

**Business Focus Series**

# **Environmental Market Conditions and Business Opportunities in Key Latin American Countries**



*Prepared by:*

**U.S. Agency for International Development**

**Office of Energy & Infrastructure**

*in Cooperation with:*

**Bureau for Latin America and the Caribbean**

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## *Executive Summary*

The environmental markets in the six key Latin American and Caribbean (LAC) countries of Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela are expected to total about \$2.45 billion in 1992. Approximately 70 percent of the spending in these markets will be for municipal and industrial water pollution projects. The air pollution control markets account for around 21 percent, while the emerging solid and hazardous waste markets should account for 9 percent of total spending. These markets are likely to grow as much as 25 to 30 percent annually in several of these countries.

*Estimated 1992 Market Size (\$ million)*

Country	Market Segment			Total	% of Total
	Air Pollution	Water Pollution	Solid/Hazardous Waste Pollution		
Argentina	53	100	15	168	7
Brazil	120	845	50	1,015	41
Chile	195	350	15	560	23
Colombia	20	15	10	45	2
Mexico	104	400	110	614	25
Venezuela	25	9	10	44	2
<b>Total</b>	<b>517</b>	<b>1,719</b>	<b>210</b>	<b>2,446</b>	
<b>% of Total</b>	<b>21</b>	<b>70</b>	<b>9</b>		

About 39 percent of the LAC environmental market is expected to come from imports in 1992. U.S. firms should account for approximately 45 percent, or \$430 million, of the total import market. The ability of U.S. suppliers to access the market should be strengthened by the fact that most of these LAC countries accept U.S. standards and many of their technical people were trained in the United States. Most LAC environmental standards have also been developed to follow U.S. standards.

## *Executive Summary*

U.S. suppliers will continue to face competition from Japanese and European suppliers, who are already gaining an edge in the market by tying equipment sales and technical assistance to attractive financial aid packages. Furthermore, U.S. firms will encounter competition from local companies in countries like Brazil and Mexico, where the capabilities of the domestic environmental industry are more advanced.

The three countries with the most developed regulatory programs -- Mexico, Chile, and Brazil -- will account for 90 percent of the LAC environmental market in the near term. The most promising opportunities exist in such high-priority sectors as improving water pollution control in Mexico and Brazil, reducing air emissions from copper smelting in Chile, and reducing mobile source emissions in Mexico and Chile.

Business opportunities in Argentina, Colombia, and Venezuela will increase as their environmental regulations are further developed and implemented. The best near-term opportunities in these markets are currently in municipal wastewater treatment in Argentina, particulate controls for power plants and industrial facilities in Colombia, and pollution control and waste management services for the petroleum sector in Venezuela.

The LAC environmental market, while modest in comparison to that of the United States, is nonetheless substantial. Furthermore, the market is likely to expand as additional environmental regulations are implemented in these countries. Because most LAC nations want to develop the capabilities of their domestic environmental industry, it is necessary that U.S. companies work with local partners through technology licensing, local manufacturing, joint venture, or local subsidiary arrangements. In the long run, as markets open, opportunities will also exist to serve the entire regional market through a subsidiary or joint venture in one LAC country.



## *Introduction and Regional Overview*

This *Business Focus Report* provides an overview of the environmental market conditions and potential business opportunities in the Latin America and Caribbean (LAC) region. The report focuses on six countries: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. These countries were selected from the 26 countries that form the LAC region because they have the largest economies and are the major sources of pollution in the region.

### *Current Economic Conditions*

The six major LAC countries have a total population of 347 million and a combined gross domestic product (GDP) of \$802 billion. While they account for 79 percent of the total LAC population (and 7 percent of the world population), these six countries account for 89 percent of the LAC region's GDP (5 percent of the world's GDP). Compared to the United States, the six countries have 35 percent more people, but their combined GDP is only about one-fifth as large.

Economic growth in the LAC region has been strong in recent years and is expected to continue. Chile and Mexico, for example, have maintained their GDP growth at around 3 to 5 percent over the last few years. Similar growth rates are expected in each country over the next few years.

The most positive economic change in the six LAC countries is their move toward market liberalization. Each has implemented various types of economic reforms -- including reduced import barriers and tax reforms -- to increase foreign access and make foreign investments more attractive. Such reforms have also helped to reduce inflation and foreign

## *Introduction and Regional Overview*

### *Key Economic Indicators*

Country	Population (million)	1992 Real GDP* (\$billion)	Projected Real GDP Growth		1992 Inflation** (%)
			1992 (%)	1993 (%)	
Argentina	33	131	4	5	22
Brazil	157	283	1.5	3	250
Chile	14	39	5	6	22
Colombia	33	46	3	3	20
Mexico	89	234	4.5	5	12
Venezuela	21	68	3	5.5	30
Total	347	802	3.2	4.3	200
Latin America Total	439	901	2.3	3.3	124
U.S. Total	256	3,632	2.9	2.6	4
World Total	5,115	15,362	2	2.3	10

\* At 1980 constant prices and exchange rates.

\*\* Projected 1992 year-end consumer price change.

Source: Adapted from Bank of America data.

debt. Chile and Mexico have been the most successful of these nations in their market reforms and currently have the most open markets. The other countries, led by Argentina and Brazil, are further opening their markets, but their progress has not been as rapid.

Market access in certain of these countries may be increased further by new free trade agreements with the United States. Of particular note is the North American Free Trade Agreement (NAFTA), which will affect Mexico. In addition, Chile is working on an agreement with Mexico that would improve access there. Furthermore, Argentina, Brazil, Chile, Colombia, and Venezuela are all seeking direct trade agreements with the United States. Finally, the LAC countries are also looking to improve trade conditions within Latin America through the Mercosur common market and other arrangements.

## *Introduction and Regional Overview*

Another positive action being undertaken by the LAC countries is the privatization of major industries, including everything from steel, mining and petrochemicals to electric utilities and municipal water companies. In many cases, state ownership has hindered economic development by fostering the inefficient use of energy, natural resources, and labor. It has also often limited environmental cleanup efforts, as governments have been reluctant to force state-owned companies to invest in pollution controls. In contrast, private firms have shown that they have the incentive to develop environmental programs to compete worldwide, but will also have the responsibility and authority to implement these programs. The enforcement of environmental regulations will also be more strict for private companies than for state-owned enterprises.

Despite these recent improvements, companies considering business in the LAC region need to recognize that the situation is not problem-free. First, inflation is still high in most of these countries, ranging from 12 percent in Mexico to 250 percent in Brazil. Second, foreign debt is still quite high, which may affect the ability to finance large environmental projects. Last, both new regulations, which are still being developed in many areas, and potential changes in governments add a degree of uncertainty to the future environmental market in the region.

### *Environmental Issues Facing the Region*

The environmental problems now faced by the LAC region are a function of the economic growth it has achieved and its demographics. The need and desire of these nations to industrialize and improve their overall economic welfare have taken precedence over environmental issues. State ownership of major industries, such as petroleum and mining, has in certain instances made the enforcement of any existing regulations difficult.

On a demographic basis, the LAC countries share similar problems derived from populations clustered in dense urban areas in close proximity to major industrial centers. Over 75 percent of the LAC population lives in urban areas, with nearly 20 percent living in seven major urban/industrial centers: Mexico City, Buenos Aires, Santiago, São Paulo, Rio de Janeiro, Caracas, and Bogotá.

The rapid increase in urban population and the unregulated growth of industry have created severe urban water and sewage problems. People and industry share the same water supplies, which have become highly polluted and are being depleted because of over-consumption. Air pollution from industry and transportation is also magnified by their high density and proximity to urban areas. In two major urban areas, Mexico City and Santiago, the problems are even more severe because of thermal inversions.

## *Introduction and Regional Overview*

As environmental conditions have become increasingly severe, public awareness of the problems has increased. Public pressure over such visible, large-scale problems such as the April 1992 sewer explosions in Guadalajara, Mexico, the pollution of Lake Maracaibo in Venezuela, and the cholera epidemic in Chile has made improved environmental policy a main issue in the LAC region. International pressure to adopt and conform to world standards has also made such policy a priority.

Although solving pollution problems has become a political priority, the LAC countries are at varying stages in terms of developing policies and regulations, and more importantly, in terms of enforcing regulations. These nations have generally had some form of environmental regulation, but many factors have combined to limit the extent of enforcement. These include:

- Clear regulatory authority has often been absent.
- Key industries have been state-owned and not forced to comply.
- Economic dependence on exports has further minimized the likelihood that plants (especially state-owned) would be shut down because of non-compliance.
- Monetary resources and technical skills for environmental enforcement have been lacking in some cases.

The regulatory and compliance situation is changing, however. Many of the LAC countries have modeled or are modeling their environmental programs on those of the United States. Generally, each country has a federal agency with overall responsibility over state or regional agencies that are also involved in regulation setting and compliance enforcement.

In many cases, the regulations that have been established are stricter than those in the United States. Differences among countries mostly involve the degree to which regulations have been developed. Mexico, Chile, Brazil, and Colombia have moved actively to streamline their regulatory processes, tighten pollution regulations, and strengthen enforcement. Argentina and Venezuela have not moved as far, but are working on new environmental programs.

The LAC countries also differ somewhat as to where environmental responsibility is centered. For example, in Mexico and Chile, federal environmental organizations such as Mexico's SEDESOC and Chile's CONAMA set regulations and monitor enforcement. In Brazil, the federal EPA (IBAMA) is active in the regulatory process, but state agencies have led the effort to institute regulations and have also been most responsible for pollution monitoring.

**Current LAC Environmental Framework**

Country	Primary Regulating Authorities	Regulations in Place	Level of Enforcement	Environmental Priorities
Argentina	Environment Secretariat	New regulations being developed. Effluent guidelines are lacking.	Low	<ul style="list-style-type: none"> <li>- Expanding wastewater treatment</li> <li>- Air pollution in Buenos Aires area</li> <li>- Urban solid waste management</li> </ul>
Brazil	Federal environmental agency – IBAMA; State environmental agencies – – two major CETESB (Sao Paulo), FEEMA (Rio de Janeiro)	Being developed for solid/hazardous wastes; in place for air and water.	Low/moderate but increasing	<ul style="list-style-type: none"> <li>- Water pollution</li> <li>- Sewage/water treatment</li> <li>- Industrial air pollution</li> </ul>
Chile	National Environment Commission – CONAMA	Strict for air; water law under development; none yet for solids/toxics.	Moderate and increasing	<ul style="list-style-type: none"> <li>- Air pollution in Santiago</li> <li>- Reduce emissions from copper smelting, diesel engines</li> <li>- Wastewater treatment</li> </ul>
Colombia	National Institute of Natural Resources (INDERENA), ministries of health and national planning, autonomous regional development corporations	In place for air and water; being developed for solid and hazardous wastes.	Low/moderate but increasing	<ul style="list-style-type: none"> <li>- Air pollution in Bogota</li> <li>- Wastewater treatment in Rio Bogota and Rio Medellin waterways</li> <li>- Urban solid/hazardous waste</li> </ul>
Mexico	Ministry of Social Development (SEDESOC); state and municipal agencies	In place for air, water, and solids; developing for hazardous wastes	Moderate and increasing	<ul style="list-style-type: none"> <li>- Air/water pollution in Mexico City, Guadalajara and Monterrey</li> <li>- Water sanitation and treatment</li> <li>- Hazardous waste transport, storage, and disposal</li> </ul>
Venezuela	Ministry of Environment and Renewable Natural Resources (MARNR)	Regulations in place for all sectors. Effluent guidelines being developed.	Low but increasing	<ul style="list-style-type: none"> <li>- Water pollution, especially for Lakes Maracaibo and Valencia</li> <li>- Air pollution at refineries and petrochemical plants</li> </ul>

## *Introduction and Regional Overview*

Overall, the LAC countries are facing similar environmental problems. Improving water quality through urban and industrial wastewater treatment and reducing air pollution from industry and vehicles are the main priorities. The fight against industrial pollution tends to be focused on selected major industries in each country: petrochemicals and steel in Brazil and Mexico, petroleum refining in Venezuela, and mining in Chile. In contrast, solid and hazardous waste treatment have received less attention to date.

Even though their overall problems are similar, each country has unique problems that dominate its environmental policy. Regulations and spending are generally focusing on solving these problems first. In Mexico and Chile, for example, reducing transport sector air pollution in the capital cities of Mexico City and Santiago is a main objective. Water pollution projects are also a major focus. In Brazil and Venezuela, the focus is on industrial air and water pollution from their leading industries, namely petroleum refining, petrochemicals, and steel.

## *Size of the Environmental Market*

The environmental market in the six LAC countries is expected to total about \$2.45 billion in 1992. About 70 percent of the spending will go towards water pollution projects, covering both industrial and municipal water and sewage treatment. The air pollution sector will total about 21 percent of the market, while the emerging solid and hazardous waste markets should account for 9 percent of the total market.

Because the regulations and enforcement programs are only now developing, the LAC environmental market should experience significant growth. Estimates from the U.S. Department of Commerce, for example, place growth at 25 to 30 percent per year for the next few years in several countries.

While each country's markets will generally correlate to its economic size within the region, the main driver will be regulations and active enforcement. Brazil, for example, is the largest country and is expected to have a market in excess of \$1 billion in 1992. However, Chile, which is about one-tenth as large, is expected to have a market of over \$500 million because it is actively developing its regulatory structure, is developing stringent regulations, and has industry commitment (particularly from multinational companies) to comply with established and planned standards.

## *Introduction and Regional Overview*

The three countries with the most developed regulatory programs -- Mexico, Chile, and Brazil -- will account for 90 percent of the LAC environmental market in the near term. The markets in Argentina, Colombia, and Venezuela will increase as regulations are developed and implemented.

### *Estimated 1992 Market Size (\$ million)*

Country	Market Segment			Total	% of Total
	Air Pollution	Water Pollution	Solid/Hazardous Waste Pollution		
Argentina	53	100	15	168	7
Brazil	120	845	50	1,015	41
Chile	195	350	15	560	23
Colombia	20	15	10	45	2
Mexico	104	400	110	614	25
Venezuela	25	9	10	44	2
Total	517	1,719	210	2,446	
% of Total	21	70	9		

Source: Adopted from U.S. Department of Commerce, World Bank, Inter-American Development Bank, and International Finance Corporation data.

### *Types of Business Opportunities*

In the near term, many opportunities will be focused on the leading environmental problems being addressed in each country. These high-priority business opportunities will tend to rotate between countries and segments as the emphasis on different environmental problems changes. Currently, for example, reducing air emissions from copper smelting is a major priority in Chile. In both Chile and Mexico, reducing vehicle-based emissions is a near-term goal.

In the long term, however, priority in the region is likely to shift to solid and hazardous waste control. Furthermore, the long term offers the prospect of increased

## ***Introduction and Regional Overview***

demand for environmental equipment and services from a range of small and medium-sized industries, which will eventually be forced to comply with new environmental regulations. A number of U.S. exporters feel that this will be an important market in the long term because smaller Latin American companies will have the hardest time meeting the new environmental standards.

In addition, each of the LAC countries will offer opportunities for pollution control equipment and services to solve on-going problems. Available information from such organizations as the Department of Commerce, the U.S. Trade and Development Program, the World Bank, and the Inter-American Development Bank suggests strong demand for seven types of equipment and five types of services in the LAC region:

### **Equipment**

- particulate and dust controls
- air pollution monitoring equipment
- water/sewerage treatment systems, both for industrial and urban waste
- water quality monitoring equipment
- scrubbers/acid gas controls
- water treatment chemicals
- solid/hazardous waste treatment equipment.

### **Services**

- emissions/effluent identification (also assistance to establish regulatory guidelines)
- integrated waste management planning
- solid waste handling
- toxic/hazardous waste handling (such as the development of nuclear waste protocols)
- environmental impact studies.

The relative demand for each of these equipment and service areas will differ between the countries. Particulate and dust controls and air pollution monitoring equipment will be in demand in almost all countries. Similarly, water and sewerage treatment equipment and water quality monitoring equipment will also be in demand throughout the region. Demand for other types of pollution controls, such as scrubbers and water treating chemicals, will, however, differ by country.

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### LAC Region Environmental Business Opportunities

Opportunity	Key LAC Countries						LAC Region
	Argentina	Brazil	Chile	Colombia	Mexico	Venezuela	
<b>Equipment</b>							
Particulate/dust control	■	■	■	■	■	■	■
Air pollution monitoring	■	■	■	□	■	■	■
Water/sewerage treatment	■	■	■	□	■	□	■
Water quality monitoring	□	■	■	□	■	□	■
Scrubbers/acid gas control		■	■		□	□	□
Water treatment chemicals	□	□	□		□		□
Solid/hazardous waste treatment	E	■	□	□	■	E	□
<b>Services</b>							
Emissions/effluent characterization	■	□	□	■	□	■	■
Integrated waste management planning	E	□	□	E	□	E	□
Solid waste handling	E	□	□	□	■	E	□
Hazardous waste handling	E	□	□	E	□	E	□
Environmental impact studies	E	■	■	E	■	E	■

Key: ■ Primary Market  
□ Secondary Market  
E Emerging Market

## *Introduction and Regional Overview*

The markets for pollution controls and related services will also vary across the LAC region, based on differences in regulations and enforcement among countries. As an example, Mexico, Brazil, Chile, and Colombia all offer on-going opportunities for services related to landfill and incineration projects; however, similar opportunities are only beginning to emerge in Argentina and Venezuela. Likewise, there is an established demand for environmental impact studies in countries such as Brazil, Chile and Mexico, but the need for such services is only now emerging in the other countries.

A large portion of the demand for environmental equipment and services will come from the public sector. This is particularly true for water pollution projects, where municipal and local cooperative water authorities will be the main customers. In the industrial sector, the major clients will be industries such as petrochemicals, steel, mining, cement, and pulp and paper, all of which are major segments of the LAC economy.

Although the region's power generating sector is small in comparison to that in the United States, it will also be a focus of environmental efforts. About two-thirds of the LAC generating capacity is currently hydroelectric; however, fossil-based capacity is expected to grow as several countries are looking to diversify their resource mix. By 1999, the six major countries are expected to have more than 55,000 MW of fossil fuel-fired capacity, about 78 percent of which will be oil-fired and about 16 percent coal-fired. Most of this capacity will require some form of pollution controls to meet existing or planned regulations. Fuel-fired, non-utility capacity (currently about 12,000 MW) may also be a candidate for controls.

Finally, it is important to note that bilateral and multilateral funding for environmental projects in Latin America is increasing steadily. The Inter-American Development Bank (IDB) currently has 14 environmental projects in the pipeline for these six countries; of these, 5 are water pollution control projects, over \$200 million each, for Brazil. The World Bank has 11 environmental projects in the pipeline for these countries. All of these will be in the water pollution and institutional strengthening areas. Finally, U.S. Government agencies such as the Agency for International Development, the Environmental Protection Agency, and the Trade and Development Program are conducting environmental assistance programs in these countries. A number of these bilateral programs will involve the procurement of environmental equipment and services from U.S. companies.

***Competitive Situation in the LAC Market***

At present, the United States is in a strong position in the LAC market, and U.S. companies should continue to enjoy a competitive position. In 1992, about 39 percent of the LAC environmental market is anticipated to come from imports. U.S. firms are expected to account for about 18 percent of this market, or over \$430 million, representing about 45 percent of total imports. The ability of U.S. suppliers to access the market should be strengthened by the fact that most countries accept U.S. standards and many of their technical people were trained in the United States. Most regulations (e.g., air standards in Chile, Brazil, and Mexico) are also being developed to follow U.S. standards.

The LAC market also attracts competition from companies worldwide. In some instances, foreign companies are already gaining an edge in the market by tying equipment sales and technical assistance to attractive financial aid packages. Japan and the European Community are both actively supporting environmental projects in the LAC region.

Furthermore, U.S. companies can be expected to face competition from local environmental companies. However, the relative mix of local and foreign competition will vary markedly by country:

- Argentina has domestic environmental capabilities, but still relies on foreign equipment and technical assistance. The country has strong ties to European firms, especially those from Spain and Italy.
- Brazil has developed strong domestic capabilities, in large part by licensing foreign technologies, and has imported very little equipment. This approach may continue to be preferred.
- Chile has relied almost exclusively on imported technology. Foreign technology will still be relied on, but there is likely to be a growing preference towards expanding local capabilities.
- Colombia has been dominated by foreign suppliers, but these suppliers (including several U.S. firms) report that the market may be shifting somewhat to give preference to local firms and local manufacturing.

## *Introduction and Regional Overview*

### *Imports and Competition in LAC Environmental Markets*

Estimated 1992 (\$ million)						
Country	Total Market	Total Imports	% of Total	U.S. Imports	% of Total	Extent of Competition
Argentina	168	42	25	11	6	Some domestic capabilities, strong import competition from Europe
Brazil	1,015	190	19	92	9	Strong domestic companies
Chile	560	500	89	200	36	European and Japanese firms very active
Colombia	45	35	78	10	22	Few domestic companies, but interest growing in acquiring foreign technology
Mexico	614	150	24	85	14	Domestic firms strong, but imports growing from Europe and Japan
Venezuela	44	43	97	38	86	Few local firms, U.S. in dominating position
Total	2,446	960	39	436	18	

Source: Adopted from U.S. Department of Commerce, World Bank, Inter-American Development Bank, and International Finance Corporation data.

## *Introduction and Regional Overview*

- Mexico has been increasingly receptive to imports, especially as tariffs come down. The local environmental industry, however, is rapidly developing strong firms with better access to large private and public contracts.
- Venezuela has been receptive to imports, but seems to prefer consortiums or formal joint ventures with local firms to execute turnkey jobs rather than direct equipment sales.

Although the mix of competition will vary among countries, a consistent theme across the LAC region is that local, after-sales service is imperative. Even though local manufacturing costs may be relatively high in some cases (in Brazil, for example), foreign firms have often lost business because local companies are fearful of not having after-sales service available.

The LAC environmental market, while modest by comparison to that of the United States, is still a substantial market. It represents a definite opportunity for U.S. companies, and the market is likely to expand as more environmental regulations take effect. Also, the economies of the LAC countries are likely to continue their growth and become more export-oriented, requiring the adoption of international environmental standards.

Because most countries want to develop their domestic capabilities, a preferred approach in the LAC region will be to work jointly with local companies, through several options:

- technology licensing
- local manufacturing, based on foreign design and engineering
- full-partnership engineering and manufacturing
- local subsidiaries.

In the long-run, as markets open, opportunities will also be created to service the LAC market without having to target each country market individually. Some local firms are already beginning to target opportunities in other LAC countries, and as import restrictions are reduced, firms will be able to establish manufacturing facilities that can service multiple LAC countries. U.S. companies may also want to consider establishing a subsidiary or joint venture in one LAC country, such as Argentina or Brazil, to serve the entire region. Trade agreements and common markets such as Mercosur will facilitate this approach.

## *Introduction and Regional Overview*

### *Country Profiles*

In the following sections, the six major LAC countries are profiled. For each country, an overview is provided, followed by discussions of:

- the current environmental situation and policy framework in each country, including regulations and key regulatory agencies
- the outlook for the environmental market, including a discussion of the key factors driving the demand for environmental technologies and services
- the size, major opportunities, and competition in the environmental markets for air pollution control, water pollution control, and solid waste and hazardous waste control
- market entry strategies, highlighting potential business approaches for each country.



## Argentina

Argentina is now following the example of its neighbor Chile. The country is opening up to international trade and stabilizing its economy to attract foreign investment. This new approach is paying off in Argentina: its real GDP is expected to reach \$137 billion in 1992, a 5.0 percent jump over 1991. The recent privatization of state-owned industries, deregulation, exchange rate reform, and other important economic reforms account for Argentina's strong economic performance. As a result, its GDP is expected to grow by 5 percent again in 1993.

Inflation is decreasing in Argentina, while trade and foreign investment are on the rise. The consumer price index, which rose nearly 5,000 percent in 1989, increased by 85 percent in 1991. Inflation is expected to drop further to 22 percent in 1992, a low rate by Argentine standards.

### *General Economic Indicators: Argentina*

	1991	1992	1993
Population (millions)	32.8	33.2	33.6
Real GDP per Capita (\$)	3,769	4,141	4,549
Real GDP (\$ billion)	131.4	136.7	143.5
GDP Growth Rate	4.0%	5.0%	5.0%
Consumer Price Change, year-end	85.0%	22.0%	20.0%
Trade Balance (\$ billion)	6.4	5.4	4.2
Total External Debt (\$ billion), year-end	53.5	47.5	45.0
Exchange Rate (Pesos/\$), year-end	--	--	0.99

Source: Bank of America, September 1991.

Lower tariffs are spurring greater volumes of trade, and imports from the United States nearly doubled from \$1 billion in 1989 to \$1.9 billion in 1991. Argentina is also experiencing rapid growth in foreign investment, including the return of flight capital that is badly needed to service nearly \$50 billion in foreign debt. This debt burden should become less oppressive once Argentina's commercial creditors restructure the country's debt under the U.S.-proposed Brady Plan.

### *Environmental Situation and Policy Framework*

At the federal level, Argentina is just beginning to devote some serious attention to the country's many environmental problems. Argentina has suffered the effects of industrialization, modernization of agriculture (pesticide use), urbanization, and rising urban poverty -- all without the benefit of sound environmental management. These impacts are not well documented, however, as the Argentine government has not collected baseline data.

The areas hardest hit by pollution are the Buenos Aires and Santa Fé Provinces, regions that require immediate action. Specific zones in these provinces that need cleanup work include the greater metropolitan area of Buenos Aires, the areas of La Plata, Bahía Blanca, Mar de la Plata, Necochea, and the industrial zones along the Río Paraná in Campana, Zarate, and San Nicolás. In particular, the Rosario area along the Río Paraná District in the Province of Santa Fé is in serious need of attention because of its concentrated industrial activity.

Significant levels of pollution are generated in the Argentine manufacturing sector, which accounted for nearly 21 percent of Argentina's GDP in 1991. Thermal capacity in the power sector is also a major pollution culprit. And because the number of cars and buses in the country has jumped significantly over the last two decades, the transportation sector also accounts for large amounts of air pollution in major cities.

Overall, Argentina accounts for only about 0.5 percent of net world emissions of greenhouse gases.<sup>1</sup> However, by virtue of the country's proximity to the South Pole (and the ozone hole), Argentina is seriously concerned with ozone depletion and is one of only a handful of Latin American countries to have signed the Montreal accords to mitigate ozone depletion.

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<sup>1</sup> According to the World Resources Institute's (WRI) greenhouse gas index, Argentina ranks 31st in the world in terms of total greenhouse gas emissions.

## *Argentina*

Argentina does not have a comprehensive national environmental law. Instead, as is the case in Chile and other developing countries, Argentina has a hodgepodge of often contradictory and overlapping norms, decrees, and by-laws. Some Argentine provinces, however, have adopted strong legislation and are far ahead of the federal government. Both the federal and provincial governments are now attempting to address regulatory and environmental compliance issues.

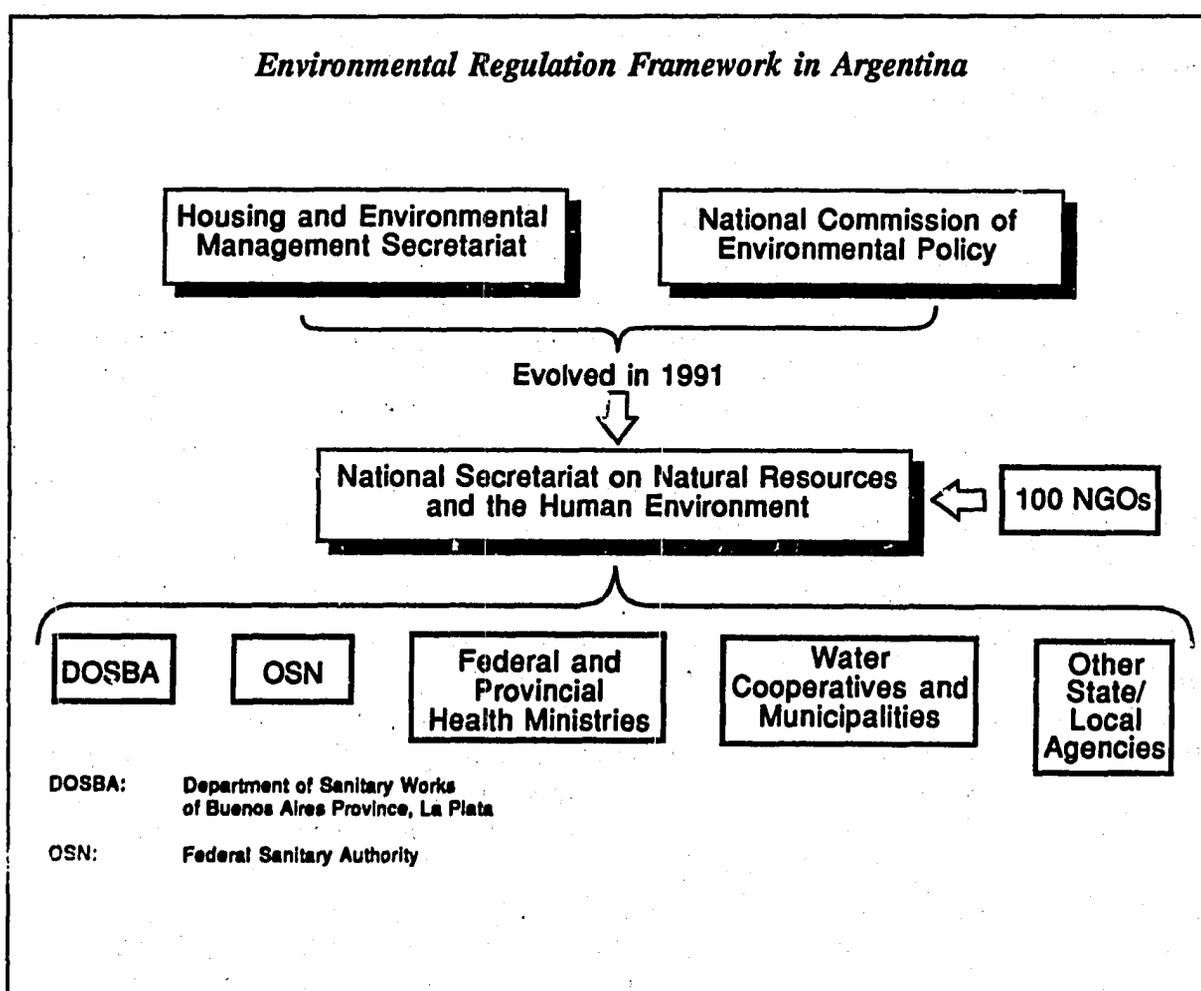
As a first step, Argentina's lower house recently passed legislation requiring an environmental impact study or statement from all public and private construction projects nationwide. This legislation is based on the precedent established by the World Bank and Inter-American Development Bank (IDB) of requiring environmental appraisals on all projects that these multilateral banks finance in Argentina.

The provinces of Buenos Aires and Córdoba have led the way in developing environmental assessment laws of their own, in particular, addressing the development of hydroelectric projects in environmentally sensitive areas. In fact, these provinces have adopted their own environmental codes covering a range of pollution areas. Buenos Aires, where the majority of Argentine industry is located, passed the first piece of environmental legislation in the entire country in 1958. The provincial government of Córdoba has its own environmental law, consisting of 64 articles containing technical norms of permissible contamination levels. The state law also authorizes the provincial government to monitor and control emissions and to investigate violations.

To reduce the fragmented authority over environmental issues, President Menem created the National Secretariat for Natural Resources and the Human Environment (SRNAH) in 1991 to oversee environmental enforcement and compliance. This independent federal agency combined the previous functions of the Housing and Environmental Management Secretariat and those of the National Commission of Environmental Policy. SRNAH coordinates environmental policy with other federal agencies (e.g., sanitation, health), municipal and cooperative water authorities, and various other state and local agencies.

Menem's choice of Secretary, María Julia Alsogaray, has been criticized by environmentalists for her pro-business background. However, Alsogaray recently demonstrated a commitment to consensus between environmentalists and industry by selecting a prominent environmentalist, Carlota Aizcorbe, to be director of the Industrial Environmental Pollution division of SRNAH.

The Secretariat is currently working with multilateral donors and the Argentine Industrial Union (an industry association) to establish effluent guidelines and limits for air, water and solid waste emissions. If the government gets its way, this effort will include a timetable for industry compliance. SRNAH also plans to draft regulations to provide tax incentives for industry to install pollution control equipment.



## *Argentina*

There are major questions regarding the Secretariat's ability to succeed in its mission because the Agency does not have the resources to fulfill its mandate. According to the U.S. Embassy in Buenos Aires, SRNAH staff are severely short-handed and have not been remunerated since early 1992. Although the Secretariat has officially been in operation since March 1992, it will not be granted an allocation in the central budget until FY 93. SRNAH and the IDB are discussing a potential \$27.5 million project to strengthen the technical and managerial capabilities of the Secretariat and several municipal agencies to enforce Argentina's new environmental regulations.

Argentina's Ministry of Health and Social Action (MHSA) is also an important player in environmental markets, having been charged with developing the country's criminal codes pertaining to hazardous waste disposal, a controversial topic in Argentina.<sup>2</sup> Severe public opposition mounted against the country's policy of importing hazardous waste (including nuclear material) from OECD nations for a fee.<sup>3</sup> A number of bills have been drafted to prohibit the importation of these wastes, and customs officials can now refuse the entry of such wastes based on the government's new environmental guidelines.

Other government agencies with an environmental role include the Water Resources Secretariat, which is made up of two decentralized agencies: the National Sanitation Corporation and the National Water Science and Technology Institute. Regional institutions that play an important role include the Transportation Secretariat and the Harbors Administration.

### *Outlook for the Environmental Market*

The need for environmental technologies will not translate into market opportunities until government regulations, enforcement, and monitoring systems are squarely in place. Although Argentina is only in the very preliminary stages of managing its pollution problems, important new developments should open the markets for pollution control

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<sup>2</sup> Argentina's environmental regulations define hazardous waste as "...waste from any material, substance, or object produced by any activity where its elimination, reuse, recovery, or disposal requires a process..." According to this definition, hazardous waste includes imported wastes, medical waste, and consumed petroleum products.

<sup>3</sup> The port of Buenos Aires has received regular shipments of toxic waste and sewage from foreign countries. A recent case involved the importation of 250,000 tons of toxic waste from Germany. Environmentalists claim that most of this imported waste is not treated properly or recycled, and ends up in illegal landfills and sewage streams.

equipment. The following table summarizes the newly emerging market forces that will establish opportunities for sales of pollution control equipment and services in Argentina over the short and medium terms.

**Key Environmental Market Drivers**

Key market drivers	Impact
Improving economy, privatization and export promotion.	Important industries such as steel, power, and petrochemicals are expected to be privatized and modernized to boost exports; significant environment-related capital spending will be required to bring plants to international standards.
Recent formation of environmental ministry by presidential decree.	Improved environmental management and pressure on both private and public enterprises to clean up.
Criminal prosecution of willful environmental negligence.	Sense of urgency among some highly visible companies to invest in pollution mitigation technologies.

The overall market in Argentina for pollution control equipment and associated services is estimated at nearly \$170 million for 1992. Of this, water pollution will have the largest market segment with \$100 million dollars; air pollution monitoring and control comes second with \$53 million; the balance is the solid and hazardous waste disposal market, with estimated sales of \$15 million.

Water Pollution	100
Air Pollution	53
Solid/Hazardous Waste	15

The market for pollution control equipment is expected to grow at an annual rate of 7 percent in 1992. Almost 25 percent of this market (\$42 million) is likely to be imported. Because their products and services are highly respected in Argentina, U.S. suppliers can expect to enjoy a significant market share. Competition from domestic firms will be stiff for

## *Argentina*

engineering services, but weak for technology. England, France, Italy, Germany and Spain are considered formidable competitors for hardware.

Environmental products and services relating to air and water quality monitoring and wastewater treatment (especially for highly toxic industrial effluent) appear to offer the greatest potential in the 1992-1996 period. The United States will be competing primarily against European companies for shares in these markets. In the short term, the procurement of foreign hardware will represent a much greater market opportunity than engineering design and consulting services, many of which can be provided domestically. The market for monitoring equipment usually precedes all others and is beginning to pick up in Argentina.

The size of these markets could be expanded further should multilateral lenders begin to pressure Argentina more aggressively to control pollution in specific sectors as a prerequisite to receiving loans targeted toward those sectors. For example, there is some interest at the IDB in requiring that Argentine businesses benefiting from an up-coming sectoral adjustment loan be required to comply with environmental laws as a condition of the loan.

The country's top economic leadership, however, is not prepared to sacrifice growth for environmental cleanup. For example, in 1992, an Argentine judge closed 17 factories on the banks of the polluted Reconquista River, and jailed 32 chief executives in order to put pressure on the private sector to comply with regulations. Top government officials quickly tempered the judge's zeal, emphasizing that Argentina's environmental problems could not be solved "overnight." This contrasts sharply with Mexico's leadership, who have not hesitated to shut down factories in critical regions, having taken a much more aggressive approach to pollution cleanup.

### *Environmental Market Opportunities and Competition*

The environmental market in Argentina is just now beginning to emerge; in 1992 it should represent close to \$170 million. Air pollution projects will represent about 30 percent of this market, water pollution projects about 60 percent, and solid and hazardous waste projects will account for the remaining 10 percent.

Large cities and industrial centers in Argentina have the worst air pollution in the country. Buenos Aires, Córdoba, San Lorenzo and Campana are the four cities suffering the greatest effects of pollution from factories, cars, and power plants -- none of which have been subject to rigorous emissions control.

Air  
Pollution  
Control

The need for air pollution control equipment is concentrated in the electric power, industrial and transportation sectors. The electric power sector is largely composed of state-owned enterprises that are now being privatized. The procurement of advanced pollution control devices (e.g., scrubbers, filters, low-NO<sub>x</sub> burners) for about 4,750 MW of thermal capacity will likely increase once the privatizations are complete.

Thermal capacity in Argentina is much cleaner than it used to be. Until the late 1970s, nearly all the country's power plants burned fuel or diesel oil with high criteria pollutant emissions. By the late 1970s, Argentina had substituted relatively clean natural gas resources for a substantial portion of its thermal capacity, reducing emissions of SO<sub>x</sub>, CO<sub>2</sub> and particulates per MW of installed capacity to below half their early 1970s' levels. The country has continued to bring on substantial "emissions-free" resources including more natural gas, hydro, and even nuclear. The share of natural gas in thermal generation jumped from 15 percent in 1970 to 73 percent in 1989, coal declined from 5 percent to 2 percent, and petroleum byproducts from 80 percent to 25 percent during this period. Around 60 percent of the country's power plants burn hydrocarbons.

Although much of Argentina's electric generating capacity is "clean," some opportunities will exist for cleaning up the emissions among the balance of both new and old coal, oil and diesel plants, especially in urban areas. Also, natural gas plants still present opportunities for NO<sub>x</sub> control, and hydropower and nuclear delays will accentuate recent increases in all criteria pollutants as a result of thermal substitution.

Argentina's future capacity will not necessarily present strong opportunities for U.S. environmental companies. This is because the country's expansion plans will continue to rely on hydropower project development. Only 350 MW of oil-fired capacity is now being planned.

The Argentine industrial sector is a large polluter in need of pollution control equipment and/or process change engineering and design services. As two of the largest industries in Argentina, the petroleum and petrochemical subsectors are prime candidates for equipment and services. The state-run oil company, Yacimientos Petrolíferos Fiscales (YPF), owns more than half the country's refining capacity, and Shell Oil and Esso (Exxon) own sizeable shares of the remainder.

## Argentina

### Existing and Projected Electric Generating Capacity in Argentina (MW)

	1989	%	1999	%	Net Additions
Hydroelectric	6,620	43	12,735	57	6,115
Nuclear	1,018	7	1,763	8	745
Oil					
Steam	4,357	28	4,692	21	355
Diesel	733	5	727	3	-6
Gas					
Steam	na	--	na	--	--
Combustion Turbine	2,138	14	1,815	8	-323
Combined Cycle	--	--	140	1	140
Coal/Lignite/Other	405	3	405	2	--
Total	15,251	100	22,277	100	7,026

Source: World Bank.

The petrochemical industry includes a several mid-sized, multinational operations that will also need to comply with environmental regulations. Some of these companies, such as Dow Química de Argentina (an agrochemicals, polyols and latex producer), are already making the necessary anti-pollution investments. This multinational firm has initiated an environmental management program to reduce air, water and solid waste streams in its operations.

The transportation sector contributes significantly to the deterioration of air quality, particularly in metropolitan Buenos Aires. A fleet of some 4 million automobiles currently burn leaded gasoline without the benefit of catalytic converters. A need exists in converting regular to unleaded gasoline and in installing catalytic converters. Large urban fleets are a starting point for such conversions.

The demand for air pollution equipment across the three sectors is expected to translate into a total air pollution market of \$53 billion in 1992:

- electric thermal power systems (about \$40 million) based on the demand for electrostatic precipitators, filters, new burners (e.g., low-NOx), and monitoring equipment and controls.
- industrial air pollution (about \$10 million) coming from items such as baghouses, heavy metal extraction, and monitoring equipment, in addition to process modifications and technologies to reduce emissions from fuel and material storage and handling.
- transportation sector air pollution (about \$3 million) based on the demand for catalytic convertors, gasoline reformulation, and kits to reduce fugitive emissions from pipelines.

### *Major Opportunities*

Significant market opportunities will exist with the following companies and sectors:

- SEGBA and Aye**

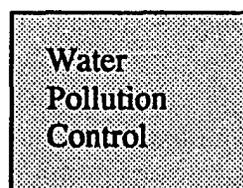
Both SEGBA and Agua y Energia (AyE) are publicly owned electric utility companies that are rapidly selling generating plant assets. Recently, SEGBA sold the 1,010 MW Puerto Nuevo plant to a Chilean utility company, and is contemplating bids for its 1,260 MW Costanera plant. Similarly, AyE is reviewing bids for its Alto Valle steam and gas turbine plants. Upgrading and pollution control modernization is expected at all these plants.
- YPF, Esso and Shell**

The national petroleum company, YPF, plus Shell and Esso, plan to upgrade and modernize several refineries and gas processing stations. Both controlled and fugitive emissions are targeted for pollution control. Significant opportunities are available for the supply of valves, flanges, and pumps. Hydrocarbon emissions are the greatest at facilities producing carbon black and acrylonitrile. These plants offer immediate markets for U.S. air pollution control equipment and associated services.

## *Argentina*

- **Transportation**      Opportunities exist among all major transportation subsectors -- rail, automobile and air -- including studies for a transportation master plan. Opportunities in traffic management, catalytic convertors, mass transit and fleet management and maintenance also exist. In addition, Argentina has implemented an aggressive program to promote the use of CNG-fired vehicles in Buenos Aires.

The pollution of surface and subsurface waters by industrial and urban wastewater discharges is considered to be among the most serious environmental management problems facing Argentina's new environmental ministry. The Río de la Plata Basin, which is home to almost 20 million people, displays several signs of adverse ecological impacts. In that basin, agrochemicals and other chemical residues have been found that originated in the Brazilian highlands. It is estimated that uncontrolled discharges of industrial effluents from major industries such as steel, petrochemicals, and textiles have contaminated many rivers in Argentina.



At present, there are a limited number of examples of large-scale public sector wastewater treatment projects. The Consejo Federal de Agua Potable y Saneamiento (COFAPyS) is currently conducting a \$250 million water quality improvement project aimed at expanding sewerage treatment in major areas. This project is part of the National Water Supply and Sewerage Program and includes World Bank, IDB and local financial participation. The purpose of the program is to strengthen water utility companies by providing technical and capital assistance. All utilities serving populations greater than 15,000 persons will be assisted. The project will procure the machinery and equipment necessary to expand the capacity of the water supply and the sewage system.

In addition to the National Water Supply and Sewerage Program, the Argentine government is privatizing the National Public Waterworks Company (OSN) in the hopes that a private operator will be able to better address the severe water pollution problems in the Buenos Aires region. OSN currently runs the Buenos Aires sewage system, which treats only 4 percent of the 824 million m<sup>3</sup> of sewage it deals with annually. Privatization will involve auctioning a thirty-year concession to run OSN and to construct a number of municipal wastewater treatment plants and a sewerage network along 14 kilometers of the Plate River. Three local-international consortia are bidding on the concession: Aguas de Buenos Aires, Consorcio Lyonnaise, and Consorcio Canal del Plata. Two foreign firms, Compagnie General des Eaux and North West Water International, are also bidding.

In the private sector, market opportunities will be limited to a few key industries in the near future. The Organo Oficial de la Asociación de Curtidores de Buenos Aires (ACUBA), the Official Organization of Tanneries of Buenos Aires, recently constructed the first collective industrial treatment facility in Argentina. Located in the Lanus District of Buenos Aires, the new plant will treat effluent discharged from 180 tanneries, producing 20,000 m<sup>3</sup> of wastewater per day. The provincial government of Buenos Aires provided 40 hectares of land for the plant, which is being designed and built by engineers from the Argentine Leather Technology Center (CITEC). ACUBA has also built a chromium recycling plant. ACUBA has actively solicited financial support from the governments of Italy, Spain and Germany, but has not received any to date.

While business opportunities in the industrial market are currently limited, leading multinational water treatment companies report that the market could be extremely large if government enforcement of effluent standards improves. One large French company notes that while only 5-10 percent of Argentine industry currently complies with national and provincial environmental standards, this year has marked a crucial turning point in laying the groundwork for improved compliance.

### *Major Opportunities*

Although no detailed statistics are available on the Argentine water pollution market, it could total about \$100 million in 1992 based on its size relative to the other major LAC countries. The demand for pollution control equipment and services could come from four sectors:

- Water Authorities**                      Municipal and cooperative water authorities will be the major customers for wastewater and sewerage equipment and related services. An example of existing demand is water treatment chemicals, on which the municipal sector spent \$10 million in 1991.
  
- Electric Utilities**                      Electric utilities will also be candidates for wastewater treatment systems for use with their thermal power plants. Like municipal authorities, one need will be water treatment chemicals for cooling and boiler water applications, a market that totaled \$16 million in 1991.

## ***Argentina***

- Industry**                      **Industrial plants may also be customers for wastewater pollution equipment and services; however, this market has not yet been clearly defined.**
  
- National Agencies**                      **As part of the proposed environmental institutions strengthening program to come on line in 1993, the IDB and SRNAH are expected to procure water and air quality monitoring equipment, in addition to management consulting services.**

**In addition, the Ministry of Public Works and the IDB are currently in the preparatory stages of a \$200 million project to clean up the Reconquista River. Bidding for industrial and municipal wastewater treatment equipment and water pollution monitoring equipment is expected to be opened in early 1993.**

### ***Competition***

**Several wastewater treatment firms report that there was no environmental activity in Argentina before 1991. Now, European companies like Degremont (France) and Sulzer (Switzerland) are actively pursuing projects in Argentina. Local capabilities are also developing as companies license foreign technology. Lockwood and Compania, S.A.I.C., for example, is associated with Thames Water International and is one of the only Argentine companies large enough to handle wastewater treatment plant construction. In 1991, Lockwood won exclusive rights to design and operate a wastewater treatment system in the province of Corrientes. Nisalco, which licenses both U.S. and European technology, is another prominent local company. Filsan is a smaller company that licenses foreign technology for small scale industrial wastewater treatment projects.**

**In the longer-term, the prospects for free-trade integration with the United States will give U.S. vendors some advantages. Currently, however, European companies have the advantage of soft loans and stronger cultural ties. The Japanese are not considered a major competitor in Argentina's environmental markets.**

Solid and hazardous waste, both from urban and industrial sources, is a growing problem in Argentina, but no comprehensive inventory has been made. It has been estimated that the Buenos Aires metropolitan area alone produces 1.2 million metric tons of hazardous solids, toxic mud and diluted solvents each year.<sup>4</sup> Virtually all of the municipal solid waste produced in Buenos Aires, including hazardous industrial and hospital waste, is dumped at the city's one landfill. This landfill is run by the Argentine company CEAMSE and Waste Management, and will soon be full.

Solid and  
Hazardous  
Waste

As the Argentine economy continues to grow, deficiencies in solid waste management will become even more apparent. Cities and towns are growing at 4 to 7 percent a year. This implies that cities with populations of over a million people are doubling in size every 10 to 17 years.

But the need for effective solid and hazardous waste disposal is not quickly translating into a market. The lack of requisite waste definitions and the enforcement of regulations -- not to mention the increasing opposition to the siting of waste disposal facilities -- makes a large market unlikely in the short and medium terms. The U.S. Department of Commerce, for example, estimated that the market for toxic and industrial hazardous waste management was only \$5 million for 1991. Assuming 1.5 million tons of waste need treatment (based on wastes generated in the Buenos Aires area, plus additional waste sources, and a treatment cost of \$200/ton), Argentina could require as much as \$300 million in solid and hazardous waste pollution control investments. Annual investments could range from \$15 million to \$30 million.

### *Major Opportunities*

In the near term, the demand for solid and hazardous waste pollution equipment and services will come from Argentina's federal environmental and health agencies, such as the Department of Sanitary Works of Buenos Aires (DOSBA) and the Federal Sanitary Authority (OSN), as well as provincial environmental organizations. These organizations are in need of services to identify pollution sources and cleanup options, and subsequently, equipment to implement cleanup efforts.

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<sup>4</sup> "Sustainable Development in Argentina," IIED-AL with CEA and GASE in *Environment and Urbanization*, vol. 4, no. 1, April 1992, p. 48.

## *Argentina*

Also in demand may be incineration equipment, methane generation systems, composting equipment, and equipment and services for landfills. These all represent options to manage Argentina's solid wastes.

### *Competition*

The solid waste market is currently dominated by the partnership of the local company CEAMSE and Waste Management, Inc. CEAMSE has been operating since 1977, and currently responsible for all municipal solid waste collection and disposal in Buenos Aires. In conjunction with Waste Management, CEAMSE is expanding into industrial hazardous waste treatment and disposal. The Argentine company claims that this move could increase its net billings by \$5 million per month.

### *Market Entry Strategies*

The Argentine environmental market represents an emerging market for U.S. suppliers. Based on the strong receptiveness of this country to U.S. goods and services, U.S. suppliers can expect to maintain their relatively strong market position. Several strategies are available to U.S. companies interested in the Argentine market:

#### **Short Term**

- Actively solicit YPF, Esso, and Shell refinery waste management projects -- water, air and solid wastes.
- Assist in the development of unleaded and reformulated gasoline fuels.
- Target Buenos Aires municipal authorities and solicit the development of integrated urban waste management systems.
- Assist the Environmental Secretariat, industry associations, and provincial governments in prioritizing environmental problems and developing effluent guidelines for industry.

**Long Term**

- Help promote pollution prevention programs at manufacturing plants.
- Develop joint venture agreements or licensing agreements with Argentine firms to manufacture basic environmental mitigation equipment and radioactive waste handling protocols.



## *Brazil*

Brazil has experienced rapid industrialization over the last thirty years, and has become a leading producer of petroleum, petrochemicals, and steel. It has developed several other major industries, including fertilizers, food, textiles and leather. Based on its 1992 real GDP of \$283 billion, Brazil is the largest market in Latin America and accounts for about one-half the LAC region's total output.

### *General Economic Indicators: Brazil*

	1991	1992	1993
Population (millions)	153.7	156.9	160.2
Real GDP per Capita (\$)	1,815	1,804	1,820
Real GDP (\$ billion)	279	283	292
GDP Growth Rate	-3.0%	1.5%	3.0%
Consumer Price Change, year-end	625.0%	250.0%	150.0%
Trade Balance (\$ billion)	13.9	13.5	12.6
Total External Debt (\$ billion), year-end	116.7	107.7	110.4
Exchange Rate (Cruzados/\$), year-end	670	2,230	5,310

Source: Bank of America, September 1991.

## *Brazil*

### ***Environmental Situation and Policy Framework***

Rapid growth in Brazil's industrial sector has caused serious air, water, and solid waste problems. The most pressing of these currently include air pollution from dust, sulfur dioxide, odors, and volatile organic compounds; the contamination of water resources with toxic waste and heavy metals; and hazardous solvents and heavy metals in the soil. The environmental consequences of this growth are now being addressed more directly by federal and state environmental protection agencies.

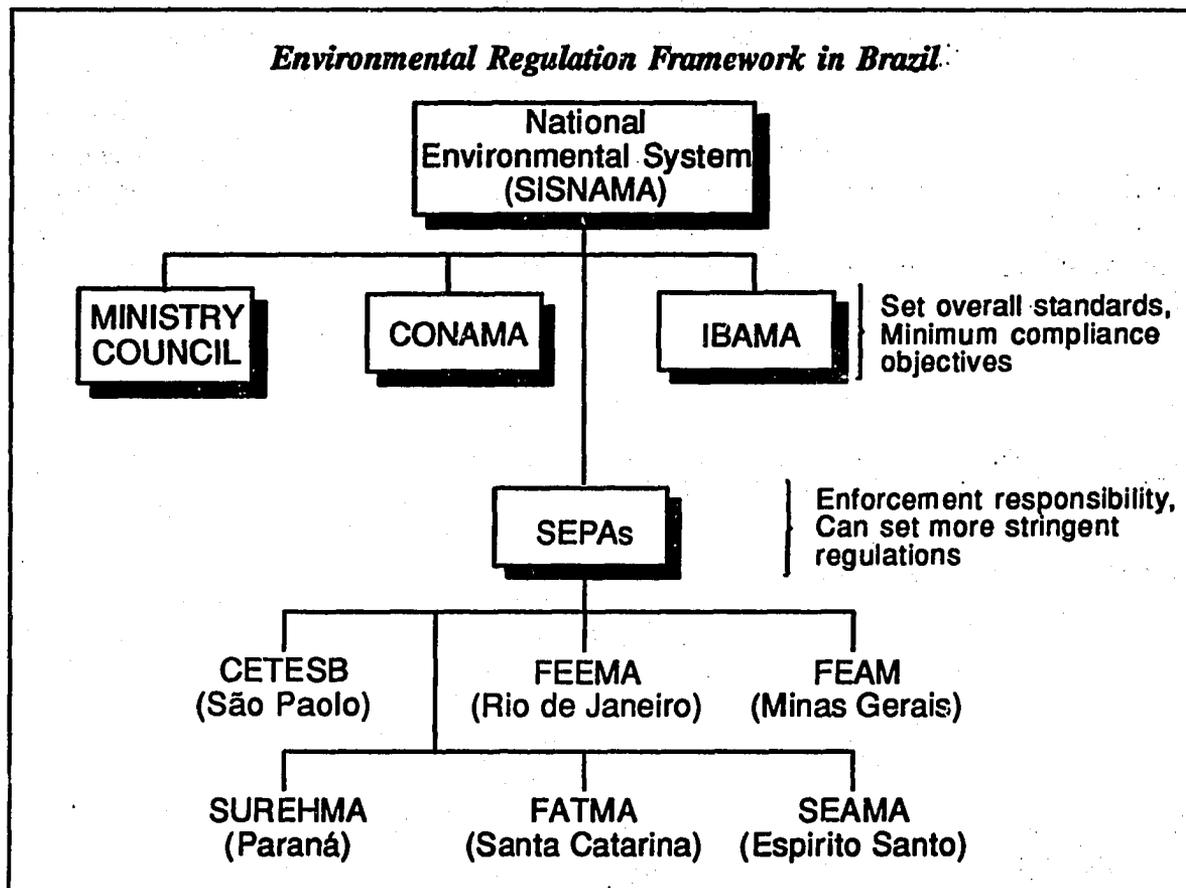
While industrial pollution is a major concern, Brazil's overall environmental situation is worsened by the geographic concentration of its population and industries, and by its persistent economic problems. Most Brazilians live in a few large cities (e.g., São Paulo, Rio de Janeiro) in the country's southern and northeast regions. These areas have a high concentration of industry, which has led to severe water pollution, municipal solid waste problems, and pollution from transportation. In São Paulo, for example, water sources are shared by industry and the general public, and only 50 percent of the city's sewage is collected and less than 10 percent is treated. Hyperinflation and foreign debt have made tackling these problems exceedingly difficult. However, Brazil recently completed negotiations to restructure a major portion of its U.S. debt, which should aid its economy.

In the late 1970s and early 1980s, environmental protection began to emerge as an issue in Brazil, and it has moved to develop a comprehensive regulatory system to deal with its environmental problems. This system delegates regulatory authority to both federal and state agencies, and mandates active efforts to provide funds to implement pollution prevention projects.

In 1981, Brazil developed a national environmental policy and created various federal agencies to implement it. In 1988, the federal constitution was amended to add specific articles for environmental protection. Brazil now has a National Environmental System (SISNAMA) that is responsible for environmental standards, environmental zoning, environmental impact assessments, and an environmental data base. The most important of these areas has been the environmental impact assessments. All companies are now required to obtain two environmental control certificates, one for the site and one for the process. These are known as a RIMA (Environmental Impact Report) and an EIA (Environment Impact Study), and must be prepared by qualified consulting or engineering companies.

The SISNAMA has four components with varying responsibilities:

- An oversight and coordinating council, which consists of representatives from all federal ministries.



- The Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), or the Brazilian Institute of the Environment and Renewable Natural Resources, which has overall federal responsibility for environmental protection.
- The Conselho Nacional do Meio Ambiente (CONAMA), or National Environment Council, which acts as an advisory council and sets licensing requirements for all polluting activities, and establishes standards for air and water quality and water discharges. The council consists of representatives from the state environmental protection agencies (SEPAs), unions, non-governmental organizations (NGOs), technical experts, and the Secretary to the President (SEMAM).

## *Brazil*

- The SEPAs (e.g., CETESB in São Paulo, FEEMA in Rio de Janeiro), which have enforcement responsibility and can set standards for their own states.

The peculiarities of Brazilian environmental regulation are that federal legislation has lagged that of the country's two main states (São Paulo and Rio de Janeiro) and is largely based on the laws of these two states. The regulations set by São Paulo and Rio de Janeiro have primarily been based on U.S. laws. Most of their emissions standards are comparable to those in the United States.

### *Comparison of Brazilian and U.S. Air Quality Standards*

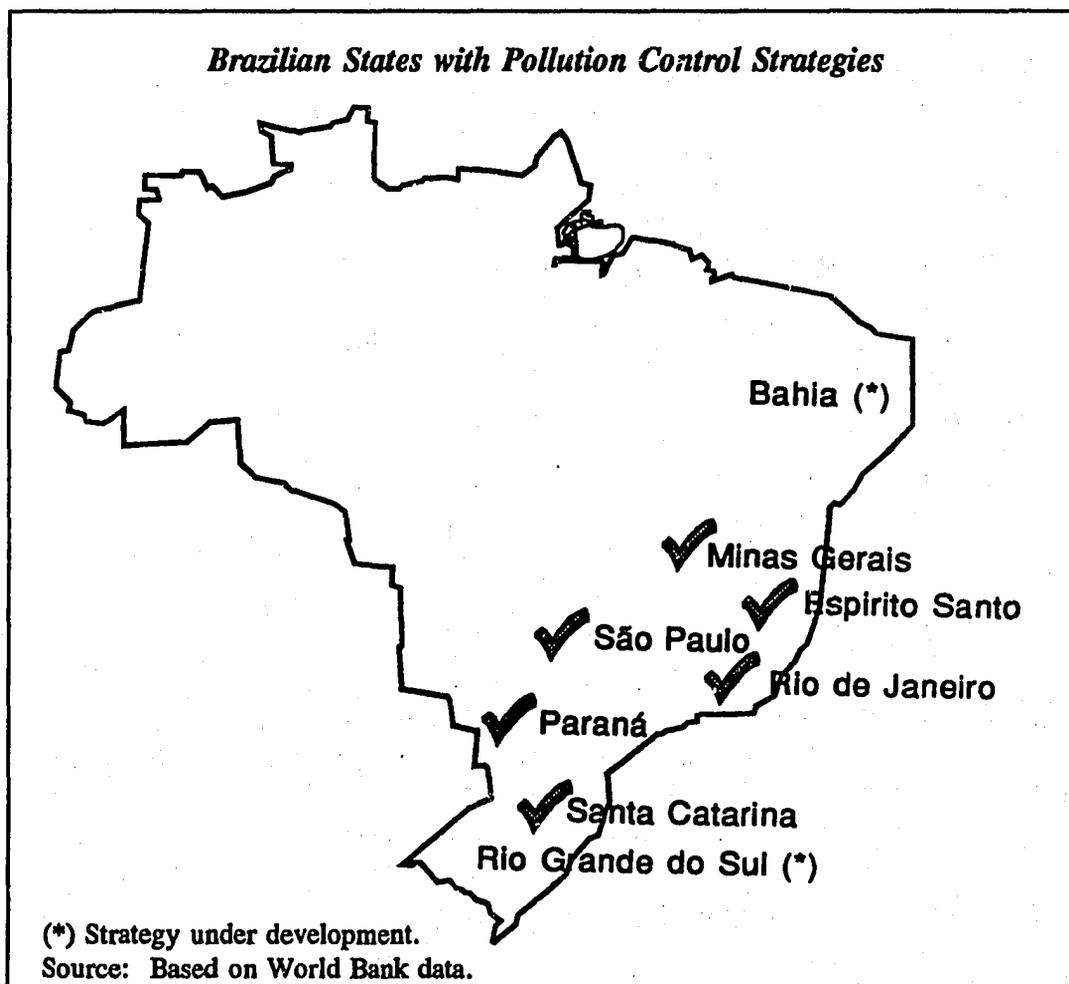
Pollutant	Measurement Period	Standard ( $\mu\text{g}/\text{m}^3$ )	
		Brazil	U.S.
O <sub>2</sub>	Annual	80	80
	24 Hours	365	365
NO <sub>2</sub>	Annual	100	100
Total Suspended Particulates (TSP)	Annual	80	75
	24 Hours	240	260
O <sub>3</sub>	1 Hour	160	235
CO	8 Hours	10	10
	1 Hour	40	40
Hydrocarbons	3 Hours	160	160

Source: PAHO.

Federal regulations in Brazil aim to provide overall guidance and set broad ambient air quality objectives and minimum compliance standards. Federal laws explicitly recognize that the states have the power to set tighter regulations and will be responsible for enforcing

both federal and state regulations. The IBAMA will only become involved in enforcement if a state cannot fulfill this role.

At present, the six most-industrialized of Brazil's 24 states have developed pollution control strategies; however, the SEPAs in only two -- São Paulo's CETESB and Rio de Janeiro's FEEMA -- have adequate staff and resources to identify and assess pollution sources. These two agencies have been the most aggressive in terms of pollution regulation and monitoring, and most of Brazil's regulations have been based on the work of these two agencies.



## *Brazil*

The central issue is thus not one of regulation, but one of enforcement. The current level of enforcement varies widely among Brazil's industrial states. São Paulo, for example, has very stringent regulations and has been active in enforcement, while Minas Gerais has more lenient regulations and does not have the resources to enforce even these weaker limits.

The most active SEPA has been São Paulo's Companhia de Tecnologia de Saneamento Ambiental (CETESB). It is one of the few SEPAs that has the technical expertise and resources to monitor and enforce regulatory compliance. CETESB's primary method of enforcement is through surprise inspections of major companies. During these visits, samples are collected to check against various standards. For the first violation, a company receives a warning and a date is set by which the problem must be corrected. A second violation can bring fines and a third can trigger a plant shutdown.

Despite the efforts of CETESB, and to a lesser degree other SEPAs, regulatory enforcement has been very difficult, especially when state-owned companies are involved. Because it is unlikely that these plants would be shut down, environmental projects have not moved ahead in many cases, despite a recognized need:

- Tubaro Steel, for example, which has plans to spend \$45 million on pollution control, spent just under \$1 million in 1991. The company, located in Espírito Santo, is trying to delay a \$24 million investment in a desulfurization system originally planned for 1993. The firm says its emissions are currently below standards.
- Similarly, COSIPA, São Paulo's state steel company, agreed to invest \$20 million to reduce particulate emissions from 140 tons/day to 20 tons/day by 1998. To date, however, implementation is lagging and the firm has already been fined 45 times in the last 10 years.

However, there are indications that state companies will give higher priority to environmental projects. CVRD, the state-owned steel company, and Centrais Elétricas Brasileiras SA (Elétrabras), the electric utility, have already developed and are beginning to act on environmental programs. Likewise, Petrobras, the state oil company, plans to spend as much as \$300 million on various environmental projects this year.

Indicative of the growing recognition of the need for environmental action in Brazil is the recent announcement by Abiquim, the Brazilian chemical association, that half of its members will participate in the new Responsible Care Program. The association has said that its participants represent more than 90 percent of the industry, and that many large companies joined the association expressly to participate in the new environmental program.

Because of Brazil's persistent economic problems, a primary federal and state strategy to implement environmental projects has been to create loan programs. Most of these financial assistance efforts combine federal and state resources and often rely on assistance from international donor organizations.

Two of the main sources of financial aid are the National Bank for Economic and Social Development (BNDES) and São Paulo's CETESB. The BNDES has a federal environmental program to aid companies, through low-interest loans, in obtaining equipment (both local- and foreign-made). Over the last five years, the organization has spent \$500 million on environmental projects. The BNDES, along with the World Bank, is currently funding a National Industrial Air Pollution Control Project. This \$100 million project will help finance industrial pollution control projects over the next four to five years.

To provide funding for environmental programs, the CETESB -- using credit from BANESPA, São Paulo's state bank -- has instituted the PROCCP (Pollution Control Program) to enable Brazilian-owned companies to acquire pollution control equipment. A total of \$200 million was requested in 1991, up from \$117 million in 1990; however, only about 20 percent was actually made available. CETESB's current priority is the cleanup of the Tiete river. The more than 1,000 companies that will be required to install waste treatment equipment as part of this effort will likely receive a large portion of the available funds.

Despite such programs, available funds are not nearly enough to cover all of the anti-pollution investments needed. As an example, the five states to be supported in the BNDES project have already identified projects totaling more than \$560 million. Likewise, the PROCOP has nowhere near the funds needed to finance the projects related to the Tiete River, which estimates indicate could cost upwards of \$2-3 billion.

### *Outlook for the Environmental Market*

Brazil is entering a period that should bring increased opportunities for foreign companies to help solve its environmental problems. At least four factors will drive these opportunities. First, public pressure is increasing to solve the country's environmental problems. Second, the country has set out to stabilize its economy and inflation, and quickly undertake the types of market-based reforms that have been successful in Mexico and Chile. These reforms, which will create import opportunities, include trade liberalization through reduced tariffs and other import restrictions, deregulation, and tax reform. Third, regulatory

## *Brazil*

agencies are beginning to actively enforce existing regulations. Finally, Brazil is continuing to privatize its key industries. Privatization should be especially beneficial to environmental markets by bringing with it international industrial companies that have the capabilities to develop and implement sound environmental plans.

### *Key Environmental Market Drivers*

<b>Market Drivers</b>	<b>Impact</b>
Increasing public pressure to address industrial and municipal pollution problems.	Pressure will create large demand for pollution control technologies, if existing regulations are enforced.
Government moving to a market-oriented economy and making its markets more open to foreign trade.	Reduced tariffs and import restrictions will create more opportunities for imports of environmental equipment and services.
State and federal agencies becoming more active in regulatory enforcement.	Regulations have been in place since 1988, but are not widely enforced. Growing pressure to enforce regulations and meet worldwide standards will create demand for pollution control equipment.
Continued move to privatize state-owned companies.	International pressure to conform to world standards will create an incentive for private companies to establish and implement environmental programs.

Because of the need for environmental cleanup and the economic reforms now being instituted, Brazil holds good business opportunities for environmental equipment and services companies. The overall environmental market in Brazil should total over \$1 billion in 1992. Most investments will go towards water pollution control (water and sewage treatment projects currently represent more than 80 percent of the total market). Air pollution investments should account for about \$120 million in 1992, while spending on solid and hazardous waste will be on the order of \$50 million.

The United States has historically been a major supplier to Brazil, and opportunities to expand U.S. exports should increase. A main avenue for business will be cooperation

with or licensing to local companies, as Brazil has many highly capable environmental companies that are often the preferred suppliers.

***Brazilian Environmental Market (\$ million)***

	1990	1991	1992 (est.)	1993-1995 (est.)
Air Pollution	115	104	120	200-225
Water Pollution	645	790	845	985-1,035
Solid/Hazardous Waste	35	45	50	70-100
Total	795	939	1,015	1,255-1,360

Source: Based on data from the U.S. Department of Commerce, *Chemical Week*, and World Bank.

***Environmental Market Opportunities and Competition***

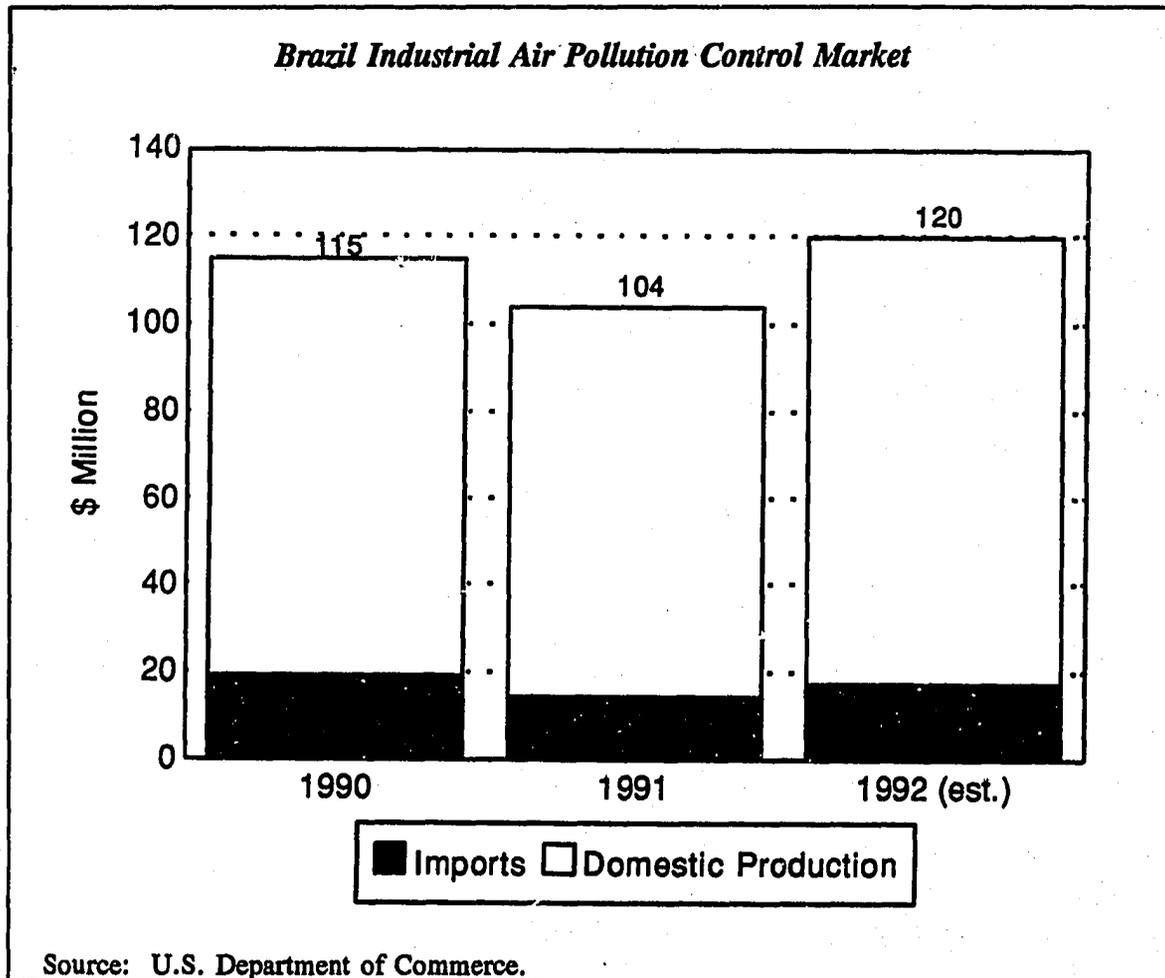
The environmental market in Brazil totaled \$939 million in 1991 and is expected to grow to about \$1 billion in 1992. Water pollution projects will account for 83 percent of this total, with air pollution and solid/hazardous waste pollution representing 12 percent and 5 percent, respectively. Project opportunities exist in industrial and utility air pollution control and in industrial and municipal water and solid waste treatment. Project opportunities should continue to expand as environmental problems become more defined. To date, water pollution needs have been reasonably well defined, while requirements for air and hazardous waste have lagged.

The air pollution control market in Brazil could total about \$200 to \$225 million per year over the next three to five years. Most of this is expected to come from projects in the industrial sector.

Air  
Pollution  
Control

The U.S. Department of Commerce (DOC) reports that the industrial air pollution control market in Brazil totalled \$115 million in 1990. The recession in Brazil reduced this market to about \$104 million in 1991, but it is expected to grow about 15 percent in 1992 to total an estimated \$120 million. The impetus for this growth is largely stricter enforcement by the states.

*Brazil*



No detailed statistics are available on the potential market for utility air pollution control, but this sector could hold substantial project opportunities. Expansion plans call for adding more than 1,800 MW of coal-fired capacity and over 500 MW of oil-fired units. By the year 2000, Brazil could have nearly 3,000 MW of coal-fired capacity and close to 4,000 MW of oil-fired capacity.

With comparable regulatory standards to the United States, and assuming comparable control costs for SO<sub>x</sub>, NO<sub>x</sub>, and particulates, Brazil's utility sector could require as much as \$750 million for air pollution control over the next ten years. Yearly investments by Eléctrobras, the government-owned utility, might be as high as \$50-75 million, but the market

will depend on the level of regulation and the degree of compliance of the state-owned utility. The government-owned electric utility and its four regional operating companies would be the sole buyers of pollution control equipment.

*Existing and Projected Electric Generating Capacity in Brazil (MW)*

	1989	%	1999	%	Net Additions
Hydroelectric	50,413	91	75,346	90	24,933
Nuclear	657	1	1,902	2	1,245
Oil					
Thermal	2,225	4	2,225	3	--
Diesel	300	<1	500	<1	200
Combustion Turbine	642	1	975	1	333
Coal	1,000	2	2,800	3	1,800
Total	55,237	100	83,748	100	28,511

Source: U.S. Agency for International Development and World Bank.

With thousands of companies, Brazil's industrial sector has the most need for air pollution control. The DOC reports that the steel, chemicals, petrochemical, and cement industries are planning large investments. The investments required could be as much as \$300-350 million/year, more than three times current levels.

Companies in these industries, particularly those that are privatizing, are coming under more public pressure to comply with existing regulations. Large multinational firms, especially those in the chemical sector, are also expected to invest heavily in pollution control. Dow Chemical, for example, plans to invest \$50 million in the next five years for its five plants; similar programs are expected at Rhône-Poulenc, Bayer, and Ciba-Geigy facilities.

## *Brazil*

Petrobras, the Brazilian national oil company, intends to spend about \$20 million by the end of 1993 to comply with FEEMA (the Rio de Janeiro SEPA) air emission standards. Sulfur dioxide and hydrocarbon emissions are the main targets. Other industries that will need pollution control equipment include pulp and paper, fertilizer, and both primary and fabricated metals.

### *Major Opportunities*

Four promising technologies are likely to represent the major areas of opportunity for U.S. companies:

- particulate controls, including electrostatic precipitators, fabric filters or baghouses, and mechanical cyclones
- acid gas controls, including both flue gas desulfurization and wet scrubbers
- monitoring equipment, mainly for filters and precipitators
- sampling equipment.

Fans, heat recovery systems, bin vibrators, and heat/vapor separators will also be needed in Brazil.

Of these areas, particulate and dust control equipment are likely to be in the greatest demand. As an example, these types of controls represent more than 70 percent of the priority projects identified in the BDNES's four-year National Industrial Pollution Control Project.

The major buyers of air pollution equipment will be industrial firms in the petrochemical, chemical, and steel industries, as well as firms in food, textiles, and other key process industries. Most of these sectors are already privatized to some extent, and others (such as petroleum refining and electric utilities) may become privatized in the near future.

In addition to air pollution control equipment markets, growing environmental concerns in Brazil could also spur markets for "clean" technologies. One example is gas-fired cogeneration, which is being investigated more actively because of Brazil's growing natural gas reserves. BANESPA, São Paulo's state bank, is planning to install an 8 MW unit, Brazil's first commercial cogeneration facility.

*Identified Projects from Brazil's National Industrial Pollution Control Project  
Priority Projects, 1992-1996 (\$ million)*

	Air Pollution				Water Pollution					Total
	Parti- culates	Dust	SO <sub>2</sub>	Odors/ Toxics	DBO	BOD	Heavy Metals	Various*	Hazard -ous Waste	
Espirito Santo	68.9	--	4.3	--	1.6	--	--	--	--	74.8
Geraiis Minas	--	300.6	--	--	--	--	--	23.3	--	323.9
Parana	6.0	--	4.6	--	--	11.2	--	--	--	21.8
Rio de Janeiro	12.2	--	3.7	37.5	--	34.8	3.4	--	--	91.6
Santa Catarina	10.5**	--	--	1.6	19.8	--	4.3	7.7	9.0	52.9
Total	97.6	300.6	12.6	39.1	21.4	46.0	7.7	31.0	9.0	565.0

\* Ammonia, COD, cyanamide, phenols, sulfates, suspended solids.

\*\* Includes some SO<sub>2</sub> projects

Source: Based on World Bank data.

Opportunities should also exist for environmental service firms, particularly those in environmental compliance planning and environmental auditing. Such major companies as General Motors, General Electric, Alcan, Klabin (a paper producer), and Brahma (a brewer) contracted for environmental auditing services in 1991. Industrial companies in Brazil have historically dealt directly with equipment companies, but now seem more willing to use consulting services to aid in evaluations. This acceptance has grown as a result of the information requirements set by the RIMA/EIA environmental impact assessment process.

## *Brazil*

### *Competition*

Brazil's air pollution control market has not been a major source of foreign imports, mostly because of past import restrictions and import duties. Imports have typically accounted for 10-15 percent of the market. Although they have declined from \$19 million in 1990 to \$14 million in 1991, imports are expected to rebound to \$17 million in 1992. Both in the near and long terms, foreign air pollution control equipment will be helped by a reduction in import duties on air pollution control equipment. The current duty is 25 percent, but the rate will decline to 20 percent in late 1992.

In recent years, the United States has accounted for the largest share of air pollution control imports to Brazil, averaging about \$3.5-\$4 million per year, or about 25 percent of total imports. The DOC projects that U.S. imports for 1992 could increase to about \$5 million, just under 30 percent of total imports.

In targeting the Brazilian market, U.S. companies will face competition from both foreign and Brazilian firms. Major foreign competitors would include Sweden, whose Flakt/ABB has a local subsidiary in Brazil, Germany, and France. Japanese companies will become more active in the Brazilian market.

United States	25%
Sweden	20%
West Germany	15%
France	15%
Others	25%

Even though competition will exist from foreign firms, the strongest competition in Brazil is likely to come from local companies. Because of past import restrictions, Brazil has developed highly capable companies, including at least the following eight major manufacturers of air pollution control equipment:

- Aero Mecanica Darma S.A.
- Aerovento Tecnologia do Ar Ltda.
- Ar Industrial Equipamentos Aerodinamicos Ltda.
- Equipamentos Villares S.A.
- Filsan Equipamentos e Sistemas Ltda.
- Kepler Weber Controle Ambiental S.A.
- Neu Aerodinamica Ltda.
- Ventiladores Bernauer S.A.

Trade restrictions have enabled many Brazilian firms to expand their capabilities by licensing technologies from major foreign firms. Established relationships with U.S. firms include Aerovento Tecnologia with Sonic Development, Equipamentos Villares and Research-Cottrell, and Aero Mecanica Darma working with Joy Technologies.

The water pollution control market in Brazil is expected to total about \$845 million in 1992. Major project opportunities should be found in both the industrial and municipal sectors.

Water  
Pollution  
Control

Brazil's industrial wastewater treatment market totalled about \$270 million in 1991. The DOC reported that the market for waste treatment equipment totalled about \$220 million, up from \$175 million 1990. Other sources report that the market for water treatment chemicals was about \$50 million in 1991, split equally between cooling and boiler water applications.

*Water Pollution Control Market in Brazil (\$ million/year)*

Sector	1990	1991	1992	1993-1995
Industrial				
Equipment	175	220	245	330-350
Chemicals	45	50	55	65-70
Subtotal	220	270	300	395-420
Municipal		490	510	540-560
Equipment	400	30	35	40-50
Chemicals	25	520	545	590-610
Subtotal	425			
Total	645	790	845	985-1,035

Source: Adopted from U.S. Department of Commerce, *Chemical Week*, and World Bank data.

## *Brazil*

The DOC projects growth of about 15 percent per year for the next three to five years in Brazil's industrial market, and also expects imports to increase because of Brazil's efforts to liberalize trade. At present, imports represent about 13 percent of the market, but could grow to 20 percent or more over the next two years.

Exact data on the municipal water and sewage treatment market are not available, but the market could average about \$600 million per year. In 1991, according to the DOC, the Brazilian water/sewerage treatment market totaled \$490 million, with growth of about 3 percent per year expected. These figures are consistent with the plans of four major state municipal agencies, which call for expenditures on water projects of \$470 million to \$500 million in 1992 and 1993. São Paulo's water authority alone has plans to spend \$340-\$350 million per year in these two years.

### *Planned Expenditures for Major Water Modernization Projects in Brazil (\$ million/year)*

State/Municipal Water Company	1992	1993	Average 1994-1997	Total
Santa Catarina CASAN	58	63	60	361
Mato Grosso do Sul SANESUL	32	30	42	230
Bahia EMBASA	43	52	77	403
Sao Paolo SABESP	340	351	355	2,111
Total	473	496	534	3,105

Source: Adopted from World Bank data.

In addition to infrastructure investment, Brazil should have continuing requirements for water treatment chemicals for municipal waste treatment facilities. In 1991, this market totaled \$30 million.

### **Major Opportunities**

Wastewater treatment will be a priority for most of Brazil's leading industries, including steel, petrochemicals, mining, and pulp and paper. These industries are expected to invest \$15 billion over the next 10 years. The country's 38 pulp plants reportedly plan to invest more than \$300 million in controls, with the country's 36 steel companies planning on similar spending. As an example, Companhia Siderurgica Nacional (CSN), the country's largest steel company, may spend more than \$90 million over the next five years. Waste treatment projects will also be needed in the food, fertilizer, alcohol, and sugar industries.

For the industrial sector, the DOC reports significant import opportunities for:

- |  |   |
|--|---|
| <input type="checkbox"/> measuring equipment | <input type="checkbox"/> monitoring software    |
| <input type="checkbox"/> demineralizers      | <input type="checkbox"/> aeration diffusers     |
| <input type="checkbox"/> osmosis equipment   | <input type="checkbox"/> chlorination apparatus |
| <input type="checkbox"/> pumps/compressors.  |   |

Identified projects from the National Industrial Pollution Control Project show a need for BOD and COD test and control equipment, as well as control equipment for oil, chemicals (sulfates, phenols), and heavy metals.

Potential will also exist for centrifuges, filtering equipment, and purifying equipment. Zero tariff status has been requested for all of these products since the beginning of 1991, meaning that Brazil does not produce comparable products locally.

In the municipal sector, significant project opportunities for foreign companies will come from the major state programs that involve financing from outside agencies, such as the World Bank and the Inter-American Development Bank (IDB). At least eight major projects are planned or underway:

- |                                       |   |
|---------------------------------------|---|
| <input type="checkbox"/> Pará Project | A \$210 million World Bank project, approved in November 1991 for the Northeast state of Pará (around the city of Belém), will target drainage, water supply, sanitary sewage, and sewer drains. Through this project, CONSAPA (Companhia de Saneamento do Pará) will procure solid waste collection systems, drainage and sewage sludge equipment, and more than 100,000 water meters. |
|---------------------------------------|---|

## ***Brazil***

- SABESP Project**

A \$600 million World Bank water project is being conducted for São Paulo Companhia de Saneamento Basico do Estado de São Paulo (SABESP). This project, running through 1994, will cover water supply and sewerage facilities and will represent only a portion of the company's five-year total investment program (through 1993), which calls for investments of \$17 billion.
  
- World Bank Water Sector Project**

A \$500 million World Bank water sector modernization project will aid the state water companies of Santa Catarina (CASAN), Bahia (EMBASA), and Mato Grosso do Sul (SANESUL). This effort will help these companies operate on a commercial basis and finance part of their six-year investment programs aimed at expanding water supply and sewerage services. Between 1992 and 1997, the three companies plan to invest \$360 million, \$404 million, and \$228 million, respectively.
  
- IDB Sewage Project**

A \$350 million IDB project will construct sewage systems for more than two dozen cities and towns.
  
- IDB Guanabara Bay Project**

A pending \$400-600 million IDB project will finance investments to assist the Grupo Executivo de Decontamination of Bahia da Guanabara (GEDEG) in reducing pollution in the Guanabara Bay and in improving sanitary services in the surrounding area.
  
- IDB Amazonas Project**

A pending \$100 million IDB project will aid the state of Amazonas (through the Governo do Estado de Amazonas) in improving the sanitary conditions of the Sao Raimundo Valley by eliminating drainage problems, reducing landslide risks, dredging several rivers, improving sewerage and streets, and expanding wastewater treatment and trash collection.

- IDB Lake Guaiba Basin Project IDB also has pending a \$280 million effort to assist the state of Rio Grande do Sul in the decontamination and recovery of the Guaiba Lake Basin. The IDB aid would contribute to the first stage of this project, which could ultimately total more than \$1 billion over a 10-12 year period.
  
- IDB Tiete River Project The IDB is considering a \$900 million project to aid in the decontamination of the Tiete River, focusing on the development of sewage systems and treatment plants.

In most of these projects, local companies will have some preferential status; however, U.S. and other foreign firms can generally bid on them, directly or in cooperation with local firms. In some cases, municipalities are actively seeking bids from foreign firms. As an example, the Municipal Department of Water and Sewage of Uberlandia (DMAE) and the Water Company of Uberaba (CODAU), both in Minas Gerais, recently ran bidding notices in the *New York Times*.

### *Competition*

As in the air pollution control market, the Brazilian water pollution control market has been dominated by local companies. Recently, about 85-90 percent of the industrial water pollution market has been supplied by local firms, while 70-75 percent of the municipal sector projects have been provided locally.

In the industrial sector, imports have in recent years averaged about \$35 million per year, just over 15 percent of the total market. The United States has had the largest share of imports, at about \$7 million or 20 percent of the total. Other major importers have included Germany (19 percent), Sweden (15 percent), United Kingdom (15 percent), and Japan (7 percent). France also has a strong presence through Degremont, which has a local subsidiary. Overall, the DOC expects that U.S. imports could grow 20-25 percent per year over the next five years, with its import share reaching 35 percent.

In the municipal sector, imports totaled about \$130 million in 1991, about 27 percent of the market. The United States currently has a strong position in this market, supplying close to 60 percent of the imports. Sweden and Japan are the other main exporters to this market.

## *Brazil*

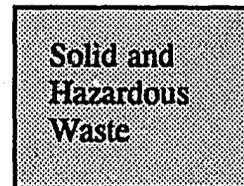
Because of the large potential size of this market, competition from foreign firms will be strong. Foreign firms that have the financial backing of government loan programs should be particularly successful. As an example, the Japanese have reportedly promised to provide \$1 billion to support the cleanup of Rio de Janeiro's Guanabara Bay, a 10-year project estimated to cost \$4 billion. The Japanese Environmental Cooperation Center, which directed the cleanup effort of Tokyo Bay, is working with local officials to devise a plan for this project. This could give Japanese companies an edge in future projects.

Like the air pollution control market, Brazilian firms have developed good technical capabilities in wastewater treatment and will be strong competitors. Technology licenses have again been widely utilized, and some firms have multiple agreements for non-competitive products. Major local firms include:

- Equipamentos Viillares, which has agreements with Davy Bamag (Germany), Dupont, Vernay (France), and Oxytech.
- Filsan, with agreements with Aqua-Aerobic, Smith Loveless, Larox (Finland), and UTB (Switzerland).
- Semco-Ral, a new joint venture of Recursos Ambientales and Semco, which provides waste management consulting and technology through import arrangements with Philadelphia Gear, Chronos Richardson, Leigh and ERL (United Kingdom), and Sandvik (Sweden).
- Miningtech Equipamentos Industriais, a leader in solid/liquid separation systems, which has agreements with Eimco, Wemco, Goslin, Shriver, Kemix, Industrial, Perrin, and Delta.
- Aquatec, a leading supplier of water treating chemicals, which is very active in all of Latin America.

Competition from local firms will be strongest in those segments where domestic technology exists. For example, Brazil has a new upflow anaerobic treatment process that should reduce the costs of primary water and sewage treatment. However, in cases where more effective treatment is needed (e.g., activated sludge), foreign technology will still be required.

The solid and hazardous waste markets are currently the smallest environmental markets in Brazil, totaling about \$45 million in 1991. These markets should have tremendous growth potential because Brazil's cleanup and disposal requirements are only beginning to be defined.



The solid waste market in Brazil is currently quite small: data from the DOC show a market of only about \$25 million in 1990. This market is expected to grow rapidly because of increasing pressure for greater waste control. The steel, petrochemicals, mining, and pulp and paper industries, for example, are expected to invest \$500 million over the next 10 years in solid waste treatment. The plastics, rubber, and chemicals industries are also expected to invest heavily in control equipment, as are fabricated metals plants involved in galvanizing, electroplating, and painting.

To date, Brazil's solid waste regulations have largely been inadequate and are not strictly enforced. Most solid waste is disposed of in landfills and receives no special processing. At present, there are only two industrial solid waste incinerators, both located in São Paulo. These units are clearly inadequate: the companies in the São Paulo area alone generate more than 50 million tons of waste per year.

In addition to solid waste, Brazil has a need for hazardous waste control and a pressing need to better identify problem areas and potential solutions. No detailed data are available on the potential market, but based on current activity, it may be as much as \$20 million per year. Projects identified or underway include:

- Four treatment facilities for the state of Santa Catarina, totaling \$9 million, identified as part of the BNDES's national pollution project.
- A \$60 million hazardous waste treatment facility in Rio de Janeiro. The Italian firm Ecoclear and the Brazilian company Gestão de Empreendimentos Ambientais have announced plans to build this facility, which will treat 200,000 tons annually. It will feature a \$30 million incinerator (imported from Finland) capable of processing 15,000 tons of waste per year.

Brazil's hazardous waste market could grow rapidly in the next few years. In July, Rio de Janeiro's legislature passed regulations requiring businesses to reduce toxic waste by 10 percent per year and 50 percent overall in the next five years. The legislation specifically targets heavy industries such as oil refining, chemicals, steel and automobile manufacturing, which produce more than 90 percent of the country's toxic waste. FEEMA will enforce the

## ***Brazil***

new regulation and has given companies until the end of 1992 to develop data on waste produced and plans for waste reduction.

### ***Major Opportunities***

To date, the limited solid/hazardous waste market has been serviced mostly by Brazilian companies. As the demand for treatment increases, these companies will be looking to expand and upgrade their available products, representing a clear export opportunity for foreign firms.

Brazil's specific product needs are not well-defined because the market is only beginning to emerge. In the short-run, the greatest need will be for measuring and monitoring equipment and for waste incinerators.

Several niche markets, on the periphery of the solid and hazardous waste markets, may also represent opportunities for U.S. firms. For example, Brazil has been fairly successful in instituting private and public sector recycling efforts. Programs are already in place for paper and glass, with new efforts beginning for aluminum cans and plastics. Plastivida, for example, is a new association of plastic resin producers, formed to promote plastic recycling.

As Brazil expands its recycling programs, opportunities may exist for collection, sorting, and other types of equipment. To date, the state of São Paulo has the most widespread recycling program, and paper has been the most widely (about 30 percent) recycled product. Clearly, there is substantial room for growth in all areas of recycling.

Another specialized niche opportunity is equipment for the monitoring, detection, and cleanup of radiation and wastes from nuclear power plants. Brazil has only one nuclear power plant (Angas dos Reis), but it will complete the Angas 2 and 3 units (for a total of 1,245 MW) in the next five to ten years; furthermore, there are plans to commission four more units by 2010. At least one U.S. firm (Thermo Instruments) already supplies specialized radiation detection equipment to the existing plant. If the plans for additional reactors go forward, additional opportunities should develop for U.S. firms.

### ***Competition***

To date, the solid waste market has been supplied almost entirely by Brazilian firms. Leaders in this market have been Equipamentos Villares, which has technology agreements with Polund Miljoteknik (Denmark), and Filsan, which has agreements with FMC, FMW (Austria), and Wimberg (Sweden).

### ***Market Entry Strategies***

In targeting Brazil, environmental equipment and service companies will face two opposing features of this market. Trade access has been opened considerably; however, past restrictions have allowed the country to develop strong domestic capabilities to produce pollution control equipment and provide related services.

Access to the Brazilian market has been greatly improved recently through reductions in import restrictions and import duties. Tariffs affecting pollution control equipment, with comparable local capabilities, are being lowered from 25 percent to 20 percent this year, while non-tariff barriers have mostly been eliminated. Equipment with no local producers of similar products can request import duty exemption, and several types of equipment (e.g., filters, purifiers, centrifuges) have already received such exemptions. Improved trade regulations will make imports of U.S. (and other foreign) technology more accessible to Brazilian companies.

Although import access to Brazil has improved, U.S. firms will still face significant competition from local companies. Past restrictions have given Brazilian firms the time to develop their capabilities, much of which has come in the form of technology licenses from U.S. and major foreign environmental companies.

Brazilian firms are no longer required to give preference to local companies, but U.S. and other foreign firms may still need local partners, financing, and technology transfer to be competitive. To access the market, several options are available to U.S. firms:

- Technology licensing.*** This has been the most successful path to date, and the demand for additional technology should continue. This will be especially true for solid and hazardous waste technologies, areas which are only now beginning to develop.

## **Brazil**

- **Complete turnkey exports.** Improved market access has made the importation of complete systems possible; however, while prices are generally higher for local equipment, it is still expensive to import complete systems because of high transportation costs. To follow this route, it will be important to establish relationships with local engineering companies that can specify U.S. equipment as part of their environmental audits. Product quality and company reputation can be strong selling points.
- **Local subsidiaries.** The initial costs to establish a subsidiary will be high, but local presence can provide the greatest market access. Local companies are generally given preference in project tenders, with non-Brazilian firms excluded from all but a small portion of the total project.

Despite limited exports to date, the Brazilian market has growing potential for U.S. companies. While foreign competition will be present, local industrial companies are receptive to U.S. firms, and there is some preference for U.S. companies based on the commonality in business approach between the two countries' industrial sectors.

A key component in structuring future projects should be after-sales service. According to the DOC, the import market has suffered because such service, although it is considered very important, has often not been available on equipment bought from foreign firms. Brazilian companies are willing to pay more for local equipment to ensure that reliable service will be available. Service is a particularly strong selling point because local technology (developed directly or indirectly from foreign licenses) is generally comparable to that offered by foreign firms.

Overall, imports will be driven by local companies looking for high-tech components or equipment that are not available from domestic companies. Imports of large equipment or complete turnkey systems are likely to remain the exception. Contacts and relationships with local consulting and engineering firms will be critical to project success.



## Chile

Over the last ten years, Chile has developed the most stable and market-oriented economy in Latin America. Its economy has grown at an average rate of 5 percent per year over the last decade, making Chile the second fastest growing country in Latin America behind Mexico. Through 1993, Chile's GDP is expected to grow by another 5 to 6 percent annually. Chile has rapidly privatized its major industries, and the government now controls less than 25 percent of total GDP. Investment and business opportunities should continue in Chile because more than 30 additional companies are to be privatized.

### *General Economic Indicators: Chile*

	1991	1992 (est.)	1993 (est.)
Population (millions)	13.4	13.6	13.9
Real GDP per Capita (\$)	2,784	2,874	2,996
Real GDP (\$ billion)	37	39	41
GDP Growth Rate	3.0%	5.0%	6.0%
Consumer Price Change, year-end	20.6%	22.2%	16.2%
Trade Balance (\$ billion)	1.0	1.0	1.0
Total External Debt (\$ billion), year-end	1.5	1.6	1.6
Exchange Rate (Pesos/\$), year-end	390	465	498

Source: Bank of America, September 1991.

Chile also has a favorable trade structure, with relatively low tariffs and duties (currently 11 percent plus an 18 percent value-added tax). It is favorable to foreign imports, and holds particular promise for imports of U.S. environmental technologies. Chile's trade

picture may improve even further if a free trade agreement is signed between the United States and Chile, or between the United States and Mexico, since Chile is working on its own trade agreement with Mexico. Chile seems to be looking more towards North America and Europe for business opportunities and less toward participation in the Southern Cone Common Market (Mercosur), based on differences in economic policies.<sup>1</sup>

### ***Environmental Situation and Policy Framework***

Like its neighbors, Chile is faced with serious environmental problems. These range from air polluted with sulfur dioxide and heavy metals to water polluted with industrial and municipal wastes. These problems have been brought on by rapid industrialization and deregulation with no consistent environmental policy, and by the concentration and close proximity of industry and people in a few areas of the country. The lack of environmental policy has meant that older, highly polluting technologies in the industrial and transportation sectors are still in use. The effect of these technologies is worsened since many industrial facilities are near urban areas, which contain more than 80 percent of the population. About 75 percent of the population lives in the country's central region, which includes the capital of Santiago.

The most immediate environmental problems Chile faces are in the Santiago metropolitan area, which contains almost 40 percent of the country's people and a high percentage of its industry. Santiago is the second most polluted city in Latin America, after Mexico City. The city is faced with severe water and sewage problems and serious air pollution problems. Attributable to old factories, diesel buses, and unpaved roads, Santiago's air pollution problems are worsened by frequent thermal inversions caused by its high altitude (just over 1,700 feet).

At present, Chile has more than 2,000 environmental laws, yet environmental problems persist because these laws have been enforced only sporadically. Enforcement is weak, in part, because more than 20 ministries have some form of environmental jurisdiction, and their responsibilities overlap to a large extent. A recent GAO report noted that "the lack of a comprehensive environmental policy may affect U.S.-Chilean free trade negotiations."<sup>2</sup>

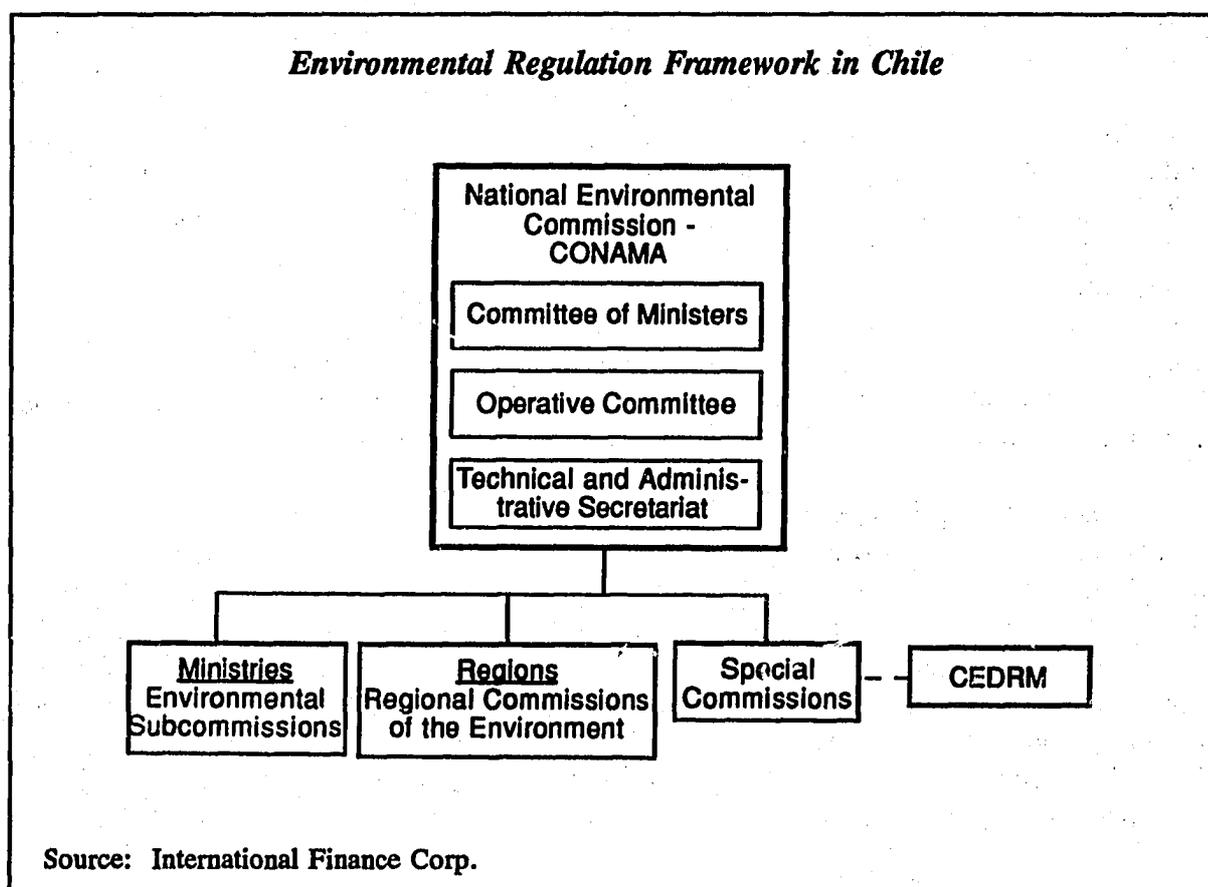
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<sup>1</sup> Mercosur includes Argentina, Brazil, Paraguay, and Uruguay.

<sup>2</sup> *Chilean Trade - Factors Affecting U.S. Trade and Investment*. U.S. General Accounting Office, GAO/GGD-92-106, June 1992.

## Chile

This situation is, however, being addressed, and in the last two years Chile's government has set environmental policy as a priority. To this end, in 1990, Chile's president created the Comisión Nacional de Medio Ambiente (CONAMA), or National Environmental Commission, to develop an overall environmental program. In part through funding from the U.S. Agency for International Development, CONAMA is now reviewing existing laws and developing a new framework for environmental regulation. CONAMA's work should yield new legislation that will create regional environmental protection commissions and centralize legal jurisdiction that is now spread across many agencies.



CONAMA has three main elements: a Committee of Ministers, an Operative Committee, and a Technical and Administrative Secretariat. The Committee of Ministers is

led by the Ministry of Natural Resources and also includes representatives from the ministries of Health, Economy, Agriculture, Mining, Housing, and Transport. Its primary responsibility is for overall coordination of the commission. The Operative Committee is responsible for analysis and technical coordination of the commission's activities. The main activities of the commission -- technical analysis and studies -- are conducted by the Technical and Administrative Secretariat.

With its national environmental protection system still under development, environmental activity in Chile is now being driven by two forces: special presidential decrees and the Special Decontamination Commission for the Metropolitan Region (CEDRM) of Santiago. Chile's president has the authority to issue presidential decrees covering the environment. Such decrees must be reviewed for their constitutionality by the General Controller of the Republic, an autonomous agency, before being implemented.

In December 1991, a decree was passed instituting strict SO<sub>2</sub> and particulate regulations. The specific limits vary by region, but are comparable to those in the United States. The most lenient limits apply to the northern areas of the country, where mining is the primary industry. This region must meet a limit of 365 µg/m<sup>3</sup> (maximum daily average) by December 1992. Southern portions of the country must reduce emissions to 260 µg/m<sup>3</sup> by the same date. The most stringent limits are for the Santiago metropolitan area, where all industries must reduce SO<sub>2</sub> and particulate emissions from stationary sources to 112 µg/m<sup>3</sup>. To meet these limits, the Ministry of Mines has required that all smelters install air-quality monitoring by June 1992.

Other new regulations are also being put into place. Chile's Superintendency of Sanitary Services (SSS) is drafting the country's first water pollution regulations. These would limit the discharge of more than two dozen substances, focusing on heavy metals and chlorine compounds. New companies will have to comply immediately, while existing facilities will have one to five years to comply. According to SSS, under the proposed regulations, most industrial companies will have to install primary treatment systems, at a minimum, while many cities will have to build sewage treatment plants over the next ten years. SSS points out that it has not yet developed a fine and penalty system to help enforce its regulations.

While air pollution is now tightly regulated and water pollution is being addressed, there is a lack of regulations for toxic wastes and integrated river basins, and an absence of any requirement for environmental impact studies. These conditions are changing, however. Many large companies are reportedly conducting studies on their own, and the Ministry of Mines expects to put in place regulations requiring all mining projects to submit

## Chile

environmental impact studies. Officials expect that the requirements for these studies will soon spread to other industries.

### *Comparison of Chilean and U.S. Air Quality Standards*

Pollutant	Measurement Period	Standard ( $\mu\text{g}/\text{m}^3$ )	
		Chile	U.S.
SO <sub>2</sub>	Annual	80	80
	24 Hours	365*	365
NO <sub>2</sub>	Annual	100	100
	24 Hours	300	--
TSP	Annual	75	75
	24 Hours	260	260
O <sub>3</sub>	1 Hour	160	235
CO	8 Hours	10	10
	1 Hour	40	40
Hydrocarbons	3 Hours	160	160

\* Least stringent limit.

Source: PAHO.

Because of the extreme environmental problems faced by the Santiago area, CEDRM was created to address the city's pollution issues. CEDRM is a special municipal commission that reports to the Secretary General of the President.

Even though Santiago already has the most stringent emissions limits in Chile, its pollution problems are so great that CEDRM hopes to reduce SO<sub>x</sub> and particulate emissions to 56  $\mu\text{g}/\text{m}^3$  by 1997. A central strategy to achieve this objective is a new pollution permit trading system. CEDRM, along with CONAMA and the Ministries of Health and Agriculture, are currently working on a permit system that will allow industry to trade

pollution rights. The agency hopes to have the system fully in place by 1997 to assist in meeting the planned lower emission limit. With this system, companies would be able to buy pollution credits, but would be charged a fee to access the trading process. These fees would be used to create a fund to help finance equipment purchases.

As part of its effort to clean up Santiago, CEDRM has moved to better characterize the nature of its pollution problems and to identify effective solutions. The U.S. Trade and Development Program is providing \$700,000 for water pollution studies and \$250,000 for air pollution studies in metropolitan Santiago.

Another major effort involves air pollution monitoring. The Netherlands is providing over \$1 million for two mobile air quality monitoring systems and technical assistance to CEDRM. Phillips Automation SPA (Italy) will supply the monitoring equipment through its Chilean affiliate, Phillips Chilena SA, while three consulting firms are studying the emissions of major polluters to recommend solutions and technologies. The technical assistance to analyze emissions is provided to industrial companies at no cost, which increases overall participation and enables a more accurate characterization of overall environmental problems.

### ***Outlook for the Environmental Market***

The overall market for environmental equipment and services in Chile is likely to be \$700 million to \$900 million per year for the next few years. Because the market is emerging rapidly, this figure could be substantially higher. As an example, the Chilean government alone plans to spend \$2.4 billion between 1991 and 1994 on new infrastructure to improve the environment and sanitation conditions in Chile.

The environmental market will include mostly municipal wastewater projects and industrial air pollution projects. Solid and hazardous waste markets are still in their infancy. The country does have some domestic engineering and manufacturing capabilities; however, much of the equipment needed for environmental projects will have to be imported. Large opportunities also exist for such environmental services as auditing and emissions monitoring.

The market will be driven by four key factors: the new air regulations, which have created an immediate demand for controls; the cleanup of Santiago, which will require air and water pollution control equipment and services; the lack of existing infrastructure, particularly in the area of water and sewage treatment; and economic changes, which are improving import opportunities.

## Chile

### Chilean Environmental Market (\$ million)

	1990	1991	1992 (est.)	1993-1995 (est.)
Air Pollution	70	110	170-220	285-400
Water Pollution	na	na	300-400	400-500
Solid/Hazardous Waste	na	na	10-20	20-30
Total	70	110	480-640	705-930

Source: Adopted from U.S. Department of Commerce, *Chemical Week*, and International Finance Corp. data.

### Key Environmental Market Drivers

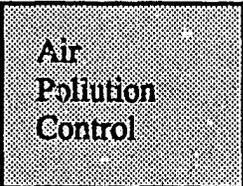
Market Drivers	Impact
New SO <sub>2</sub> and particulate regulations.	Creating immediate need for air pollution controls and monitoring equipment.
Environmental cleanup is a government priority, particularly for the Santiago area.	Creating a need for pollution controls for air, wastewater, sewerage and transportation.
Lack of infrastructure to deal with municipal water and sewerage problems.	Will require major investments in systems to collect, transport, and treat waste.
Stable and market-oriented economy.	Makes market more open to technology imports.

Chile's leading buyers of pollution control equipment and services will be the major municipal agencies in charge of water, sewerage, transportation, and industrial air pollution programs, and private industrial firms. The main industrial sector targets will be copper and fish processing companies, two industries in which Chile is a leading world producer. Other industries with a large need for pollution controls will include paper and petrochemicals.

### ***Environmental Market Opportunities and Competition***

The overall environmental market in Chile is difficult to quantify because its air regulations are relatively new and regulations for other sectors are only now being developed. Although precise estimates are not available, the market is likely to be as much as \$700 million to \$900 million per year for the next three to five years. About 55 to 60 percent of the market will be for wastewater treatment, with air pollution accounting for most of the balance. In the near-term, only a small market will exist for solid and hazardous wastes. As regulations become more developed, particularly for water, solid, and hazardous wastes, the potential market could be substantially larger.

Chile's air pollution market was only about \$110 million in 1991. This investment came largely from industrial companies that decided to install pollution controls in advance of expected regulation. Now that regulations have been passed, the market will grow quickly. In 1992, it could reach \$220 million, while a conservative estimate would place the market at \$285 to \$400 million annually for the next few years. The U.S. Department of Commerce (DOC) is more optimistic, however, reporting that this market could expand from \$400 million to \$1.5 billion over the next three to five years.



Air  
Pollution  
Control

Based on the limits set in the 1991 Presidential decree, there is an immediate need for air pollution control equipment in Chile. With CEDRM's plans to move to even lower emissions levels, there should be a continuing need for controls through 1997.

The main market for air pollution equipment will be the industrial sector. The DOC estimates that in the two years preceding the new air regulations, this sector spent about \$49 million on controls in 1989 and about \$70 million in 1990. For 1991, the DOC estimates that spending increased to \$100 million. These figures are best viewed as general measures of market size because no specific figures on air pollution equipment sales in Chile exist and there are no existing import categories for this equipment. CONAMA, for example, does not have precise figures, but the agency estimates that the market is currently about \$50 million to \$100 million per year, mostly for smelters and refineries.

Because the Chilean market is evolving rapidly and its industries are only now focusing on compliance options, the air pollution market could become substantially larger. Growth in this market is expected to be at least 30 percent per year for the next few years. However, its growth could be even higher depending on the development of regulations and the pattern of compliance.

## Chile

### Chilean Air Pollution Market (\$ million)

	1990	1991	1992 (est.)	1993-1995 (est.)
Industry	70	100	130-150	200-220
Utility/Non-Utility Power	na	na	25-50	35-80
Transportation	na	10	15-20	50-100
<b>Total</b>	<b>70</b>	<b>110</b>	<b>170-220</b>	<b>285-400</b>

Source: Adopted from U.S. Department of Commerce and International Finance Corp. data.

In the industrial sector, the major buyers of air pollution control equipment will be the metals industry, with copper smelting representing about 90 percent of Chile's estimated 1 million tons/year of sulfur emissions. Other industries with particulate emissions problems include metals/mining, cellulose, glass, petroleum/petrochemicals, leather, textiles, and food.

Chile's fishmeal plants will be in need of odor control devices. Of the 45 existing plants, 15 have already installed new drying and evaporation systems to reduce odor; however, at an average of \$3 million to \$5 million per plant, an additional \$70 million to \$90 million of equipment is needed to convert the remaining plants.

#### Major Sources of Sulfur Emissions in Chile

Copper Smelting	90%
Power Plants	5%
Roasting Plants	2%
Cement, Refineries, and All Others	3%

Source: International Finance Corporation.

Because Chile's air regulations are relatively new, no clear pattern has emerged as to how companies will respond to them. Some private sector firms made investments prior to the regulations, but many have yet to respond. To meet the new SO<sub>2</sub> and particulate limits, most companies seem to be looking to install scrubbers quickly. For example, a major iron smelter in the Santiago area (Fundición de Acero Zeraus, González García) plans to install two-phase scrubbers to cut current SO<sub>x</sub> emissions (nearly 22,000 µg/m<sup>3</sup>) by 98 percent. Other companies, such as Refractarios Chilenos SA, Recsa, and Sumar SA, have also installed two- and three-phase scrubbers. Some of these companies have spent as much as \$4 million already, but are still unable to meet emission standards.

Unlike some Latin American countries, government-owned companies represent only a small part of Chilean industry. In fact, only three major enterprises, CODELCO (copper mining), ENAMI (mining) and ENAP (petroleum), are not likely to be privatized. These firms seem to already have plans to spend more than \$300 million over the next five years to meet required environmental standards. ENAMI, the national mining company, has already spent \$0.5 million on SO<sub>2</sub> and particulate monitoring systems and is planning new ovens and chemical recovery systems, with investments likely to exceed \$250 million.

While industry will represent the largest market for air pollution controls, utility and non-utility power plants will also represent a notable market. This market will be driven by two factors. First, Chile is looking to diversify its power sector and develop its coal reserves because of recent droughts. Second, it has a growing non-utility (self-generation and cogeneration) sector, with about 870 MW of fuel-fired capacity at present.

Chile's utility sector has 3,110 MW of installed capacity, of which 910 MW are fossil fuel-fired. Firm expansion plans call for an additional 424 MW of coal-fired capacity; however, the DOC reports that about 1,200 MW of thermal capacity, counting both utility and non-utility capacity, is under construction or in prefeasibility, about 770 MW more than committed expansion plans. This is presumably in response to Chile's efforts to diversify from hydroelectric generation.

*Existing and Projected Electric Generating Capacity in Chile (MW)*

	1989	%	1999	%	Net Additions
Hydroelectric	2,200	71	3,664	73	1,614
Oil/Diesel	76	2	76	2	--
Gas/Combustion Turbine	151	5	161	3	10
Coal	683	22	1,107	22	424
Total	3,110	100	5,008	100	1,888

Source: USAID, World Bank.

Assuming control costs comparable to the United States, Chile's utility market for air pollution controls (based on firm plans) could total \$200 million to \$240 million over the next five to ten years; annual investments could thus range from \$20 million to \$50 million. To equip existing non-utility capacity and the additional thermal capacity reported by the

## *Chile*

DOC could require an additional \$150-160 million in controls, about \$15-30 million per year. Power sector demand could thus total as much as \$35-\$80 million per year.

Chile's main power sector clients for controls, which are now mostly private companies, will be its three largest utilities: Empresa Nacional de Electricidad SA (Endesa), Compañía Chilena de Generación Eléctrica SA (Chilgener), and Empresa Eléctrica Colbún-Machicura SA (Colbun). Industrial clients will include paper/cellulose companies, which have a large portion of the self-generation capacity, as well as metals/mining, chemical, and petroleum companies.

Although the transportation sector is not likely to be the largest sector in terms of spending, it is the main contributor to Chile's air pollution problems. The deregulation of this sector has allowed many vehicles to be imported, most of which have highly polluting diesel engines. Santiago, for example, has nearly twice as many diesel buses as São Paulo, Brazil, despite having only about one-fourth the population.

Based on identified projects, the transport sector could require \$50 to \$100 million per year for pollution control. Projects in this sector will include catalytic converters for automobiles and buses, the replacement of older diesel vehicles, and the introduction of alternative fuels. The primary projects identified to date fall in the Santiago area, under the jurisdiction of CEDRM:

- \$50 million to replace old buses between 1991 and 1993, \$500 million to replace the entire fleet
- \$8-12 million to create public transport service centers to improve vehicle maintenance
- \$20 million to equip taxis with catalytic converters and to set up an alternate fuel test program.

Beginning in 1992, three regions in Chile will require all new vehicles to have catalytic converters and use unleaded gasoline. This new requirement should apply to the entire country by 1994. The national petroleum company (ENAP) says that it can already supply more than three times the amount of unleaded gasoline that will be needed by 1994; therefore, the main market in the transportation sector will be for emissions and maintenance technologies, rather than for new fuels capabilities.

***Major Opportunities***

Chile's air pollution market should represent a major opportunity for U.S. firms because most Chilean companies know and understand U.S. technology. In fact, many Chilean engineers have been trained in the United States and have a favorable view of U.S. companies. A difficulty in targeting this market is that many projects have to be conducted in the very near term to meet the new standards set for the end of 1992. Beyond 1992, opportunities will focus on helping companies comply with even more stringent regulations (such as those planned for the Santiago area). Demand will also come from firms that have been unable to fully comply with existing standards.

Major opportunities for air pollution equipment in the near term will include:

- Gas emission controls, such as scrubbers and flue gas desulfurization. Scrubbers are likely to be in great demand as coal, oil, and wood burning sites need to switch fuels (to gas) or install scrubbers. Coal and wood sites must install controls this year; oil units have slightly more time to comply.
- Particulate controls, such as filters and electrostatic precipitators. Heavy demand will come from the mining/metals industry (smelters) and foundries.
- NOx controls.

The demand for this equipment will mostly come from the industrial sector. To help finance projects, CEDRM hopes to set aside \$50-\$90 million. CEDRM reports that in the Santiago area alone, as many as 300-500 plants need air pollution controls, with individual plant investments ranging from \$100,000 to \$1 million. The Inter-American Development Bank (IDB) has proposed a \$65 million project to assist environmental projects at refineries. CEDRM also hopes to provide \$3-\$5 million in financing to help reduce emissions from heating systems of commercial buildings.

Near-term opportunities in the transportation sector will also be focused on CEDRM's activities. The principal projects will include vehicle replacement, service centers, and catalytic converter retrofits. As an example, Santiago's buses (more than 13,000 total) are required to have catalytic converters by year end. At a cost of \$6 million, about 5,000 buses will be converted using systems made by Engine Control Systems Ltd. (Canada). The city is also actively expanding the use of electric trolley buses powered by overhead cables; some buses have already been purchased from Russia and Belarus.

## *Chile*

In addition to equipment, CEDRM's executive secretary has said that environmental services will be in demand, particularly air pollution monitoring equipment for industrial companies and municipalities. The IDB, for example, is considering a \$133 million project that would help finance air pollution monitoring projects and provide consulting services, targeting industrial and engine emissions.

While control equipment and related services will represent a large part of the air pollution control market in the near term, a large market should also develop in Chile for advanced processing technologies and chemical recovery systems. Some possible opportunities include:

- Adding chemical plants to treat waste gases and fumes, with potential applications in mining, foundries, and pulp and paper.
- Modernizing copper smelters and installing sulfuric acid chemical recovery plants, with potential investments totaling as much as \$400-\$450 million.
- Installing advanced smelters. For example, Outokumpu Chile SA, ENAMI, and CODELCO are considering a new \$400-\$500 million smelter project.
- Retrofitting new low-emissions technologies. An Exxon subsidiary, for instance, is installing new copper dryers (made by Kvaerner AS of Norway), which use gas rather than oil, to reduce CO<sub>2</sub> and particulate emissions, and is also installing a sulfuric acid plant to recover SO<sub>2</sub> emissions.

In the long run, Chile could develop a large market for fuel conversions as one response to air pollution. Empresa Chilena de Gas Natural SA, a consortium of the oil and gas companies of Compañía de Petróleos de Chile (Copec), Compañía de Consumidores de Gas de Santiago (Gasco), Abastecedora de Combustibles SA (Abastible), Engas, and Shell Chile, is studying the feasibility of converting the 120 largest oil users in the Santiago area to natural gas. The consortium is considering building a gas pipeline from Argentina. Likewise, Gasoducto Trasandino SA, a consortium formed by Empresa Nacional de Petróleo (ENAP), Snam-Italgas, Engas-Catalana de Gas, and Gas de Madrid, is studying the possible construction of a gas pipeline.

## *Competition*

The DOC reports that Chile imports all of its air pollution controls; however, other sources indicate that a small amount of local production capability exists. Through 1991,

## Chile

DOC estimates that the United States has had about a 40 percent share of the import market, or \$40 million, with the remainder from Europe (20 percent) and Asia (30 percent). Both total and U.S. imports are expected to grow at more than 30 percent for the next few years.

While the Chilean market should be favorable to U.S. companies, competition from foreign companies will be strong. U.S. equipment seems to be viewed favorably, based on its perceived quality; however, the credit terms offered by firms of other countries are often more attractive. Japan and the European Community have both been providing soft loans for environmental investments in Chile. These loans are usually tied to imports from the lending country. Three countries that seem to have especially close ties to Chile are Spain, Germany, and Italy.

While the majority of the equipment to date has been imported, Chile does have a few equipment companies. A few of these produce technologies that are generally imported, but most will be competition for less sophisticated equipment. Leading Chilean firms include:

- |                          |                      |                          |                     |
|--------------------------|----------------------|--------------------------|---------------------|
| <input type="checkbox"/> | Díaz y Bodelon Ltda. | <input type="checkbox"/> | Marco Chilena       |
| <input type="checkbox"/> | Werkhuizen Schepens  | <input type="checkbox"/> | NUS Corporation     |
| <input type="checkbox"/> | Idreco Sudamericana  | <input type="checkbox"/> | Carr y Compañía SA. |

Local firms are more likely, however, to be competitive for environmental services. For example, the major mobile monitoring program currently sponsored by CEDRM is being conducted by Bongaerts, Kyyper & Huiswaard Consulting Engineers (BKH) of the Netherlands (which is providing financial assistance) along with two Chilean firms, Tessam-Hartley SA and Intec-Chile. Other major Chilean consulting/engineering firms that have been active in the environmental market include:

- Arze, Reciné y Asociados Ingenieros Consultores Ltda.
- Bakovic y Balic
- CADE-IDPE Ingeniería y Desarrollo de Proyectos Ltda.
- Cruz y Davila Ltda.
- ICC-Conic Consultores Ltda.
- Inecon Ingenieros Economistas y Consultores Ltda.
- Ingenieros Consultores Asociados Ltda.
- Victor Bogado Ingenieros Consultores Ltda.

While both equipment and engineering companies have capabilities and experience in the environmental market, many local firms are likely to be looking for partners. Leading companies are likely to be new entrants to the market rather than primary competitors.

## *Chile*

Because recent regulatory focus in Chile has been on air pollution, the water pollution market is far less defined. It could, however, total between \$400 million and \$500 million per year for the next several years because there is a critical need to improve the country's water and sewerage systems.

Water  
Pollution  
Control

Chile has more than 200 public sewerage systems that collect waste from about half of the population, but wastewater from the other half is discharged directly to rivers, lakes, and coastal waters. Most municipal and industrial wastewater is currently untreated. An outbreak of cholera in 1990 has made improvements in water sanitation a priority.

No detailed estimates on the water pollution market in Chile are available, as regulations are only now being developed, but the data available indicate that the market could exceed \$400 million per year. Estimates made for the International Finance Corporation (IFC) indicate that \$300 million to \$1 billion could be required for the Santiago area alone, depending on whether primary treatment (anaerobic lagoons) is sufficient or if additional treatment (activated sludge) is required.

The government estimates that as much as \$300 million will be needed between 1991 and 1994 for sewerage infrastructure and water treatment plants. Santiago's Empresa Metropolitana de Obras Sanitarias (EMOS) is planning a \$500-\$600 million project to treat all sewage by 1994. Four treatment plants are to be built over the next eight years at a cost of \$280 million. Initially, two sewerage pipelines will be constructed to carry untreated sewerage outside the city, eventually to be linked to sewerage treatment plants. The estimated cost of the pipelines is \$25 million.

In a similar effort, Empresa de Obras Sanitarias de Valparaiso SA (ESVAL) plans to invest \$175-200 million through 1997 to upgrade its sewerage system, improve and expand potable water sources, and increase water sanitation. ESVAL has already received some financing from the World Bank and Japan for this project.

In addition to launching major upgrades of municipal water and sewerage treatment facilities, Chile represents an increasing (but still modest) market for water treating chemicals. In 1991, for example, the municipal water treating market accounted for about \$10 million, while the industrial market totaled about \$20 million: \$10 million for boiler and cooling water applications and \$10 million for other applications.

The main buyers of water pollution controls will be the three main municipal agencies in charge of Chile's sanitation services: EMOS, ESVAL, and the Empresas Regionales de Obras Sanitarias. Private sector industries and large state-owned companies, such as

CODELCO, ENAMI, and ENAP, will also be likely customers for controls. In the private sector, the main water polluters are mining, fishmeal, and paper companies.

Several municipal agencies and industrial companies are actively exploring the use of bacteria to treat sewage. ESVAL, the municipal sewage and water department of Concepción (Empresa de Servicios Sanitarios del Bío Bío), and two major paper companies are investigating bacteria to treat urban and industrial sewage. One local firm, Novel Woods SA, is developing a bacterium (T-Enz) for such applications.

Because regulations are only beginning to emerge, the industrial water pollution market is largely undeveloped. Several firms have installed treatment plants, but significant further potential should exist in this area. Examples of recent projects include:

- Celinas Winter is installing a \$0.2 million primary wastewater treatment plant for a meat processing plant.
- Compañía Manufacturera de Papeles y Cartones S.A. (CMPG), a major pulp and paper company, is spending just over \$3 million for a wastewater treatment plant. The plant is being built in anticipation of regulations.
- Cellulose maker Licancel SA (a subsidiary of Attisholz AG of Switzerland) is building a \$1 million wastewater treatment plant to comply with regulations that are expected to be in place this year or next.
- Exxon Minerals and Coal's subsidiary Cía Minera Disputada de Las Condes is installing a \$4 million wastewater treatment plant to treat copper smelter effluent.

Other firms planning to install wastewater treatment facilities include Inforsa SA, a major cellulose company, which intends to install a primary wastewater treatment plant, and Nestles, which will spend more than \$12 million for secondary facilities at its seven Chilean plants.

### ***Major Opportunities***

Until specific regulations are issued, control requirements for industry and municipalities will remain uncertain. At a general level, it is clear that Chile will have a growing and continuing need for water and sewerage treatment in both its industrial and municipal sectors. Needs will also exist for drinking water purification.

## *Chile*

In addition to the major projects initiated by the main municipal agencies (e.g., EMOS, ESVAL), other significant water pollution projects are likely to emerge. For example, there is a need to clean up and sanitize the Canal El Morro in Talcahuano, one of the most contaminated water systems in the world. Initial efforts could require as much as \$20 million. Another example is a possible \$83 million IDB project to assist Chile in water management. The IDB is also funding a \$60 million project by the Empresa de Servicios Sanitarios de Atacama (Emsat), Atacama's regional water and sewage authority, to develop sewage systems and wastewater treatment plants for 10 municipalities in Northern Chile.

Most Chilean projects will be open to U.S. companies, but they often have some limits on foreign participation. Last year, for example, EMOS requested international bids for a water treatment plant to serve western Santiago. Foreign companies were mainly solicited for equipment bids only, while local firms were asked to handle the majority of the construction.

Studies by the DOC and IFC suggest that important opportunities should develop in industrial water pollution control. Major areas of need will be:

- water quality monitoring for paper, wood processing, and fish processing plants
- water filters for pulp and paper, fish processing, and mining operations
- water treating chemicals for pulp and paper, fish processing, and mining operations
- sludge processing equipment, mostly for mining facilities.

In addition, Chile offers opportunities for very specialized pollution controls as well as low-tech requirements. One industrial company, for example, is planning to use bacterial leaching for copper recovery and water treatment rather than face possible fines for acid mine drainage. At the other end of the spectrum, the major harbors involved in Chile's fish processing operations need systems to clean up the fish unloading operations at these ports.

### *Competition*

With activity in the water pollution market only beginning to develop, local competition will not be strong on the equipment side. Instead, Chilean firms are likely to be most active in planning, construction and engineering. A prime example of the type of

market opportunity in Chile is the city water plan developed for EMOS. A local engineering company, Cade-Idepc Ingenieros Consultores, along with Coyne et Bellier (France), developed the overall plan, while foreign firms, Degremont & Malmaison (France) and Hipp Engineering Ltd. (Canada), will mainly supply engineering services and equipment. The first plant to be built under the plan was designed by Tahal Consulting Engineers (Israel), while construction is being handled by the Chilean construction consortium Besalco-Arauco.

The most likely local competition in this market will come from larger contract engineering firms, such as Empresa Constructora Delta SA, Empresa Constructora Desco SA, and Empresa Constructora Hartley y Cía. Other local firms with capabilities include:

- |                          |                          |                          |                  |
|--------------------------|--------------------------|--------------------------|------------------|
| <input type="checkbox"/> | Aguas Industriales Ltda. | <input type="checkbox"/> | ANHSA Ingenieros |
| <input type="checkbox"/> | Arze, Recincé y Asocidos | <input type="checkbox"/> | Hauskoning       |
| <input type="checkbox"/> | Idreco Sudamericana      | <input type="checkbox"/> | Ipalle           |
| <input type="checkbox"/> | Kantek SA-Valle SA       | <input type="checkbox"/> | SK Ecologia      |
| <input type="checkbox"/> | Solano Vega & Associates | <input type="checkbox"/> | Wemin SA.        |

Some of these firms may want to partner with U.S. equipment suppliers to increase their technical know-how.

As with the air pollution market, international firms are likely to be the main competitors, capitalizing on attractive financing for large projects. In selected areas, Latin American companies may also be present. For example, Brazilian companies appear to be actively pursuing the wastewater treatment market.

Solid and hazardous wastes are the least established environmental markets in Chile, which has no toxic waste regulations. The current market is probably on the order of only \$10-2\$0 million per year, mostly involving landfills and solid waste disposal. Demand should grow rapidly, however, as regulations are developed in the next few years.

Solid and  
Hazardous  
Waste

Chile currently disposes of its solid waste in sanitary landfills. Municipal and industrial wastes are collected and disposed of in the same manner. There are yet no procedures for the control and disposal of hazardous and infectious waste from hospitals. The country also has no waste incinerator. In the industrial sector, some mining companies have tailing ponds or water recirculation to treat possibly hazardous discharge water, but may still discharge wastewater untreated into surrounding waterways.

## *Chile*

CEDRM has earmarked \$5-\$10 million to prepare new landfills, and has said that additional expenditures would be made in the future for hazardous waste treatment plants. Based on these plans, and assuming no changes in disposal methods, the market is probably no more than \$10-\$20 million per year.

### *Competition/Major Opportunities*

Chile does not have strong domestic capabilities in either solid or hazardous waste disposal. Technologies from foreign companies will be in demand, but subject to the development of future regulations.

In the near-term a major need is environmental services to help identify existing waste problems and solutions. CEDRM, for example, says that it has no idea how much waste is being generated and where it is being disposed. This problem is particularly acute for toxic waste.

Over the next few years, the most promising opportunities will be in solid waste treatment and disposal. Potential clients will include the major municipal sanitation authorities, pulp and paper companies, mining plants, and fish and wood processing facilities. As regulations are put in place, other opportunities are likely to emerge, including incinerators, hazardous waste treatment, and waste separation and recycling systems.

### *Market Entry Strategies*

In targeting Chile, U.S. firms will benefit from the fact that local professionals have often been trained in the United States and understand U.S. technology. Further, Chile has a fairly open economy and has historically had a strong preference for U.S. goods. The DOC suggests that the goodwill attached to the U.S. Environmental Protection Agency can be used as a marketing tool. A main impediment to business in the country may be the favorable financing and loan conditions offered by non-U.S. importing companies with the backing of their countries' export development agencies.

Three existing distribution channels can be used, depending on the type of equipment and size of the exporter:

- import houses/commission agents
- joint ventures/local subsidiaries or partners
- direct turnkey sales.

Import houses and commission agents may be best suited to smaller companies looking only to export one or two products; however, care must be taken, as these firms can represent several competing products. The DOC suggests that it may be advisable to work with smaller firms when a specific product becomes more important to the overall business. Established contacts with local environmental authorities would be an important qualification.

Joint ventures with local partners may be a preferred vehicle for first-time exporters to Chile. Many projects are being structured to include a significant local component, mostly construction and/or engineering. Depending on their initial successes, U.S. firms may then wish to establish local subsidiaries; however, while local representation or presence is important, there is no evidence that a subsidiary is necessary to compete in Chile.

Because Chile does not have a large local base of environmental technologies or capabilities, direct sales may be more successful here than in some other Latin American countries. The largest environmental projects are likely to be announced through international bids, particularly those involving multilateral financing (e.g., World Bank, IDB). This is likely to cover major sewerage infrastructure projects, as well as large air monitoring, water treatment, and solid waste projects.

Since local representation or presence is important, environmental consulting assistance can be a means to gain initial market access. With many pollution programs and projects only now being defined, it is the right time for U.S. companies to provide assistance in pollution assessment and monitoring. Other foreign countries have been quite active in providing such technical assistance.

After consulting or technical assistance, the most immediate markets are air pollution control followed by water pollution. Demand for solid and hazardous waste technologies will depend on regulations still to be developed.



## Colombia

While many Latin American countries were suffering economic crises in the 1980s, Colombia experienced average economic growth rates of 3.5 percent and diversified its productive capacity. This success is attributed to the government's prudent macroeconomic management policies, which have continued with the Gaviria administration's *apertura* program. Launched in late 1990 to enhance economic growth and modernize local industry, the *apertura* program has liberalized Colombia's markets. Colombia's GDP growth fell to 3.0 percent in 1991, however, as a result of guerilla violence, fiscal austerity measures implemented to control inflation, and low levels of private investment due to uncertainty over the short-term success of the *apertura* reforms.

### General Economic Indicators: Colombia

	1991	1992	1993
Population (millions)	32.4	33.1	33.8
Real GDP per Capita (\$)	1,471	1,486	1,500
Real GDP (\$ billion)	47.7	49.2	50.6
GDP Growth Rate	3.0%	3.0%	3.0%
Consumer Price Change, year-end	24.0%	20.0%	15.0%
Trade Balance (\$ billion)	1.6	1.2	1.0
Total External Debt (\$ Billion), year-end	18.1	19.2	20.3
Exchange Rate (Pesos/\$), year-end	670	770	840

Source: Bank of America, September 1991.

## *Colombia*

Exports continue to fuel Colombia's growth, and much progress has been made in diversifying exports away from coffee. Growth in the petroleum and mining sectors and other non-traditional exports helped compensate for the decline in world coffee prices. Reduced guerilla violence and increased confidence in the government's macroeconomic reforms should result in increased investment in 1992 and 1993.

### *Environmental Situation and Policy Framework*

Like other Latin American countries, Colombia is now suffering serious environmental problems as a result of decades of rapid urbanization and industrialization. Severe municipal and industrial pollution problems are threatening public health and economic growth in Colombia's major production centers.

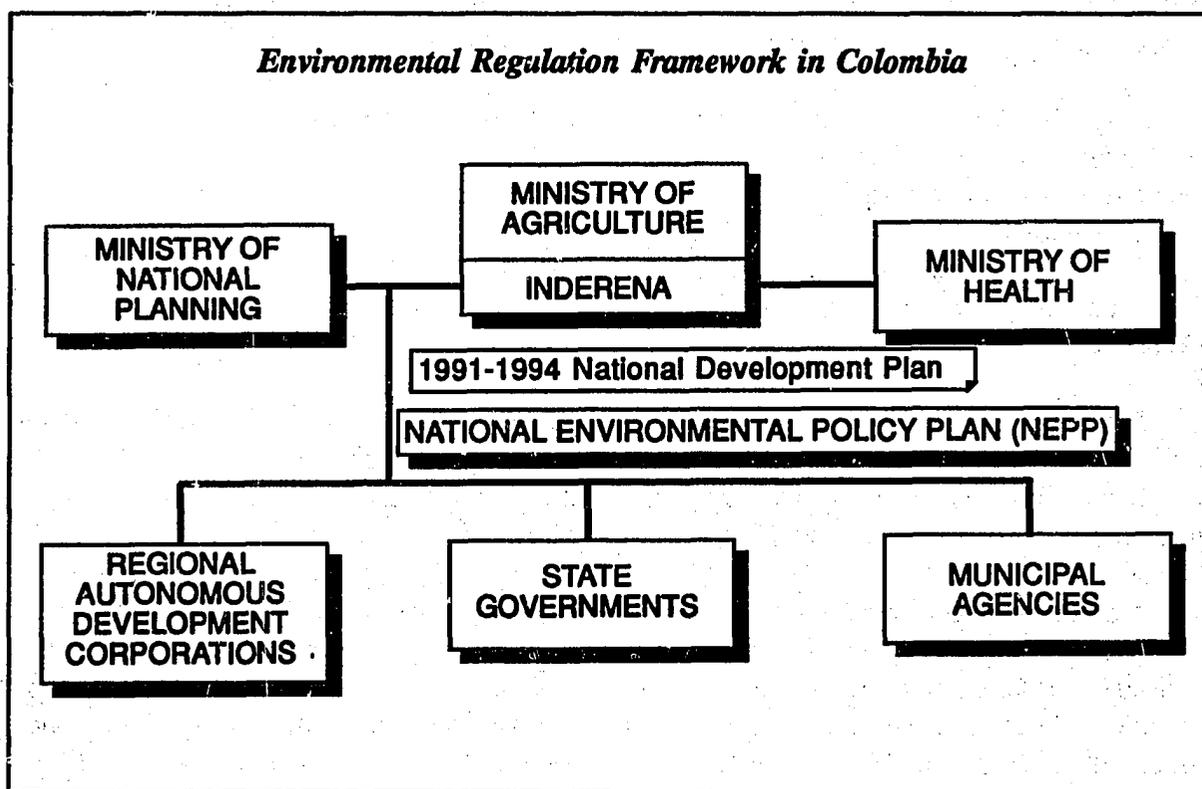
Over 60 percent of the Colombian population lives in urban areas. While municipal authorities are responsible for the provision of basic services, including water supply and the collection, treatment and disposal of waste, most cannot afford to keep investments in environmental infrastructure in line with urban and industrial growth. Water pollution in the Bogotá River, for example, is causing major public health problems, affecting agricultural output, and raising the cost of treating the water at the Tibitó plant which supplies the city of Bogotá. The most intensely used river in Colombia, the Río Bogotá receives untreated domestic and industrial waste from over 25 municipalities and the city of Bogotá itself. Bogotá is the largest city in Colombia, with a population of 6 million, and the highest concentration of industry in the country. Not only is the river completely dead downstream from the city but it also constitutes a major public health hazard.

Unlike most other Latin American countries, Colombia established a comprehensive framework of environmental regulation over two decades ago. The agency currently responsible for environmental protection, the Instituto Nacional de Recursos Naturales Renovables (Inderena), was created under the direction of the Agriculture Ministry in 1968.

In 1974, the National Code on Renewable Natural Resources and Environmental Protection was enacted. This law has been called the first all-inclusive environmental law in the world. Since its passage, responsibility for environmental management has been shared by Inderena, the Ministries of Health, Public Works, Defense, and Energy and National Planning; departmental (state) governments; numerous municipal agencies; and 18 regional autonomous development corporations.

Although they were originally created in the 1960s to promote economic and social development, the regional autonomous development corporations play an important role in

executing environmental programs. The Corporacion del Valle del Cauca (CVC), for example, launched a water pollution control program as early as 1969. CVC and the other regional development corporations now share major environmental management responsibilities with Inderena.



Inderena, however, has suffered from a lack of sufficient funding, legal authority and political support; the agency has thus had a difficult time enforcing both public and private sector polluters' compliance with Colombia's environmental laws. Enforcement has been complicated by conflicts and rivalries among the many agencies with environmental responsibilities and by the lack of coherence in national environmental policy.

The government has recently launched several major initiatives to improve environmental management and to make additional resources available for environmental

## *Colombia*

projects. For example, the Colombian legislative assembly recently rewrote the country's 105-year-old Constitution. The new Constitution, which came into effect in July 1992, contains what has been called the most comprehensive set of environmental legislation to be passed in Latin America. By strengthening administrative, political and planning decentralization, the new Constitution aims to create a solid framework for regional and local participation in environmental management. In July 1992, the Constitutional Court extended authority to enforce Colombia's new environmental laws to municipal officials. Now, local mayors, attorney generals, and health officials can fine and shut down industrial facilities in that violate national standards, without approval from Inderena.

Under the Direction of Colombia's National Planning Department, macroeconomic policy is executed by the relevant agencies in the National Planning System: the planning offices of the national ministries, regional development corporations, departmental (state) councils and planning offices, and municipal planning offices. A new National Development Plan has been developed for 1991-1994 which sets as a major goal the decentralization of political, economic and planning authority to the municipalities, as part of a new initiative called the "Pacific Revolution."

This new framework also provides the institutional foundation for the implementation of environmental policy. Through the new Constitution and the 1991-1994 National Development Plan, the Colombian government is attempting to integrate environmental management into economic and social planning at all levels.

One objective of the 1991-1994 Plan is improving environmental management and enforcement through the National Environmental Policy Plan (NEPP). The NEPP focuses on institutional reorganization, ecosystem management, environmental education and community participation, disaster prevention, economic dimensions of environmental management, and international cooperation. The NEPP targets four sectors for new environmental initiatives: agriculture, energy and mining, urban sanitation and waste management, and civil works.

A key component of the NEPP is redesigning the ineffective, decade-old water and air pollution tax system. According to a recent study by Inderena, not one air pollution tax and only a small number of water pollution taxes have been collected since the system was implemented. Inderena estimates that \$100 million in taxes should have been collected from 1984 to 1991 from industries polluting the Río Bogotá. The complexity of the process used to determine the level of taxes due and a lack of resources for enforcement are cited as the major reasons why the tax system was so weak. In addition to overhauling the tax system, the government plans to establish a system of tax credits, tradeable permits, and other market-based incentives to induce industries to use clean technologies.

In May 1992, President Gaviria introduced a bill to Congress proposing the creation of a Ministry of the Environment. The new Ministry would be responsible for national environmental policy, and the coordination of the autonomous regional development corporations and other agencies involved in environmental issues. The proposed legislation would also give the President and the new Minister of the Environment the power to implement penalties and incentives for industry to comply with national environmental regulations. In addition, an attorney general for the environment would be created to enforce penalties and prosecute violators. Finally, a National Environmental Council would be created to coordinate environmental management among the government ministries, and a National Environmental Fund would be established to finance environmental protection activities. Passage of this legislation may be held up, however, because of the administration's current lack of credibility with the Congress.

Under the proposed system, the autonomous regional development corporations would have primary responsibility for enforcing environmental regulation. These corporations will continue to be financed by state budgets. Although funding issues for the new ministry are not yet resolved, the government announced in October 1991 that the environmental budget for 1992 would be almost doubled from 0.3 percent to 0.55 percent of GDP, or from \$140 million to \$270 million. The National Planning Department expects that sources of funding for the budget increase will include fines on industrial polluters, and Inderena plans to publish a list of the worst polluting companies to bring public pressure on industrial polluters. The new system will also provide a mechanism for non-government organizations (NGOs) to have direct contacts with a new national state prosecutor's office in charge of environmental affairs.

The Colombian government is also attempting to deal with the sensitive topic of pollution control in the oil exploration and development industry. In July 1992, Inderena and the Secretary General of Colombia launched the Comisión Especial de Petróleo y Medio Ambiente (CEPMA) to coordinate national environmental policy initiatives affecting the industry and to keep an eye on the pollution control practices of oil companies. There are currently 7 local and 18 foreign oil companies operating in Colombia. CEPMA is composed of officials from Inderena, the Ministry of Health, the Attorney General, the National Planning Department, the Ministry of Mines and Energy, and the national oil company (Ecopetrol). It is hoped that the formation of the commission will help clear up existing

## *Colombia*

disputes between the government and a number of oil companies conducting exploration in the Cusiana oil field.<sup>1</sup>

With the help of the U.N. Development Program, Inderena and the National Planning Department launched the Program of International Technical Cooperation in July 1991. The program is being carried out in three major phases. During the first phase, Inderena reviewed and prioritized a list of over 600 proposals for environmental projects emanating from a number of government agencies and NGOs. Inderena presented the final list of 184 priority projects to the G7 at the April 1992 UNCED preparatory meetings in order to solicit international funding to match commitments from Colombian sources. A number of these projects focus on urban and industrial pollution control; if funding is secured, they could present major business opportunities for U.S. environmental companies. The second phase of the program will involve strengthening the capacity of government agencies and NGOs to implement the projects that receive adequate funding. The third phase entails decentralizing the program's execution under the direction of the future Ministry of the Environment.

While the government is currently seeking international funding for these projects, a number of bilateral agencies are already working on pollution assessment and control projects in Colombia. The German and Dutch development assistance organizations have been especially active in the air, water and solid waste sectors.

In addition to the national programs, a number of state and local agencies are implementing their own pollution control programs. The city of Bogotá, for example, recently launched its first effort at comprehensive environmental management. On June 30, 1992, the Bogotá Department for Environmental Management (DAMA) released the Plan de Gestión Ambiental (PGA), a management plan covering air and water pollution, waste disposal, polluting industries, and public lands in Bogotá. A major focus of the plan is to clean up the San Benito area, which contains 300 tanneries, the largest concentration of these plants in South America. Tannery operations in San Benito have caused major air and water pollution problems in the Tunjuelito River. Another aim of the program is to strengthen DAMA's authority to coordinate the environmental activities of the Bogotá Departments of Planning, Finance, Public Works, and Water and Sewage. In 1990, DAMA created a special fund for financing the PGA, in part through revenues collected from gasoline taxes and fines on polluting industries. In 1992, DAMA will spend \$1.2 million to execute the program.

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<sup>1</sup> In 1990, a potential 3-4 billion barrel reserve was discovered at Cusiana in the state of Casanare. A number of international oil companies are conducting exploration operations at Cusiana 2 in eastern Casanare. The Cusiana discovery could ensure Colombia's self-sufficiency in oil until 2010.

Last, several examples can be cited in which Colombian industry has taken initiative to deal with environmental issues in anticipation of the more stringent enforcement of pollution standards in the future. During its annual assembly in November 1991, the Colombian National Association of Industrialists (ANDI) issued a policy report stating that Colombian industry should use "clean" technologies imported from industrialized countries in order to achieve higher production while using less energy and non-renewable resources. ANDI also announced that it was setting up an environmental office to advise on the establishment of environmental norms and act as a spokesman for Colombian industry on environmental issues.

Current levels of public pressure to deal with the country's severe pollution problems help to maintain the momentum the government has developed in the area of environmental reform. Because the regulatory framework in Colombia allows for significant public input in environmental management, environmental NGOs have been able to exert considerable pressure on the government, especially in the months surrounding the UNCED Conference. Furthermore, the new Constitution contains strong environmental provisions, including an article on collective rights that gives citizens and the state the right to sue private property owners for environmental damage or to order public appropriation of that property.

### ***Outlook for the Environmental Market***

Several key economic, demographic, political, and regulatory trends in Colombia are currently driving the growing demand for environmental technologies and services: severe pollution, environmental initiatives, public pressure, and the opening of Colombian markets. All of these factors will contribute to the growing demand for air, water, solid and hazardous waste treatment equipment and services.

The overall market for pollution control in Colombia should be around \$40 million in 1992, or about 20 percent higher than in 1990 or 1991. Most of the investments in this market will be made in air (\$19 million) and water (\$15 million) pollution control equipment. The combined solid and hazardous waste markets should not exceed \$10 million.

## Colombia

### Key Environmental Market Drivers

Market drivers	Impact
Severe pollution problems caused by urbanization and industrialization	Drives demand for urban and industrial environmental infrastructure projects and waste recycling systems
Major national environmental initiatives	Makes greater resources available to state and local authorities for environmental projects and forces industry to become more environmentally sensitive
Public pressure on the government to deal with environmental problems	Ensures government commitment to improving enforcement, continuing new programs, and providing financing for environmental activities
<i>Apertura</i> program of market liberalization	Creates more favorable climate for importing environmental goods and services and for investing in environmental activities

### Colombian Environmental Market (\$ million)

	1990	1991	1992	1993-1995 (est.)
Air Pollution Control	15	16	19	20-22
Water Pollution	18	16	15	16-18
Solid/Hazardous Pollution	na	na	5-10	10-20
Total	33	32	39-44	46-60

Source: Adapted from U.S. Department of Commerce data.

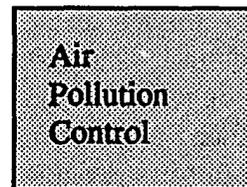
Imports dominate the Colombian pollution control market, with import market shares reaching around 78 percent in 1992. The United States alone has held more than 40 percent of this market over the past few years. The DOC estimates that the U.S. share will continue to grow at a rate of 6 percent over the next three years. This trend will be enhanced by President Gaviria's *apertura* program of market liberalization. *Apertura* reforms have opened Colombia's economy to foreign trade through comprehensive investment, tax, trade,

financial, foreign exchange and labor reforms. In addition, it has significantly lowered import barriers and created a more favorable business climate for U.S. companies.

### ***Environmental Market Opportunities and Competition***

The Colombian pollution control market totalled \$32 million in 1991 and is expected to grow to around \$40 million in 1992. Further growth is anticipated and market demand could range between \$46 million and \$60 million in 1993-1994. Project opportunities exist in air and water pollution control projects for regional development corporations, municipal authorities, and industrial facilities in the major cities (Bogotá, Medellín, Cali). Business opportunities in the solid and hazardous waste markets are less clearly defined.

The total air pollution control market in Colombia was around \$16 million in 1991. According to U.S. Department of Commerce (DOC) projections, this market should reach about \$19 million in 1992. Over 80 percent of this market will consist of imports. The major sources of air pollution in Colombia are fossil fuel-fired power plants, cement factories, iron and steel mills, and the chemicals industry. Mobile sources are another important source in the big cities of Bogotá, Cali and Medellín.



Products with the best sales potential include electrostatic precipitators for coal-fired power plants, cement factories, and iron and steel mills. The DOC reports that sales to private industrial facilities account for 65 percent of the market, with the balance involving orders placed by state-owned industries.

The framework for air pollution regulation in Colombia was set forth in the Comprehensive Environmental Law of 1979. The air pollution provisions in this general law were subsequently reinforced by Decree 2 of 1982, which sets maximum permissible levels of SO<sub>x</sub>, NO<sub>x</sub>, and other air pollutants from fixed sources. Resolution 3002 of 1991 establishes emission standards for mobile sources, but a national institutional structure for enforcing these regulations does not yet exist.

Under the current structure, the Ministry of Health retains responsibility for implementing fixed-source air and water pollution control regulations and enforces them through its regional branches, with the assistance of state and municipal agencies. Under the new national environmental policy initiatives, the regional development corporations will cooperate more closely with the Ministry of Health on air pollution issues. While

## Colombia

government determination to enforce air regulations has been weak, the Ministry of Health does manage a network of around 50 monitoring stations throughout the country and has negotiated with a number of large industrial facilities to study their air and water emissions.

It appears that the government is cracking down on industries in the major cities. In 1991, as part of the newly elected Mayor Caicedo's environmental campaign, the Department of Health temporarily closed over 47 factories, ordering them to install improved chimneys, furnaces, boilers, and filters and to convert to cleaner fuels. Several facilities, including the municipal asphalt plant run by the Department of Public Works, were shut down. The asphalt plant, one of the largest in the country, was closed for lead and sulfur emissions. Plans for a new \$1.4 million asphalt plant to be built in a Bogotá suburb could include significant investments in filters and other air emissions control equipment. The Colombian State Prosecutor's Office issued a warning in March 1992 to 50 companies in Bogotá that were in violation of clean air standards. In April, the Bogotá Department of Environmental Sanitation shut down four brick factories<sup>2</sup> and a lead recycling facility for failing to heed this warning by installing proper filters and following recommendation to replace coal with cleaner fuels.

Project opportunities may also exist in air pollution control for Colombian power plants. Assuming that Colombia adopts emissions standards comparable to those in the United States and similar control costs for SO<sub>x</sub>, NO<sub>x</sub>, and particulates, Colombian electric utilities could require a \$170-\$340 million investment in air pollution control before 2002, or the equivalent of \$17-34 million per year just to equip existing plants. In addition, the Ministry of Mines and Energy plans to add 600 MW of coal-fired steam plants by 1999. Besides retrofitting existing fossil fuel-fired facilities, opportunities may exist in fitting these

### *Major Buyers of Air Pollution Equipment and Services in Colombia*

State-owned industries (oil and gas, fertilizer, power generation, coal, asphalt, petrochemicals)	35%
Cement	18%
Chemicals	14%
Iron and Steel	11%
Brick and Tile	9%
Textiles	7%
Pulp and Paper	4%
Other	2%

Source: U.S. Department of Commerce.

<sup>2</sup> Around 30% of air pollution in Bogotá comes from brick, concrete and asphalt factories.

new plants with electrostatic filters and other air pollution controls. The size of the air pollution control market for electric utilities will depend heavily on the level of regulation and the degree to which the 31 Colombian electric utilities are in compliance. The government may decide, however, not to pressure the utilities to comply with strict air standards in the near future because most of them are in poor financial shape. In addition, lighter rains than usual have resulted in lower hydroelectric power production and caused a major power shortage in Colombia; the government is therefore depending on fossil fuel-fired plants to operate at full capacity.

*Existing and Projected Utility Generating Capacity in Colombia (MW)*

	1989	%	1999	%	Net Additions
Hydroelectric	6,656	75	9,082	77	2,426
Oil/Diesel	567	6	567	5	0
Gas/Combustion Turbine	880	10	880	7	0
Coal	726	9	1,326	11	600
Total	8,829	100	11,855	100	3,026

Source: U.S. Agency for International Development.

*Major Opportunities*

- Emission Control Equipment for New Vehicles in Bogotá**

The Bogotá Department of Health issued a new regulation that requires producers of new gas-fired vehicles to install evaporative emission canisters for burning fuel tank and carburetor emissions by 1994. The installation of such equipment on older cars is determined according to a sliding scale of allowable emissions. The Health Department and Traffic Department will license private garages and workshops to install the filters, and enforcement will be financed through a tax on gasoline sales. The regulation will not be implemented before September 1992 because DAMA is still trying to figure out what type of filters can be installed that can handle the high sulfur content in Colombian gasoline. Catalytic converters will be promoted if Ecopetrol goes ahead with plans to produce low-sulfur gas this year. The regulation was issued

## Colombia

after a \$4 million Japanese Government study determined that 70 percent of air pollution in Bogotá emanated from mobile sources.

Particulate Controls for Bogotá

Under the Plan de Gestion Ambiental for Bogotá, the Secretaría de Salud del Distrito (the municipal branch of the Ministry of Health) will soon require all public and private industrial facilities located in the city to install dust collection systems.

Particulate Controls for Industrial Facilities

As part of a local pollution control initiative, steel, iron, cement, asphalt, and paper factories in Sogamoso are gearing up to install air filters (see description above).

### Competition

Despite the fact that high import tariffs and licensing requirements kept the Colombian market relatively closed to foreign firms before the *apertura* program was implemented, the United States maintained a 49 percent average annual share of the Colombian air pollution control market in the period 1981-1987, according to the U.S. Department of Commerce. The DOC also found that the U.S. share of the market averaged 50-55 percent from 1988-90, while domestic production averaged only 17 percent. This dominance of U.S. suppliers is attributed to a preference among Colombian buyers for U.S. equipment and brand names. Local production is focused mostly on mobile source air filters, filters for industrial machinery and dust masks. U.S. companies prominent in the Colombian market include American Air Filter, Cambridge, Farr and Koch. Most foreign producers sell through local representatives or distributors.

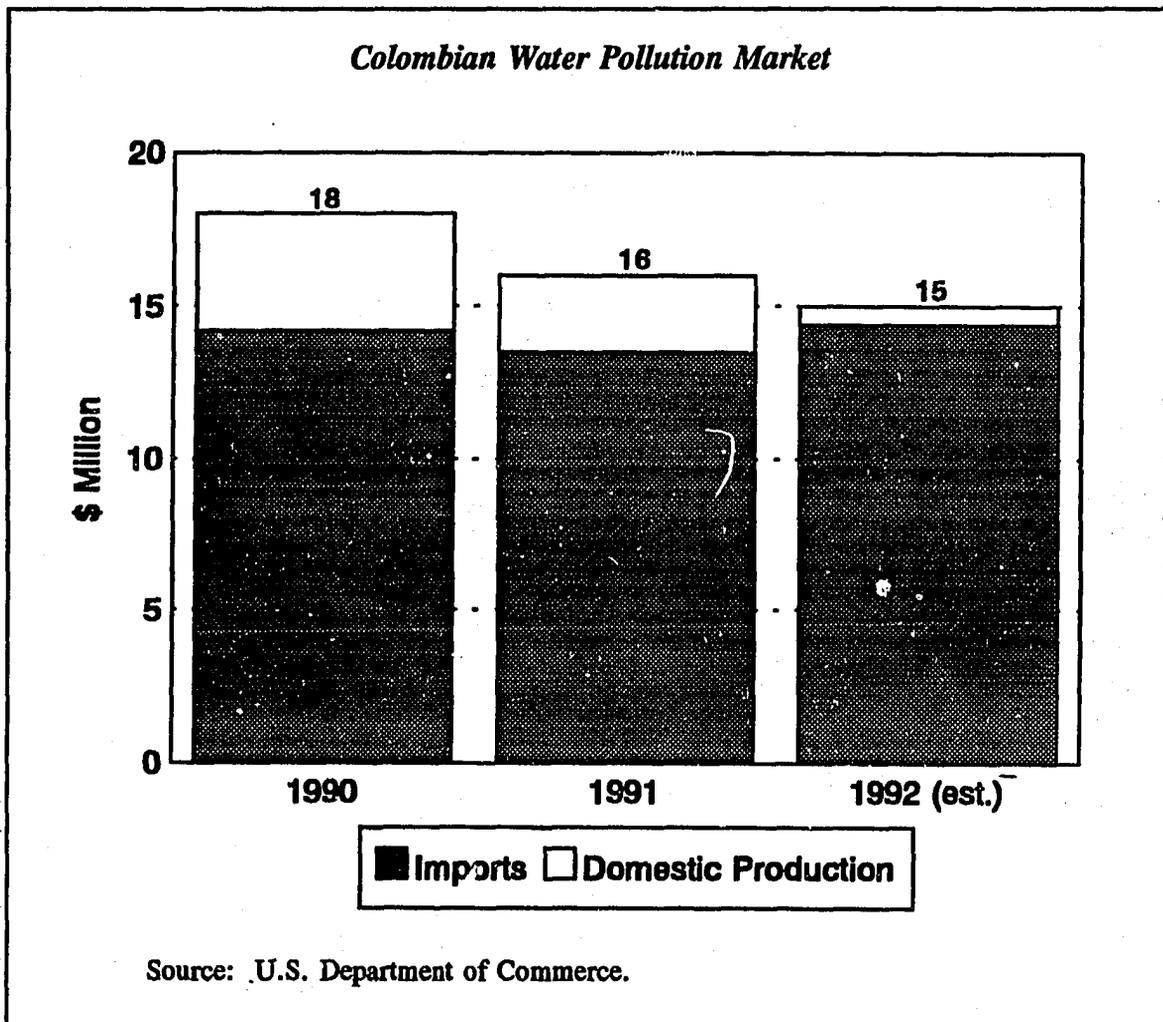
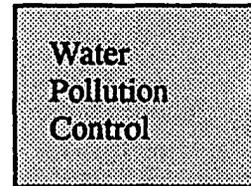
**Colombian Air Pollution Market:  
Average Annual Shares  
1981-1987**

United States	49%
Domestic Production	17%
France	13%
West Germany	7%
Japan	6%
Italy	5%
Other	3%

Source: U.S. Department of Commerce.

Colombia

According to the DOC, the total market for water pollution equipment and services in Colombia averaged \$16-\$18 million in 1990-1991 and is expected to be about \$15 million in 1992 (Exhibit 5.7), according to the DOC. The categories of water pollution equipment imports with the best sales records in Colombia include water pressure-reducing, gate, check and relief valves; water pumps; water meters and leak detection instruments; and chloride and chemical feeders.



## *Colombia*

The DOC further projects 5 percent annual growth in the Colombian water pollution control market in 1992-1994. The most promising business opportunities exist with regional water and sewage companies. Colombian water and sewage companies are typically independent public corporations serving a number of municipalities within a particular watershed. The largest of these include the Regional Autonomous Corporation for the Protection of the Bogotá, Ubaté and Suárez Watersheds (CAR), the Water and Sewage Company of Bogotá (EAAB), the Medellín Public Works Company (EPPM), and the Valle del Cauca Water and Sewage Company (ACUAVALLE). These public corporations fall under the direction of the National Planning Department and are all linked with the 35-year-old Colombian Society for Sanitary and Environmental Engineering (ACODAL). ACODAL groups all public and private sector agencies dealing with water pollution control in Colombia. ACODAL's Drinking Water Development and Basic Pollution Control Plan for Colombia 1991-2000 estimates that \$1.5 billion is needed to complete the various water supply and treatment plans drawn up by these agencies. If funding is secured for these projects, this could translate into an average demand of \$150 million per year for potential water supply and treatment projects over the next 10 years.

The market for industrial wastewater treatment equipment and services is not as well-defined. The city of Bogotá, for example, has no program for monitoring and controlling industrial effluents; DAMA is currently in the beginning stages of designing an industrial wastewater control strategy. The overhaul of the national water pollution tax system may, however, drive the demand from industrial customers for wastewater treatment equipment and services. Under the Program for International Cooperation in the Environment, Inderena is seeking external assistance to begin preliminary research for a National Environmental Quality Network. Several activities under the proposed program may present business opportunities for U.S. water quality analysis and monitoring companies. Potential opportunities exist to perform chemical and microbiological analysis of the most polluted watersheds in Colombia, construct sampling stations in these basins to monitor water quality, and draft proposals for the design of a national network of water quality monitoring stations and laboratories.

### *Major Opportunities*

- |   |   |
|---|---|
| <input type="checkbox"/> Water Pollution Control for the Río Bogotá | EAAB and the World Bank are currently preparing an action plan to execute the \$500 million Pollution Abatement and Sanitation Project for the Río Bogotá. If approved, the project would involve procuring equipment and consulting services for major wastewater treatment systems. |
|---|---|

- Wastewater Treatment Plants for the CAR**

The CAR is currently implementing the five-year, \$76 million Upper Bogotá River Environmental Rehabilitation Program. The Inter-American Development Bank is providing \$50 million in financing for the program, a substantial portion of which will be invested in wastewater treatment plants and training programs in water quality monitoring. The program includes plans for the construction of 23 wastewater treatment plants to serve 21 municipalities on the Upper Bogotá. According to the Inter-American Development Bank, the investment allocation for this program over the 1990-1995 period is: wastewater treatment systems - \$27.9 million, irrigation and swamp management - \$14.0 million, soil protection and forestation - \$5.7 million, natural resource management studies - \$2.1 million, and sanitary landfills - \$1.4 million.
  
- Wastewater Treatment for the Villapinzón Tannery Industry**

Another important component of the CAR's Upper Bogotá Rehabilitation Program involves the construction of a plant to treat waste in Villapinzón. The plan is to treat wastewater from the wet, tanning, and chrome stages of the tanning process. These tanning stages wastewater will be combined with domestic effluent and sent to a plant with 63 liter/capacity.
  
- Pretreatment for Slaughterhouse Waste in CAR's Jurisdiction**

In several municipalities on the Upper Bogotá, slaughterhouse effluent can account for up to 40 percent of the total volume of wastewater discharged into the river. In 1987, CAR launched a special program to construct pretreatment systems for slaughterhouses in 21 municipalities under its jurisdiction. The Upper Bogotá Rehabilitation Program builds on this initiative with plans to construct slaughterhouse pretreatment systems in nine more municipalities. Feasibility studies for these systems have already been completed.
  
- Wastewater Treatment Plants in Medellín**

The Instituto para el Manejo Integral del Río Medellín y Sus Afluentes was recently established by the federal government in order to implement a 20-year, \$440 million program to clean up the Medellín River. The first phase of the project involves the construction of a \$45-million wastewater treatment plant in San Fernando and a \$120 million plant in Bello. Funding for the project has not been fully

## Colombia

secured yet; around \$2.6 million has been donated by the municipal water and sewage company of Medellín (Empresa Pública de Medellín-EPM). It is expected that 5 percent of Colombia's 12 percent sales tax will go towards financing the project.

Wastewater Treatment Plants in Sogamoso

The Sogamoso Public Service Company (Boyacá state) recently announced plans to construct new municipal wastewater treatment plants. The announcement came as part of the public-private sector environmental cleanup initiative launched in June 1992 (see description above).

Wastewater Treatment for Industrial Facilities in Itagüí

Industrial facilities in the city of Itagüí (Antioquia state) are currently being held responsible for a series of sewer explosions in June 1992. A citizens committee has been formed to put pressure on the mayor to force local industries to treat their waste before it is discharged to the municipal sewer.

### Competition

Foreign suppliers have dominated the Colombian water pollution control market over the past several years. In 1991, imports accounted for 89 percent of the total market for water pollution control equipment and services. Of the import total, U.S. products and services accounted for 48 percent. Local production is concentrated on a limited number of products including cast iron water pumps, automatic control valves, flocculators, chloride feeders, and filter beds. In addition, most local companies prominent in the market build wastewater treatment plants. The DOC names Tecniaguas, Jorge Triana & Compañia, and Acuatecnica Limitada as the most important local players.

#### *Water Pollution Market Share in Colombia (1991)*

United States	48%
West Germany	17%
Italy	9%
Brazil	7%
Other	19%

Source: U.S. Department of Commerce.

Good data on the market for solid and hazardous waste treatment are not available for Colombia. It is likely, however, that this market will not exceed \$10 million per year until stricter regulations are developed and new sources of funding are secured for existing projects.

Solid and  
Hazardous  
Waste

Inderena reports that 14,320 tons of solid waste were produced daily throughout the country in 1987. Of this total, only around 32 percent was disposed of in sanitary landfills; the rest was dumped in unregulated sites and rivers, or buried. Another study of recycling in Colombia reported that 42 percent of the total volume of solid waste is recyclable. Glass, paper and cardboard comprise the largest percentage of the recyclable waste. In 1987, only 9 percent of Colombian solid waste was actually recycled. Although the public health and environmental problems caused by unregulated disposal are becoming acute, solid waste regulations are just emerging. In Bogotá, where 5,200 tons of solid waste are produced daily, DAMA and the Empresa Distrital de Servicios Públicos (EDIS) are only now drafting a master plan for solid waste management in the city and surrounding areas.

According to Inderena, few data exist on the volume and disposal of hazardous waste in Colombia. A study of the city of Bogotá estimates that 100 tons of hazardous waste are produced there daily; of this, 50 tons are recycled, while the remainder is dumped indiscriminately. Although the new Constitution requires that toxic substances be properly treated and disposed of, there is a lack of regulated landfills for hazardous waste and little enforcement of existing regulations. The city of Bogotá has no system for managing toxic waste.

A few small steps have been taken by the government in recent months, however. The Ministry of Health recently established the Division of Potentially Toxic Substances to manage hazardous waste programs. In addition, the Corporacion Autónoma Regional para la Sabana de Bogotá plans to conduct a survey of hazardous waste generated in Colombia, while EDIS and the local Ministry of Health office plan to design a TSD program for toxic waste in Bogotá. Besides these efforts by government agencies, several groups of private industries have taken steps to improve hazardous waste management and disposal in their own facilities. A good example is the group of fertilizer companies in Barranquilla, which developed its own "responsible management" program.

## Colombia

### Major Opportunities

- Sanitary Landfills for the CAR**

As part of the Upper Bogotá River Environmental Rehabilitation Program (see "Water Pollution Control Market"), the CAR is planning the construction of sanitary landfills for solid waste in 25 municipalities along the Upper Bogotá. Feasibility studies and site selection for 25 landfills have already been completed. Opportunities may exist for U.S. companies in the collection, transport and compacting of waste for these facilities.
  
- Consulting Services for EDIS**

Bogotá's solid waste management company is currently developing the Plan General de Reciclaje para Bogotá. Opportunities may exist for consulting firms to assist EDIS in carrying out this program, including waste characterization studies, the design of market-based incentives for recycling, and the dissemination of information on appropriate recycling technologies.
  
- Municipal Solid Waste Disposal Equipment for IDB Project**

The Colombian Development Bank FINDETER and the IDB are discussing a potential \$67 million Program for Urban Development. The program would include a global credit facility for financing municipal solid waste disposal and sewerage projects, and would involve the procurement of the necessary equipment and services to execute these projects.
  
- Hazardous Waste Landfill and Incinerators for Bogotá**

Bogotá's municipal solid waste management company, the Empresa Distrital de Servicios Públicos (EDIS), plans to contract with a private firm to build a high-security landfill to handle solid and hazardous waste from the city of Bogotá. In addition to this opportunity, DAMA is seeking external assistance to support a \$3 million, two-year pilot hazardous waste disposal project for hospital, slaughterhouse and tannery waste in the city of Bogotá. If funding does come through, immediate opportunities will exist in designing a hazardous waste collection plan; long-term opportunities could include selecting appropriate disposal sites and constructing pilot incinerators.

- Design of a Hazardous Industrial Waste Management Strategy for CVC      CVC, the regional autonomous development corporation of the Cauca watershed (which serves the city of Cali), is currently seeking international funding for a five-year program to develop a technical information system for managing industrial hazardous waste, to train people for TSD activities, and to develop a technical and legal program to encourage the recycling of industrial hazardous waste.
  
- Hazardous Waste Treatment Facilities for Sogamoso      Under the Sogamoso cleanup initiative, a number of local iron smelting companies and family-operated utensils and ceramics operations are working with engineers from the University of Tunja on plans to install toxic waste treatment plants (see description above).

### ***Market Entry Strategies***

U.S. companies seeking to do business in Colombian pollution control markets will benefit significantly from the well-established reputation of American equipment and services. There are a number of important factors to consider when entering the Colombian market, however:

- Bidding on public sector contracts***

Decree 222 of 1983 covers contracting with official entities and dependencies. First, this decree gives preferential consideration to Colombian bidders. Second, it requires foreign bidders on a government contract to establish legal representation in Colombia. Third, foreign bidders are obligated to associate themselves with Colombian companies for at least 40 percent of the contract value. This can be accomplished through joint filing of the bid, or by subcontracting local companies or individuals. It is expected that these requirements will be revised under the *apertura* program; it is therefore important to keep a close watch on the new regulations coming out of the Colombian Congress.

- Partnering with Colombian companies***

Because of the above requirements, most foreign companies currently active in Colombia work through a local distributor or representative.

## ***Colombia***

### ***Maintaining cost-competitiveness in the Colombian market***

**In most cases, unsubsidized foreign environmental equipment and services are not price-competitive in the Colombian market. Import tariffs on finished equipment are still higher than tariffs on components. Local assembly and distribution operations can lower production and transportation costs significantly and help U.S. companies remain cost-competitive vis-a-vis local, or European and Japanese companies.**



## *Mexico*

President Salinas's market liberalization program has created extremely positive trends in Mexico's leading economic indicators. In 1991, Mexico's GDP of \$224 billion was among the highest in Latin America, second only to that of Brazil. The GDP is expected to grow by 4.5 percent and 5.0 percent in 1992 and 1993, respectively.

Trade liberalization, subsidy reduction, an extensive privatization program, the removal of foreign exchange controls, incentives for foreign investment, and debt reduction have all boosted investor confidence in Mexico. This trend is reflected in the return of around \$5 billion in flight capital over the last three years, and the increase in total foreign investment from \$500 million in 1985 to nearly \$7.2 billion in 1991.

### *General Economic Indicators: Mexico*

	1991	1992	1993
Population (millions)	87.5	89.2	90.8
Real GDP per Capita (\$)	2,558	2,624	2,704
Real GDP (\$ billion)	224	234	246
GDP Growth Rate	4.5%	4.5%	5.0%
Consumer Price Change, year-end	17.0%	12.0%	12.0%
Trade Balance (\$ billion)	-7.7	-9.0	-9.2
Total External Debt (\$ billion), year-end	105	115	123
Exchange Rate (Pesos/\$), year-end	3,090	3,300	3,520

Source: Bank of America, September 1991.

## *Mexico*

The prospects of a North American Free Trade Agreement (NAFTA) with the United States and Canada provide another important stimulus to private investment in Mexico. New investments, combined with favorable trade conditions, have created significant opportunities for foreign companies. Subsidy reductions, the privatization of parastatals, and other market liberalizations will further promote more realistic pricing policies for resources and services, and thus create more favorable conditions for contracting services to private companies.

### *Environmental Situation and Policy Framework*

Pressures from growing urban populations and increasing numbers of industrial facilities have strained Mexico's environmental infrastructure to the limit. Over 70 percent of the Mexican population of 89 million live in urban areas, and almost half of the total labor force lives in the three largest cities of Mexico City, Guadalajara, and Monterrey. Urban population pressures in these cities have increased the demand for already-scarce clean water, and produced massive volumes of residential wastewater and solid waste. In addition, almost one-fourth of Mexican industry is concentrated in these three cities. Most industrial facilities in Mexico City, Guadalajara and Monterrey belong to the highly polluting industries that dominate the Mexican economy: petroleum, metals, chemicals, sugar, pulp and paper, textiles, food processing, automobile parts, and cement.

The framework of environmental regulation in Mexico is set forth in the 1988 General Ecology Law, which granted authority to the Ministry of Urban Development and Ecology (SEDUE) to develop and enforce national regulatory schemes (*reglamentos*) and technical environmental standards (NTEs). Since 1988, the federal government has enacted five major *reglamentos* and over 59 NTEs governing a range of air, water, solid, and hazardous wastes. The development of the Mexican environmental protection regime involved much cooperation between the U.S. EPA and SEDUE; as a result, many Mexican standards and U.S. regulations are similar. In many cases, however, the Mexican regulations are as or more strict than their counterpart U.S. regulations.

In addition to the federal laws, 28 of the 31 Mexican states have enacted their own environmental laws, although no state has yet passed its own technical standards. As in the United States, state and municipal governments are responsible for enforcing compliance with federal regulations within their jurisdiction.

*Framework of Environmental Regulation in Mexico*

**GENERAL ECOLOGY LAW OF 1988**

- Sets criteria for developing specific regulatory regimes (*Reglamentos*)
- Gives SEDUE authority to develop environmental programs through *reglamentos* and technical ecological standards

**REGLAMENTOS (5)**

- Environmental Impact Assessment
- Air Pollution (national)
- Air Pollution (Mexico City)
- Hazardous Wastes
- Water Pollution (drafted)

**TECHNICAL ECOLOGICAL STANDARDS (NTEs)**

- Numerical limits that implement the General Ecology Law and *reglamentos*
- Each standard developed after close examination of U.S. standards and Mexico
- Department of Health statistics > 59 NTEs to date

**STATE ENVIRONMENTAL STATUTES**

- 28 of 31 Mexican states and the Federal District have adopted state laws
- Federal statutes provide minimum standards; state laws must be stricter

## *Mexico*

SEDUE was dissolved in early 1992 and its responsibilities turned over to the newly created Ministry of Social Development (SEDESO). SEDESO comprises three sub-secretariats: Urban Development and Infrastructure, Regional Development, and Housing and Fixed Resources. SEDESO works with key federal agencies to implement the national environmental regulations. The Comision Nacional de Ecologia (CONADE) was created by the General Ecology Law to improve coordination between federal, state and municipal agencies. Now under SEDESO's jurisdiction, CONADE studies priority environmental issues and proposes programs to address them.

On the regional level, SEDESO cooperates with state and municipal agencies to enforce environmental regulations. Responsibility for pollution control activities in Mexico City, for example, is shared among SEDESO, the Departamento del Distrito Federal (DDF) which governs the Federal District, and the Government of the State of Mexico. The state governments of Queretaro and Nuevo Leon are among the most advanced in terms of having well-established environmental agencies. Previously, SEDUE maintained a representative in each state, who had the responsibility of inspecting industrial facilities and monitoring water and air quality. It is not clear at this time whether SEDESO will operate along the same lines.

Increasing public pressure has compelled the Mexican government to implement several highly visible environmental initiatives in recent years. In 1989, SEDUE launched the National Program for the Protection of the Environment (1990-1994), a four-year strategy to reduce air, water, solid waste, and noise pollution in the largest urban areas. In Mexico City, the government recently issued two major ultimatums: industrial facilities have until September 1992 to initiate plans to install recycling equipment for their wastewater discharges, and until next spring to clean up their air emissions or be forced out of the city.

While compliance with environmental regulations has traditionally been weak in Mexico, the Salinas Administration has recently taken steps to improve the enforcement capacity of federal and state agencies by increasing the number of federal inspectors and decentralizing authority to state regulatory bodies. Highly publicized factory closures in Mexico City and other major cities have also contributed to increased compliance with the new regulations.

For those industries that SEDESO identifies as violating national pollution regulations, the penalty ranges from complete to partial or temporary plant closure. Plant closures are intended to force serious negotiations between SEDESO and the violating company, with reopening permitted only after a compliance agreement and timetable are worked out. While SEDESO periodically fines violators up to \$80,000 per violation, the agency typically resorts to plant closures because of the difficulty involved in administering and collecting the fines.

Between 1989 and 1991, SEDESO (then SEDUE) forced the closure of some 900 factories. The Mexican periodical *El Nacional* reported that as of October 1991, SEDUE had closed 1,686 plants and concluded 1,239 agreements with industrial facilities. Environmentalists in the United States and Mexico charge that SEDESO often allows closed plants to reopen a few days later without requiring any compliance. Nevertheless, the closures have driven the managers of some facilities, especially those in Mexico City, to initiate their own plans to install pollution control equipment. Given the economic and enforcement problems of plant closures, however, a policy relying more heavily on penalties than closures may be re-instituted in the future.

In April 1992, a \$126 million program was launched to strengthen the environmental management and capacity of the central government while decentralizing enforcement authority to key state and municipal agencies. The project is being financed by an \$80 million World Bank loan and a \$46 million contribution from the Mexican government. In addition to the institutional strengthening components of the program, nearly \$40 million will go to air and water pollution control and monitoring projects. The program also will finance the technical studies necessary to prepare over 100 new NTEs in the air, water, solid and hazardous waste sectors.

Last, much public attention in both Mexico and the United States has been focused on the severe environmental problems along the border. To address these, EPA and SEDESO are implementing the Integrated Environmental Plan for the Mexico-U.S. Border Area, which outlines a bilateral strategy to protect trans-boundary environmental resources, expand the financing of environmental protection, mobilize private sector support, and cooperate in regulatory enforcement. Continued pressure from citizens' groups and other non-governmental organizations will ensure the Salinas Administration's commitment to improving enforcement, continuing new initiatives, and financing environmental activities.

### ***Outlook for the Environmental Market***

The size of the Mexican environmental market is expected to increase nearly four-fold during the 1990s. Four key drivers create a favorable market in Mexico for U.S. environmental technology imports. As discussed earlier, these are: continued market liberalizations, which will increase private sector investment; rapid urbanization and industrialization, which fuel the rapidly growing demand for environmental technology in Mexico; the recent efforts of the Mexican government to enforce stringent new environmental standards; and public pressure on the government to improve living conditions in Mexico's major cities.

## *Mexico*

### *Key Environmental Market Drivers*

<b>Key market drivers</b>	<b>Impact</b>
Market liberalization and increased private sector investment	Favors more realistic pricing for environmental services; industry has more resources to invest in pollution control
Severe pollution problems caused by urbanization and industrialization	Drives demand for large-scale urban environmental infrastructure projects and waste recycling systems
Improved enforcement of strict environmental regulations	Increases immediate demand for industrial waste treatment equipment
Public pressures on the government to deal with environmental problems in major cities	Raises incentive for highly visible pollution control initiatives; ensures government commitment to improving enforcement, continuing new programs, and financing environmental activities

As a result of these market drivers, some of the best international business opportunities for U.S. environmental equipment manufacturers and services providers lie in the air, water, solid and hazardous pollution control sectors of Mexico. According to the U.S. Department of Commerce (DOC), these markets should total more than \$610 million in 1992.

### *Mexican Environmental Market (\$ million)*

	1990	1991	1992 (est.)	1993-1995 (est.)
Air Pollution	78	90	104	119-157
Water Pollution	105	126	400	500-780
Solid/Hazardous Waste	83	95	110	127-167
<b>Total</b>	<b>266</b>	<b>311</b>	<b>614</b>	<b>746-1104</b>

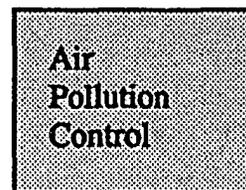
Source: U.S. Department of Commerce

Investments in water pollution control will make up the lion's share (66 percent) of this market, totalling around \$400 million in 1992. Spending on air pollution control will exceed \$100 million, while investments in solid and hazardous waste equipment and services will reach \$110 million. All of these markets are expected to experience rapid growth over the next few years: the water pollution control market will grow 25 percent per year, while the air, solid and hazardous waste markets will experience 15 percent annual growth. Given the long-standing economic relationship, geographic proximity, and the emerging Free Trade Agreement between the United States and Mexico, U.S. companies are uniquely poised to penetrate these environmental markets.

### ***Environmental Market Opportunities and Competition***

The Mexican pollution control market totalled \$311 million in 1991 and is expected to grow to around \$614 million in 1992. Further growth can be expected and market demand could range between \$745 million and \$1104 million in 1993-1995. Major business opportunities exist in air and water pollution control projects for industrial facilities in Mexico City. Pollution monitoring equipment and wastewater treatment systems for municipal agencies also offer significant potential.

According to the DOC, the total market for air pollution control equipment and services in Mexico was around \$90 million in 1991, and will reach \$104 million in 1992. This market is currently driven primarily by pressure on the federal government to deal with the severe smog problems in Mexico's largest cities.



Air pollution in Mexico City, in particular, has become a major issue in domestic politics. In 1991, the Mexico City daily air quality index (Indice Metropolitano de la Calidad del Aire, or IMECA) exceeded the danger level of 200 on more than 140 days. In Mexico City, mobile sources account for around 85 percent of air pollutants, while 15 percent comes from industrial activities and electricity generation. In Monterrey and Guadalajara, however, industry and autos are equally polluting. The U.S./Mexico border region is another major source of air pollution, with the two largest cities of San Diego/Tijuana and El Paso/Juarez reaching crisis levels.

## *Mexico*

The regulatory regime covering air emissions comprises two *reglamentos*, one at the national level and the other for Mexico City. The National Air Pollution Reglamento covers stationary and mobile-source controls, the establishment of the National Air Quality Monitoring System, and enforcement actions. The Mexico City Air Pollution Reglamento covers traffic patterns, motor vehicle emissions, and inspections in the greater metropolitan area.

While SEDESOL's regulations are often modeled after U.S. clean air laws, much remains to be done in the area of monitoring and enforcement. Most of the air monitoring stations in Mexico require manual operation. The entire system is managed at the federal level, with few if any companies measuring their own pollution output. Recognizing the urgent need to expand and upgrade its monitoring network, SEDESOL plans to use the pending World Bank loan to establish automatic monitoring stations in the country's 20 most populous cities.

Besides stepping up enforcement of these regulations, the government has taken additional steps to deal with the Mexico City air pollution problem. A \$6 billion program spanning four years has been established by the Mexican government to reduce mobile source air pollution in Mexico City through fuel substitution, public transport expansion, and auto emissions control and monitoring. The program is being administered by the newly created Commission for the Prevention and Control of Air Pollution in the Valley of Mexico, and funding is provided mainly by the Mexican and Japanese governments, with contributions of 78 and 20 percent, respectively. Two major goals of the program are expanding the production of unleaded and oxygenated fuels and promoting the installation of catalytic converters on automobiles. PEMEX plays a key role in this program through the conversion of refineries at Tula, Salamanca, Cadereyta, Salina Cruz, Cangrejera, Madero and Minatitlan.

***Mexico City Air Pollution  
Control Program:  
Sources of Funding  
(\$ million)***

Mexican Government	3,671
Japan Overseas Economic Cooperation Fund	689
Japan Exim Bank	228
Interamerican Development Bank	46
World Bank	44

Source: Comprehensive Pollution Control Program for the Mexico City Metropolitan Zone, April 1991.

Other steps taken by the government to control air pollution in Mexico City include: 1) the closure of PEMEX's major oil refinery, 18 de Marzo, located in Mexico City, 2) the complete or partial closure of over 250 industrial facilities in Mexico City, 3) the conversion of the national electric utility's Valle de Mexico oil-fired power plant to use natural gas, 4) the enforcement of a one-day-a-week driving ban, 5) expanded light rail and other public transportation systems, 6) a 55 percent increase in gasoline prices, 7) a requirement that all automobiles sold after 1991 use unleaded gas and be equipped with catalytic converters, and 8) the required replacement of taxis and buses with less polluting models in two years.

Although industrial emissions control programs are not given the same policy and budgetary attention as those focusing on reducing mobile source emissions, the government is attempting to crack down on highly-polluting industrial facilities located in Mexico City. These include chemicals, refined oil products, asphalt, plastics, cement, steel, food, and textile factories.

Finally, the national electric utility, the Comision Federal de Electricidad (CFE), has taken several steps to control emissions from Mexico's power plants. CFE plans to reduce sulfur dioxide emissions, primarily by switching to low-sulfur fuel, which is a more economical approach in CFE's opinion than installing scrubbers. At several facilities, such as the Valle de Mexico plant, fuel substitution from oil to natural gas is being promoted. Particulate emission reduction is being addressed through the use of electrostatic precipitators at CFE's two major coal-fired power plants (multiple units of Carbon II).

### ***Major Opportunities***

The DOC reports that equipment with the best sales prospects in Mexico includes dust collectors and filters, silencers for exhaust gases, respirators, gas/particle sampling analyzers, air pollution monitors, mobile laboratories, metering instruments, electrostatic precipitators, oxidation systems, and gas absorbers.

- |  |   |
|--|---|
| <input type="checkbox"/> Coal<br>Power<br>Plant<br>Electro-<br>static<br>Precipitators | Six 350 MW coal-fired power plant units are expected to be installed over the coming eight years. Units 1 and 2 of the Carbon II power plant at Piedras Negras, Coahuila are expected to be operational in 1992. These units are conventionally financed and developed by CFE. Units 3 and 4 of Carbon II, to be installed by 1995, are being developed by Foster Wheeler, Mecanica de la Pena, and Bufete Industrial under a build-lease-transfer (BLT) arrangement. All of these power plants will require scrubbers and electrostatic precipitators. |
|--|---|

## Mexico

### Existing and Projected Electric Generating Capacity in Mexico (MW)

	1990	%	1999	%	Net Additions
Conventional Thermal	13,156	52	18,081	41	4,925
Hydroelectric	7,805	31	10,900	25	3,905
Duel (Oil/Coal)	1,687	7	9,250	21	7,563
Coal	1,200	5	3,300	8	2,100
Geothermal	705	3	1,030	2	325
Nuclear	675	2	1,350	3	675
<b>Total</b>	<b>25,228</b>	<b>100</b>	<b>43,911</b>	<b>100</b>	<b>18,683</b>

Source: Comision Federal de Electricidad.

- Clean Fuels Production** PEMEX is implementing three projects to reduce sulfur levels to under 1 percent in fuel oil and diesel fuel for a total investment of \$650 million. In addition, 15 plants will be built to produce higher octane gasoline for a total investment of \$549 million.
- Mobile Source Emissions Controls for Mexico City** Under the World Bank-funded Transport Air Quality Management Program, SEDES0 and the DDF recently completed a comprehensive program for controlling air pollution from urban transport in Mexico City. Once implemented, the program will open up major sales opportunities for catalytic converters, emissions monitoring systems, and other equipment and services.
- Chemical Industry Air Pollution Reduction** Mexico's third-largest petrochemical company, Industrias Resistol S.A., is contemplating a \$1.5 million investment in equipment to reduce SO<sub>2</sub> and other emissions from its sulfuric acid and polystyrene plants. Resistol aims to achieve zero emissions to air, water, and land by the year 2000.
- Steel Industry Dust Collection** Mexico's largest private iron and steel company and the country's eighth-largest corporation, HYSLA S.A. de C.V., is considering installing dust and iron fiber collection equipment to control particulate emissions from its plants. Projects at various steel mills are expected to require a total investment of about \$15 million over the next five years.

### Competition

Imports of air pollution control equipment and services grew from 14 percent to 23 percent of the total air pollution market between 1988 and 1990 due to trade liberalization and a growing demand for foreign technology that was not available on the local market. In 1989, the United States accounted for 26.5 percent of the \$15.3 million import market.

The position of U.S. industry is strong due to the proximity of U.S. suppliers and the good reputation of American technology, although West Germany, Japan, France, and Switzerland represent major competitors and are aggressively pursuing the Mexican air pollution market. The European Community has jointly financed a market study with the International Finance Corporation that examines business opportunities for European firms in Mexican environmental markets.<sup>1</sup> In addition, the Japanese Export-Import Bank has extended loans and grants to Mexico as part of its \$6 billion Program Against Air Pollution in Mexico City. While some of these loans are "untied," Japanese companies can be expected to play a significant role in these projects.

#### Air Pollution Import Market Share in Mexico (1989)

United States	26.5%
West Germany	20%
Japan	14%
Switzerland	7%
Other	14.5%

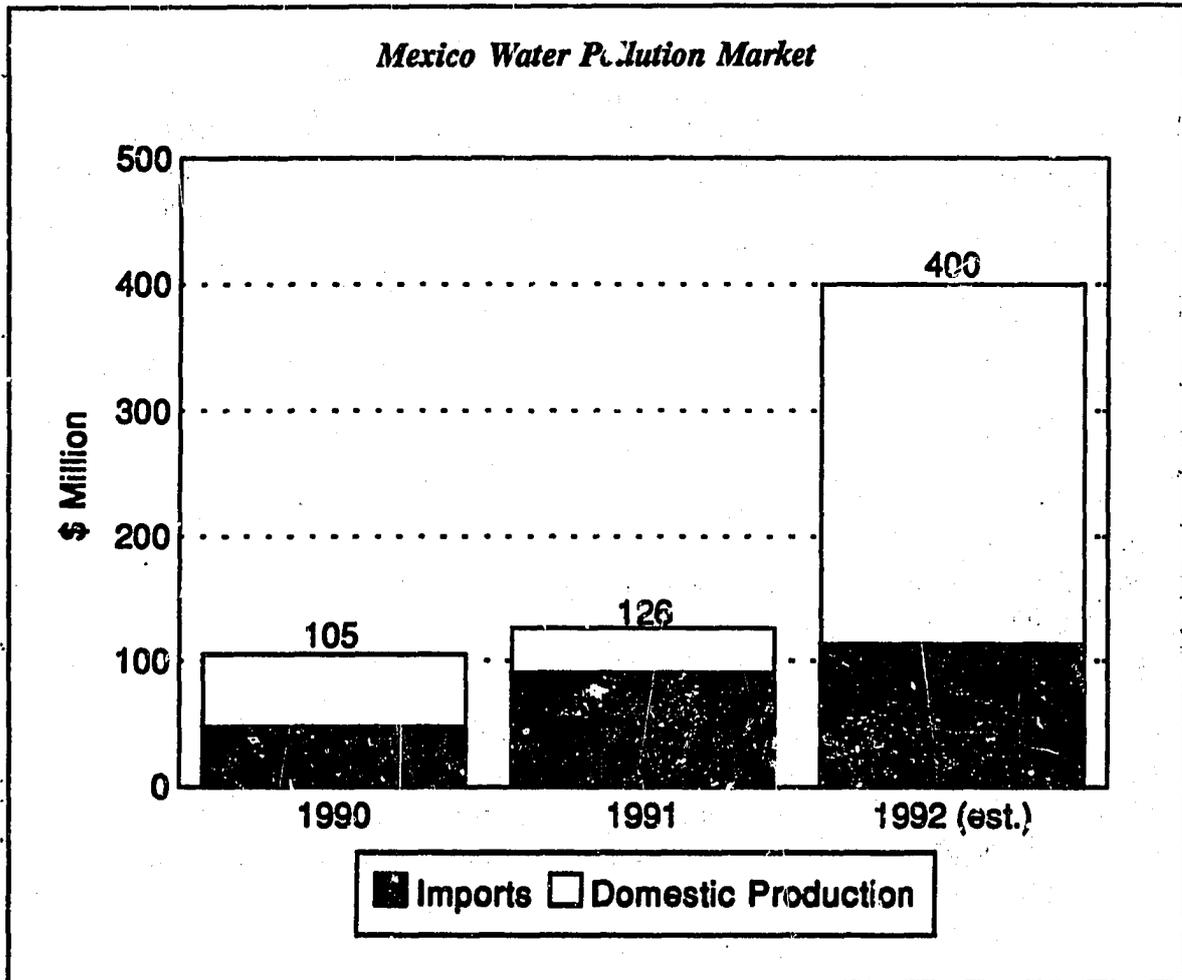
Source: U.S. Department of Commerce.

The U.S. Department of Commerce has estimated the total market for water pollution equipment and services at about \$126 million in 1991. The DOC expects that the market will jump drastically to \$400 million by the end 1992, and grow by 25 percent annually between 1992 and 1993. The most active water pollution equipment imports involve those based on conventional technologies that are not produced locally and that can be transferred without modification, such as aerators, chlorinating equipment, screens, water clarifiers, pumps and filter presses.

Water  
Pollution  
Control

<sup>1</sup> International Finance Corporation. *Identifying Market Opportunities in Environmental Goods and Services: Mexico*. London: Environmental Resources Limited, 1991.

*Mexico*



A number of key factors make the wastewater treatment market one of the most promising of the environmental markets in Mexico. Massive volumes of untreated wastewater from residential and industrial sources have produced critical conditions in Mexico's most important watersheds and exacerbated water scarcity problems in major urban centers. Furthermore, the local capacity to deal with the water problem is severely limited; in October 1991, it was estimated that only 25 percent of the 420 municipal and industrial water treatment plants in the country were actually in service. Of the 110 plants in service, less than half were operating efficiently. In the municipal sector, only 15 percent of the total volume of domestic wastewater is treated. Many municipal plants operate below capacity

due to a lack of trained operations personnel, reliable equipment and security installations, and favorable topographic conditions.

Existing wastewater treatment capacity for the industrial sector is equally low. Over 80 percent of total industrial discharges in Mexico come from nine highly polluting industries: sugar, chemicals, pulp and paper, petroleum, beverages, textiles, iron and steel, electronics, and food processing. As in the municipal sector, only 15 percent of industrial wastewater is actually treated.

Furthermore, Mexico suffers from serious water supply constraints. Around 80 percent of the nation's existing and potential sources of water supply are found below 500 meters, while 75 percent of the population and 80 percent of industrial activity are located above this altitude. As a result, Mexico City and other major urban areas have to pump water from lower regions at considerable expense. Rising water tariffs are beginning to reflect the scarcity and high cost of transporting water in certain geographic regions. In 1989, the price of water was raised throughout the country; in Mexico City alone, water prices increased by 1,360 percent during that year. The move to more realistic pricing has substantially increased investments in wastewater treatment, recycling systems and water meters, and encouraged water conservation.

Water pollution regulation in Mexico is fairly comprehensive. The Comision Nacional de Agua (CNA) is the autonomous agency under the Ministry of Agriculture and Hydraulic Resources (SARH) that is responsible for managing water supply, and monitoring discharges from municipal wastewater treatment plants and agricultural sources. SEDESOL retains responsibility for setting and enforcing NTEs governing wastewater discharges from industrial sources.

All sources discharging to receiving waters or municipal sewer systems must have prior authorization from and register their wastewater discharges with SEDESOL. It is reported, however, that few sources actually comply with this regulation. In addition, point-source discharges must meet relevant NTEs set by SEDESOL; these industry-specific numeric limits on water pollutants closely resemble the national effluent standards outlined in the U.S. Clean Water Act. There are currently more than 32 NTEs covering a range of industrial discharges and governing discharges to publicly-owned treatment works. While existing NTEs cover conventional pollutants, regulations governing toxic metals and organics have yet to be fully developed. Point-source discharges may also be subject to site-specific special conditions established for the purpose of meeting water quality standards applicable to particular receiving bodies.

## *Mexico*

The National Water Quality Monitoring Network consists of 380 stations managed by SEDES0 and 774 stations managed by CNA. This system is supported by a network of 21 state, 10 regional and 3 central analytical labs. Unlike the U.S.'s self-monitoring programs, monitoring in Mexico is done primarily by federal inspectors who lack resources for adequate testing, site visits and reporting. Around \$16 million of the World Bank Loan to SEDES0 will go towards improving the agency's effluent monitoring and enforcement capabilities.

In addition to improved enforcement of existing water regulations, programs are being implemented to address the water pollution problem in critical areas. In its 1990-1994 environmental strategy, SEDES0 has given high priority to five river basins with the most concentrated urban and industrial development: the Panuco, Lerma-Santiago, San Juan, Balsas and Blanco watersheds. All of these basins receive the majority of their wastewater discharges from industrial sources. SEDES0 also places high priority on water pollution control in Acapulco, Coatzacoalcos, Ensenada, Salina Cruz, Lázaro Cárdenas and Villahermosa in light of their importance as ports and tourist destinations.

The federal government has also planned an additional investment of \$220 million to build wastewater treatment plants and sewers in eight cities on the U.S. border: Tijuana, Mexicali, Nogales, Ciudad Juárez, Nuevo Laredo, Reynosa, Matamoros and San Luis Río Colorado. The U.S. Government has also committed \$360 million to environmental projects along the border. To date, significant progress has been made on these investments: the first phase of construction of a wastewater treatment plant in Nogales was completed in October 1991, a \$200 million facility serving Tijuana/San Diego is close to completion, and the construction of a plant covering Laredo/Nuevo Laredo is expected to be completed soon.

CNA is currently implementing its 1990-94 Water Supply and Sanitation Sector Plan. The plan proposes a four-year total investment of \$5 billion to establish an effective institutional framework for the water sector based on sound cost-recovery policies. A key principle underlying this strategy is the decentralization of financial authority from CNA to state and municipal water agencies. The 1990-94 Plan supports this objective by encouraging local water agencies to charge user fees in order to enhance their financial viability. Domestic sources of financing for the plan include CNA itself, the National Solidarity Program, state and municipal funds, user fees, and credits from the Mexican development bank, Banobras. The World Bank has agreed to provide a \$300 million loan to Banobras to help finance the program. Although the program includes a pilot project in the Rio Lerma basin, which serves parts of Mexico City, the loan does not cover water systems in Mexico City, Guadalajara, or Monterrey. These regions are covered in part by several large IDB projects, including a \$300 million loan to the Guadalajara Intermunicipal System of Water and Sewers, and a \$325 million loan to the Water and Drainage Service of Monterrey.

**1990-1994 Water Supply and Sanitation Sector Plan:  
Projected Investment Schedule (\$ million)**

	1990	1991	1992	1993	1994	Total	%
Water Supply	206	674	696	691	728	2,995	66
Sewerage Treatment	64	233	252	247	238	1,033	23
	16	122	108	113	118	476	11
<b>Total</b>	<b>286</b>	<b>1,029</b>	<b>1,056</b>	<b>1,051</b>	<b>1,084</b>	<b>4,504</b>	<b>101</b>

Source: World Bank.

In addition to these federal activities, several Mexican states have incorporated water pollution components in their development plans. The State of Jalisco Development Plan for 1989-95, for example, emphasizes the construction of new wastewater treatment plants and the enforcement of existing water pollution control legislation. As of 1990, 26 new wastewater treatment plants had been built in the basin.

Private sector investment in wastewater treatment is increasing significantly in response to new legislation and the shortage of clean water. A number of industrial facilities are gearing up to meet the Departamento del Distrito Federal's recent mandate that all industries located in the Federal District submit plans to install recycling equipment for their process wastewater by September 1992.

In addition, several groups of private manufacturers have taken collective initiatives to build their own wastewater treatment systems. Recently, a group of Mexican firms in Vallejo, Mexico City, rehabilitated an old municipal treatment plant in order to treat wastewater flows from the local drainage system to a standard suitable to supply their own factories. Another innovative scheme was initiated by the Tlalnepantla Industry Association to set up a private utility to build and run a plant to treat residential waste flowing into the Rio Tlalnepantla for industrial use. As proposed, the utility would recover operational costs by charging user fees to the Association members, which include fourteen of the largest industrial water users in the Rio Tlalnepantla area. Although the number of examples is currently limited, the trend toward collective private sector initiatives in wastewater treatment appears to be growing.

## *Mexico*

### *Major Opportunities*

- Recycling Equipment for Industries in the Federal District (D.F.) of Mexico City**

The acute shortage of clean water in Mexico City has led the DDF and CNA to implement several drastic water regulations in recent months. In March 1992, the DDF issued an ultimatum giving all industries located in the D.F. six months to begin planning the installation of wastewater recycling systems in their plants. The DDF plans to provide concessionary financing to help companies comply with this new requirement. In October 1991, CNA announced that a Fee Law for Wastewater Discharges would be implemented soon. The new fee law will require all industries in the Valley of Mexico to pay a fee on discharges containing more than 300 mg/liter of COD and more than 30 mg/liter of total suspended solids. In addition, all facilities discharging more than 3,000 cubic liters of wastewater per month will need to install monitoring equipment. Although private sources expect that these new laws will not be strictly enforced until September or October 1992, a number of industries in Mexico City are now initiating efforts to install wastewater recycling and treatment equipment.
  
- Municipal Wastewater Treatment in Guadalajara**

The Guadalajara Intermunicipal System of Water and Sewers (SIAPA) and the IDB are in the preparatory stages of the \$600 million Guadalajara Potable Water and Sewerage Project. This project will involve substantial procurement of wastewater treatment plants and associated consulting services.
  
- Wastewater Treatment Systems and Service Contracts for Industrial Estates and Tourist Developments**

The DDF's new policy of not allowing new polluting industries to locate in Mexico City has led to the development of industrial estates where all environmental considerations are dealt with collectively. A good example is the Iztapalapa Estate in Mexico City, which is built and serviced by FINSA, a Mexican industrial estate utility company specializing in border zone developments. FINSA currently plans to construct a plant on the estate to treat not only effluents from the resident garment and electronics manufacturers, but also wastewater from a nearby municipal system for industrial use. Feasibility studies for the plant are being conducted by Degremont. If the Iztapalapa Estate is successful, FINSA will go ahead with plans for nine other estates in the area. Government agencies and private developers in high-profile tourist areas are also beginning to include water pollution

controls in the planning of infrastructure investments. CNA and the Mexican contractor Grupo Mexicano de Desarrollo are currently engaged in a water supply and treatment system in Cancun, to be supplied on a build-operate-transfer (BOT) basis.

- Wastewater Treatment Systems and Service Contracts for Industry Associations**

Rising water prices and the threat of SEDESO's inspections have driven several local industry associations to invest in collective water treatment systems. In the Rio Tlalnepantla area, northwest of Mexico City, where water prices for industrial customers currently range from 1,500 to 2,500 pesos/m<sup>3</sup> (about \$0.50-0.85/m<sup>3</sup>), the local industry association plans to build a \$4 million plant to treat residential wastewater for use in the members' factories. In addition, highly-polluting members of the Tianguistenco Industry Association in the Rio Lerma basin are financing feasibility studies for a \$700,000 collective treatment system in anticipation that SEDESO will crack down on them in the near future.
  
- BOT Schemes and Service Contracts with Municipal Water Authorities**

Due to numerous competing claims on the central budget and continued fiscal austerity on the part of the Salinas administration, federal grants for investments in municipal water pollution control are declining. This has led to an increased demand for BOT schemes and service contracts with private companies. In Aguascalientes, for example, a consortium of SISSA (a Mexican firm specializing in environmental services) and Compagnie Générale des Eaux (France) is currently under contract with the municipality to operate the local water supply and treatment system.
  
- Water Pollution Monitoring Equipment**

Boosting existing capacity to monitor both municipal and industrial wastewater flows is currently a high priority for SEDESO. This translates into a significant export potential for U.S. flow meters, spectrometers, sampling and laboratory equipment, and other components of water pollution monitoring systems. Because the self-monitoring requirements for Mexican industries are not well-defined by the national regulations, the most likely buyers of U.S. monitoring equipment will be SEDESO and state water agencies in high-profile regions like Mexico City and the border area.

## Mexico

### Competition

Until the late 1980s, high tariff barriers allowed Mexican firms to dominate the market for water pollution control equipment. As these barriers continue to be lowered by the Salinas administration, the share of imports in the Mexican water market is growing steadily.

Due to its geographic proximity, existing business networks, and reputation for quality products, the United States remains the principal foreign supplier of water pollution control equipment and services. It accounted for over half of all imports in 1989, while Japanese, German and French firms held 15, 14 and 9 percent of the import market, respectively.

Major U.S. suppliers of water pollution control equipment and services to Mexico include Babcock and Wilcox, Zurn Industries, Dorr-Oliver, Millipore Corp., and Ecodyne. Non-U.S. firms with a strong presence in the Mexican water market are Degremont (France), Biwater (UK), and Compagnie Générale des Eaux (France).

Despite the rising share of imports, domestic producers are still prominent in the wastewater treatment market. Among the most visible local companies are Aquamex, Etrasa, Agua-Treat, and Filtros y Purificadores Azteca. An IFC team investigating the Mexican water pollution equipment market found that while local firms do compete successfully in price-sensitive, low-technology markets, such as the small-scale wastewater sector, most Mexican manufacturers import at least a portion of their equipment.

The Department of Commerce estimates that the combined market for solid and hazardous waste control equipment and services was \$83 million in 1990 and \$95 million in 1991. It is expected that this market will reach \$110 million in 1992 and continue to grow at 15 percent per year over the next few years.

It appears that sales of industrial hazardous waste treatment, storage and disposal (TSD) equipment and services will account for the largest share of this market. The DOC

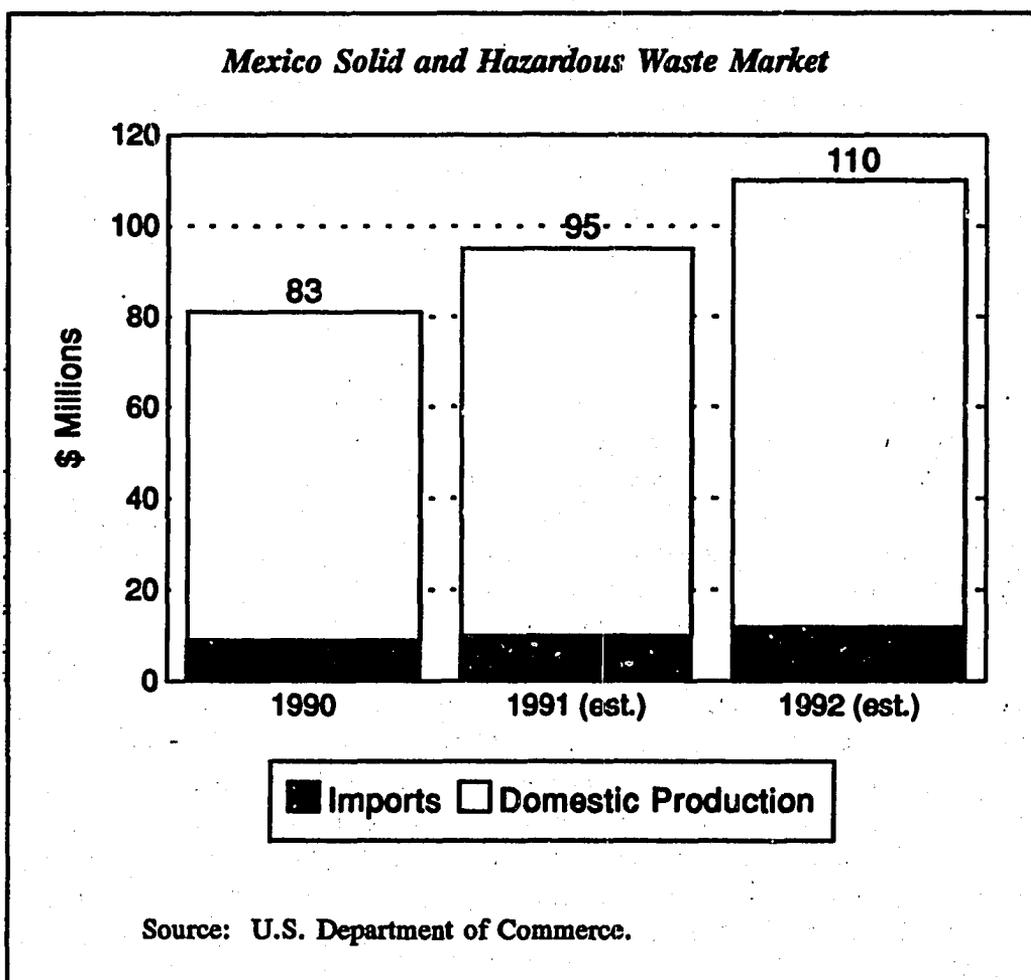
#### *Water Pollution Import Market Share in Mexico (1989)*

United States	60%
Japan	15%
West Germany	14%
France	9%
Other	2%

Source: U.S. Department of  
Commerce.

Solid and  
Hazardous  
Waste

claims that the equipment with the best sales potential are waste recycling plants for solvents, used oil, heavy metals, and other hazardous wastes. It is estimated that around 70 percent of industrial waste in Mexico is totally recyclable. A few opportunities may also exist in solid waste collection and disposal.



Over 52,000 tons of municipal solid waste and 120,000 tons of non-hazardous industrial solid waste are generated in Mexico daily. More than 80 percent of all industrial solid waste emanates from the mining industry alone. Of the 75 percent of municipal solid

## *Mexico*

waste that is collected each day (85 percent of which is in Mexico City), 41 percent is properly disposed of in sanitary landfills, while the rest is deposited in unregulated open dumps. Around 13,000 tons daily remain on city streets. There are only 34 sanitary landfills in the entire country, with the capacity to treat only 21 percent of total solid waste generated in Mexico. In addition, there are only five composting plants in the country, with a combined installed capacity of 2,070 mt/day. All of these facilities, however, are operating below 50 percent capacity. Of the three municipal landfills that serve Mexico City, two will reach full capacity by 1996.

Most of the unregulated dumps are presided over by the *pepenadores*, who make their living by recovering scrap metal, rubber and other reusable materials. The extensive informal recovery system run by the *pepenadores* presents a significant obstacle to the privatization of municipal solid waste disposal services. Just last year, a group of *pepenadores* succeeded in halting plans to establish a major waste disposal utility in Acapulco.

Although a national regulatory framework for hazardous waste control was implemented in 1988, no regime is in place to govern the collection and disposal of municipal and non-hazardous industrial solid waste. SEDESO is now initiating preliminary studies to develop technical standards controlling the site selection, design, construction and operation of sanitary landfills, and the incineration of municipal wastes. Most of these new standards will not be implemented until 1994. In addition, waste management NTEs governing a number of industries, such as oil and gas extraction, petrochemicals, fertilizers, iron and steel, and asbestos, are scheduled to be enacted in 1994-95.

Around 13,000 tons of hazardous waste are produced daily in Mexico. Mexico City alone accounts for over 2,500 tons per day, most of which is dumped into sewers or municipal landfills. In addition, the *maquiladora* industries along the U.S. border, especially the electronics, transportation equipment, furniture, and sports equipment assembly operations, produce massive amounts of hazardous waste; it is estimated that 95 percent of the hazardous waste generated by the *maquiladoras* between 1969-89 is completely unaccounted for. Other highly contaminated zones are Monterrey, Guadalajara, Toluca, San Luis Potosí and Puebla.

While the capacity exists to treat nearly one-third of the hazardous waste generated in Mexico, only about 5 percent is properly treated and disposed of. Of the existing three hazardous waste landfills, only one, located in the state of Nuevo Leon, is actually in operation. This site, which only began receiving toxic waste in 1991, is operated by the Mexican company Residuos Industriales Multiquim S.A. (RIMSA) and only services 120 companies. The other two landfills are located in the state of San Luis Potosí. One was

closed because it was full and the other was shut down for failing to meet SEDUE regulations. Not until 1990 did Mexico City contract with Chemical Waste Management to build the country's first hazardous waste incinerator in Texcoco. No treatment facilities exist for infectious clinical waste, which is often sent to unregulated dumps or disposed of in rivers.

Certain regulatory, political and economic trends combine with this lack of existing capacity to create a very promising import market for hazardous waste TSD equipment and services:

- First, a comprehensive set of regulations governing hazardous waste already exists in Mexico. The National Hazardous Waste Reglamento requires generators of hazardous waste to be authorized by SEDESOS, to keep monthly logs and submit semi-annual reports, to record all movements of the waste, and to destroy all PCB wastes. The regulation also requires hazardous waste generated by *maquiladora* industries to be returned to the country of origin.
- Second, the existing NTEs that implement the federal *reglamento* are relatively stringent and comparable to U.S. standards. In fact, the number of compounds that classify as hazardous under Mexican law is greater than in the United States. Likewise, 23 of the 27 compounds that both countries classify as hazardous have lower maximum permissible levels in Mexico.
- Third, new generators must receive authorization from SEDESOS, whereas U.S. hazardous waste laws only apply once the waste leaves the site, or is treated, stored for more than 90 days, or disposed.

On the other hand, SEDESOS has not yet drafted treatment-oriented land disposal restrictions comparable to U.S. RCRA restrictions, nor has it dealt with the issue of leaking underground storage tanks. NTEs covering the management of solvent wastes, clinical waste treatment, incinerator treatment of hazardous wastes, recycling and reuse of hazardous wastes, and design, construction and operation of controlled storage facilities are not due to be implemented until 1994.

Although the NTEs governing hazardous waste are strict on paper, enforcement is strained by SEDESOS's limited resources for inspection. Enforcement is accomplished mainly by shutting down a facility temporarily in order to compel factory managers to enter negotiations with SEDESOS on how they plan to deal with their waste problem. Enforcement is a particular problem in the *maquiladora* zones; the compliance rates for submitting manifests for hazardous waste TSD activities is around 7 percent, and the record for

## *Mexico*

submitting manifests for importing/exporting hazardous waste is around 24 percent. Nevertheless, growing public pressure on the federal, state and local governments to deal with industrial waste flows is helping to increase compliance. Bilateral environmental groups on the border have been particularly effective in calling attention to the numerous violations of existing hazardous waste regulations in the *maquiladoras*.

### *Major Opportunities*

Given the extensive informal waste recovery system operated by the *pepenadores*, solid waste market opportunities are primarily limited to equipment contracts with local authorities and state governments. Because the *pepenadores* refuse to handle industrial waste, however, opportunities may exist for sorting and recycling industrial non-hazardous solid waste, especially in the mining and minerals extraction industries. Other major opportunities include:

- Consulting Services for SEDESO      According to the requirements of the World Bank loan to SEDESO, the new regulations governing municipal and industrial solid waste disposal must be drafted and implemented within the 1993-95 timeframe. SEDESO plans to contract with consulting firms to carry out the studies necessary prior to drafting the solid waste NTEs.
  
- Sanitary Landfill Design and Construction for the DDF      Anticipating that two of Mexico City's three municipal landfills will be full by 1996, the DDF conducted a feasibility study for constructing landfills on a number of sites throughout the city. Although the study identified 20 sites that were technically and environmentally sound, the DDF has been hesitant to go ahead with construction plans because of public opposition. The DDF is currently conducting a campaign to inform the public that sanitary landfills will have no negative effects on Mexico City's neighborhoods. When the DDF does decide to proceed, opportunities may exist for U.S. firms to assist with the design, construction and operation of the new landfills.

Hazardous wastes present far larger opportunities for U.S. firms. Among them:

- Hazardous Waste Treatment and Disposal for Mexico City**

Currently, there are no hazardous waste disposal facilities near Mexico City. Protecol S.A., a joint venture between Waste Management, Inc. and a group of Mexican investors, is studying the possibility of treating and landfilling 100,000 tons of hazardous waste per year close to Mexico City. The project was declared environmentally sound in an evaluation conducted by Dames and Moore, but final approval of the project by SEDES0 has been held up due to controversy over site selection. If the project is approved, opportunities may exist for U.S. companies to supply the required treatment and landfill technology.
  
- Guadalajara Treatment Facility**

The Jalisco Trust Fund, a group of private entrepreneurs, the state government, and the Jalisco bank Promex, plan to invest over \$900 million in a hazardous waste treatment facility near Guadalajara.
  
- Joint Ventures with Private Mexican Investors to Build and Operate Hazardous Waste Facilities**

In the face of limited federal resources, SEDES0 is counting on private investors to build treatment and disposal facilities. This creates significant opportunities for U.S. companies to enter into joint ventures with Mexican investors. For example, two new \$25 million hazardous waste treatment facilities will be developed this year in San Luis Potosí and Veracruz. The two 120,000 ton-per-year facilities will be built and operated by a joint venture between the U.S. company Metalclad Corp. and two groups of Mexican investors. The facilities will use state-of-the-art catalytic extraction technology, developed by Molten Metal Technology of Cambridge, MA, which transforms certain hazardous wastes into commercial products without producing toxic byproducts. Opportunities for this type of venture may also be good along the U.S./Mexico border, where public pressure is forcing the *maquiladora* industries to comply with existing hazardous waste regulations.
  
- Industrial Hazardous Waste Recycling**

The high price of hazardous waste disposal, due to a shortage of proper sites, is driving demand for industrial waste recycling equipment and services. RIMSA charges between \$50 and \$200 per ton, depending on volume, composition and handling requirements. The Mexican subsidiary of the British chemical company ICI reports spending around

## Mexico

\$40 per barrel of hazardous waste that it sends to the Nuevo Leon disposal facility. The high cost of disposal is causing many companies to look for ways to reduce output and recycle waste. For example, a Mexican steel galvanizing plant recently contracted with a U.S. company to install and service a closed-loop recycling system for its pickling wastes.

Mexico City  
Clinical  
Waste  
Collection  
and  
Incineration  
Incineration

The Ministry of Health has contracted with SISSA to design a solution for properly disposing of hospital waste in Mexico City. If SISSA's feasibility study for a system to collect the waste from Mexico City hospitals and treat in a central incinerator proves viable, opportunities may exist for U.S. companies specializing in clinical waste treatment, storage and disposal.

### Competition

Foreign companies are moving fast to take advantage of the emerging hazardous waste opportunities in Mexico. Chemical Waste Management has already invested over \$20 million in this market and plans to set up transport operations and construct four recycling and containment centers for hazardous waste. Dupont S.A. (100 percent American-owned) is also studying the potential for setting up industry-specific hazardous waste incineration services.

Local competition is solid, however, and growing rapidly. Química Omega, a Mexican-owned company, specializes in hazardous waste management and solvent recycling. Founded nine years ago, the company now has 50 employees and enjoys high profit margins. Química currently operates a solvent recycling plant in Tenago, where it treats wastes from a number of industries, including several *maquiladoras*. Química Omega

#### *Solid and Hazardous Waste Import Market Share in Mexico (1989)*

United States	72%
West Germany	8.7%
Switzerland	3.1%
Japan	2.9%
France	2.4%
Other	10.9%

Source: U.S. Department of  
Commerce.

is also working closely with U.S.-based Safety Kleen on several innovative potential projects, including cement kiln incineration systems.

### ***Market Entry Strategies***

Under the current constellation of economic, regulatory and political pressures for pollution control in Mexico, the time is ripe for U.S. companies to position themselves for long-term business in that nation. While the capabilities of the Mexican environmental industry are growing steadily, many companies are eager to partner with foreign firms that offer access to high-tech pollution control technology.

With import tariffs lowered significantly, and even eradicated in cases where no local producers exist, foreign environmental technology and services are more readily accessible to Mexican companies. In addition, the Mexican government's drive to encourage private participation in the provision of environmental services opens up significant opportunities for BOT schemes and service concessions for partnerships of Mexican and foreign firms. In light of the pending United States/Mexico Free Trade Agreement, U.S. companies have a distinct advantage over other foreign competition in pursuing these opportunities.

The following are important factors to consider when entering the Mexican market:

***Positioning for longer-term gains***

Despite the opportunities immediately available to foreign companies, Mexico is a long-term market. U.S. companies must be ready to commit in the long-term, even they do not realize profits until after the first few years. The world's major environmental companies (Degremont, Waste Management, etc.) have all made substantial investments in Mexico.

***Partnering with Mexican companies***

Working with a Mexican company, whether as a distributor or joint venture partner, is often the key to success in securing a solid foothold in the Mexican market. This is especially important when bidding on large-scale BOT or service contracts with public sector entities. Additionally, well-trained local representatives, who can maintain permanent contact with Mexican clients, are indispensable to providing quality service and avoiding miscommunication.

## ***Mexico***

***Maintaining cost-competitiveness in the Mexican market***

In most cases, unsubsidized foreign environmental equipment and services are not price competitive in the Mexican market. Often, tariffs for importing finished equipment are higher than for importing components. Using Mexican workers in local assembly and distribution operations can lower production and transportation costs significantly and help U.S. companies remain cost-competitive vis-a-vis local, European and Japanese companies.

***Designing the terms of representation contracts***

In order to maintain a healthy relationship with a Mexican representative or distributor, it is recommended that representation contracts be renewed on a yearly basis.



## Venezuela

Venezuela's GDP reached \$66 billion in 1991. Its economy is expected to post 3.0 percent real growth for 1992 and 5.5 percent growth for 1993. Monetary policy in Venezuela continues to reflect the government's objective of maintaining low inflation rates. But despite this objective, inflation is anticipated to reach around 30 percent for 1992. Venezuela enjoyed a trade surplus of about \$5 billion in 1991 because of the strong demand for oil among its major customers and the temporary disruption of Kuwaiti and Iraqi oil supplies during the Gulf War.

### *General Economic Indicators: Venezuela*

	1991	1992	1993
Population (millions)	20.3	20.8	21.4
Real GDP per Capita (\$)	3,237	3,246	3,335
Real GDP (\$ billion)	65.7	67.7	71.4
GDP Growth Rate	5.0%	3.0%	5.5%
Consumer Price Change, year-end	36.0%	30.0%	35.0%
Trade Balance (\$ billion)	5.0	3.2	2.8
Total External Debt (\$ billion), year-end	36.5	38.1	39.8
Exchange Rate (Bolivars/\$), year-end	65	80	100

Source: Bank of America, September 1991.

## *Venezuela*

The petroleum sector dominates Venezuela's economy, accounting for nearly 28 percent of the country's GDP. Venezuela is the world's seventh-largest oil producer, after the Commonwealth of Independent States (the former Soviet Union), Saudi Arabia, the United States, Iran, China, and Mexico. The Venezuelan oil industry has grown significantly since the 1973 oil crisis and is one of the largest suppliers of crude oil to the United States. PdVSA (the state-owned oil company) owns and operates oil exploration, transport, refining and distribution facilities around Caracas. This company provides about 75 percent of the government's total income and 80 percent of the nation's export earnings. Other major components of the Venezuelan industrial sector include mining, cement, steel, petrochemicals, and aluminum.

Venezuela continues to liberalize its trade and investment climate by promoting a free trade regime among its major partners and welcoming direct foreign investment. The principal foreign investors in the economy include the United States, United Kingdom, and Switzerland. Today, foreign ownership of companies in the retail, telecommunications, water, and sewage industries is being actively sought. A recent Presidential Decree liberalized the direct foreign investment climate by allowing 100 percent ownership and easier profit/dividend repatriation.

### *Environmental Situation and Policy Framework*

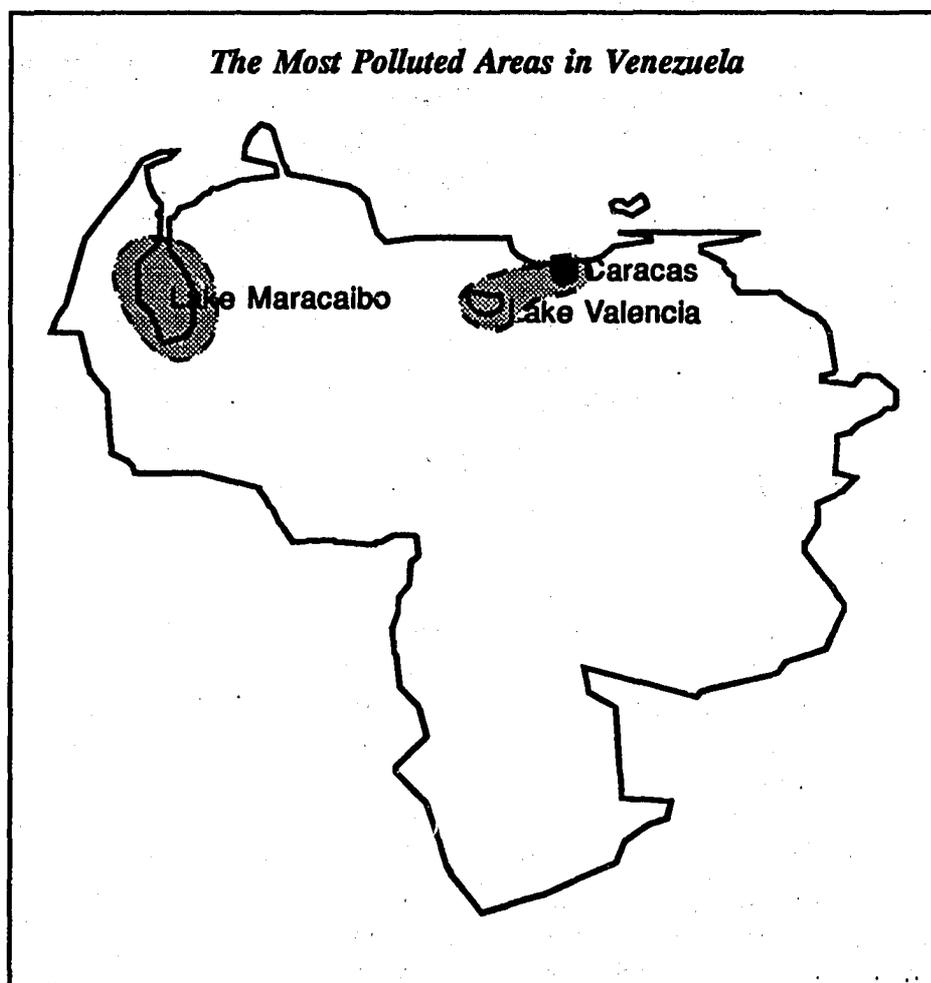
Environmental concerns came to light in Venezuela during the late 1970s when pollution levels along Lake Maracaibo, the continent's largest freshwater lake located in northwestern Venezuela, were publicized for the first time. The levels of mercury, lead, and other compounds in the lake were found to be high in many instances and to exceed World Health Organization standards in some cases. Another seriously affected area is the Lake Valencia basin. Lake Valencia is located south of the urban sprawl of Caracas and is host to the majority of the urban population of Venezuela.<sup>1</sup>

Like many other Latin American countries, the Venezuelan government has invested heavily in developing mineral extractive industries with large export potential. The country's air, water and land endowments have been substantially affected by the subsequent

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<sup>1</sup> Venezuela's Ministry of Environment and Renewable National Resources estimates that the City of Caracas has approximately 4 million people and the greater Caracas region almost 6 million people.

development of oil and gas fields, orimulsion,<sup>2</sup> and other minerals such as gold and silver, together with strong growth in other parts of industry.



The perimeter of the Lake Maracaibo basin includes a substantial number of industrial establishments that produce significant volumes of effluent, yet have limited access to wastewater treatment plants. Growth in the basin has generated a sharp increase in water requirements, which has made it necessary to bring water from the Pao River basin since

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<sup>2</sup> Orimulsion is high-viscosity crude oil, composed primarily of coal tar. Orimulsion lies close to the earth's surface and is found in the Orinoco River basin in central Venezuela. PdVSA produced almost 12.4 million barrels of orimulsion during 1991, and exports small amounts of the fuel (e.g., to the United Kingdom).

## Venezuela

1973. Water use is expected to double to about 22 m<sup>3</sup>/second by the year 2000. The region's explosive industrial growth has left about 20 percent of its residents without adequate water supplies.

At present, substantial quantities of dilution water are being added to supplement Lake Maracaibo's water table and improve its overall water quality.<sup>3</sup> In addition, about 50 percent of the polluting industries around the Lake's basin have installed some sort of wastewater pre-treatment facilities. As of early 1991, however, there were no publicly-owned treatment works to collect and pre-treat waste from all plants before discharge into the basin.

To control and regulate the growing pollution problems in the regions surrounding the two lakes, the Venezuelan Congress published 17 decrees in the late 1970s implementing the environmental regulation known as the *Ley Organica del Ambiente* (LEA), also called the Organic Law. The LEA defines detailed norms and standards for hazardous waste, forestry activities, greenhouse gas emissions, solid waste, medical waste, mining, and the disposal of radioactive materials.

The Ministry of Environment and Renewable National Resources (MARNR), created in 1977 by federal directives, is responsible for implementing the LEA. The MARNR also consolidated the various environmental management responsibilities that had been spread among many federal and state ministries and organizations. Historically, however, the states played only a minor role in the formulation, implementation, and enforcement of environmental policy and regulations.

In April 1992, the *Ley Penal del Ambiente*, or the Criminal Enforcement Law (CEL), went into effect, vesting MARNR with additional compliance enforcement powers. The CEL imposes strict criminal penalties and heavy fines for polluting the environment or causing harm to people as a result of environmental negligence. Furthermore, the presiding judge is compelled to issue a jail sentence and a monetary fine for all proven violations. The judge can also order the polluting entity to shut down its operations until the necessary precautionary or pollution abatement measures have been taken. The CEL decree highlights the need for compliance around priority areas, with particular emphasis on the deterioration of water quality in the Lake Valencia and Lake Maracaibo basins.

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<sup>3</sup> Extensive limnological research has declared the lake hypertrophic, which routinely causes fishkills. The lake acts as one large oxidation pond and in spite of the added dilution water (approximately 520,000 cubic meters per day), much of the lake's surface displays relatively low organics/total coliform counts. This is attributed to the natural disinfection qualities of the lake.

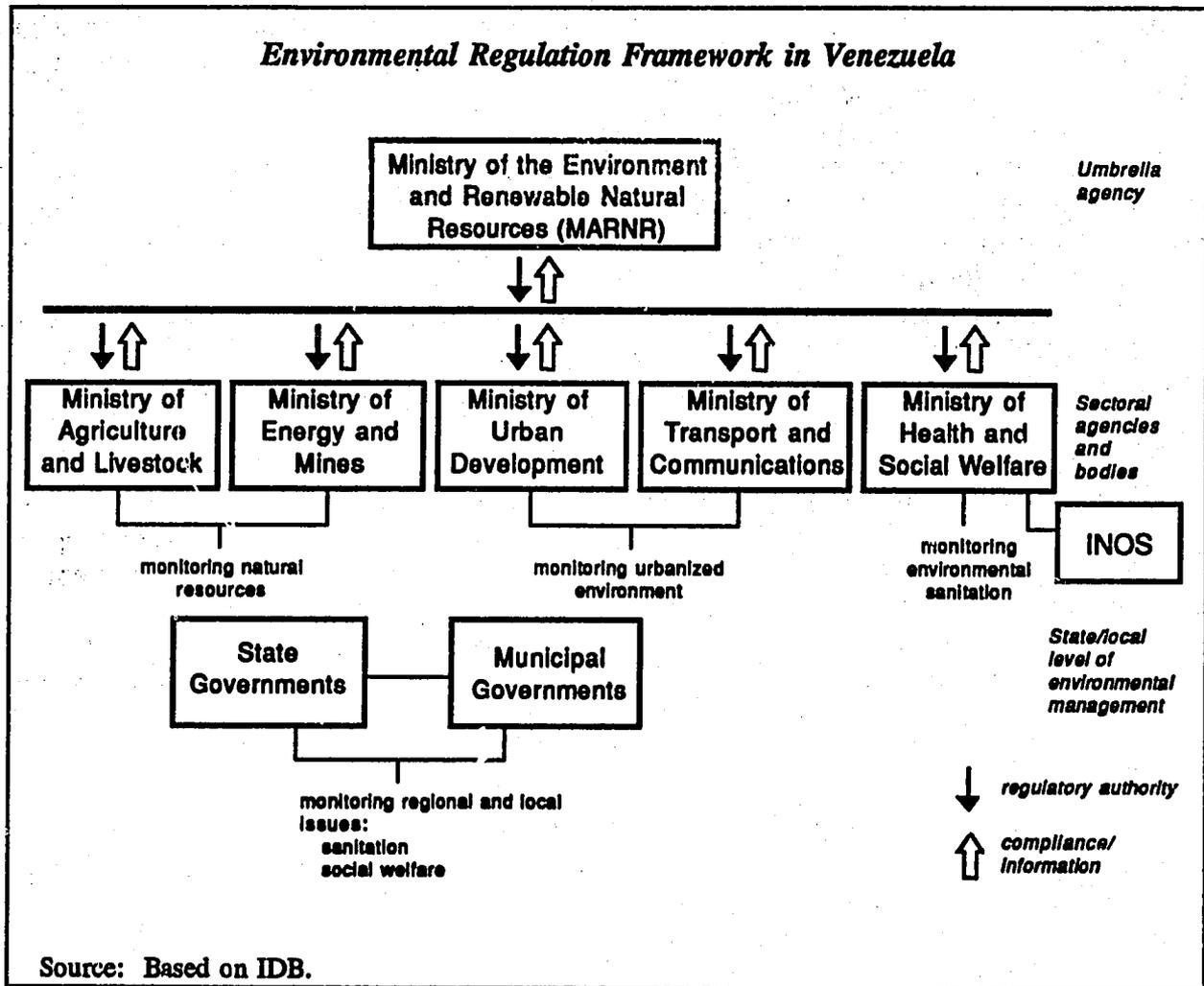
In addition, the MARNR has given companies until July 27, 1992 to register information on their air and water emissions. They also have until August 7, 1992 to submit information regarding their hazardous waste discharges and plans to come into compliance with existing pollution standards.

The National Guard recently set up an environmental police department to enforce the CEL and its deadlines. The Venezuelan business community is currently up-in-arms about the Guard's involvement, especially since it was already investigating 31 cases of environmental "violations" before the MARNR deadlines had passed. Additionally, plant managers complain of being harassed by National Guardsmen, who demand permits that are not yet available from MARNR. It remains to be seen if MARNR and the National Guard can keep up the current level of enforcement in the face of industry's complaints.

Despite reported non-compliance with air, water, and urban waste regulations, MARNR has yet to conduct compliance audits for the bulk of the country's manufacturing facilities. Also, specific standards for air, water and hazardous waste, which were adopted during the 1980s, are only now being developed as effluent guidelines for industry. With the exception of recent incidents involving the National Guard, the implementation and enforcement of these standards have been slow. Enforcement is further complicated by federal control of the dominant oil and petrochemical industry, the country's major foreign exchange earner.

At present, with the policy directives of the Organic Law, some increased enforcement by MARNR, and rising public awareness, environmental issues are gradually coming to the forefront. Current policy directives are aimed at solidifying the relationship between the 20 states and the federal government, and call for strict monitoring and enforcement of Venezuelan environmental standards. These forces signal a growing constituency in favor of environmental management at the institutional, public and private sector levels.

Venezuela's regulatory structure is primarily directed towards achieving pollution control via end-of-pipe measures rather than promoting pollution prevention. However, the MARNR is beginning to urge the petroleum/petrochemical and the chemical manufacturing industries to increase their pursuit of pollution prevention technologies. In addition, the CEL is expected to trigger new regulatory strategies to advance pollution prevention through various incentive schemes (e.g., tax exemption for investment in pollution control and prevention equipment). Overall, MARNR is well positioned to promote integrated pollution management through various financial incentives, mandatory planning, and facility-licensing procedures.



### Outlook for the Environmental Market

In light of the new policy climate, the Venezuelan environmental market is expected to grow rapidly during the 1990s, especially in such sectors as petroleum refining. During the next decade, the markets for environmental products and services will be led by three main drivers: the expansion and modernization of the petroleum sector; increased enforcement of environmental regulations, including strict criminal penalties for non-compliance; and growing efforts to clean up the country's main sources of pollution.

**Key Environmental Market Drivers**

Key market drivers	Impact
Expansion and modernization of the petroleum sector, the main contributor to export receipts and GDP.	Higher investments in environmental management and pollution control equipment for the petroleum industry.
Environmental regulation appended to include a stringent criminal code enforceable on all violations (the CEL). Regulation and compliance are now concentrated in a single agency, the MARNR.	Increased enforcement for multinationals and state-run companies. The market will respond favorably because of the high cost of non-compliance.
Strong government and private-sector motivation to improve environmental conditions around Caracas and Lake Valencia.	Increased market for wastewater treatment and sewage plants. Also, more investments by growing non-petroleum sectors of the economy.

Venezuela's overall market for pollution control equipment and services was estimated at \$42 million in 1991. This market is poised to grow by 6 percent in 1992 and by 12 percent next year, reaching a total of \$48 million in 1993. The market for pollution control equipment alone is expected to grow at 6 percent per year (from \$28 million to \$32 million) between 1991 and 1993. Venezuela currently imports almost 97 percent of its pollution control equipment, with the United States supplying close to 89 percent of this market. U.S. imports are expected to grow 8 percent per year in 1992 and 1993.

**Venezuelan Environmental Market (\$ million)**

	1991	1992 (est.)	1993 (est.)
Air Pollution Control*	23	25	27
Water Pollution	9	9	10
Solid/Hazardous Pollution	10	10	11
Total	42	44	48

\* Includes chemical/power generation and pollution control equipment.

Source: Adapted from U.S. Department of Commerce data.

## Venezuela

Environmental services accounted for 33 percent of the Venezuelan environmental market in 1991, totaling \$14 million, and are expected to maintain a similar share in 1992 and 1993.

Wastewater pollution studies and industrial air pollution modelling proved to be the most sought-after services in 1991, contributing \$4 million and \$3.5 million to that year's total market, respectively.

This short-term market growth is explained by the record investments made by leading Venezuelan industries (e.g., PdVSA and Venepal, a large pulp and paper concern), coupled with an expected increase in environmental regulation and compliance as a result of the promulgation of the CEL in April 1992.

U.S. companies can expect to enjoy a majority market share as their products and services are highly respected. Competition from local domestic and third-country suppliers is considered moderate and there are few trade barriers to enter the environmental market.

Water Pollution Discharge Studies	4.0
Industrial Air Pollution Modelling	3.5
Environmental Planning and Impact Assessments	3.0
Contamination Surveys	2.5
Waste Disposal Siting and Design	1.0

Source: U.S. Department of Commerce

### ***Environmental Market Opportunities and Competition***

Of the \$42 million Venezuelan environmental market in 1991, air pollution equipment and services totaled \$23 million (55 percent), while water pollution projects accounted for \$9 million (21 percent), and solid/hazardous waste contributed \$10 million (24 percent). The total market is expected to grow to \$44 million in 1992 and to \$48 million 1993, with the shares of the three sectors remaining relatively constant. The major opportunities for pollution control and waste management are in the petroleum sector and in the diverse industries around Lake Valencia and Lake Maracaibo.

Recent air quality studies performed by MARNR indicate that leading air pollution indicators have substantially improved in the Caracas metropolitan region since 1986. Equipment to monitor CO<sub>2</sub>, suspended particulates, and lead and dust concentrations has been installed in five zones in Caracas: El Silencio, La Yaguara, El Cementerio, Los Ruices, and La Trinidad. The greatest improvements were seen in airborne lead concentrations, which were reduced by almost three times from their previous levels. This improvement was achieved primarily by an aggressive effort on the part of MARNR and PdVSA to reduce the lead content in gasolines. The coordinated effort has proven to be very successful, and the Institute of Petroleum Research is now willing to play a role in mitigating transport-related emissions in other cities.

Air  
Pollution  
Control

The most polluting industries in Venezuela include pulp and paper, petrochemicals, food processing, and the primarily oil-fired electric power plants. These industries contribute to the growing demand for engineering services, including air pollution modelling, plant emissions surveys, and the installation of monitoring equipment in environmentally-sensitive areas.

Venezuela also has a CFC reduction program in place; a recent report from MARNR indicates that the country has reduced its use of ozone-depleting chemicals from 0.34 kg per person in 1986 to 0.17 kg per person in 1991. This 50 percent reduction has been achieved in a number of ways, including utilizing CFC free-technology and resources from the Montreal Protocol's Multilateral Fund.

Venezuelan electric utilities are slowing their capacity expansion during this decade. This gives them a chance to invest in pollution abatement equipment and to improve their operating efficiencies. The double-digit electric power demand growth of the early 1980s will not be seen again in this century. The World Bank has estimated a 2-3 percent growth rate as more likely, although utility and business officials in Venezuela are hoping to see demand growth rates in the 5 percent range. Venezuela's power generation expansion plan until 2000 will be dominated by hydroelectric projects, complemented by moderate thermal plant additions.

The air pollution market is projected to total about \$25 million in 1992. Of this, nearly \$20 million will be for equipment, of which \$13 million will cover controls, monitoring, and diagnostic equipment for the petroleum refining, petrochemicals and utility power generation industries. A total of \$5 million will be spent on services for industrial air pollution monitoring and environmental planning and impact assessments.

## Venezuela

### *Existing and Projected Electric Generating Capacity in Venezuela (MW)*

	1989	%	1999	%	Net Additions
Hydroelectric	10,581	63	20,515	73	9,934
Oil					
Thermal	3,954	23	4,417	16	463
Combustion Turbine	2,228	13	2,752	100	504
Diesel	98	<1	296	1	198
Total	16,861	100	27,980	100	11,099

Source: RCG/Hagler, Bailly, Inc. and World Bank estimates.

### *Major Opportunities*

PdVSA

The state-owned oil company plans to spend close to \$7.5 billion through 1996 to upgrade, expand and acquire oil and gas production, particularly to produce a number of new refined products and meet new environmental rules for refined products sold in the U.S. market, its most important export market. Sizable spending for environmental compliance is expected at all PdVSA facilities.

Pequiven

The national petrochemical company also plans to develop new product lines and to streamline its operations by shutting down old plants and modernizing others. Pequiven made close to \$820 million worth of new investments during 1991.

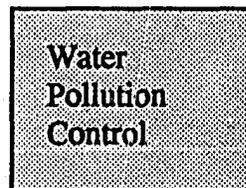
A new complex on the Paraguana peninsula (State of Falcon) is being developed close to the LAGOVEN and MARAVEN (PdVSA subsidiaries) refining centers. Further activities are planned in the State of Anzoategui, next to the Jose cryogenic plant operated by CORPOVEN, which is also a PdVSA subsidiary. These additions are expected to require significant environmental abatement equipment to comply with MARNR standards.

- CADAFE**      This is the largest electric utility in Venezuela. It owns most of the country's thermal electric generating capacity. Most of CADAFE's thermal generation is achieved from oil-fired boilers with a few combustion turbines and diesel engines. CADAFE recently embarked on converting the first unit of the oil-fired Planta Centro station to gas-fired generation. The second and third units will be converted by 1993. These conversions are opportunities to sell low-NO<sub>x</sub> burner and gas cleaning equipment.
  
- Venepal**      This pulp and paper industry giant also expects to modernize its plants during the 1991-1996 period.
  
- Industry**      Several new capacity expansion projects are planned by Venezuela's private industries. The Moron complex which is located in the State of Carabobo and supplies industrial products and fertilizers, plans to nearly double its capacity by 1996. Also, the Guayana mines plan to increase their production capacity from 20 to 25 million tons per year by late 1992 and 40 million tons by the year 2000. These additions are expected to require significant environmental abatement equipment. Plant expansions are also being undertaken by SIDOR, the state-owned steel producer.

### ***Competition***

No major local suppliers of air pollution control equipment or diagnostic equipment were identified during this study. The United States appears to be competitive and enjoys a majority share in this market. Furthermore, air pollution control equipment is only subject to a 1 percent import duty surcharge in Venezuela.

The basin of Lake Valencia, together with the metropolitan area of Caracas and its surroundings, is the most highly developed region in the country. The region contains Venezuela's largest concentrations of urban population, industrial activity and agricultural potential, and employs about 70 percent of the domestic work force in close to 1,000 industrial establishments. Until as recently as two years ago, many of these establishments did not engage in either primary or secondary treatment, and often discharged raw waste into Lake Valencia.



## *Venezuela*

An extensive set of regulations, developed specifically for the Lake Valencia region, now authorizes MARNR to enforce environmental regulations in a very strict manner. In compliance with Resolution No. 124 of the LEA, more than 160 of the 237 factories classified as medium- to heavy-quantity dischargers have already constructed water treatment systems or are in the process of doing so. The water pollution problems seen in other river basins such as the Caroni river (eastern Venezuela) are also significant.<sup>4</sup>

The National Sanitation Administration (INOS) is the state agency responsible for the country's water and sewage supply. It owns and operates several large sanitation projects under contract from the Ministry of Public Health and Welfare. INOS is now in the process of being decentralized and plans to increase its emphasis on wastewater and sewage treatment projects.

There is general confusion in Venezuela as to whether the government or the private sector should initiate the development of wastewater treatment plants. Recognizing the need for increased water services, the multilateral development banks such as the World Bank and the InterAmerican Development Bank have supported various wastewater and sanitation projects proposed by state and federal agencies to serve the Lake Valencia area. In particular, there are three major municipal wastewater treatment projects underway:

- The Los Guayos treatment system, which has recently been completed, provides service to the old part of Valencia, the San Diego valley, industrial zones and adjacent districts.
- The La Mariposa wastewater treatment system is a modular four-part system with a capacity of about 2 cubic meters per second of water. The treatment system serves the southern and eastern parts of the cities of Valencia and Tocuyito.

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<sup>4</sup> Recently, the Guyana Conservation Society brought charges against ten Venezuelan mining companies for allegedly dumping mercury-laden wastes in the Caroni River. Further, a recent study by a Canadian consulting firm revealed that the lower Caroni River area was heavily contaminated with mercury. The mercury concentration levels recorded were 950 times higher than those indicated by previous studies.

- The Maracay-Taiguaiguay system<sup>5</sup> manages the wastewater discharges of Maracay, Palo Negro, Cagua, Turmero located near the eastern end of the lake basin. This third plant treats wastewater from the city of Maracay, which contributes about 30 percent of the total volume of wastewater pollutants entering Lake Valencia.

The U.S. Department of Commerce (DOC) reports that the Venezuelan water pollution market, covering both the industrial and municipal sectors, totaled about \$9 million in 1991. Of this, about \$4 million was for pollution control equipment, while \$5 million was for water pollution discharge studies and environmental impact assessments. The market is expected to be comparable in 1992 and 1993, but is poised for growth given the stricter implementation of the LEA and the CEL in the future. Simultaneously, general awareness of environmental issues has improved at most public and private establishments.

### *Major Opportunities*

- INOS                      This state agency represents a major end user market segment for wastewater equipment, as it is charged with implementing several wastewater treatment projects from the 8th National Plan.
  
- Treatment works              Projects such as the Los Guayos, La Mariposa and the Maracay-Taiguaiguay systems offer a substantial market for treatment equipment, monitoring devices, and associated engineering services. These projects are crucial to the success of pollution mitigation efforts for Lake Valencia.
  
- States                        The State of Monagas lies in the northeastern coastal region of the country. It comprises about half a million persons and the major river basins of Guarapiche and Amana, which show a high degree of contamination. Water supply and sewerage systems are currently inadequate, with only 60 percent of the population being connected to the sewage collection system. Opportunities in these states include

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<sup>5</sup> The Maracay-Taiguaiguay system has a design capacity of 4 m<sup>3</sup>/second, which is sufficient for the region's needs until the year 2000. The system consists of a collector that transports wastewater to the Camburito pumping station, which will transport it further to the Taiguaiguay reservoir. The treated waters will be used for irrigation, managing the water level in the lake, and for resupplying water to spent aquifers.

## *Venezuela*

improving the coverage of sewerage and increasing the capacity of collection systems.

Similar opportunities exist in the States of Merida and Barinas. Specific sewage treatment plant needs have been identified for the cities of Merida, El Vigia, and Barinitas.

**CADAFE**

This utility often fails to meet boiler water chemicals standards. As a result, sales opportunities exist there.

**VENEPAL**

The Venezuelan paper maker C.A. Venezolana de Pulpa y Papel has recently agreed to fully comply with all MARNR water quality standards. This agreement calls for VENEPAL to fund and construct a wastewater treatment plant within 30 months. This arrangement supplements the planned expansion of an existing VENEPAL wastewater treatment facility. VENEPAL would pay a monthly operational fee and a charge for inspection and supervision during construction.

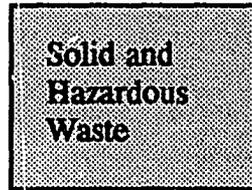
**Industry**

Industrial plants represents a large market for primary and secondary wastewater treatment centers. The expanding Moron complex, the steel maker SIDOR, and major mineral firms near the Guayana mines and cities represent potential purchasers.

**MARNR**

MARNR and the IDB are currently designing a \$65 million watershed management program that includes a substantial water quality control and monitoring component. Competitive bidding is expected to be opened at the end of 1992.

Because the solid and hazardous waste markets are only now emerging in Venezuela, little information is available on current market conditions, competition, and major opportunities. However, the petroleum and petrochemical industries are likely to represent major clients. Federal and municipal agencies should also be clients for waste management equipment and planning and assessment services.



The DOC reports that the market totaled \$10 million in 1991, divided evenly between equipment and services. Service projects included contamination surveys, waste disposal siting and design, and environmental impact studies. In the near term, the market can be expected to remain about the same, but like water and air pollution, could grow rapidly as regulations are more strictly enforced.

### ***Market Entry Strategies***

The Venezuelan industrial sector represents a strong, traditional market for U.S. suppliers. Based on the country's receptiveness to U.S. goods and services, U.S. environmental companies can expect to maintain or establish relatively strong market positions.

Possible market entry strategies for U.S. companies interested in Venezuelan opportunities include:

#### ***Short-Term***

- Actively solicit PdVSA refinery waste management projects -- water, air and solid wastes.
- Target municipal authorities that need integrated urban solid waste management systems.
- Assist in the development of unleaded and reformulated gasoline fuels.
- Work closely with U.S. architecture/engineering/construction companies pursuing general industrial projects.

## ***Venezuela***

### ***Long-Term***

- Assist in the development of pollution prevention programs at multinationals.
- Develop joint venture or licensing agreements with Venezuelan firms.

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