaders on the use of municipal bonds to finance public sector infrastructure. This was no doubt time well spent, though it is still too early to assess the sustainability of this ongoing program.

Conclusion: Designers and implementers of pilot programs need to develop a plan to ensure that benefits will continue once the program ends. That usually requires an institutional structure with adequate funding and capacity. These needs should be addressed at the project outset. Potential sources of funding include environmental fees and fines collected from industries, support from local or federal agencies, and development assistance organizations.

4. **Replication.** *An industrial pollution prevention program cannot hope to reach all firms directly but needs an intermediary to spread the message. Careful targeting with an eye to sharing and spreading successful results can also encourage replication.*

In a dynamic private sector, companies compete to win market share, and they will not voluntarily share information with their competitors about ways to minimize costs. This was the case in both the **Philippines** and **Chile**, where companies were reluctant to share their newly learned techniques with competitors. In **Russia**, too, there was little or no replication beyond the targeted industries and wastewater treatment plants. Rather, each company closely guarded its production techniques, not wanting to help competitors. When there is no incentive for a firm to share new technology with others, replication is difficult. In the Philippines, Chile, and Russia, USAID used a "retail" approach, working with one factory at a time. Impact will be greatest when an institutional structure (such as an industrial trade association) is used to disseminate pollution prevention findings throughout an industry (the "wholesale" approach).

In **India**, the TEST project used an untargeted retail approach to introduce pollution control technologies. Any company of any size from any industrial sector located in any part of the country was eligible to apply for a loan. By contrast, the CTI project is using a targeted wholesale approach. Export-oriented companies from three industrial sectors have been strategically selected. In addition, CTI, unlike TEST, works 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.

In the **Czech Republic**, there was no evidence of replication from one municipality to another. There are at least two ways replication might have been improved at the municipal level. The first is to develop manuals that explain how to prepare loan applications and provide examples of successful applications, with templates for different kinds of projects. Distributing these manuals beyond the target municipalities can support replication. The second way is to target groups of municipalities (such as municipal associations) so members can spread the word. In either case, a replication strategy must be explicitly planned.

Conclusion: Pilot and demonstration projects working one-on-one are unlikely to be replicated—unless replication is planned from the beginning and built into the implementation plan. Even then, replication is unlikely to occur if it involves revealing trade secrets. Replication may be improved by working not just with individual businesses (the retail approach) but also with industry trade associations (the wholesale approach) or with a government agency. If the retail approach is used, donors should target plants where the owners are influential leaders in the industry. Trade associations can be neutral in sharing information among their members. A government regulatory agency is most likely to benefit companies facing compliance problems. Finally, replication may be enhanced when a cadre of pollution engineers is trained.

5. **Credit/Financing.** *Lack of financing is typically not a serious constraint for large firms that want to procure pollution control and prevention technology. However, it often hinders individual small and medium-size firms. For municipalities, domestic environmental funds or bonds can be important sources of financing for environmental infrastructure.*

In the **Philippines** and **Chile**, most companies adopted low- or no-cost techniques that were simple and had an immediate effect on pollution reduction and cost savings. A few companies required financing, but only if they made large capital investments (for example, if they were building a new factory or introducing a new production technology). In these cases, in Chile, conventional financing was used. However, in the Philippines, pollution-related financing was a relatively recent practice. As a result of USAID-funded studies, however, both the Land Bank of the Philippines and the Development Bank of the Philippines now target small and medium-size firms with concessional loans to finance investments in pollution prevention. In **Russia**, even low- and no-cost solutions to urban and industrial pollution were not readily adopted because they had a high opportunity cost. And unlike in the Philippines and Chile, credit was not readily available for capital investments due to tight money, high risk, and financial market imperfections. Even if credit were available, pollution technology was often inappropriate.

The TEST project in **India** assumed that Indian companies would need financing to purchase pollution prevention technology from U.S. suppliers. Although individual small and medium-size Indian companies often did require financing, large companies did not (or they were able to secure financing without donor assistance). Unfortunately, TEST did not concentrate on small companies; high transaction costs or strict lending criteria may have been barriers. More important, though, Indian companies were reluctant to buy pollution technologies or process techniques from the United States unless demonstrations had shown they were suitable for local operating conditions—and Indian financial institutions were reluctant to lend funds for the purchase of untested technologies. In addition, U.S. pollution technologies were typically too expensive to find widespread acceptance in the Indian market. All of these factors limited the demand for credit. India's FIRE-D project introduced the concept of private-sector financing of urban environmental infrastructure. After successfully assisting several municipalities, including Ahmedabad, USAID is widely praised by Indian counterparts for carefully nurturing this idea.

In the **Czech Republic**, USAID helped 22 municipalities prepare loan packages in a form that banks and environmental funds could use in making lending decisions. However, project personnel and city leaders both concluded that the technical assistance was of little interest or value. There were three reasons: (1) larger municipalities already had the expertise; (2) most municipalities believed the fund's approval process was arbitrary and political, so improved packaging would not make a difference; and (3) smaller municipalities were not given sufficient hands-on experience to learn how to package loan applications. The situation was somewhat analogous to that in India where project designers made assumptions that proved invalid.

Conclusion*:* Financing is often available to industries that can demonstrate a positive return on investment and a history of repaying their loans. Larger firms, in particular, typically do not require concessional financing. Though municipalities need financing for investments in environmental infrastructure, they do not always need technical assistance in how to package loan applications. When such assistance is needed, it should be provided as part of a comprehensive response, not as a stand-alone component. Environmental funds will be handicapped if political factors affect their approval procedures or if they are not perceived as transparent and open. Regional funds (as in Poland) tend to manage these problems better than national funds (as in the Czech Republic).

6. **Measuring Results.** *"Before" and "after" data are needed to monitor program performance and assess program impact. Program sustainability within a company and replication beyond it depend on the availability of reliable data and information.*

In **India**, data were not available on environmental quality in Indian cities or discharge rates from industrial sectors; nor were epidemiological or other health data available for populations located near industrial zones or participating companies. Lack of baseline data greatly reduced the ability to conduct an accurate assessment of environmental and health impacts of USAID-funded programs. The same was true in **Russia**. At all three wastewater treatment plants and key industrial enterprises, sufficient data had not been systematically gathered to enable an unambiguous assessment of the effects of various plant upgrades. Without good data it was impossible to disentangle the effects of Russia's economic downturn from the effects of the USAID projects, as both could have produced the same outcome—reduced pollution.

Data collection is essential to establishing a baseline against which to monitor progress and measure results. But it is important to collect data for the right indicators. Collecting data for inappropriate indicators will yield irrelevant results. For example, an important goal of the **Philippines** project was to improve human health by reducing water pollution. But the pollutant that was measured, BOD, does not directly affect human health.

Conclusion: USAID needs to conduct accurate program appraisals. This depends on accurate data that analytically link USAID interventions with their effects on reducing pollution. Program benefits are more likely to be sustained and replicated when factory staff are involved in collecting and analyzing data. Factory staff are more likely to collect data for appropriate indicators, and management is more likely to believe, and therefore use, its own data and analysis.

2 Background

Cities in developing countries experiencing rapid growth are increasingly unhealthy places to live. This stems from inadequate control of industrial effluents and emissions, insufficient collection and disposal of sewage and solid waste, and emissions from vehicles. The key links between urban environmental degradation and deteriorating public health include (1) air pollution, which causes respiratory diseases, and (2) water pollution, which causes waterborne diseases such as diarrhea, dysentery, and cholera. (A third source of poor public health is land pollution due to uncontrolled dumping of municipal and industrial wastes.)

For decades, the international scientific community has issued warnings on the adverse health effects of air and water pollution. The main impacts on health are premature death (mortality) and sickness (morbidity). More than 70 percent of deaths from outdoor air pollution are in developing countries. In Mexico City, for example, airborne particulate matter kills about 6,400 residents a year. Air pollution caused more than 175,000 premature deaths in China in 1995. The total health costs of urban air pollution in developing countries were estimated at nearly $100 billion in 1995, with chronic bronchitis accounting for $40 billion. Water pollution is equally serious. For example, Asia's rivers contain 20 times more lead, on average, than those in industrial countries. Every year water pollution causes nearly 2 billion cases of diarrhea in the developing world, and diarrheal diseases kill some 5 million people annually (UNDP 1999, 28, citing UNDP 1998).

A worldwide review of 126 cities estimates that 130,000 premature deaths and 50-70 million incidents of respiratory illness occur each year due to air pollution.

Air Pollution

Tropospheric ozone, sulfur oxides (SO_X), nitrous oxides (NO_X), atmospheric lead, and particulates all contribute to air pollution. Combustion of fossil fuels (coal, oil, and natural gas) by industries is a principal source of these pollution-causing emissions.[1] Most developing countries rely on fossil fuels to meet much of the energy needs for industrialization and economic growth. Although particulates generated from burning coal, especially coal with high sulfur and ash content, generally have the most serious effects on human health, coal is still used extensively as a key energy source in several countries, including China and India.

A worldwide review of 126 cities where ambient levels of particulates exceed World Health Organization (WHO) guidelines estimates that 130,000 premature deaths and 50-70 million incidents of respiratory illness occur each year due to air pollution (Brandon 1998, 39, citing Maddison 1997).

[1]Burning fossil fuels causes air pollution. It is also the principal cause of increased concentrations of carbon dioxide in the atmosphere. Carbon dioxide is not a form of air pollution and is not detrimental to human health, but it is the principal cause of global climate change.

In Manila, Bangkok, and Seoul, premature deaths number 2,000-4,000 a year. Each of these cities claims 30,000-90,000 cases of severe chronic bronchitis annually. In monetary terms, the costs of air pollution total seven percent of urban gross domestic product (GDP) in Manila and Bangkok, and 4 percent in Seoul. Elsewhere in the world, air pollution impacts are comparable: 40,000 premature deaths a year in India; 36,000 in the newly independent states; 4,000-6,000 in Cairo; and 6,400 in Mexico City. The economic value of this health damage represents 3-10 percent of urban income (Brandon 1998, 39, citing Lvovsky and Hughes 1998).

Studies have compared the cost of pollution abatement with the health benefits gained. They have found the cost per life saved is low—often $1,000 or less. Studies have also found that the rate of return on controlling particulate emissions is high, making it an extremely cost-effective public health approach in all cities with high levels of particulates (Brandon 1998, 39).

A World Health Organization study showed that improved water supply and sanitation reduces morbidity and mortality associated with diarrhea and other diseases by 25 and 65 percent, respectively.

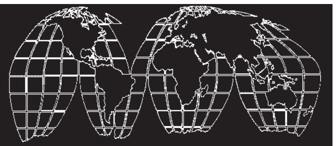
Water Pollution

While air pollution affects all city residents more or less equally, water pollution disproportionately affects the poor who live in slums and squatter settlements, which lack potable water, sanitation, drainage, and are often located closer to waste dumps and industrial sites. In fact, the principal source of water pollution is disposal of untreated municipal sewage and industrial waste into rivers and streams. It has been reported that sewage is the worst cause of water pollution in developing countries, and leads to the most health problems. A WHO study showed that improved water supply and sanitation reduces morbidity and mortality associated with diarrhea and other diseases by 25 and 65 percent, respectively (Brandon 1998, 40, citing Esrey, et al. 1991). One way to reduce morbidity and mortality rates caused by water pollution is to increase urban access to piped water and improve urban sanitation; another way is to reduce and treat the discharge of pollutants and industrial wastes into rivers.

Focus of Analysis

This assessment focuses primarily on industrial pollution in urban areas, and to a lesser extent it covers municipal pollution (untreated sewage and wastewater disposal). It does not cover pollution caused by automobiles or by industries located in rural areas, as neither has been a primary area of emphasis for USAID until recently.

Industrial pollution is a manifestation of wasteful and inefficient production processes. Waste and inefficiency occur at two levels: (1) individual industries and firms (cement plants, for example) and (2) power plants that supply the energy used by individual industries, firms, and households. In economic terms, industrial pollution is a classic example of negative externalities. For example, a factory or a power plant does not incur a financial cost if its smokestack spreads pollution over nearby towns. Instead, the pollution costs are borne by those who have to breathe polluted air; the costs are external to the factory. Although society would benefit if the factory reduced pollution, the factory would gain little or no financial benefit by doing so. The factory would have to bear the costs, while others gained the benefits. To address this issue, USAID has supported various activities, including programs to increase production efficiency (and reduce pollution) at both individual firms and power plants.



3 Overview of the Five Case Studies

As noted, this Center for Development Information and Evaluation (CDIE) assessment examined the impact and performance of USAID urban and industrial pollution programs in five countries: the Philippines, Chile, the Czech Republic, India, and Russia. An overview of each country program reveals that the activities supported by USAID are not entirely comparable, which complicates the synthesis of results.

Philippines

USAID implemented the Industrial Environmental Management Project (IEMP) in the Philippines from 1992 to 1997. It was funded at $13.2 million. Unlike many industrial pollution programs, which stress treatment of waste, IEMP stressed prevention. The project's principal goal was to improve human health.

The Industrial Environmental Management Project in the Philippines confirmed that industry-led economic growth can be compatible with environmental protection.

Pollution management appraisals were a central feature of IEMP. These audits are a straightforward way to assess opportunities for reducing industrial pollution through low- or no-cost techniques and capital investments in equipment. Implementing audit recommendations typically contributes to increased productivity while reducing waste and emissions. Pollution audits were done for 143 small and medium-size industrial firms located throughout the Philippines, excluding Metro Manila. In addition, 2,600 people participated in training seminars, and many others participated in a series of public-private dialogs on new environmental regulations—some of them based on policy studies prepared with project support. The Philippines project confirmed that industry-led economic growth can be compatible with environmental protection.

Chile

In 1993, USAID launched the Environmental Pollution Prevention Project (EP3). Chile was the first of nine countries worldwide where the project was implemented. Valued at $1.3 million, the project ended after only three years, in 1996, when Chile "graduated" from receiving USAID assistance. As in the Philippines, the project in Chile did not focus on "end-of-pipe" treatments—reducing pollution at the smokestack or drainpipe. Instead, it was designed to reduce pollution at its source by introducing cleaner industrial production processes and by reducing and reclaiming industrial waste. For this to work—to prevent pollution at its source—industrial firms had to be convinced that pollution prevention pays and is financially beneficial. Therefore, the project funded 26 pollution prevention diagnostic assessments, similar to the pollution audits in the Philippines.

These audits showed it was possible to save money while reducing pollution, which was particularly important in Chile. In many countries, manufacturers are encouraged to reduce pollution by a carrot-and-stick approach. The carrot is cost savings; the stick is the threat of fines or a plant shutdown. In Chile, such punitive measures did not exist, so the project necessarily concentrated on cost savings. In addition, it trained nearly 2,500 people in industrial-pollution prevention and created a cadre of private-sector pollution engineering consultants.

The Environmental Pollution Prevention Project in Chile was designed to reduce pollution at its source by introducing cleaner industrial production processes and by reducing and reclaiming industrial waste. For this to work, industrial firms had to be convinced that pollution prevention pays and is financially beneficial.

Czech Republic

USAID's Environmental Action Program Support (EAPS) project was a $17-million effort to decrease or reverse environmental degradation in seven central and eastern European countries. The project implemented in the Czech Republic began in 1995 and was funded at $1.4 million. It was executed at the national and local levels. At the national level, it supported a resident advisor to help strengthen the institutional capacity of the Czech State Environmental Fund. Created in 1991, this fund was needed because many Czech municipalities did not generate sufficient revenues to pay for large capital projects to reduce airborne pollution from district heating plants. The municipal bond market, another potential source of funds, was nonexistent, and commercial banks were not making loans to municipalities to upgrade their facilities.

At the local level, the project provided technical assistance and training to help 22 small municipalities with highly polluting heating plants prepare loan applications for submission to the State Environmental Fund. Municipalities that received loans were able to upgrade their district heating systems, which typically involved switching from high-sulfur coal to cleaner burning fuels. The result was reduced air pollution. Unlike the Philippines and Chile case studies, which addressed industrial pollution, the Czech Republic case study addressed urban pollution.

EAPS was later implemented in Poland, lasting somewhat longer than the EAPS project in the Czech Republic. It was funded at $2.75 million, twice the amount spent in the Czech Republic. The overall approach, though, was similar—namely, to strengthen domestic environmental funds and help municipalities get loans for environmental upgrades. Whereas a single national-level state fund was created in the Czech Republic, 49 regional funds (as well as a national-level fund) were established in Poland. Regional funds appear to have a clear advantage over a single national fund because they are better able to manage local problems that arise.

India

A decade ago, following India's leap into industrialization, USAID designed the Trade in Environmental Services and Technologies (TEST) project. It had two objectives: (1) to enhance trade opportunities for U.S. companies that exported pollution prevention and control equipment and (2) to improve environmental conditions in India. The project authorized funding of $25 million from 1992 to 1997, with $20 million for loans to Indian companies that needed financing to procure environmental services or pollution prevention technologies from U.S. companies. The other $5 million was for a U.S. contractor to identify U.S. suppliers of environmental technology and to facilitate commercial transactions between U.S. and Indian firms.

A second project in India, the Clean Technology Initiative (CTI), was designed as a follow-on to TEST. Total authorized funding was increased from $25 million to $29.95 million, and the completion date was extended by five years, until 2002. CTI, which is ongoing, helps leaders of Indian industry become more competitive in international markets by encouraging sound environmental performance. It emphasizes pollution prevention and market-based strategies (polluter-pays paradigms), as distinct from command-and-control approaches. In this respect, it is similar to the Philippines project, which also introduced market-based approaches to controlling water pollution, and to the Chile project, where government-enforced environmental regulations were nonexistent. Unlike TEST, which worked with individual companies (the "retail" approach), CTI uses the "wholesale" approach (working with trade associations of strategically targeted industries).

A third project, Financial Institutions Reform and Expansion (FIRE), focuses on urban pollution (as in the Czech Republic) as distinct from industrial pollution. It has two components: FIRE-R ("R" stands for *regulatory*) covers government regulation of the stock market; FIRE-D (with "D" signifying *debt*) covers the debt market. The original five-year project (1994-1998) was extended by another five years, until 2003, and like CTI, is ongoing. The project addresses two issues. The first concerns mechanisms to finance urban environmental infrastructure (such as sanitation, water supply, and solid waste management). The second concerns actual delivery of environmental infrastructure to benefit the urban poor. At the end of FY 1998, $19.5 million had been obligated to support both objectives. In addition, the project is supported by up to $125 million in loans from USAID's Environmental Credit Program.

The FIRE-D project in India has worked with an expanding group of municipal governments and urban agencies, helping to privatize services previously performed by poorly staffed and equipped government agencies.

Russia

In 1992, USAID launched the Environmental Policy and Technology (EPT) project in Russia. (The project was also implemented in other countries of the former Soviet Union.) Funded at $128 million, the project included several subprojects. Two of these were the Water Quality subproject in Moscow beginning in 1994 and the Russian Air Management subproject in Volgograd implemented during 1993-99. Both were implemented by the U.S. Environmental Protection Agency (U.S. EPA) at a cost of $11 million.

The Moscow Water Quality project sought to reduce health risks by improving the quality of drinking water. It did this by introducing new approaches to managing wastewater treatment facilities at industrial enterprises in the cities of Tver, Gagarin, and Dimitrov, which are upstream from Moscow. The project also developed a small watershed program in the Istra District near Moscow, where it sought to curb agricultural runoff that was affecting water flowing into the Moscow *oblast*. The Istra watershed program supported the construction of dams and manure-storage facilities, worked with local livestock operators, and demonstrated solid waste management techniques. The Russian Air

Management project was implemented in Volgograd, a large industrial city ranked as the sixth most polluted city in Russia in 1993, when the project began. The project developed and tested an air quality management system, provided training and technology, and supported public awareness of the adverse effects of air and water pollution.

4 Program Elements

Most USAID-funded urban and industrial pollution programs support interventions in one or more of five areas: economic policy reform, government regulations and standards, institution building, education and awareness, and technological change. This assessment was designed to provide insights into the relative importance of these five factors in controlling and reducing air and water pollution caused by urban industries.

Economic Policy Reform

Governments often try to control pollution by relying primarily on command-and-control approaches—creating regulations and enforcing them. An alternative is to use market-based approaches that impose fees and provide incentives to achieve the same objectives. For example, because energy generally represents a significant cost of industrial production, companies try to reduce costs by conserving energy. As demand for energy declines, utilities burn less fuel and produce less pollution. However, unless a country's energy pricing policy encourages use of cleaner fuels and power sources or use of energy-efficient technologies, companies will continue to use the least expensive energy sources—including less efficient and environmentally less desirable sources, such as highly polluting diesel-powered generators. Thus, an energy pricing policy will either encourage or discourage (often through subsidies or taxes) the levels and types of energy that industries use. Similarly, input prices (such as for water) are often set artificially low, especially in centrally planned economies, leading to excessive consumption per unit of output and disproportionately high levels of waste and pollution.

Most of the industries affected by the **Philippines** project were relatively water intensive (for example, agricultural processing and textile production). Thus, any reduction in water use would theoretically yield significant cost savings for the company—but only with realistic pricing policies. Unfortunately, water from municipal systems in the Philippines is inexpensive, and groundwater is free. Thus, there is little economic incentive to conserve water. Although the Philippines traditionally has relied primarily on command-and-control approaches rather than on market-based instruments to reduce pollution, under IEMP the government established a polluter-pays system for the Laguna Lake Development Authority. Companies were assessed fees on their effluent discharge into the lake, and those that reduced waste generation were rewarded with lower fees and penalties.

In **India**, the government subsidized the price of water, energy, and raw materials to promote rapid industrialization. Because material inputs were priced artificially low, industries used them intensively and expanded capacity beyond what was economically justified, thereby increasing pollution. In 1991, the government began to address these problems through significant economic reforms and greater liberalization. It encouraged competition through deregulation, while reducing subsidies and tariffs. As in the Philippines, India introduced market-based instruments, including the polluter-pays principle, to encourage industries to implement pollution control measures.

Although almost all other countries subsidize pollution control and prevention, that is not the case in **Chile**, where subsidies, concessional loans, and investment credits do not exist. Their absence reflects the deliberate economic policy of the Chilean government, which relies almost completely on private enterprise and free markets to drive the economy. Thus, many companies in Chile were already financially motivated to undertake pollution prevention measures to save money, reduce waste, and decrease input costs without government intervention. In short, a sound economic foundation was already in place when the Chile project began.

To combat inefficiency, waste, and pollution in the **Czech Republic**, the government allowed energy prices to rise slowly toward international market levels. Higher prices led to increased energy efficiency which, in turn, contributed to improved air quality. In addition, the government subsidized natural gas prices, which led to a gradual shift from burning coal to natural gas. As in the Philippines, India, and Chile, the Czech government adopted market-based instruments, including user fees and pollution charges (as well as a system of fines and closure orders), to help control pollution. And as with Chile, project designers in the Czech Republic did not need to change economic policies, because appropriate policies were largely in place. This was partly due to growing pressure to conform to European Union environmental standards.

The two projects implemented in **Russia** were not designed to help reform economic policy. Unlike the situation in Chile and the Czech Republic, though, this was not because Russia's policies did not need reform. They did, as Russia historically has undervalued production inputs such as oil, coal, gas, and water, using a system that did not recognize the role of markets (central planning) or a system of subsidies. Both approaches tend to increase the demand for inputs and increase environmental damage associated with their oversupply and inefficient use. Russia's energy prices are still below market levels. This helps explain why Russia is one of the world's least efficient energy consumers. In 1997, for example, Russia consumed 61,000 British thermal units (Btus) of energy for every $1,000 of GDP, the highest rate in the world. This compares to 31,000 Btus in India and 11,600 Btus in the United States. Thus, economic policy reform, especially price policy reform for inputs and energy, may well have helped Russia reduce industrial pollution.

Government Regulations and Standards

Environmental laws, standards, and regulations—and a government's capacity and willingness to enforce them—are pivotal factors in explaining the effect of pollution prevention projects. In many countries, though, enforcement has a poor track record, partly because the regulations are unrealistically stringent and partly because enforcement agencies are corrupt.

Russia illustrates the point, as it has some of the most stringent environmental standards in the world. But it also has especially lax enforcement, in part because the laws are complex and inconsistent across jurisdictions. Moreover, its pollution fees and fines are unrealistic, which reduces compliance, drains resources, and undermines the political will needed for law enforcement. Cambridge International Forecasts states that of 250,000 reported violations of environmental standards, 40 percent go unpunished or unrectified.

India is another case in point. It was the first nation to provide for environmental protection explicitly in its constitution. Since the early 1970s, the Indian government has enacted 16 legislative measures that provide guidelines for protecting and improving the environment. However, the government's capacity and willingness to enforce its laws have often been wanting. This is understandable: When there is a perceived trade-off between a sound economy and good environmental practices, India's politicians and industrial leaders have opted for fewer environmental controls and less environmental enforcement. Given these political realities, judicial activism has become the key driver in forcing Indian companies to adopt pollution prevention and control measures.

One objective of the **Philippines** project was to provide the government's Department of Environment and Natural Resources with advice on issues about regulations for industrial environmental management. Policy studies were the key mechanism for achieving this objective. The department had already developed a five-year agenda for such studies when IEMP began, which was a good indication of the demand for expert advice. Despite this effort, uneven enforcement of existing regulations remains a serious problem.

An effective environmental regulatory framework was already in place in the **Czech Republic** when the EAPS project began. Legislation such as the Clean Air Act had been passed and was being enforced. The government's interest in maintaining sound pollution abatement was partly due to its desire to become a member of the European Union. Therefore, as was the case with economic policy reform in the Czech Republic, assistance to strengthen the government's environmental regulations and standards was not needed.

This was also the case in **Chile**, where EP3 was, by design, an industry-oriented program with little emphasis on economic policy or governmental regulations. It focused on the supply side: environmental audits, clean technology, and trained environmental engineers. It soon became apparent, though, that the demand side was weak, as cost-savings were not enough to motivate industry to curb pollution. Regulations—and their enforcement—were needed to spur industry's interest in pollution prevention. Without the threat of fines and penalties, industrial demand for pollution control measures was limited.

Institution Building

Strong public and private institutions are often seen as indispensable to ensuring clean air and water in any country. This includes institutions at both the national and local level.

The project in the **Czech Republic** helped strengthen public institutions at two levels: at the national level through the Czech State Environmental Fund and at the local level through municipalities. Assistance to the State Environmental Fund focused on improving transparency, ensuring that grant approval was not influenced by political and personal factors, and emphasizing proper technical and financial analysis of loan submissions. At the local level, the project helped municipalities prepare and submit loan packages and then stayed in close touch with the Environmental Fund to obtain financing.

In **India**, it made sense for USAID to concentrate on the private sector, as the World Bank was already strengthening key public sector environmental agencies. USAID worked with the Industrial Credit and Investment Corporation of India (ICICI), now a well-established and competently managed financial intermediary. The Agency also helped strengthen several national-level industry associations, primarily the Confederation of Indian Industry and the Federation of Indian Chambers of Commerce and Industry. As noted above, India's state courts have recently become active in pollution control cases—even though court lawyers generally have little formal training or professional experience with environmental law. Therefore, CTI has exposed several court justices and state lawyers to modern judicial environmental issues in other countries. The FIRE-D project has worked with an expanding group of municipal governments and urban agencies, helping to privatize services previously performed by poorly staffed and equipped government agencies.

In **Chile** as well, USAID concentrated almost entirely on the private sector. Although various Chilean environmental agencies were emerging in the mid-1990s, EP3 did not provide direct assistance to them. Several dozen organizations, representing the government, nongovernmental organizations (NGOs), and the private sector, now address environmental issues. However, because they are relatively new, almost no linkage exists between these institutional structures and the USAID project. For example, the Commission on the Environment, the Chilean environmental protection agency, did not become fully effective until after the USAID project ended in 1996.

The FIRE project worked with a variety of target audiences in several Indian cities to introduce the concept of private financing of public infrastructure. As a result, municipal bonds, the first in South Asia, were issued successfully in Ahmedabad for the construction of water and wastewater works.

In **Russia**, less than one percent of the federal budget is allocated to support environmental objectives. As a result, the country's environmental institutions are poorly staffed and inadequately equipped. USAID provided training to help strengthen these institutions, primarily through the Center for Environmental Training and the Volgograd Environmental Services Administration. It also supplied basic environmental equipment—flow meters, automatic samplers, dissolved oxygen meters, Sludge Judges, and colorimeters.

The **Philippines** is characterized by duplication of effort and conflict among organizations responsible for the environment and industry. The picture is further complicated because these agencies work at both the national and local level. The USAID project focused on the Department of Environment and Natural Resources (a government agency), mainly at the local level. This large regulatory bureaucracy has primary responsibility for setting environmental standards and enforcing them. Its frequent leadership changes during project implementation and staff turnover made institution building difficult, at best.

Education and Awareness

Many urban and industrial pollution programs have educated representatives of industry, government, NGOs, the general population, and local consultants about the health costs of air and water pollution and the financial benefits of pollution prevention. These education and awareness programs often have included outreach and institutional capacity building.

The **Chile** project concentrated on technical assistance and training to build knowledge and awareness of pollution prevention (at the time, not a well-known concept in Chile) and to encourage industry to adopt appropriate technology. The project trained local environmental consultants about the value of pollution prevention; they, in turn, helped convince industries that such investments would help them save money. Of the 2,500 people trained in industrial pollution prevention concepts, 1,061 were from industry, 752 from universities, 309 from government, 252 from NGOs, and 123 from local environmental consulting firms. Despite the increased supply of pollution control engineers, however, demand for the services of these specialists is still lacking. Without the threat of fines and penalties (Chile had no pollution regulations at the time), companies appear to have little interest in reducing pollution, though this may change as public pressure increases.

The **Philippines** project also supported a significant training component designed to build environmental awareness and technical knowledge. The training targeted not only the private sector (environmental consultants, managers, and technical staff from industry), but also national and local government staff. The project offered seminars and roundtables for private-public sector dialog on proposed reforms in environmental policy. It also deliberately "Philippinized" the content of the courses, which made the courses more appropriate and effective for the participants and helped develop a corps of Filipino instructors. Finally, publications produced under the project had far-reaching impact, especially a series of success stories that were widely circulated throughout the Philippines.

The **India** projects relied heavily on informal training programs to introduce new approaches and technologies. Much of this educational work was conducted through India's two leading business associations, which routinely disseminated information to their members. CTI benefited from the Internet, which was in its infancy when its predecessor, the TEST project, was designed in 1991. By 1997, USAID assistance had helped create a world-class web portal providing access to information on clean technology. The FIRE project worked with a variety of target audiences in several Indian cities to introduce the concept of private financing of public infrastructure. As a result, municipal bonds, the first in South Asia, were issued successfully in Ahmedabad for the construction of water and wastewater works. Environmental education and awareness was also promoted through international travel fellowships and exchange programs available through the United States-Asia Environmental Partnership (U.S.-AEP). Since 1992, well over 200 U.S.-AEP/India exchanges have been conducted.

In the **Czech Republic,** training courses were carried out in northern Bohemia and northern Moravia, where the USAID project was implemented, and in Prague, where the Czech State Environmental Fund was located. These courses were not instrumental in helping officials of municipalities apply for loans from the State Environmental Fund. However, they did introduce various computer models, one of which aided municipalities in estimating their borrowing limits.

The public participation program of the Air Management project in Russia increased awareness of environmental issues, helped develop printed and reference materials, and elevated environmental quality to a "political issue."

Education and awareness programs were supported under both projects in **Russia**. The Center for Environmental Training offered over 20 programs to more than 400 participants. The training was supported by USAID, as well as a U.S.-based NGO, the U.S. EPA, and Russian public and private partners. Approximately one-third of the Istra component budget of the Moscow Water Quality project was allocated to support environmental education activities. These included a program for school children, public events, and newspaper and radio campaigns designed to reach the public. The public participation program of the Air Management project increased awareness of environmental issues, helped develop printed and reference materials, and elevated environmental quality to a "political issue."

Technological Change

USAID often supports the development or transfer of environmental technologies and practices—including retrofitting pollution control and prevention technologies and investing in modern, clean technologies for new plants. This sometimes involves providing the financing required to purchase new technology.

In **Chile**, the pollution audits recommended new practices and technologies ranging from low- and no-cost housekeeping, maintenance, and process changes to major capital investments. The attractiveness of any particular measure depended solely on its potential to increase short-term operating profits. Acceptance of recommended changes averaged 40 percent, but this varied greatly among the 26 participating firms. Key factors influencing acceptance were the suitability of the audit recommendation, the size of the investment, the benefit-cost ratio of the investment, and the skill and business savvy of the firm's owners and managers. Surprisingly, some factory owners were reluctant to implement changes even when cost savings and all other indicators were strongly positive. This anomaly also occurred in the Philippines.

As its name suggests, the Industrial Environmental Management Project (IEMP) in the **Philippines** emphasized the *management* of technological change—including the use of pollution audits—and only indirectly specific technologies. As in Chile, the audits typically recommended low- and no-cost process changes rather than capital investments in cleaner, more modern and efficient equipment. Capital investment in pollution prevention equipment was a relatively recent activity for both businesses and financial institutions in the Philippines. Companies were unaccustomed to making bankable cost calculations, and bankers were unaccustomed to reviewing loan requests for these purposes. However, using materials developed by the USAID project, both the Land Bank of the Philippines and the Development Bank of the Philippines provided concessional loans to small and medium-size firms to finance pollution prevention and waste minimization efforts.

Based on the results of a market survey undertaken in **India** in 1991, USAID identified technology gaps in the control of air and water pollution. The USAID project was designed to fill those gaps, while introducing U.S. environmental technologies to the Indian market. These technologies would presumably be attractive to Indian industry and replicated throughout the country. All that was needed, at least initially, was to match U.S. suppliers with Indian customers. However, it soon became clear that the Indian market could not and would not pay U.S. prices for finished products or services with high U.S.-made content. In most cases, India already had or could easily develop the necessary manufacturing capability. Therefore, successful U.S. counterparts adjusted by engaging in joint ventures or licensing agreements with Indian partners.

The USAID project in the **Czech Republic** promoted techniques that recovered waste heat and converted combustion sources from coal to natural gas. It also improved techniques in preparing loan applications and analyzing the technical and financial merits of projects. However, it did not directly provide new technology or engineering assistance.

The USAID-funded Commodity Import Program (CIP) in **Russia** indirectly supported the Moscow Water Quality project by providing state-of-the-art environmental technology valued at over $4 million. Most of the improvements at the wastewater treatment plants near Moscow can be traced directly to that equipment. This was not the case, however, with the Air Management project, because much of the technology was inappropriate for Russia's operating environment. In addition, delivery of the air quality sampling equipment and source-testing equipment was seriously delayed under the CIP.

5 Program Impact

Urban and industrial pollution prevention programs can have at least three effects: economic, environmental, and health. The following discussion examines the impact of each country's program in these areas.

Economic Impact

Successful pollution prevention programs reduce or eliminate the amount or toxicity of pollutants that enter the waste stream or the atmosphere, thereby generating environmental benefits and improving the health of employees and others. Just as important, though, they impart financial benefits to companies and factories.

This was true in the **Philippines**, where pollution audits identified opportunities for 143 participating companies to reduce water pollution, while increasing revenues and reducing costs. The firms collectively invested $27 million to implement many of the waste minimization measures identified in the audits. These investments resulted in annual net benefits of $33 million. Net benefits accrued to the firms primarily because they were able to increase revenues through recovery of product or sale of what was formely waste; cost savings were not as important a factor. Although more than 18 industries were represented by the 143 firms, two industries accounted for most of the net benefits. Cement manufacturing accounted for 33 percent of the benefits, and starch manufacturing accounted for 27 percent. Each pollution audit cost $28,000, on average, yet financial benefits for all companies (excluding the six in the cement and starch industries) averaged $61,000 per company—high enough to justify the cost.

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Pollution audits were completed in **Chile** for 26 firms, which, altogether, implemented approximately 40 percent of the recommendations. This resulted in annual savings estimated at $1.9 million, compared to total one-time investments of $1.4 million. With an average one-time investment of $53,000 per factory, annual savings were $72,000 per factory. Investment costs were recovered in just nine months, on average; pollution was reduced by 32 percent; and annual water savings were 1.4 million cubic meters. Although all 26 factories benefited, the mining and food processing industries accounted for over 90 percent of the investment and savings.

The greatest financial returns accrued to larger companies, which were willing and able to undertake larger investments. In addition, many of these companies had linkages to or were owned by foreign firms that encouraged or required pollution prevention, and some were export-producing firms that were required by importing countries to meet higher environmental standards. However, most firms were interested in no- or low-cost investments rather than higher cost investments, even when the higher cost investments had higher estimated rates of return. These firms tended to have small budgets, short planning and accounting horizons, reluctance to depart from time-tested patterns of production and risk aversion, inadequate knowledge of new production technologies, and insufficient management resources to supervise new procedures.

In **India**, USAID provided technical assistance under the TEST project to 92 companies, 25 of which were identified as candidates for potential trade agreements with U.S. firms. Ultimately, ICICI approved 14 loans to 12 Indian companies that entered into trade agreements. (Two of the 12 companies received two loans each.) The 14 business deals were valued at $35 million, of which the project financed $9.4 million, or 26 percent of the total value. According to an external evaluation, all borrowers were repaying their loans on schedule as of September 1996. By May 2000, this was no longer the case. Of the 14 loans, 2 had been repaid in full, 6 were being repaid, 2 had been restructured, and 4 had been canceled or were in litigation. Actual sales of pollution control equipment and services (measured by volume or value) were not tracked for most of the 12 Indian companies that received loans. Therefore, the financial benefits of investing in industrial pollution control measures could not be assessed. However, self-reported data for several firms (such as Kirloskar American Air Filter) demonstrate that benefits were positive.

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Throughout the 1990s, U.S.-India trade in environmental technologies and services increased. In 1990, the Indian market for these technologies and services was only $220 million. By 1994, estimated demand had increased to $1.9 billion; by 2000, it had increased still further to about $2.5 billion. Continued growth in demand is estimated at 15 percent annually. The United States has been able to take advantage of this expanded Indian market: U.S. exports of environmental equipment to India increased by 29 percent per year from 1992 to 1995. However, it is difficult to assess the extent to which the USAID project played a role. As of early 1996, the United States had the largest share of environmental joint ventures (40 percent). According to the U.S. Foreign and Commercial Service, U.S. companies were expected to satisfy about 6 percent of the $2.5 billion demand projected for 2000, valued at $150 million. These are impressive results.

USAID obligated $1.4 million to support the project in the **Czech Republic.** Of these funds, $650,000 was used to help 22 municipalities prepare loan applications for submission to the Czech State Environmental Fund; $750,000 was used to improve the operating efficiency of the State Environmental Fund. The evaluation team found that the 22 project-assisted municipalities reduced particulate matter by .05 tons per $1,000 invested. By contrast, all municipalities receiving loans from the Environmental Fund reduced particulate matter by .27 tons per $1,000 invested—five times the reductions realized in USAID-assisted municipalities.

In short, the $650,000 investment was not cost-effective, because the 22 USAID-assisted municipalities did not reduce particulate matter by nearly as much as those that were unassisted by USAID. The same was true for other forms of pollution: SO_2 was reduced by .06 tons per $1,000 invested in USAID-assisted municipalities, compared to .33 tons per $1,000 invested in all projects; NO_2 was reduced by .01 tons in the USAID-assisted municipalities, compared to .04 tons for all projects.

Thus, the 22 USAID-assisted municipalities that used loan funds to upgrade their energy utilities did reduce pollution. But the reduction was much less than what the Environmental Fund accomplished by adopting policy recommendations proposed under the project that increased the availability of funds for lending nationwide. The evaluation suggests several reasons for this. First, the value of the average Environmental Fund intervention was larger than the average municipal intervention, suggesting that economies of scale may have come into play. Second, but less likely, the municipalities typically estimated the amount of pollution reduction, and perhaps they overestimated these amounts to improve the odds of having their loans approved.

The process of using emulsified waste fuel oil at Russia's Red October Steel Mill dramatically reduced fuel consumption, emissions, and wastewater discharge. In addition to saving $2,000 a day in fuel costs, this effort is sustainable and has been widely replicated.

In **Russia**, it was impossible to estimate the economic impact of the Moscow Water Quality project. First, baseline data did not exist for some of the sites; second, it was impossible to disentangle the effect of the economy's downturn from that of improved water treatment. In short, it was impossible to say how much of the improvement in water quality was due to reduced industrial activity and how much was due to the project. With the Istra component, there was no measurable economic impact on project participants or on Russian society in general.

The only clear case of positive economic impact from the Air Management project was from installation and operation of diesel and waste oil (boiler fuel) emulsifiers at the Red October Steel Mill. This process of using emulsified waste fuel oil dramatically reduced fuel consumption, emissions, and wastewater discharge. Moreover, it is sustainable and has been widely replicated. At this one steel mill alone, an estimated $2,000 per day was saved in fuel costs through use of this technology.

Environmental Impact

The following discussion examines the environmental impact of USAID-supported urban and industrial pollution programs in the five countries. Each of the five countries achieved reductions in pollution during the period of analysis. Nevertheless, it is unclear how much of this improvement is the result of USAID urban and industrial pollution programs. The lack of "before" and "after" data in some cases and the decline in industrial production in others make it difficult to attribute environmental improvements to USAID interventions.

Although the **Philippines** project targeted various industries, its focus was mainly on those discharging organic wastes into the water, especially biochemical oxygen-demanding (BOD) material. (BOD material consumes dissolved oxygen, thereby lowering oxygen levels to the point where, at the extreme, the water cannot sustain life.) The project also helped reduce suspended solids (which reduce water quality, silt coral reefs, and harm agriculture) and heavy metals and toxins (which directly harm human health). In addition, it identified ways industries could reduce input requirements, thus saving water and energy.

As a result of these interventions, water use was reduced by an estimated 36.9 million cubic meters per year; BOD material was reduced by an estimated 43.5 million kilograms annually. These and similar reductions for other pollutants can probably be attributed to the USAID project. Of course, positive environmental results would also occur if a company's production declined, because less water would be used and less total pollution would be produced. However, it was impossible to determine how much of the decline in BOD was due to lower industrial output and how much was due to project interventions. A single industry, sugar milling, accounted for the largest share of water-use reduction (77 percent) and BOD reduction (69 percent). Measured by BOD, water pollution decreased by 29 percent, on average, for all companies combined. However, over 85 percent of total BOD reduction occurred in only 17 of the 143 companies targeted by this project.

In **Chile**, project managers estimated that pollution would be reduced by 32 percent, on average, at the 26 factories where audits were carried out. Unfortunately, no baseline or post-project measurements of air and water pollution existed to confirm this estimate. The main source of pollution was fuel used in the production process. Several of the targeted companies switched from coal to natural gas, a decision driven mainly by the lower price of gas, not because gas is a much cleaner fuel. Regardless, this switch lowered levels of particulate matter and sulfur dioxide emissions. In 1998, emissions of sulfur dioxide met Chilean federal standards, which are comparable to U.S. EPA standards; they even met the more stringent California state standards. This achievement was due almost solely to industrial conversion to natural gas and increased use of natural gas for local power generation.

Interventions at the municipal level under the **Czech Republic** project also focused on switching fuels—in this case, fuels used for district and residential heating systems—from dirtier lignite to cleaner natural gas. As a result, particulate matter was reduced by 412 tons per year, sulfur dioxide by 493 tons per year, and nitrogen dioxide by 116 tons per year. The environmental impact of these reductions was improved outdoor and indoor air quality, though these effects were difficult to quantify because of the lack of baseline data and ambient air quality measurements.

The project also supported nearly a dozen studies to improve operations of the Czech State Environmental Fund. Many of the study recommendations were adopted and implemented, allowing the fund to increase its annual environmental loan portfolio by nearly $24 million. These additional resources enabled the fund to make additional loans, which further reduced pollution. The environmental impact of these additional loans varied, depending on the types of projects financed; unfortunately, this information was not available. However, the evaluation team estimated total annual reductions in air pollution attributable to USAID support of the Environmental Fund as follows: particulate matter by 6,400 tons; SO_2 by 7,900 tons; and NO_2 by 980 tons.

The evaluation team in the Czech Republic estimated total annual reductions in air pollution attributable to USAID support of the Environmental Fund as follows: particulate matter by 6,400 tons; SO_2 by 7,900 tons; and NO_2 by 980 tons.

In **India** as well, factories installed pollution control devices and implemented process changes as recommended by the USAID-funded projects. The result was reduced emissions into the atmosphere and effluents into the water. However, as in other countries, it was impossible to quantify these changes in environmental quality without baseline data, continuous sampling of air and water quality, and source attribution studies. As stated in the final project report, not enough money was earmarked for monitoring program impact. However, one company that benefited under the USAID project, Kirloskar American Air Filter, did collect environmental data for 1999. The data show that after installation of pollution control equipment manufactured and sold by Kirloskar, particulate matter was reduced by 6,312 tons per day, on average, at 123 companies in four industries. Five cement factories can be credited with 78 percent of these reductions. Equally impressive reductions in water pollution were achieved by using the technology supplied by Kirloskar to treat industrial effluent.

The Smolensk Environmental Training Center in **Russia** tracked wastewater quality before and after 696 wastewater treatment operators were trained. It found that water quality had improved at municipal sites that had received training and equipment under the USAID project. The Center made no attempt to disaggregate the effect of the training from that of the equipment and new techniques. Nor was it possible to measure the environmental effects of the overall decline in economic activity, which no doubt altered both the composition and volume of wastewater treated. The environmental effects of interventions at Istra were modest or negligible, owing to the relatively small size of the demonstration activities, the decline in productive activity, and the failure of some interventions to take firm hold.

Air pollution, as measured by particulate matter, was reportedly reduced by 8 to 12 percent under the Air Management project implemented in Volgograd. This may help explain why Volgograd was ranked as the 6th most polluted Russian city at the outset of the project, but is now ranked as the 20th most polluted city. However, the depressed economy, which caused reduced production at the Red October Steel Mill and closure of the Silica Brick facility, no doubt contributed more to reduced air pollution than the USAID project. Moreover, at least 50 percent of the air pollution in the city stems from sources *not* addressed by the project.

Health Impact

Air and water quality standards are established primarily to protect human health. For example, particulate matter in the air comes from partially burned fuel, soot, exhaust smoke, industrial metal grinding, and condensation of gases. When a person breathes particles from these sources, they are trapped in the nose, throat, and respiratory tract. Similarly, untreated municipal effluent or sewage is a major cause of diarrheal disease. Industrial wastewater also often contains a wide range of pollutants known to cause cancers, organ failures, and neurological disorders and is typically discharged along with municipal wastewater. To what extent did USAID-supported urban and industrial pollution programs help countries combat these health problems?

The principal goal of the **Philippines** project was to improve human health. Unfortunately, the project did not concentrate on those industries that most directly harm health. Nevertheless, it did have a positive health impact, although that impact was indirect and difficult to measure. For example, levels of BOD and total suspended solids, two pollutants that damage aquatic life, were reduced, and as a result, water quality likely improved. And since many Philippine communities depend heavily on fish protein, nutrition likely improved. The project also reduced air pollution. Interventions at cement plants, for example, reduced emissions of suspended particulate matter that endangers human health. However, data necessary to establish these linkages and quantify their positive health effects were not available.

The same was the case in **Chile**. Although the USAID project helped firms reduce pollution discharges and meet discharge standards, thereby improving human health, no baseline emissions and effluent data were available to estimate or quantify health impacts. In the **Czech Republic** as well, interventions supported at the municipal level had a positive health impact, mainly by reducing particulate matter in the air, but owing to lack of data, the effect was not measurable.

Analyzing changes in human morbidity and mortality in response to changes in environmental quality requires both environmental data and health surveillance data. No such information was collected in **India**. One can only assume that distribution of potable water, trash pickup, and development of environmental infrastructure such as sewer systems in low-income areas improved human health. Anecdotal evidence exists to support this assumption. For example, beneficiaries of the USAID-supported "slum networking" project in Ahmedabad reported fewer visits to doctors and hospitals. However, "before" and "after" surveys have not been conducted, so data to substantiate and quantify these claims are not available.

Health impacts were not measured in **Russia**. It is likely, however, that municipal water treatment plants and industrial wastewater treatment facilities contributed to improvements in Moscow's drinking water. Under the Air Management project, levels of exposure to various pollutants were supposed to have been measured and then ranked according to their effects on human health. Had this been done, efforts to reduce emissions could then have been undertaken sequentially, pollutant by pollutant. However, engineers interviewed by the evaluation team indicated that data were not gathered. Thus, if changes in health occurred, they could not be attributed to the USAID intervention as distinct from other factors, such as the depressed economy.

6 Program Performance

Program performance is normally assessed based on (1) the program's effectiveness in meeting stated objectives, (2) the sustainability of benefits after donor funding ends, and (3) the replication of activities beyond the program.

Effectiveness

The program goal in each of the five countries was to reduce environmental degradation and improve public health, while promoting sustainable economic growth. Several key questions help assess program effectiveness in achieving this goal. Were benefits significant? Did the program work with the right people? Was the approach the best way to get the job done? The discussion that follows considers program performance in the context of these questions.

Successful pollution prevention in **Chile** was generally associated with good plant management. Good managers saw pollution prevention as an integral part of efficient production. They adopted pollution reduction and waste minimization strategies to save money and improve product quality. Thus, enterprises that benefited most from the USAID project tended to be dynamic and capable of modifying their industrial processes to take advantage of changing markets. In fact, most of these firms introduced new technologies, clean production practices, and pollution prevention processes beyond those recommended by the project. By contrast, small, less dynamic firms did not fare as well. These firms may have had different priorities, less capital, or greater skepticism about the financial merits of pollution prevention.

An alternative approach would have been to target companies with the worst pollution. However, these companies often had financial problems owing to weak management. They were producing the wrong product mix with inefficient machinery. Although targeting these companies may have been the best way to clean up the most pollution, pollution prevention efforts generally stand a better chance of success if they target more progressive, better managed firms. Thus, the Chile project was effective, yet it might have been even more effective if it had targeted a group of companies in one or two industries, rather than 26 companies in eight industries.

In contrast, the **Philippines** project concentrated on small and medium-size firms outside Metro Manila. This was a good choice because the World Bank was targeting companies in Manila. In addition, larger companies were typically already using modern, less-polluting technologies, often because they were connected to multinational corporations and the export market, which typically required cleaner production processes and technologies. Smaller firms, in comparison, often lacked the technology, resources, and knowledge to address industrial pollution. They were often among the dirty (heaviest polluting) industries located outside the major cities. In fact, many of the 143 companies that volunteered for pollution audits were among the Philippines' "dirty dozen" or so heaviest polluters, and they had environmental compliance problems.

As in Chile, the Philippines project might have been even more effective if (1) it had targeted companies in fewer industries (rather than 18), and (2) the targeted companies' management had maintained audit recommendations and complied with pollution regulations (less likely with the major polluters). In addition, one of the project's main objectives was to improve human health. Heavy metals, harmful bacteria, and industrial chemicals are health problems; BOD is not. Nevertheless, the project measured changes in BOD, rather than changes in levels of these other pollutants.

In the **Czech Republic**, USAID provided technical assistance to improve financial operations of the Czech State Environmental Fund. The fund implemented most recommendations with positive results. For example, the time required to process loans was significantly reduced, enabling the fund to process more loans and thereby increase the potential for more environmental benefits. In addition, the fund decreased the grant portion of total project costs from 80 percent to 60 percent, allowing it to expand its financing capacity while reducing its risk. Finally, the fund lowered interest rate subsidies, began charging interest on municipal loans, and extended loan terms from 5 to 10 years. Most municipalities assisted by the project confirmed that they had better access to fund officials. However, they also indicated that the time lapse between submitting a loan application and receiving a response had not decreased noticeably. On balance, though, the project was highly effective at the national level.

At the municipal level, the project was much less effective. Many municipalities reported that technical assistance was not critical to their securing financing from the Environmental Fund for two reasons. First, under the Clean Air Act, some municipalities were forced to reduce pollution regardless of project assistance. Second, project-supported feasibility studies and training did not significantly improve the ability of municipalities to carry out technical, financial, and environmental project evaluations. This conclusion is supported by the fact that there was no difference in loan approval rates between project-assisted municipalities (40.9 percent) and nonproject-assisted municipalities (41.3 percent). The project was also implemented in several other countries, including neighboring Poland, where the results were much different. The Krakow Environmental Fund, which is a regional fund (not a national fund as in the Czech Republic), reported a higher loan approval rate for municipalities receiving project assistance (almost 90 percent) compared to municipalities receiving no project assistance (67 percent).

The effectiveness of USAID's urban and industrial pollution program in **India** is mixed. The effectiveness of the TEST project, in particular, was compromised because several critical project assumptions proved invalid. For example, a preproject market survey identified important pollution prevention technologies that India needed—and for which the United States had clear manufacturing superiority. However, it later became clear that importing finished pollution control equipment from the United States was financially unattractive to Indian companies. As a result, 12 of the 14 loans approved by ICICI were for U.S.-India joint ventures or licensing agreements with U.S. companies; under such agreements, pollution control equipment was manufactured or assembled in India. Only two loans were approved so that Indian companies could import environmental services or products directly from U.S. companies.

Although Indian companies of any size from any industrial sector located anywhere in India were eligible to apply for a loan, ICICI's lending criteria may have favored larger companies. As in Chile, such companies tended to be strong financially and already had access to the domestic capital market and external sources of funding. Moreover, it was primarily the large industries that were export-oriented that invested in pollution control. This suggests that many of the 14 business transactions almost certainly would have proceeded even without the concessional financing provided by the TEST project, though perhaps not as quickly or on terms as favorable. By contrast, smaller companies often did need financing but could not meet ICICI's lending criteria. Finally, the project probably would have been more effective if the state pollution control boards had improved their capability to enforce environmental regulations—as had been assumed during project design. Although the World Bank initiated activities to improve enforcement, they met with only limited success. As a result, many enforcement actions have been left to India's ill-prepared judicial system.

In **Russia**, the quality of drinking water at all three municipal sites improved with adoption of pollution control techniques and use of project-supplied equipment. The key was to improve local expertise in wastewater treatment methods, especially new water monitoring and enforcement techniques. In addition, use of automatic samplers and flow meters at industrial sites had convinced firms to reduce waste flows and cooperate to a greater degree with water control authorities. By contrast, the pilot farms in the Istra watershed demonstrated only modest results, largely because the farming and livestock sectors were unstable. Although this effort developed a base of critical environmental data about the watershed, this was of little value without an ability to use the data.

The Air Management project was designed to implement continuous sampling using high-technology sampling stations provided under the CIP. As indicated above, the equipment did not arrive until 1997. Therefore, from 1994 to 1997, the U.S. EPA carried out field-intensive saturation studies based on over 1,100 samples of air quality taken throughout Volgograd. This program enabled local expertise to build a robust database and provided a supply of reliable equipment for collecting future samples. At the national level, it created interest in establishing a maximum standard for particulate matter.

Receipt of source-testing equipment (used to identify alternative pollution control measures, including low- and no-cost measures) was also seriously delayed under the CIP. Therefore, source assessments initially planned for over 40 industries were ultimately carried out at just three: Red October Steel Mill, Volgograd Aluminum Factory, and the now-defunct Silica Brick Plant. Although the emissions inventories were conducted successfully at these few industries, actual emissions have changed due to changes in plant operating rates and plant closures, thereby compromising the utility of the effort. On the other hand, emissions testing helped educate Russian environmental inspectors, industry environmental staff, and ministry officials, and it trained others in the use of sophisticated continuous analyzers. The effectiveness of the training far outweighed any accomplishments resulting from technological upgrades and equipment installation. For example, a $250,000 Instrumented Source Testing Trailer supplied under the CIP was not in use; rather, it was stored at an engine factory with two flat tires. Most other components of the Air Management project were also ineffective.

Sustainability

Sustainability is achieved when a program continues to operate and provide benefits after development assistance ends.

In part due to USAID's training efforts, **Chile** now has a cadre of trained industrial environmental engineers working principally in the private sector and universities. Many have become managers and heads of environmental agencies that have important roles in pollution measurement, control, and prevention. Several have established their own environmental consulting firms. As a result, many of the aims of the project have been institutionalized, and commitments have been made to ensure that pollution prevention concepts are sustained. Chile's Commission on the Environment, for example, has adopted environmental standards, and the philosophy of pollution prevention has been incorporated into the country's regulatory framework. The future of pollution prevention and clean production looks bright. USAID can claim much credit for recognizing an important need in Chile and for responding early and effectively.

The **Philippines** project was a pilot effort designed to introduce the concept of pollution audits. A pilot project can be expensive, but if the new techniques are widely adopted, sustained, and replicated, then the initial investment is justified. Unfortunately, this was not the case. A 1994 independent evaluation attributed this situation to the fact that sustainability had not been stressed in the original project design. Another factor may be that many of the businesses that volunteered for pollution audits were among the Philippines' "dirty dozen" or so heaviest polluters with a history of environmental compliance problems. Site visits revealed a mixed picture. Some companies did not adopt the audit recommendations in the first place; others adopted the recommendations initially but later dropped them. A few companies had suspended or closed plant operations, making a determination impossible. No evidence existed that any business had conducted additional audits after the end of the project.

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Interviews, also, uncovered a range of reasons for the lack of sustainability: a natural resistance to change plant operations that already "seem to work well"; the time required to monitor and collect baseline data to "sell" the audit approach to plant owners; the effort required to keep existing audit recommendations in force; and lack of support by company owners. As most audit recommendations were either no-cost or low-cost (as distinct from capital intensive), the sustainability of more demanding recommendations was considered extremely unlikely.

The State Environmental Fund of the **Czech Republic** is financially stable and likely to remain so for at least two reasons. First, it reduced the grant portion of its costs from 80 percent to 60 percent, which enabled it to preserve its capital base longer. Second, it began charging interest on noncommercial loans, thereby increasing its revenue stream and further strengthening its long-term financial sustainability. In contrast, USAID assistance provided to the 22 municipalities in preparing loan applications is unlikely to have any long-term effect. Project staff and municipal staff worked together in only a few cases developing and packaging loan applications. As a result, municipal staff did not develop the skills needed to prepare applications in the future.

The TEST project in **India** will prove sustainable if the 12 companies that received loans under the project stay in business and repay their loans. That will depend in part on expansion of the Indian market for the environmental services and technologies provided by these companies. Market demand, in turn, hinges mainly on the extent to which the government enforces its environmental standards and regulations. USAID's CTI project is ongoing, making it too early to assess sustainability. In the case of FIRE-D, considerable time was required to change the mind-set of India's business and government leaders so they would accept the idea of using municipal bonds to finance public-sector projects. This acceptance has now been achieved. Infrastructure projects have been initiated in two municipalities, and construction is likely to proceed smoothly elsewhere. Yet to come, though, is a new set of challenges. Water charges must be established that are financially sound yet politically acceptable. Equally important, investors in municipal bonds must be repaid on time. Only then will it be possible to assess the sustainability of this activity.

The U.S. EPA, which implemented the USAID projects in **Russia**, was acutely aware of the need for program sustainability. It therefore emphasized training, no-cost and low-cost methods to improve water quality, and institutional strengthening. This strategy paid off for the Moscow Water Quality project. Three years after project completion, all wastewater treatment activities were operational (except for industrial enterprises that had closed). The project contributed to financial sustainability in two ways. First, it provided equipment and training to the water testing laboratories, which allowed them to become certified. Certification, in turn, allowed the laboratories to perform services for a fee, thereby providing them with a source of income. Second, the project identified various adjustments at municipal water treatment plants that resulted in reduced costs, enabling them to accomplish more within a fixed budget. In contrast, most activities supported under the Istra component of the project were not sustained. One of the two livestock operations closed during the project, and the other sold most of its animals. However, many of the education materials developed under this component were still being used.

The system for monitoring air quality by sampling particulate matter under the Volgograd Air Monitoring project was sustainable. It was easy to operate and repair, required minimal maintenance, and had low operating costs. In addition, there was a substantial reserve of spare parts, as 40 samplers were delivered and only four or five were currently in use. By contrast, the system introduced for continuous air sampling was not sustainable. The equipment was not operating due to lack of spare parts, calibration gases, and operator resources. In addition, the laboratories equipped under the CIP were not sustainable. This is because industrial demand for the services to be performed by these laboratories did not materialize, mainly because they were too expensive. Conducting source assessments, however, had become a marginally sustainable commercial service.

Most other components of the Air Monitoring project also were not sustainable. For example, use of continuous analyzers (housed in the nonfunctioning, CIP-supplied mobile trailer) for emissions testing was not sustainable, because operating costs exceeded revenues and prospective clients were typically unable to pay for the services. Further, the methods and procedures recommended by the project have yet to be accepted by the Russian government. Visible emissions testing, an alternative to continuous analyzers, was also unsustainable, because it was not integrated into a legally enforceable procedure for compliance testing. The human health and risk assessment component was not effective and is unlikely to be sustained; nor is the compliance and enforcement component. By contrast, the education and awareness activities at the Center for Environmental Training will be sustained, but only if there is funding.

Replication

Replication refers to the difficult process of extending benefits beyond the original target areas, participants, or industries.

With over 10,000 “brown sector” companies in the **Philippines**, it was clear that replication of pollution audits beyond the 143 participating firms would be needed. Unfortunately, plant interviews consistently described replication as either nonexistent or negligible. Some plant managers regarded the audit as proprietary as it may reveal trade secrets. Others indicated there was no real forum for discussing replication. Still others viewed replication as counterproductive, because it involved sharing audit recommendations with competitors. In addition, local government staff knew of no replication of audit recommendations in their regions. No replication was occurring through word of mouth, local seminars, or other formal or informal means. These findings were consistent with the views of professional and trade groups.

Of 17,000 small and medium-size enterprises in the Santiago area of **Chile**, just 26 were chosen for environmental audits. Clearly, replication of successful results would be essential. But, as in the Philippines, firms were reluctant to divulge secrets about their industrial processes. Owners and plant managers did not want to share information about operational changes that resulted in cost savings. They wanted to protect proprietary information, including information contained in the audits, to protect their competitive positions. This made replication difficult. Targeting firms or trade organizations within a particular industrial sector or a specific geographic area might have led to greater outreach and more expansive coverage. In addition, selecting companies whose owners were leaders within their trade association might have been an effective way to enhance replication. Finally, information was perhaps more likely to be disseminated when influential people were involved with the audit.

Although there are thousands of municipalities in the **Czech Republic**, there is only one State Environmental Fund. Therefore, while the issue of replication applies to the former (municipalities), it does not apply to the latter. That said, there was no evidence of replication from one municipality to another, perhaps because replication was not an explicit project objective. In Poland, on the other hand, there are 49 regional environmental funds and more than 2,000 local environmental funds (rather than a single state environmental fund at the national level). The Krakow Fund, one such regional fund assisted under the USAID project, was able to transfer what it learned to other regional funds. The same is true for the Katowice Fund, another regional fund assisted by USAID. In short, replication worked in Poland. This suggests that several regional funds have a clear advantage over a single national fund. Regional funds appear to be more flexible, are closer to the environmental problems, and can provide technical support more easily.

A key objective of the TEST project in **India** was to increase exports of environmental services and technologies from the United States to India. Accordingly, one measure of replication is the extent to which the Indian market for such services and technologies has grown. In 1991, U.S. suppliers were exporting about $6 million of environmental equipment to India annually, or about 4 percent of the total market estimated at $135 million. In 2000, they were exporting $150 million of pollution control equipment and services, 6 percent of the much larger $2.5 billion Indian market. Thus, the volume of U.S. exports to the Indian market was 25 times larger in 2000 than it was in 1991. Unfortunately, it is difficult to determine how much, if any, of this increase in U.S. exports can be attributed to USAID programs. It appears that replication is already occurring with the ongoing FIRE-D project. Following the example of Ahmedabad, the first municipality in India certified as creditworthy for the purpose of issuing unsecured commercial bonds, 13 other municipalities have sought fiscal review to obtain a credit rating.

In **Russia**, there has been little full-scale replication of wastewater treatment facilities beyond the three sites supported under the Moscow Water Quality project. Replication has also been limited on the industrial side. Perhaps firms used what little money they had for production improvements rather than environmental improvements. Whatever the reasons, replication did not occur. By contrast, monitoring and inspection programs have been replicated elsewhere. For example, monitoring equipment has been moved from one industry to another. Moreover, laboratories not targeted under the project are now certified and equipped, and some are providing services to industry for a fee. In addition, replication of environmental education efforts under the Istra component has been a great success. The number of schools in the Istra region has increased from 7 to 28. Moreover, all schools in the Moscow region now teach environmental education using materials developed under this component of the project. Textbooks, now in their second edition, are being sold to schools throughout Russia. Practical activities, such as environmental cleanups, are undertaken monthly.

Most activities supported under the Air Management project were not replicated. For example, there is no evidence that the particulate matter sampling program was replicated; unless equipment and operating budgets are subsidized or covered by others, replication is unlikely. Similarly, the laboratories equipped under the project have not been replicated due to the high cost of operation and insufficient contract work. The practice of constructing improved emissions inventories has not occurred, so there is no replication. Emissions testing using continuous analyzers has not been successfully replicated. However, two pollution control measures introduced under this project have been replicated at other facilities in Volgograd and beyond: (1) fine-tuning boiler firing procedures and (2) use of the fuel oil emulsification process.

Annex A Evaluation Methodology

The assessment involved fieldwork in five countries: the Philippines, Chile, the Czech Republic, India, and Russia. Criteria used to select countries were as follows:

- ❑ The countries should include USAID-funded projects that had relatively homogeneous objectives, thereby permitting comparability among countries.

- ❑ The countries should include projects for which USAID funding was not unusually small.

- ❑ The countries should pose no security problems for the assessment teams.

Evaluation teams (of three to five people each) spent two to three days in Washington, D.C. at USAID participating in a team planning meeting and approximately three weeks in-country gathering data. Each team consisted of a team leader from CDIE, an economist or other expert knowledgeable about environmental economics and environmental regulatory policy, and an environmental engineer or other technical expert knowledgeable about industrial and urban pollution prevention technology (see Annex B for a list of country teams).

Before conducting fieldwork, the teams reviewed project documentation available in Washington and interviewed people based in Washington who were knowledgeable about urban and industrial pollution programs implemented by USAID in the countries of focus. In conducting fieldwork, the teams relied primarily on three data sources: documents not available in the United States, key informant interviews, and site visits.

Evaluation teams interviewed a broad range of key informants. These included managers of urban industries where pollution control technology had been (or was being) used; private-sector suppliers of pollution control devices; representatives of environmental groups, government, and NGOs; USAID staff; other donors; and USAID contractors that had implemented the projects. These informants also included a rich mix of trade and professional groups knowledgeable about urban and industrial issues. The teams carried out site visits in each country. Both the best cases and those that might have been less successful were selected. The option of selecting only "success story sites" to assess best case impacts and best case opportunities for sustainability and replication was rejected.

Teams used two interview protocols (or topical guides), rather than formal questionnaires or other survey instruments to gather data. The first was designed for site visits, usually factories, municipalities, or other beneficiaries; the second, for program managers and implementers. The topical guides served not only to structure the interviews in each country, but also to ensure some degree of comparability among countries.

Annex B Case Studies and Evaluation Teams

Chile

Reducing Urban and Industrial Pollution in Chile. Impact Evaluation. December 2000. PN-ACG-619. Available on-line at: www.dec.org/pdf_docs/PNACG619.pdf

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Czech Republic

Reducing Urban and Industrial Pollution in the Czech Republic. Impact Evaluation. August 2001. PN-ACG-628. Available on-line at: www.dec.org/pdf_docs/PNACG628.pdf

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Reducing Urban and Industrial Pollution in India. Impact Evaluation. August 2001. PN-ACG-629. Available on-line at: www.dec.org/pdf_docs/PNACG629.pdf

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Reducing Urban and Industrial Pollution in the Philippines. Impact Evaluation. September 2000. PN-ACG-611. Available on-line at: www.dec.org/pdf_docs/PNACG611.pdf

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Reducing Urban and Industrial Pollution in Russia. Impact Evaluation. February 2002. PN-ACP-069. Available on-line at: www.dec.org/pdf_docs/PNACP069.pdf

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