



MEXICO

ENVIRONMENTAL TECHNOLOGIES EXPORT MARKET PLAN



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Preface

The office of Environmental Technologies Industries, through the Commercial Section of the U.S. Embassy in Mexico, commissioned the production of this report covering short- and medium-term business opportunities in Mexico for U.S. suppliers of environmental equipment and services. The report informs U.S. environmental companies of specific market opportunities that will be available in Mexico as a result of the inauguration of a new federal administration that has listed environmental protection as one of its top priorities.

This report was produced by Hanhausen & Doménech Consultores S.C., a Mexico City-based consulting firm specializing in market research, business opportunity analysis, and project development.

It is important to consider that Mexico has gone through a dramatic change in government. For the first time in over 70 years, the federal government is under the control of a center-right, pro-business political party.

This new government is planning a widespread reform to promote economic and social development in Mexico with a clear emphasis on environmental issues.

With the new administration in office for only few months, most of the new programs are still at the conceptual stage. This report outlines the areas covered by the new programs, although many details on how those initiatives will materialize have yet to be defined. Many of the programs are expected to be presented in stages. The first stage, covering water and forests, was presented in conceptual terms in March 2001. Additional programs for municipal waste and hazardous waste are expected to follow.

To allow individual companies to monitor future developments on environmental programs in Mexico, we have included in Appendix B a list of contact information for the new environmental authorities.

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Abbreviations and Acronyms

APAZU	Programa de Agua Potable, Alcantarillado y Saneamientos en Zonas Urbanas (Potable Water Program for Urban Zones)	CONIECO	Consejo Nacional de Industriales Ecológicos (National Council of Environmental Industries)
BANCOMEXT	Banco Nacional de Comercio Exterior (National Foreign Trade Bank)	COPARMEX	Confederación Patronal de la República Mexicana (Confederation of Mexican Employers)
BANOBRAS	Banco Nacional de Obras y Servicios Públicos (National Bank for Public Works)	DGCOH	Dirección General de Construcción y Operación Hidráulica (General Directorate for Construction and Operation of Hydraulics)
BECC	Border Environmental Cooperation Commission	EPC	engineering, procurement, and construction
BEIF	Border Environmental Infrastructure Fund	ETI	Environmental Technologies Industries (U.S. Department of Commerce)
BOD	biological oxygen demand	FINFRA	Fondo de Inversión en Infraestructura (Fund for Infrastructure Investments)
BOT	build-operate-transfer	FMCN	Fondo Mexicano para la Conservación de la Naturaleza (Mexican Nature Conservation Fund)
CAM	Comisión Ambiental Metropolitana (Metropolitan Environmental Commission)	FORTEM	Programa de Fortalecimiento de Estados y Municipios (Program for Strengthening State and Municipal Authorities)
CANCINTRA	Cámara Nacional de la Industria de la Transformación (National Chamber of the Manufacturing Industry)	GDP	gross domestic product
CCE	Consejo Coordinador Empresarial (Business Coordination Council)	G25	group of environmental experts
CEC	Commission for Environmental Cooperation	Haztraks	Hazardous Waste Tracking System
CESPEDES	Centro de Estudios del Sector Privado para el Desarrollo Sustentable (Private-Sector Center for Studies toward Sustainable Development)	IBRD	International Bank for Reconstruction and Development
CETES	Certificados de la Tesorería de la Federación (Mexican Treasury Certificates)	IBWC	International Boundary and Water Commission
CFE	Comisión Federal de Electricidad (National Electricity Commission)	IDB	Inter-American Development Bank
CIMARI	Centros Integrales para el Manejo y Aprovechamiento de Residuos Industriales (integrated centers for treatment and disposal of hazardous waste)	IFC	International Finance Corporation
CIMEX	Conservación Internacional de Mexico (Conservation International Mexico)	IMECA	Indice Metropolitano de la Calidad del Aire (Metropolitan Index for Air Quality)
CNA	Comisión Nacional del Agua (National Water Commission)	IMI	International Market Insights
CNG	compressed natural gas	IMTA	Instituto Mexicano de Tecnología del Agua (Mexican Institute for Water Technologies)
CO	carbon monoxide	INE	Instituto Nacional de Ecología (National Institute of Ecology)
CONAGUA	Comisión Nacional del Agua (National Water Commission, currently CNA)	ISA	Industry Sector Analysis
CONCAMIN	Confederación de Cámaras Industriales (Confederation of Industrial Chambers)	JBIC	Japan Bank for International Cooperation
		JICA	Japan International Cooperation Agency

kg/d	kilograms per day	SAGARPA	Secretaría de Agricultura, Gandería, Desarrollo Rural, Pesca y Alimentación (Secretariat of Agriculture, Cattle Raising, Rural Development, Fisheries, and Feeding)
LIBOR	London interbank offered rate		
lps	liters per second		
m ³ /s	cubic meters per second		
mg/l	milligrams per liter	SCT	Secretaría de Comunicaciones y Transportes (Secretariat for Communications and Transportation)
ml/l	milliliters per liter		
NAFINSA	Nacional Financiera (Mexican government-owned bank)	SEDESOL	Secretaría de Desarrollo Social (Secretariat for Social Development)
NACEC	North American Commission for Environmental Cooperation	SEMARNAP	Secretaría de Medio Ambiente y Recursos Naturales y Pesca (Secretariat of the Environment, Natural Resources, and Fisheries, now SEMARNAT)
NADBank	North American Development Bank		
NAFTA	North American Free Trade Agreement		
NO ₂	nitrogen dioxide	SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales (Secretariat of the Environment and Natural Resources)
NOMs	Normas Oficiales Mexicanas (Mexican Official Regulations)		
O ₃	Ozone	SHCP	Secretaría de Hacienda y Crédito Público (Secretariat of Finance)
OECF	Overseas Economic Cooperation Fund	SIAPA	Sistema Intermunicipal de Agua Potable y Saneamiento (Intercity Drinking Water and Sanitation System)
OOMAPAS	Organismo Operador Municipal de Agua Potable y Saneamiento (Municipal Water and Sewer Operating Body)	SIASPA	Sistema Integral de Administración de la Seguridad Industrial y la Protección Ambiental (Integrated Management System for Safety and Environmental Protection)
PAN	Partido de Acción Nacional (National Action Party)		
Pb	lead		
PCBs	polychlorinated biphenyls		
PDAP	Project Development Assistance Program	SIMEPRODESO	Sistema Metropolitano de Procesamiento de Desechos Sólidos (Metropolitan Solid Waste Processing System)
PEMEX	Petróleos Mexicanos (Mexico's government-owned petroleum company)	SINAICA	Sistema Nacional de Información de la Calidad del Aire (National Information System on Air Quality)
PM2.5	particles under 2.5 microns		
PM10	particles under 10 microns	SIP	State Implementation Plan
PPM	particles per million	SO ₂	sulfur dioxide
PRI	Partido Revolucionario Institucional (Institutional Revolutionary Party)	TSP	total suspended particles
		TSS	total suspended solids
PROAIRE	Programa para Mejorar la Calidad del Aire en el Valle de México (program for improvement of air quality)	UN	United Nations
		USAID	U.S. Agency for International Development
PROFEPA	Procuraduría Federal de Protección al Ambiente (Office of the Attorney General for Environmental Protection)	U.S. DOC	U.S. Department of Commerce
		U.S. EPA	U.S. Environmental Protection Agency
PVEM	Partido Verde Ecologista de México (Mexican Green Environmental Party)	U.S. ExIm	U.S. Export-Import Bank
		U.S. TDA	U.S. Trade and Development Agency
REXEMAR	Red Mexicana de Manejo de Residuos (National network between the federal government, waste generators, research centers, and local authorities)	VOCs	volatile organic compounds
SADM	Servicios de Agua y Drenaje de Monterrey (Monterrey water utility)		

Note: Unless otherwise noted, dollar figures given in the text represent U.S. dollars. The exchange rate was calculated at 10 Mexican pesos to the U.S. dollar.

Executive Summary

Mexico, with a population fast approaching 100 million inhabitants, changed dramatically in the last decade and will continue to do so in the coming years. A new federal administration took office in December 2000 with a strong mandate to change Mexico for the better. President Vicente Fox has defined environmental protection as a matter of national security and will deal with the challenge accordingly. This strong commitment is expected to translate into a major boost in the demand for environmental technologies and services in Mexico. Expectations of further economic growth and stability bode well for the continued expansion of the Mexican environmental market and of opportunities for U.S. environmental companies.

Private-sector sources estimate the size of the Mexican environmental market at \$3.9 billion per year and foresee a 7-percent market growth during 2001 and a 12-percent annual growth for the 2002–2005 period.

Increased private participation will be encouraged in every environmental sector because there are not enough government funds to pay for all the necessary programs and infrastructure. To succeed, the government must continue to strengthen the financial structures of municipal authorities, which will execute a growing number of environmental projects. Service fees will be used to attract private investment. A strong signal in this direction is President Fox's recent proposal to increase water prices by 50 percent to help pay for needed infrastructure. Improving environmental infrastructure is the first environmental priority under the recently launched program National Crusade for Forests and Water. Development of this crusade illustrates both the magnitude of the challenge and the seriousness of the government's commit-

ment to attracting new private investment and to avoiding falling further behind in developing the needed environmental infrastructure.

Other areas, such as improving air quality in Mexico City, will remain priorities. Mexico City is undertaking a major assessment of its air quality and will present a final evaluation in July 2001. The findings will become the basis for developing a new 10-year air-quality improvement program. Similarly, a growing number of programs for the improvement of air quality (PROAIRE) will be developed for other urban areas during the Fox administration.

Enforcement authorities, leveraging a growing social awareness of the importance of sustainable development, will introduce a "green company" logo that will be displayed on the products of those companies exceeding compliance with environmental regulations.

Both municipal and hazardous waste programs and projects will also be promoted in the short run. Mexico City will need to develop a new major landfill, and federal environmental authorities will promote waste minimization, recycling, and transportation projects for hazardous waste.

Projects financed by multilateral institutions and federal environmental programs present the best short-term opportunities. Other opportunities exist within Mexico's parastatal industries, especially the national oil company, PEMEX, and the national electric utility, CFE.

The Mexican environmental market will continue growing, thus creating a spectrum of new business opportunities for U.S. suppliers. The attractiveness of this market to suppliers from the United States and other nations will make it increasingly competitive.

Chapter 1

Economic, Political, and Financial Issues

Economic Performance and Trends

The Mexican economy performed well in 2000, achieving the highest economic growth rate of any Latin American country. Official year-end figures published by the Banco de México (the central bank) for 2000 indicate that the gross domestic product (GDP) grew 6.9 percent, while a downward trend in inflation continued. Inflation in 2000 declined to 9.0 percent, the lowest level since before the 1994 economic crisis. Expectations of further growth and stability bode well for the continued expansion of the Mexican environmental market and of opportunities for U.S. environmental companies. (See Figure 1.1.)

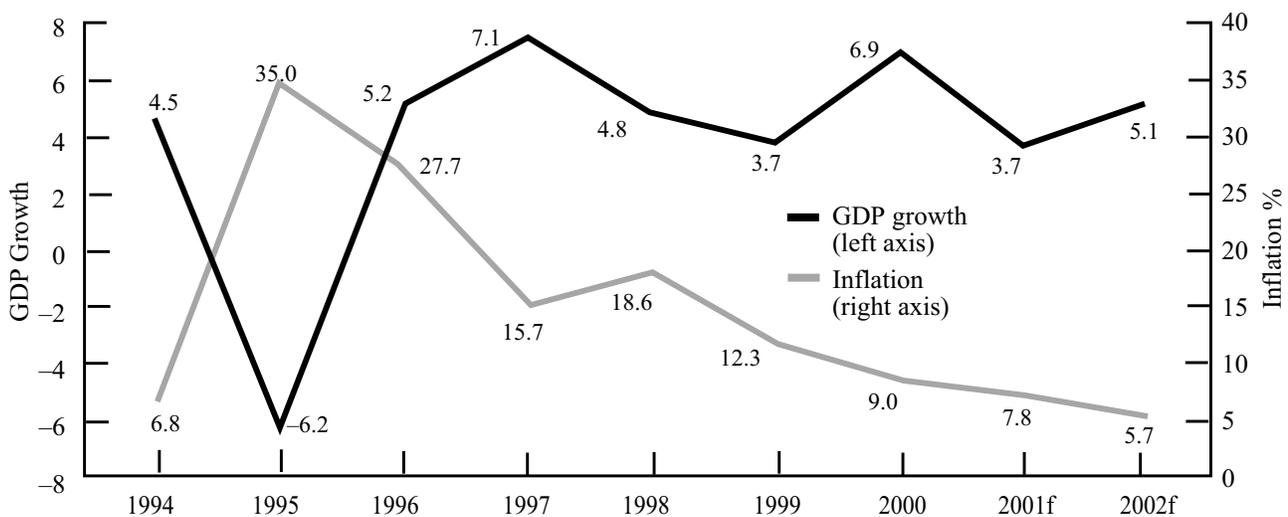
Mexico's positive performance in 2000 was driven by prudent fiscal and monetary policy, as well as by renewed business confidence and a positive international environment. Internationally, Mexico benefited from strong growth in the U.S. economy along with increasing world

prices for oil. Despite the expected slowdown in U.S. growth and a fallback in oil prices, economic analysts still forecast Mexico to have continued strong economic growth in 2001.

Positive business and consumer confidence are also driving Mexico's economic resurgence. Private investment grew 12.4 percent in 2000, and private consumption grew 8.7 percent, fueled by increased employment and a slight improvement in real wages. This growth follows a period where economic uncertainty cooled business investment, particularly hurting investments in the environmental area, which were deemed nonessential.

Another economic improvement that will greatly aid U.S. companies is the stability of the peso-dollar exchange rate. Past fluctuations in this exchange rate have had a very negative effect on the Mexican environmental market. The costs of imports in pesos skyrocketed, living standards fell, and long-term environmental

Figure 1.1 Mexico's Economic Performance, 1994–2002 (percent)



f = forecast

Source: Banco de México; forecasts by BBVA-Bancomer.

projects could no longer be financed because of extremely high borrowing costs.

The Mexican government has adopted a floating exchange rate whereby market conditions determine the exchange price. This policy, combined with positive international conditions and prudent fiscal and monetary policy, has brought stability to the peso, as Figure 1.2 shows.

Mexico continues to import at a higher rate than it exports, causing the country's current account deficit to reach approximately 3.3 percent of GDP for 2000. Capital inflows, particularly U.S. foreign investment (see Figure 1.3), have covered this shortfall, and Mexican international reserves are strong. Growing foreign confidence in Mexico's economic fundamentals should continue to result in strong capital inflows.

Mexico's positive economic performance in the past few years and the signing of the North American Free Trade Agreement (NAFTA) have more than doubled trade between the United States and Mexico in the past five years.

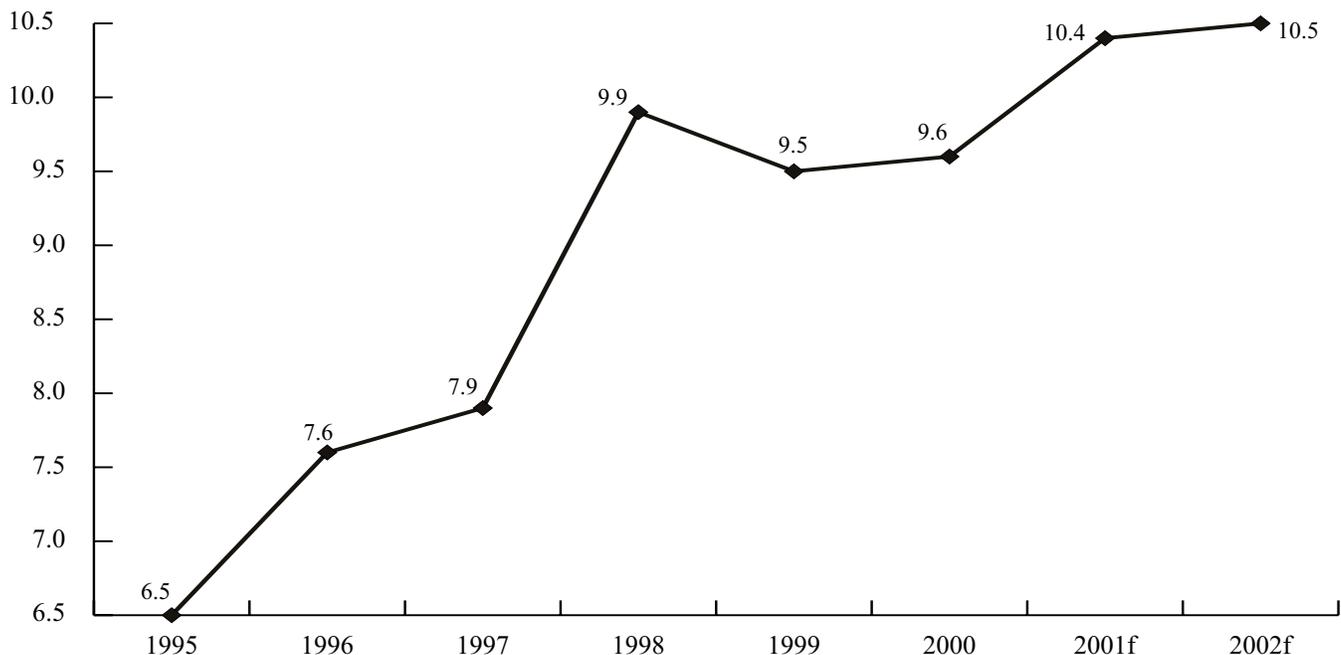
The new administration of President Vicente Fox has signaled that it will continue to pursue and strengthen the recent economic policies that have provided the framework for Mexico's economic turnaround. Those policies include prudent fiscal and monetary policy to ensure that internal demand does not generate inflation-

ary pressures. For example, the new administration plans to reduce federal expenditures immediately if government revenues from oil fall below target. The short-term goal is to reduce the public sector's deficit to under 0.5 percent of GDP. Over the medium term, the government has pledged to achieve a balanced budget.

The Fox administration also intends to push for structural economic reforms to improve Mexico's overall economic efficiency. Among those reforms are significant overhauls of Mexican labor and tax laws. In March 2001, the administration presented the Mexican congress with a proposal for a complete reform of the Mexican tax code. This initiative's most controversial topic is a proposed 15-percent sales tax on foods and medicines, which were previously exempt. The administration is betting heavily on the passage of this reform, which is its only current means for abating the public sector's deficit and raising additional income for social expenditures.

The Fox administration is forecasting economic growth for 2001 at 4.5 percent, with an inflation target of 6.5 percent. It estimates that the average exchange rate will be MXP 10.1 per \$1, with an end-of-period value of MXP 10.7 per \$1 or a nominal adjustment of around 11 percent from current levels. See Table 1.1 for a full range of government macroeconomic projections. Private-sector analysts are predicting lower growth and slightly higher inflation (3.7 percent and 7.8 percent, respec-

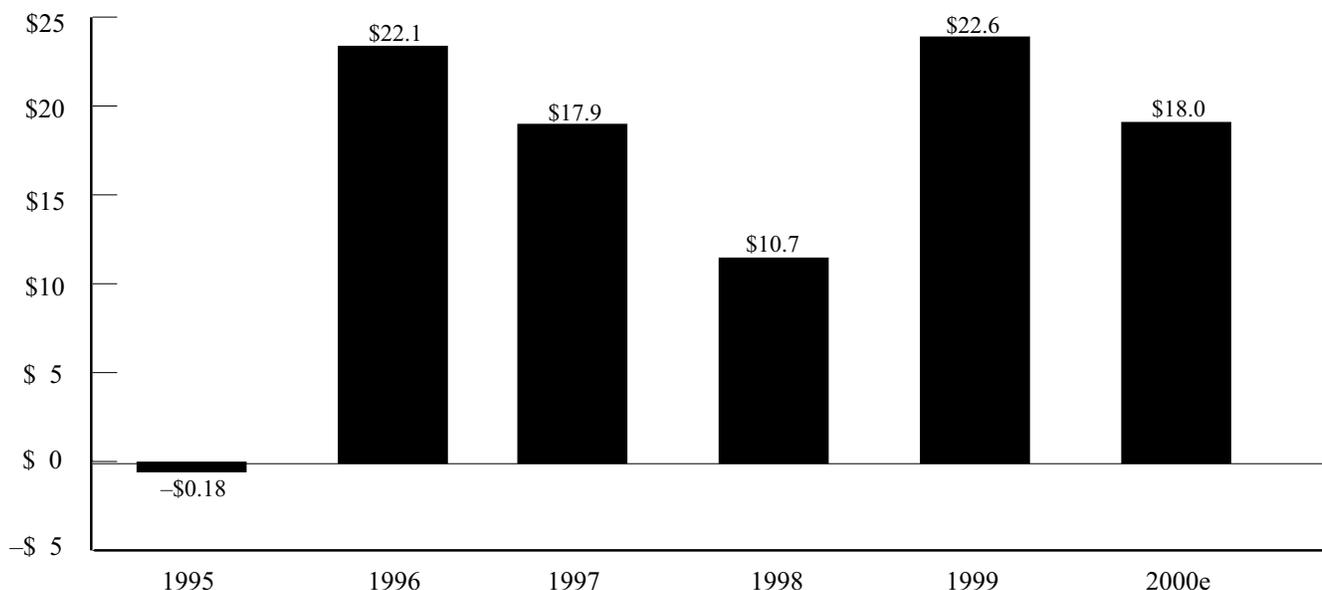
Figure 1.2 Exchange Rate, 1995–2002 (Mexican pesos per U.S. dollar)



f = forecast

Source: Banamex-Accival.

Figure 1.3 Foreign Direct Investment in Mexico, 1995–2000 (billions of U.S. dollars)



e = estimate

Source: Banamex-Accival.

tively), caused by a slowdown in the U.S. economy and lower oil prices.

New Political Mandate: Commitment to the Environment

Vicente Fox, a former Coca-Cola executive and governor of the state of Guanajuato, was elected president on July 2, 2000, ending 71 years of dominance of the Mexican presidency by the ruling party, Partido Revolucionario Institucional (PRI, Institutional Revolutionary Party). President Fox ran as the candidate for the coalition *Alianza por el Cambio* (Alliance for Change) formed by the National Action Party (PAN) and Partido Verde (PVEM, Mexican Green Environmental Party).

During the presidential campaign, Fox emphasized the importance of protecting Mexico's environmental resources. He particularly noted the significance of the fight against pollution in the country's metropolitan areas and spoke of the need for environmental protection as a national security issue.

President Fox took office on Dec. 1, 2000. In one of his first actions, he restructured the Secretariat of the Environment, Natural Resources, and Fisheries (SEMARNAP). The restructured agency was renamed the *Secretaría de Medio Ambiente y Recursos Naturales* (SEMARNAT, Secretariat of the Environment and Natural Resources). Under this restructuring, the fishery activities were delegated to the Secretariat of Agriculture,

Cattle Raising, Rural Development, Fisheries, and Feeding (SAGARPA). In addition, the new SEMARNAT will be more involved in regulatory activities and will take over some planning responsibilities that were spread among decentralized entities. One of the main ideas is to convert the Instituto Nacional de Ecología (INE, National Institute of Ecology), which currently plays an important regulatory role, into a research center more specialized in environmental investigation and information systems and less dedicated to issuing regulations. INE will be SEMARNAT's think-tank.

The Fox administration is expected to promote an increase in private participation in most environmental sectors and to minimize the federal government's spending on subsidies and project development. This privatization can be achieved only by strengthening the financial and operational capacity of state and municipal authorities that are responsible for providing services; by creating a regulatory framework that allows tariff adjustments while protecting the interests of users; and by developing better coordination among the different levels of government to ensure a long-term relationship with private investors. The administration also plans to increase the pace of decentralization efforts started by the past administration to strengthen local control over potable water, wastewater, and municipal waste services. President Fox stated that he will increase cooperation with the United States over environmental issues, especially in the border region.

Table 1.1 Government Macroeconomic Projections

	2000e	2001p
Gross domestic product:		
Real GDP (percent)	6.90	4.50
Nominal GDP (MXP billion)	5,496.00	6,133.10
GDP deflator (percent)	11.00	6.80
Inflation:		
Dec.–Dec. (percent)	8.90	6.50
Nominal exchange rate:^a		
Average (MXP to \$)	9.50	10.10
Interest rates (28-day CETES):^b		
Nominal, average (percent)	15.20	12.40
Real (percent)	6.80	6.20
Current account:		
Millions of dollars	18,958.50	22,848.00
As percentage of GDP	3.30	3.80
Public balance:		
As percentage of GDP	0.93	0.50
Support Variables:		
U.S. GDP:		
Real growth	5.00	3.00
U.S. inflation:		
Dec.–Dec. (percent)	2.90	2.50
Oil price (Mexican oil mix):		
Average price (\$ per barrel)	25.80	18.00
Average volume of oil exports ^c	1,678.00	1,825.00
External interest rate:		
LIBOR ^d (percent)	6.60	6.50

e = estimated p = projected

a. Because Mexico has a flexible exchange rate regime, these numbers cannot be interpreted as an exchange rate projection. However, for the purpose of calculating some items of the budget, these references were used.

b. Certificados de la Tesorería de la Federación.

c. Thousand barrels per day.

d. London interbank offered rate.

Source: Secretariat of Finance, *General Guidelines for Economic Policy, 2001*.

President Fox's government is expected to create a favorable environment for private investment in environmental projects. A strong signal in this direction is the president's recent proposal to increase water prices by 50 percent to cover the real cost of water and help pay for needed infrastructure. Legislation changes will be required to implement this plan, and three levels of government will be involved in decisions; hence, the changes will take time to implement. Meanwhile, projects with federal or multilateral funding will continue to represent

the largest public-sector opportunities in the environmental arena.

The administration will promote all environmental areas. This commitment has been evidenced by the inclusion of the secretary of environment in three different cabinet-level policy-making groups. As a starting point, the government recently presented its first far-reaching environmental program aimed at protecting and restoring water resources and forestry in Mexico. The program, called the National Crusade for Forests and Water, will be the basis for many specific projects that will involve private investment, technologies, and services.

Financial Issues Affecting the Mexican Environmental Market

The Fox administration will promote strategies to revive private-sector investment in major environmental projects, particularly in the areas of water and municipal waste. Since the early 1990s, the Mexican government has aggressively pushed through many legal and regulatory reforms designed to increase the participation of private-sector firms in all aspects of the environmental sector. The government has sought to promote private-sector participation not only to bring in much needed capital but also to increase the efficiency of the services.

As a result of these reforms, many environmental projects, totaling hundreds of millions of U.S. dollars, were structured under various concession arrangements whereby the private company would take most of the project risk. In the 1990s, many U.S. and foreign environmental companies were given build-operate-transfer (BOT) contracts to construct municipal wastewater facilities, concessions to operate water systems, or concessions to build and operate municipal landfills.

At the time, it was hoped that such arrangements marked the beginning of a huge market opportunity for foreign environmental firms and particularly U.S. companies. Unfortunately, the fallout from the Mexican economic crisis in 1994 and institutional and financial problems at the local level stalled many of those projects. As a result, hundreds of millions of dollars of much needed private investment in potable water, wastewater, and municipal waste projects has not gone forward.

Those market and financial impediments have created a huge backlog of environmental projects. Mexican federal, state, and local governments, in concert with multilateral groups, have sought to identify and overcome

those obstacles to allow this potentially lucrative market to flourish. Major impediments are as follows:

- Investors and lenders are seeking high interest rates because of the sector’s past difficulties.
- No program is in place to subsidize needed environmental infrastructure in cases where the project is not financially feasible from a private investor’s standpoint.
- In many areas, residents are not accustomed to paying for water, wastewater, or municipal waste services and, therefore, are reluctant to do so.
- Although water and municipal waste services are provided at the local level, the local institutions lack

the experience and financial viability to support major environmental projects.

A number of programs have been proposed, and some have been implemented to overcome these impediments and reinvigorate the environmental market. Finding ways to finance those major environmental projects will greatly enhance the potential market opportunities for a broad spectrum of U.S. companies. The most important funding programs implemented thus far to promote environmental projects are shown in Table 1.2. These mechanisms and specific programs are discussed in detail in Chapter 10, except for APAZU, which is discussed in Chapter 5.

Table 1.2 Federal and Multilateral Funding Programs

<i>Implementing Entity</i>	<i>Program Description</i>
Comisión Nacional del Agua (CNA, National Water Commission) ^a	Under the Potable Water Program for Urban Zones (APAZU), a federal program, a municipality can request grants for water and wastewater investments in exchange for committing to improve its operational efficiency.
Banco Nacional de Obras y Servicios Públicos (BANOBRAS, National Bank for Public Works)	Through its Fund for Infrastructure Investments (FINFRA), BANOBRAS provides risk capital and subordinated capital to major projects, as well as grants to fund project feasibility studies.
North American Development Bank (NADBank)	The Joint U.S.-Mexico lending institution provides loans and loan guarantees for wastewater treatment and solid waste projects on the U.S.-Mexico border.
U.S. Environmental Protection Agency (U.S. EPA)	The agency provides grants for water infrastructure in the border area.
Secretariat for Social Development (SEDESOL)	SEDESOL provides grants for solid waste projects, preinvestment studies, and technical assistance.
Japan International Cooperation Agency (JICA)	Through the Japan Overseas Economic Cooperation Fund (OECF), JICA provides credit lines for water infrastructure and wastewater treatment plants.
U.S. Export-Import Bank (U.S. ExIm Bank)	U.S. ExIm Bank provides loan guarantees for the acquisition of U.S. environmental equipment and services.
U.S. Trade and Development Agency (U.S. TDA)	U.S. TDA provides grants for feasibility studies and promotes U.S. exports to infrastructure projects overseas.
Inter-American Development Bank (IDB) and BANOBRAS	IDB and BANOBRAS fund a program for the strengthening of state and municipal authorities (FORTEM), as well as the Aquifer Recharge Project in the Federal District (Mexico City).
World Bank	World Bank programs include the Natural Disaster Management Program, the Water Resources Management Project, and Mexico City Air Quality Improvement II (under negotiation).

a. Name will change to CONAGUA.

Chapter 2

Environmental Policies and Trends

Past Policies and Progress (1995–2000)

Environmental protection was a primary goal of the preceding administration of President Ernesto Zedillo, and progress was made on several fronts. Giving added impetus to that effort was Mexico's ascension to the NAFTA and other international trade treaties. The Zedillo administration is credited with strengthening the General Law of Ecological Balance and Environmental Protection in December 1996. Those changes increased the responsibilities of municipalities and states and increased sanctions, including criminal penalties for polluters. The administration also sought to increase the participation of the private sector in bringing new investment into all segments of the market, but particularly into the water and wastewater areas.

National Development Plan 1995–2000 set forth the aggressive environmental program of the Zedillo administration. The specifics were outlined in the chapter "Environmental Policies for Sustainable Growth." That chapter made an overall assessment of the state of the environment in 1995, laid out general policy goals, and then set specific targets for 2000. The government further refined its environmental goals in two additional policy documents: "Environmental Program 1995–2000" and "Hydraulic Program 1995–2000." Table 2.1 shows the progress made toward the goals set forth in those plans.

As Table 2.1 shows, Mexico achieved success in meeting many of its goals, particularly in delivering potable water and sewage services to an increasing percentage of the population. Important increases were also made in air-quality monitoring. Much-needed capacity was built for the treatment of bio-hazardous waste. Environmental investment increased significantly, although it fell beneath the \$4 billion target. The goal of treating 82 m³/s of wastewater was not met largely because of the lack of progress in building major new wastewater facilities in Mexico City and Guadalajara. Those projects are expected to materialize during the current administration.

As for hazardous waste, the past administration developed a very comprehensive program, which depended on major private-sector investments for the construction of integrated centers for treatment and disposal of hazardous waste (CIMARI). Social opposition to the siting

of those facilities led local officials to refuse the necessary permits to construct them. As a result, the safe confinement and disposal of hazardous wastes remain a critical environmental problem in Mexico. The government has decided to give full responsibility for these projects to SEMARNAT, which will work with local governments to address the siting and licensing issues.

Pending Environmental Challenges

Water

Mexico has increased dramatically its potable water coverage and now has the second highest coverage ratio in Latin America, trailing only Chile. One of the key challenges facing Mexico is that, although it has abundant water resources, most of those resources are located away from the major population centers. In the northern and central regions of Mexico, where 70 percent of the population is located, water resources are scarce. That uneven distribution of resources has resulted in the over-exploitation of aquifers, the contamination of surface water bodies, and the destruction of aquatic ecosystems. To reverse those negative impacts, Mexico must vastly improve management of its water resources by restoring aquifers, improving the efficiency of water distribution, enhancing water conservation, and treating its wastewater before returning the wastewater to the country's surface waters. All those challenges must be accomplished in the context of limited investment dollars amid a growing population and increasing industrial activity.

Wastewater Treatment

At present, 78 percent of municipal wastewater and 85 percent of industrial wastewater are returned to water bodies without adequate treatment. Most progress in building new municipal wastewater treatment capacity has been achieved in tourist zones and in the northern border region. Elsewhere progress has been limited. Both Mexico City and Guadalajara, which are Mexico's two most populous cities, still discharge most of their waste-

Table 2.1 Results of the Environmental Programs, 1995–2000

<i>Area</i>	<i>Situation in 1995</i>	<i>Proposed Goal for 2000</i>	<i>Situation in 2000</i>
Water	76.6 million inhabitants served potable water	Serve 86.9 million inhabitants potable water	87.5 million inhabitants served potable water
	70 m ³ /s of installed capacity	Reach 75 m ³ /s of installed capacity for potabilization	78 m ³ /s of installed capacity for water potabilization (1999)
	Over 55 percent of water distributed not metered	Strengthen municipal water utilities to improve metering and collection	39.9 percent of water distributed not metered (1999)
Sewage	56 million inhabitants served	Serve 60.6 million inhabitants	73 million inhabitants served
Wastewater	17 m ³ /s treated	Treat 82 m ³ /s	43 m ³ /s treated
	60 percent of wastewater treated on the northern border	Support the state and municipal authorities of 22 northern border cities to increase their levels of wastewater treatment	75 percent of wastewater now treated; also, all border cities have planned wastewater treatment projects and 31 water or wastewater treatment projects were built or are under construction
	Address situation in most polluted systems	Build new treatment capacity in the Valley of Mexico (Mexico City) and the Lerma-Santiago system	Almost all wastewater in Mexico City still untreated
Solid waste	30 percent of all municipal waste not collected	Reach 90 percent in collection and dispose of 75 percent in adequate landfills	80 percent of the municipal waste collected and 48 percent disposed in adequate landfills
Hazardous waste	8 million metric tons generated per year	Promote minimization in generation and recycling	Many companies structured minimization programs, but robust industrial growth leaves the volume generated unchanged
	Inadequate regulatory framework	Improve legislation to allow for the efficient management of hazardous waste	Legislation still inadequate
	Insufficient infrastructure for confinement	Promote construction of integrated centers for treatment and confinement of hazardous waste	No new confinement infrastructure built and operating; several notable failures of private attempts to build new capacity
	Insufficient infrastructure for treatment of bio-hazardous waste	Promote creation of infrastructure and services for the control of bio-hazardous waste	Current capacity of 24,870 kg/hr; although overall capacity is sufficient, some regions still lack facilities
Air pollution	One PROAIRE operating in Mexico City	No specific goal set	Seven PROAIRE operate in cities with highest air pollution levels in Mexico
	Five cities with air-quality monitoring systems	No specific goal set	15 cities with air-quality monitoring systems
Investment	Environmental investment estimated at \$1.8 billion in 1995	Environmental investment of over \$4 billion	\$3.761 billion estimated investment
Institutional framework	Limited availability of environmental information	Development of the National System for Environmental Information	Comprehensive registry established for hazardous waste generators; increased monitoring of air and water quality; increased number of environmental impact assessments and risk studies completed

m³/s = cubic millimeters per second

Source: Based on information from the National Development Plan 1995–2000, Environmental Program 1995–2000, Hydraulic Program 1995–2000, CNA, SEDESOL, INE, and CONIECO.

water without any kind of treatment. The Mexico City project, the most important municipal wastewater project in the country, has been stalled despite having received a financial credit from the Overseas Economic Cooperation Fund (OECF) in 1997. Many other large cities continue to discharge their untreated waters and are now in violation of regulation NOM-001-ECOL-1996. This regulation required all cities with more than 50,000 persons to have treatment capacity in place by Jan. 1, 2000.

The industrial sector, particularly large corporations, has seen notable progress in controlling its water discharges. The larger corporations have been the focus of enforcement efforts, and other corporations are part of the country's voluntary environmental audit program. Larger corporations also have the financial resources to invest in advanced treatment technologies. This effort has created a growing market for industrial wastewater treatment technologies and services. Increasingly, mid-sized and smaller companies will be compelled to take action to curb their water discharges as well. As municipalities build new wastewater facilities, industry will be pressured to end illegal discharges into sewers, as those discharges can damage municipal facilities.

Solid and Hazardous Waste Management

Mexico still greatly lacks infrastructure and services in both hazardous waste and municipal solid waste. Less than half of such waste receives proper handling, confinement, or treatment, in part because of a lack of enforcement and in part because of a lack of facilities to handle this waste stream. The government has tried to promote waste minimization and recycling, but those efforts are only partial solutions. As a result, there are a large number of illegal dumps, and industrial residues are mixed with municipal wastes or discharged into the sewers or water bodies or are improperly stored on site. All those conditions create huge public health and environmental risks.

Air Pollution Control

Air pollution is a severe problem in many large and medium-sized cities in Mexico. INE estimates that vehicles generate over 75 percent of all air pollution in the country, while industries and other fixed sources generate the remainder. The severity of air pollution problems in Mexico's metropolitan areas has spurred a comprehensive effort to reduce both mobile and fixed-source pollution by implementing PROAIRE. PROAIRE plans have now been extended to cover seven cities, and results have been encouraging. The new administration, in combination with state and municipal authorities, is implement-

ing PROAIRE plans in 10 other cities with more than 500,000 inhabitants. In addition, the government of Mexico City is expanding its current program to cover a time horizon of 10 years. Among the priorities of this expanded plan are the eventual conversion of the public transportation system to natural gas (see "Mobile Sources" in Chapter 8), stricter limits for nitrogen oxide, the regulation of suspended particles under 2.5 microns (PM_{2.5}), and the introduction of TIER II vehicles (vehicles that under U.S. law meet the 2004 to 2006 emission requirements of the 1990 Clean Air Act amendments) in 2007. In addition, the plan will propose reestablishing an environmental trust fund for Mexico City, which will help finance many air pollution control initiatives.

Soil Remediation Technologies

The Procuraduría Federal de Protección al Ambiente (PROFEPA, Office of the Attorney General for Environmental Protection) is undertaking a program to inventory contaminated sites across the country. The program has moved forward slowly because of lack of funding. To date, 105 contaminated sites have been identified, and remediation efforts have occurred or are occurring at 17 of those sites (see Table 7.3). The U.S. Environmental Protection Agency (U.S. EPA) is working with Mexican authorities to determine the feasibility of doing brownfield redevelopments on some of those sites.

In addition, Mexico has started a national register of hazardous waste generators. That initiative is spurring companies to end illegal discharges and to fix past damage from illegal discharges.

Other Equipment and Services

The federal government is increasingly pushing responsibility down to municipal governments, particularly in the areas of water and municipal solid waste. Further, 1999 reforms to article 115 of the Mexican Constitution granted wider environmental authority to the municipalities, making them more clearly responsible for enforcing environmental regulations.

At the local level, both environmental infrastructure, such as wastewater treatment or secure landfills, and institutional capacity and financial resources are often lacking. Mexico's federal government, in combination with the World Bank and the Inter-American Development Bank, have developed programs to strengthen the ability of local municipal entities to regulate, operate, and finance necessary infrastructure. This trend will drive a market not only for municipal infrastructure, particularly in the areas of wastewater and solid waste, but also for technologies that allow municipalities to be more effi-

cient in their operations and more effective in their oversight of environmental regulations.

New Policies of the Fox Administration

As this document is being completed, the Fox administration has begun a restructuring of the federal government's role in the sector, including a reorganization of the primary federal environmental agency, SEMARNAT. The Fox administration will formally present its environmental goals in the soon-to-be published National Development Plan 2001–2006.

Among the changes resulting from this restructuring are the following:

- Fisheries responsibilities have been transferred from SEMARNAT to SAGARPA, prompting the change of the agency's name to SEMARNAT.
- The new head of SEMARNAT is Víctor Lichtinger, former head of the Commission for Environmental Cooperation (CEC), a NAFTA-related agency that promotes environmental cooperation among the three NAFTA partners.
- SEMARNAT has begun a review to clarify responsibilities in the environmental sector, including clearly delineating the responsibilities of state and municipal authorities. SEMARNAT is reviewing environmental regulations known as Normas Oficiales Mexicanas (NOMs) and will propose changes to encourage compliance by small and medium-sized companies.
- Víctor Lichtinger named José Campillo García, former technical secretary of the Exterior Commerce Cabinet of the Presidency, as the new attorney

general for environmental protection. Lichtinger announced that the attorney general's office will be more autonomous and will work more closely with the public.

- SEMARNAT formed a working team with members of CNA, SAGARPA, the Secretariat of Economy, and the Secretariat of Finance (SHCP) to define a scheme for planning, building, and operating water infrastructure.
- Lichtinger announced that SEMARNAT will encourage private participation in water infrastructure and in municipal waste collection and recycling projects. The federal government will try to overcome the barriers that have limited private participation in those sectors in the past.
- SEMARNAT will prioritize developing new hazardous waste confinement or treatment capacity. It will work with local authorities, citizen groups, and the public to develop a consensus on the need for and siting of new facilities.
- SEMARNAT is working on a program to encourage water recycling on the part of large private users of potable water.
- The new administration will likely increase environmental expenditures on the Mexico-U.S. border.

SEMARNAT has a budget of \$1.44 billion for 2001.¹ This figure represents a 5-percent increase over the previous year and includes the total expenditures for SEMARNAT and its decentralized agencies such as CNA and INE.

1. Federal Government Budget, 2001. The exchange rate used is 10 Mexican pesos per \$1.

Chapter 3

The Market for Environmental Technologies

Market Size and Potential

According to the Consejo Nacional de Industriales Ecológicas (CONIECO, National Council of Environmental Industries), the Mexican environmental market was valued at \$3.761 billion during 2000 and is expected to reach \$4.212 billion by 2001, representing an increase of 7 percent. Figure 3.1 shows the breakdown of the market for 2000.

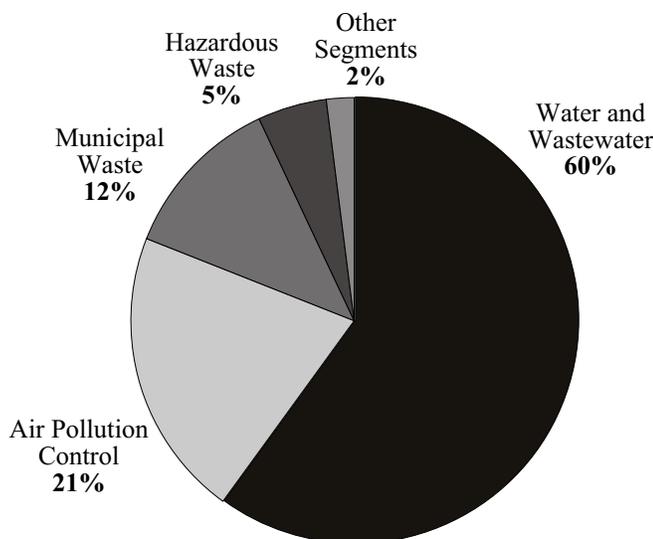
On a gross basis, Mexico invests more money in the environmental sector than any other Latin American country except Brazil. Nevertheless, environmental investment is low in Mexico (0.61 percent of GDP), according to an evaluation of 24 countries by the Centro de Estudios del Sector Privado para el Desarrollo Sustentable (CESPEDES, Private-Sector Center for Studies Toward Sustainable Development). The country was trailed only by Colombia and Venezuela, and was outspent by Chile, Brazil, and Argentina, as well as

numerous countries outside the region. However, CONIECO expects that the Mexican environmental market will grow at a rate superior to 12 percent from 2002 to 2005 if current favorable economic conditions remain throughout that period.

For Mexico to boost its investment numbers substantially, it must find ways to increase private-sector investment in major environmental infrastructure projects. The new administration is expected to make a major push to alleviate obstacles to private-sector investment—particularly in making the population aware of the need for those investments and of the negative consequences of not moving forward.

Investments in the water and forestry areas are expected to register the highest growth rates among the different environmental areas. Fox's government will prioritize restoration of Mexico's surface water bodies, conservation of aquifers, reforestation, and protection of Mexico's forests.

Figure 3.1 Mexico's Environmental Market in 2000



Source: CONIECO.

Market Shares and Increased Competition

U.S. technologies and services traditionally have dominated Mexico's environmental market. U.S. companies provide 60 percent of the total market demand and 73 percent of the environmental import market. The closest competitors are Germany, Canada, Spain, and Japan, each with less than a 5-percent share of environmental imports.

During the past five years, the number of environmental technologies and services providers in Mexico has grown significantly. It is common for international companies entering the market to create a joint venture with a local company. Some international companies have established a direct presence by incorporating a local subsidiary.

Increased competition in the market has initiated a move toward company consolidation, as many of the initial market participants were small companies not able to access major projects on their own. By merging, such companies can provide a more integrated suite of services. This consolidation phenomenon is expected to con-

tinue in the near term, making the market increasingly dominated by major players.

The free trade agreement signed between Mexico and the European Union in 2000 is expected to increase the interest of suppliers from that region in the Mexican market. One advantage that those companies have over suppliers from other regions is that the euro is undervalued against the Mexican peso. Another advantage is that European firms can provide their clients with extremely competitive financing terms.

Environmental Investment Incentives

At present, Mexico offers two tax and import incentives to encourage private investment in environmental technologies:

- 1. Accelerated Depreciation:** This incentive allows a company to deduct 100 percent of the value of an investment in environmental equipment on the acquisition or installation date. The deduction is applied against the company's 35-percent corporate income tax liability.
- 2. Elimination of Import Duties:** Environmental protection equipment can be imported duty-free into Mexico from every country, subject to conditions established by SEMARNAT and the Secretariat of Economy. For a product to be eligible for the

incentive, it must be proven to be environmentally beneficial, a competitive product must not currently be manufactured in Mexico, and the buyer must complete an application to the Secretariat of Economy to ensure that the product is currently listed on the approved product list. This list is constantly being updated and revised.

The federal government offers several monetary incentives to municipalities, specifically for water and wastewater investments. One of the most important is APAZU, which provides federal monies to municipal and state water utilities that improve their commercial capabilities. A second is offered through NOM-001-ECOL-1996, which provides preferential potable water rates for municipalities and industries that apply high levels of treatment to their water discharges.

In cities having PROAIRE, companies that invest in improving their operations, either by minimizing air emissions or installing air pollution control equipment, can continue operating even during emergency air pollution contingency periods, whereas polluting companies have to decrease their operations by up to 50 percent.

President Fox has mentioned that the development of incentives will be a key priority in his environmental agenda. A special committee will be created under the authority of INE for the development of such incentives, including tax incentives, to be negotiated with the Secretariat of Finance.

Chapter 4

Legal and Regulatory Framework

Institutional Framework within Mexico

Mexico's principal federal environmental agency is the Secretariat of the Environment and Natural Resources (SEMARNAT). That agency, formerly called SEMARNAP, was first created in late 1994 at the beginning of the Zedillo administration. It is the umbrella ministry for Mexico's policy-making and enforcement agencies in the environmental sector. SEMARNAT itself is focused on environmental policy-making and setting sector priorities for this sector rather than in promoting particular projects.

The Fox administration is currently restructuring SEMARNAT and its decentralized entities. (See Figure 4.1 for a diagram of the current framework.) Each unit will be responsible for specific functions inside SEMARNAT. The changes call for the Undersecretariat of Planning and Environmental Policy to be responsible for the design of plans, policies, and overall coordination of actions inside SEMARNAT. The Undersecretariat of Promotion and Environmental Regulation will be responsible for coordinating entities within the sector, producing environmental regulations, and developing links between the environmental sector and other economic sectors. The Undersecretariat of Management and Environmental Protection will be responsible for managing the government's environmental program and dealing directly with industry and individuals. It will be responsible for issuing permits, licenses, concessions, authorizations, and any other documents related to the environment and natural resources. Other changes will further decentralize functions to the state and municipal levels.

SEMARNAT is also evaluating the creation of a sustainable development cabinet formed with representatives from most federal secretariats. That cabinet would play a central role in environmental policy-making and would ensure that environmental policies were implemented within the different sectors of the economy.

Within SEMARNAT are three decentralized entities that play major implementing roles in the sector and have a more direct impact on market conditions and opportunities:

- 1. CNA.** The National Water Commission, the central player in Mexico's potable water and wastewater markets, has both regulatory and enforcement authority and is also the main source of federal monies for water infrastructure. CNA derives its near total authority over water issues directly from article 27 of the Mexican Constitution. As its core responsibilities, CNA assigns water rights to users, including rights to discharge into bodies of water and to assess usage fees; enforces water-related environmental regulations set by INE; and plans the overall goals for water resources with an emphasis on the efficient development of the resource. It also provides technical assistance to local water authorities, assists in project development, and provides financial support to priority water projects, particularly in low-income areas. SEMARNAT is analyzing the possibility of removing CNA from the secretariat to increase its autonomy within the sector.
- 2. INE.** The National Institute of Ecology is responsible for developing environmental standards and regulations, approving environmental impact assessments, and granting federal environmental permits for major works. Currently, INE is also responsible for setting and implementing policies and programs for hazardous waste. Under the institutional reorganization, most of INE's responsibilities will be transferred to SEMARNAT, and INE will become more of a research center rather than a policy-making entity. A new role for INE will be to develop additional economic incentives for environmental protection.
- 3. PROFEPA.** The Office of the Attorney General for Environmental Protection is Mexico's primary environmental enforcement agency. It is responsible for enforcing hazardous waste regulations, policing industrial activities with an interstate environmental impact, and overseeing federal lands and protected natural areas. PROFEPA is organized into three entities: one oversees regulatory enforcement, one deals with community involvement and complaints,

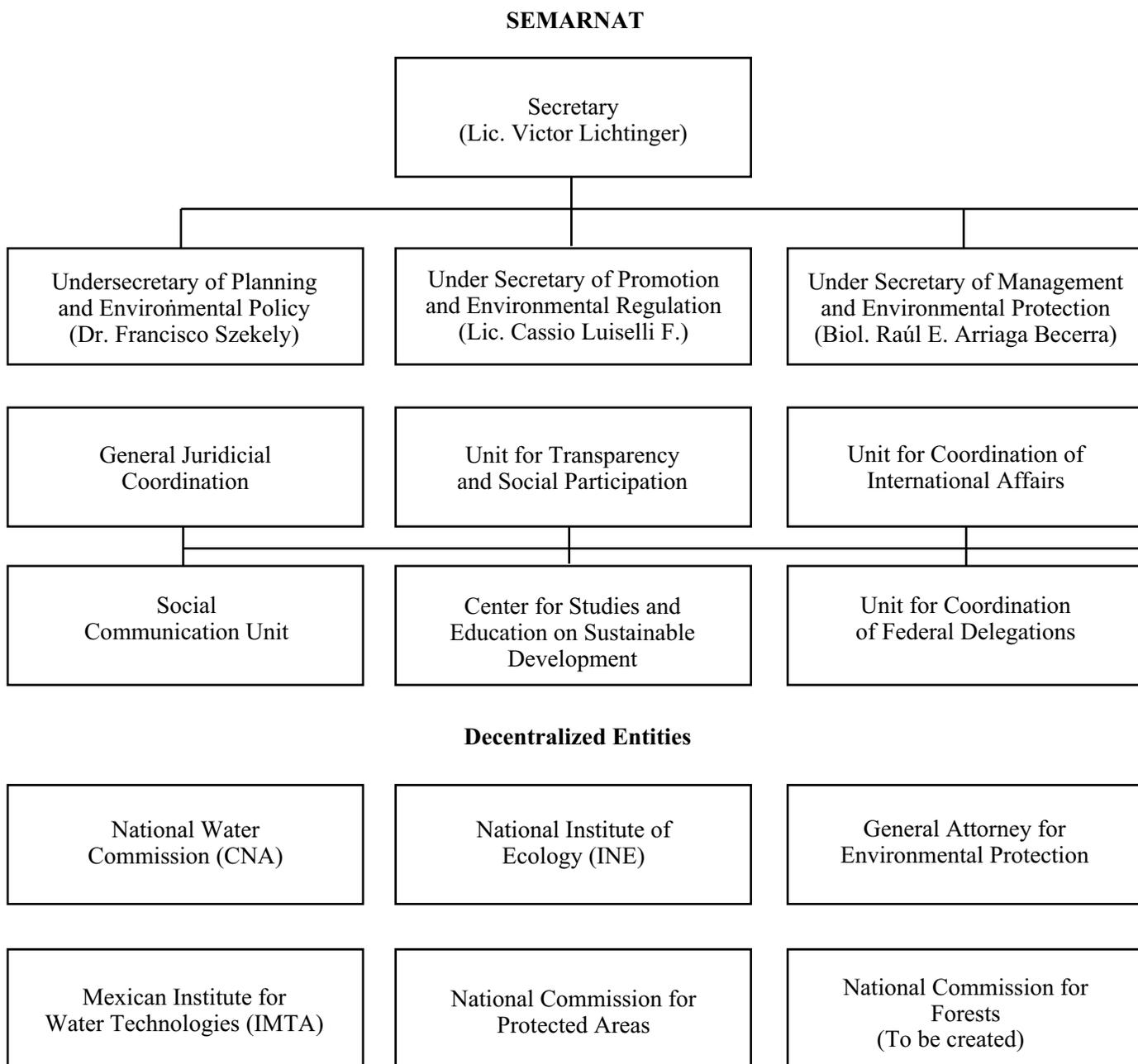
and one oversees the voluntary industrial audit program. At the state level, PROFEPA has 32 local offices, one in each of Mexico's 31 states and one in the Federal District.

Another entity involved in Mexico's environmental sector is the Mexican Institute for Water Technologies (IMTA), a technological research institute of the Mexican government. IMTA is responsible for technology development, certification of new technologies, and research on water and wastewater. IMTA's activities are limited; CNA carries out most technical assistance to municipal and state authorities.

In addition, most state governments include a secretariat, directorate, or institute for environmental protection. About half of these state secretariats include enforcement institutions responsible for verifying compliance with both federal and state environmental regulations.

Municipalities are also responsible for providing potable water, wastewater, and municipal waste services. In general, those services are carried out by a separate water or municipal waste entity that operates the related facilities. As the federal government continues to push responsibility down to the local level, these local utili-

Figure 4.1 Institutional Framework within Mexico SEMARNAT



ties are increasingly important as sources of projects and as consumers of equipment and services.

U.S. and Binational Institutions

As a result of NAFTA, two binational institutions were created to contribute to the development of environmental infrastructure in the border region (considered the territory 100 kilometers north and south of the U.S.-Mexico boundary). The border region was targeted for special attention because of its high rate of economic growth as well as the need for a regional approach to resolving growing environmental problems. The new institutions are as follows:

1. **BECC:** The Border Environmental Cooperation Commission (BECC) works with border communities to identify and develop infrastructure projects. BECC then has a review process for certifying environmental projects after which they are eligible for financing from NADBank. BECC focuses on projects in the areas of wastewater treatment, drinking water supply, and solid waste management facilities. Beginning in 2001, BECC will also consider projects in the areas of managing hazardous waste, recycling, and installing new water taps.
2. **NADBank:** The North American Development Bank, using capital provided by the U.S. and Mexican governments, provides loans and loan guarantees to public- and private-sector environmental infrastructure projects. NADBank recently established a modest program for solid waste management projects as well as an initiative to begin offering below-market-rate loans.

Additional BECC and NADBank information is included in Chapter 10. Other environmental institutions concerned with the border region are as follows:

1. **IBWC:** The International Boundary and Water Commission (IBWC) has increasingly become a policy-making entity focused on allocating water rights along the border. IBWC's previous responsibilities for developing and operating water-related infrastructure have largely been supplanted by BECC and NADBank.
2. **U.S. EPA:** The U.S. Environmental Protection Agency, working through BECC and NADBank, plays an important role in developing environmental infrastructure on the Mexican side of the border. The U.S. EPA is a board member of both institutions and

administers several million U.S. dollars in construction grants for border infrastructure projects in both countries. The U.S. EPA has provided over \$211 million to the Border Environmental Infrastructure Fund (BEIF) administered by NADBank. It has contributed another \$22.5 million to the Project Development Assistance Program (PDAP).

Principal Environmental Laws and Regulations

At the federal level, Mexico has two comprehensive environmental laws that drive the market. The first is the General Law of Ecological Balance and Environmental Protection, which was first enacted in 1988 and later amended in December 1996. This statute provides the general framework with which all state laws and federal regulations must comply. It is a broad-based law that states policy principles in the areas of:

- Bio-diversity protection
- Establishment and administration of natural protected areas
- Assessment of environmental risks and impacts
- Stewardship of natural resources
- Prevention and control of pollution, including enforcement

The second major piece of environmental legislation is the National Waters Law, which derives its authority directly from article 27 of the Mexican Constitution. The National Waters Law is a very important law that delineates the structure of water rights in Mexico and establishes guidelines for granting concessions for exploiting water resources.

The policy goals in those two laws are implemented through specific quantitative regulations called *Normas Oficiales Mexicanas* (NOMs) and through voluntary standards called *Normas Mexicanas*. Those standards are largely based on U.S. and international regulations. As in the United States, regulations come into effect after a comment period during which private companies, environmental groups, citizen groups, and other parties affected by the proposed regulations offer their input. Following the input period, and after consideration of the comments received, the final regulations are issued and published in the *Diario Oficial* (Official Gazette).

At present there are 55 federal environmental regulations, as shown in Table 4.1.

A complete listing of Mexican environmental NOMs, including their full text in Spanish, is available at www.ine.gob.mx/dgra/normas/no_menpu.htm.

Table 4.1 Current Environmental Regulations by Sector, 1995–2000

<i>Sector</i>	<i>1995</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Environmental impact	0	0	0	6	6	6
Natural resources	4	4	4	4	4	5
Noise	4	4	4	4	4	4
Wastewater	44	44	1	3	3	3
Air	17	18	19	21	22	22
Air monitoring	5	5	5	5	5	5
Fuel quality	1	1	1	1	1	1
Hazardous waste	8	8	8	8	8	8
Municipal waste	0	1	1	1	1	1
Total	83	85	43	53	54	55

Source: INE.

The number of regulations has decreased from 85 to 55 since the government has simplified its water regulations. Before 1997, special discharge regulations applied to different industry segments depending on the level of environmental hazard associated with the processes of each activity. That regulatory framework was cumbersome to oversee and enforce, and many industries went unregulated.

In 1997, NOM-001-ECOL-1996 replaced 43 existing water discharge regulations and also made the municipalities responsible for monitoring and enforcing discharges to municipal sewer systems. NOM-001-ECOL-1996 set forth limits for discharges into national bodies of water by both municipalities and industries. One year later, two additional regulations were enacted: NOM-002-ECOL-1996 set industrial discharge limits to urban sewage systems, and NOM-003-ECOL-1997 set regulations for water reuse.

In addition to federal regulations, 29 of the 31 Mexican states have local environmental laws. The provisions of those laws must meet the general criteria outlined in the federal General Law. Although state laws can be broad based, they usually affect most directly the two areas over which local authorities have direct statutory authority: (1) the markets for wastewater facilities and services and (2) municipal waste collection and disposal.

A main priority of the Fox administration is to review current NOMs in an effort to rationalize their application. Currently, the regulatory framework is not complete and spreads enforcement responsibilities among different federal, state, and municipal entities. The Fox administration will propose changes to clarify enforcement responsibilities, while seeking to expand enforcement and compliance to cover small and mid-sized companies. To date, enforcement has been directed mostly at larger and multinational operations.

Other Laws That Affect Environmental Markets

The Mexican market is generally very open to U.S. firms wishing to sell environmental technologies and services. U.S. firms wanting to sell directly to the Mexican government need to follow the provisions set forth in both the Law of Public Works and Related Services and the Law of Public-Sector Acquisitions, Leases, and Services. Those laws detail the conditions under which firms must bid for the right to sell goods and services to Mexican government entities. The two laws were enacted on Jan. 4, 2000, replacing the old Public Works and Acquisitions Law.

U.S. firms should note that the new laws give freedom to the tendering agencies to request a minimum level of domestic content in the equipment or services sought. The new regulations also stipulate that tenders should be available on the Mexican government procurement Internet site Compranet, www.compranet.gob.mx, and that the tendering agency should be allowed to receive offers through electronic means. U.S. companies can also procure bid documents through that Internet-based service.

Mexico offers two types of tenders for public works projects and acquisitions of equipment and services. The most common tenders are *national tenders*, which bar foreign companies from participating and which generally involve older technologies. U.S. companies can participate in national tenders through a Mexican representative, in conjunction with a Mexican partner, or by incorporating a local subsidiary company in Mexico.

Conversely, international tenders allow foreign companies to participate directly as bidders under the same conditions as domestic players. That type of tender usually involves purchases of technologies not available in

Case Study 4.1 Flood-Control Units for Mexico City

In October 2000, the Mexico City government, through the General Directorate for Construction and Operation of Hydraulics (DGOH), released a national tender for the acquisition of two flood-control vehicles. In the tender documents, DGOH requested a minimum level of domestic content equal to 50 percent of the total value of the units. Because Mexico does not manufacture flood-control units, the bidders had to integrate imported equipment into vehicles manufactured in Mexico. In addition some Mexican structural parts (e.g., hoses, sirens, and tires) were integrated into the vehicles to reach the minimum level of domestic content required by DGOH.

Three companies participated in the tender. The acquisition was awarded to the Mexican company GH Maquinaria y Equipo. This company, the leader in sales of municipal service vehicles, participated in the tender integrating the flood system of its represented company, Vac-Con, into Frainliner trucks, which are manufactured in Mexico and thus considered 100-percent Mexican. In addition, GH Maquinaria y Equipo used Mexican-manufactured hoses and labor, achieving a domestic integration content of more than 60 percent.

Vac-Con, based in Green Coves Spring, Fla., is fast becoming Mexico's leader in the supply of municipal service vehicles. The quality of its vehicles and the work performed by its representative in Mexico have led to strong brand recognition within Mexico's municipal utilities.

Mexico or is associated with an internationally financed project.

Enforcement Activities and Trends

Enforcement of environmental regulations in Mexico is spread among different authorities at the federal, state, and municipal level. At the federal level, the primary enforcement authorities are PROFEPA and CNA. CNA's role is discussed further in Chapter 5. This section mainly focuses on the efforts of PROFEPA.

PROFEPA's enforcement strategies have focused on resolving environmental problems with violators through voluntary means rather than through the imposition of fines or criminal penalties. For example, if a company's operations have contaminated its soil with hazardous waste, PROFEPA is likely to seek an agreement with the owner to remedy the damage rather than to seek financial or criminal sanctions.

To date, PROFEPA has focused much of its enforcement efforts through an inspection program to identify and mitigate pollution sources within areas under federal jurisdiction. PROFEPA has federal jurisdiction over

industries in the power generation, pulp and paper, cement, chemical, petrochemical, oil, and mining sectors, as well as industries located in federal areas. Enforcement activities have been focused on larger industrial establishments, which are perceived to be the most polluting.

Under the inspection program, environmental compliance has increased significantly within multinational and large Mexican corporations. Inspectors have reported a gradual decrease in the number of grave infractions cited at those facilities. That increased compliance is the result of the scrutiny that the large entities have received as well as their capacity to invest in pollution control technologies. The compliance story is different for small companies, which lack the financial resources to invest in environmental equipment needed to comply with regulations.

The number of inspection visits has decreased continuously over the last five years, but those conducted have been much more thorough, resulting in greater industrial investment and compliance. The number of small infractions remains high, and the authorities believe that making visits more exhaustive will lead to the highest level of compliance.

The Fox administration is expected to clarify and centralize enforcement activities in a single entity within SEMARNAT and will strengthen this federal entity. It has not been decided yet if enforcement activities will remain in PROFEPA or be vested in a new undersecretariat within SEMARNAT. It is clear, however, that the enforcement activities currently in the hands of the National Water Commission will be transferred to the new enforcement agency. The new administration is also expected to work harder to assist municipalities and local governments in strengthening their enforcement capabilities.

Other Federal Programs

The Programa Nacional de Auditoria Ambiental (Environmental Audit Program), also known as Programa Industria Limpia (Clean Industry Program), was introduced in 1992 as a voluntary environmental audit program. The goals of the program were to increase environmental compliance in a nonadversarial manner and to allow companies to invest in needed technologies over time, thereby avoiding an undue financial burden. Under the program, companies volunteer to submit themselves to a strict independent audit of their environmental practices, applying not only national but also international standards. By agreeing to do so, such firms

forestall enforcement actions and may receive certification as a “clean company.”

To participate in the program, a company must apply to PROFEPA. Participation is both voluntary and confidential. Once the application is accepted, the company contracts an independent auditor from a list of private environmental auditors certified by PROFEPA. The independent auditor reviews the company’s operations, evaluating the level of pollution emissions, the quality of pollution minimization efforts, and the effects of such efforts on worker health and accident prevention. The independent auditor conducts the audit under the supervision of the PROFEPA.

The audit results in an inventory of needed improvements along with an action plan that includes all the measures and investments the company needs to perform to comply with national and international standards. The final action plan is a result of a negotiation between the company and PROFEPA and is put forth in an agreement providing a grace period from enforcement action as long as the company complies with the action plan. When the plan is completed, PROFEPA grants the company a clean industry certificate. (The certificate provides that inspectors will not visit the company for a two-year period, except in case of accident.) The company can also use the certificate to enhance its public image as a clean company.

As of August 2000, a total of 1,614 companies (mostly large industrial companies) applied and 1,431 concluded their environmental audits. A total of 1,239 action plans were signed, and PROFEPA had granted 542 clean industry certificates.

Because audits under the program almost always result in action plans requiring technology investments, the program is a strong generator of business opportunities for U.S. companies. Although many larger companies have now complied, audits continue and will increasingly extend to medium-sized companies that are not yet part of the program.

PROFEPA is also undertaking a program to identify and remedy sites polluted with hazardous waste throughout Mexico. The program has been slow to develop over the past several years because of budgetary constraints. The goal of the program is to identify, inventory, and characterize abandoned hazardous waste sites. Under this program, PROFEPA has identified 105 contaminated sites in 17 different Mexican states. Only in the case of 15 sites has PROFEPA performed the necessary studies to characterize the types and quantities of hazardous materials present in the land. PROFEPA is expected to accelerate the program given the health and environmental

risks associated with such sites. See Table 7.3 for a list of the sites.

Other Key Environmental Market Players

In Mexico, most industrial sectors have chambers that represent the interests of their member companies. Most Mexican industrial chambers now have environmental councils, which serve as industry advocates with environmental regulatory authorities. Visiting members of those councils allows companies providing environmental equipment and services to have a clear and detailed picture of the particular environmental challenges and needs within specific industries.

In addition, two independent organizations have been formed to advance the interests of environmental companies in Mexico. The following organizations are actively involved in the areas of policy and regulatory development, and they also serve as a clearinghouse for information on Mexican environmental companies and technologies:

- 1. CONIECO.** The Consejo Nacional de Industriales Ecologistas (National Council of Environmental Industries, or CONIECO) is a nonprofit business association with more than 1,100 members, most of which are environmental companies. The main objective of CONIECO is to promote environmental awareness among Mexican industry and society. CONIECO is particularly involved in promoting energy savings, waste recycling, and rational water use, including water recycling. CONIECO also participates in establishing Mexican environmental regulations. A specific unit within CONIECO promotes investments in environmental technologies. That unit serves as a link between technology suppliers and companies seeking specific solutions. CONIECO has also been very useful in linking new technology and service providers with potential Mexican partners.
- 2. CESPEDES.** The Centro de Estudios del Sector Privado para el Desarrollo Sustentable (CESPEDES, the Private-Sector Center for Studies Toward Sustainable Development) was created by the former director of INE, Gabriel Quadri, in collaboration with the Consejo Coordinador Empresarial (CCE, the Business Coordinating Council). CCE is an influential organization representing the interests of major Mexican corporations. CESPEDES develops and publishes studies suggesting policy changes

needed for the country to move toward more sustainable development. The center works on creating public awareness of the need for environmentally responsible economic growth. CESPEDES also

assists Mexican companies in finding the best available technologies to develop environmentally friendly processes.

Chapter 5

The Water Sector

Mexico's water market represents the most important single market for U.S. exports of environmental equipment and services. On a gross basis, Mexico is rich in water resources, receiving about 4,799 m³ of water per inhabitant per year.² At the same time, a great disparity exists between where those resources are located and where they are needed. Most rainfall and water resources occur in the southeastern portion of the country, whereas the majority of the population resides in the central highlands and north of the country.

For example, Mexico City must pump water at great cost from a distance of 127 kilometers to supplement local water resources, including underground aquifers. Further, overexploitation of those aquifers is causing portions of the city to sink at the rate of up to 50 centimeters per year. In the arid northern regions of Mexico, surface water sources do not exist, and it is becoming increasingly difficult to find new underground sources.

At present, 80 percent of Mexico's water comes from 470 underground aquifers. The government estimates that at least 90 of those aquifers are overexploited or illegally tapped. Protection and rehabilitation of aquifers are among the main drivers behind Mexico's commitment to treating wastewater discharges, promoting water recycling, and decreasing water losses.

The imbalance between supply and demand creates a strong need in Mexico to better manage and invest in water infrastructure. In fact, Mexico is currently in the midst of a \$350 million project financed in conjunction with the World Bank to comprehensively model, monitor, and manage its aquifers. State and municipal governments in Mexico's north have even studied the feasibility of constructing desalinization plants. It is unlikely that governments will pursue that option because of the high costs of those advanced technologies.

Despite fundamental supply problems, Mexico has been able to supply an increasing percentage of its growing population with potable water. Mexico has increased the percentage of residents having access to potable water to 87.4 percent. Coverage is much higher in urban areas than in rural areas; 91.5 percent of urban residents have access to potable water, whereas only 65.7 percent of rural residents enjoy such access.

2. *Panorama Actual del Agua en México* (Mexico City: CNA, 1999).

Most dollars for potable water infrastructure flow from the federal government. Although municipalities are tasked with providing the service, they are often financially unable to pay for needed system improvements or expansions. Some effort has been made to attract private investment dollars into the potable water sector, but those flows have been limited and in the short term will likely continue to play only a minor role in creating new infrastructure.

Mexico continues to have serious municipal wastewater pollution problems with only 22 percent of its wastewater receiving any treatment and only 12 percent treated to meet regulatory standards. Mexico City is one of the worst offenders, generating about 40 m³/s of municipal wastewater while having an installed capacity to treat only 5.6 m³/s. This situation results in an important health hazard because the outflow reaches a river used for irrigation purposes. A similar situation occurs in Mexico's second largest city, Guadalajara. A lack of wastewater treatment capacity is seen in major cities throughout the country, creating an urgent need for new investments.

Industrial wastewater treatment has seen strong progress in recent years among large corporations but not among medium-sized and small companies, which in many cases continue to discharge chemicals and oils directly into water bodies or municipal sewer systems. Among the worst offenders are those in the chemical, sugar, textile, and pulp and paper segments.

Federal, State, and Local Responsibilities

Mexico's water regulatory framework and institutions derive their authority from two constitutional mandates. Article 27 of the Mexican Constitution establishes that water resources belong to the federal government and that individuals, companies, and even municipal governments can exploit these resources only through a concession granted by the federal government. The federal government has vested its authority over water resources within the Comisión Nacional del Agua (National Water Commission, or CNA).

Although article 27 puts the federal government in ownership of the resource, article 115 places the respon-

sibility for administering and providing water-related services, including potable water, sewage, and wastewater treatment services, in the hands of municipal governments.

At the local level, authority to provide water services resides with the municipal water utilities, autonomous local water utilities commissioned to provide water services. Because many of those utilities are financially weak, CNA provides funding and technical assistance toward increasing their service capabilities and improving their financial situation.

Mexico has promulgated two main water laws, which derive their authority from article 27. The National Waters Law defines the waters that are the property of the nation and delineates the structure of water rights. The Federal Law of Water Rights establishes the terms, conditions, and pricing for the use of water, including payments for exceeding water-quality discharge limits. That law is updated every year to adjust prices to reflect inflation.

Each state has its own water law, which determines how water services are provided and the method by which water tariffs are set and adjusted. State laws also detail the level of private participation permitted in providing services and developing infrastructure.

Of Mexican states, 19 approve their tariffs through an administrative council of the local water utility, 10 approve them through a vote of the local congress, and 1 allows the state governor to set tariffs. Twenty state laws now allow the suspension of water services to residents or businesses for lack of payment.

In 1998, CNA developed a model state water law, which allows for private participation and sets a comprehensive tariff adjustment system, which is based on the cost of water and economic conditions. The model law also allows termination of service for non-payment. CNA has sought to encourage states to adopt the model law in an effort to modernize the local management of water resources. To date, the states of Hidalgo, Mexico, and Sonora have adopted the model law. In addition, nine states are now seeking state congressional approval of the model law.

U.S. environmental companies will find opportunities in Mexico within the three different levels of government. Within CNA are opportunities for technologies in the areas of water well drilling, water reinjection systems, emergency response services, and water-monitoring services. At the municipal and state levels, opportunities exist for investments in potabilization plants, pumping stations, water networks, water metering systems, bill-

Table 5.1 Municipal Discharges

<i>Size of Population</i>	<i>Date of Compliance Plan</i>	<i>Date for Compliance</i>
Larger than 50,000	June 1, 1997	Jan. 1, 2000
20,001 to 50,000	Dec. 31, 1998	Jan. 1, 2005
2,501 to 20,000	Dec. 31, 1999	Jan. 1, 2010

Source: NOM-001-ECOL-1996.

Note: CNA can require earlier compliance on the basis of the impact of the current discharges on the receptor body or if non-heavy metal discharges exceed five times the standard.

ing and collection systems, and wastewater treatment and equipment maintenance systems.

Water Regulations

The Zedillo administration greatly simplified the regulatory structure for wastewater discharges. It replaced the 44 NOMs that regulated wastewater discharges with just three. The original 44 NOMs established a schedule of fees for using and discharging into water bodies. Discharge quality standards were fairly strict, with municipalities required to achieve an effluent quality of 30 mg/l (milligrams per liter) of biological oxygen demand (BOD) and 30 mg/l for total suspended solids (TSS). Industrial standards were set depending on the activity performed and did not take into account the nature of the body of water into which discharges were made. Industrial standards were also strict, making compliance difficult because of the high investment cost.

The reforms not only simplified the regulatory structure but also relaxed the standards. However, penalties for discharges exceeding the standards were increased. The reforms also extended compliance periods, granting a grace period to municipalities and industries not in compliance.

Mexico's wastewater market is now driven by three regulations, NOM-001-ECOL-1996, NOM-002-ECOL-1997, and NOM-003-ECOL-1997.

NOM-001-ECOL-1996

NOM-001-ECOL-1996, the central driver for the municipal wastewater market, applies to municipalities and industries that discharge directly into water bodies. The standard is based on three categories of receptor water bodies. Thus, municipalities and industries face differ-

Table 5.2 Non-Municipal Discharges

<i>Parameter 1— BOD (tons/day)</i>	<i>Parameter 1— TSS (tons/day)</i>	<i>Date of Compliance Plan</i>	<i>Date for Compliance</i>
Greater than 3	Greater than 3	June 1, 1997	Jan. 1, 2000
1.2 to 3.0	1.2 to 3.0	Dec. 1, 1998	Jan. 1, 2005
Less than 1.2	Less than 1.2	Dec. 1, 1999	Jan. 1, 2010

Source: NOM-001-ECOL-1996.

Table 5.3 Water Discharge Parameters

<i>Parameter</i>	<i>Type of Receptor Body</i>					
	<i>A</i>		<i>B</i>		<i>C</i>	
<i>Mg/l (except as specified)</i>	<i>D.A.</i>	<i>M.A.</i>	<i>D.A.</i>	<i>M.A.</i>	<i>D.A.</i>	<i>M.A.</i>
Grease and oil	15	25	15	25	15	25
Floating material	Ab.	Ab.	Ab.	Ab.	Ab.	Ab.
Sedimentary solids	1	2	1	2	1	2
TSS	150	200	75	125	40	50
BOD	150	200	75	150	30	60
Total nitrogen	40	60	40	60	15	25
Phosphorus	20	30	20	30	15	25
Heavy metals:						
Arsenic	0.2	0.4	0.1	0.2	0.1	0.2
Cadmium	0.2	0.4	0.1	0.2	0.1	0.2
Cyanide	2.0	3.0	1.0	2.0	1.0	2.0
Copper	4.0	6.0	4.0	6.0	4.0	6.0
Mercury	0.01	0.02	0.01	0.01	0.01	0.01
Nickel	2.0	4.0	2.0	4.0	2.0	4.0
Lead	0.5	1.0	0.2	0.4	0.2	0.4
Zinc	10.0	20.0	10.0	20.0	10.0	20.0
Ph	5/10	5/10	5/10	5/10	5/10	5/10
Temperature (°C)	N.A.	N.A.	40	40	40	40

D.A. = Daily Average M.A. = Monthly Average Ab. = Absent N.A. = Not Available

Receptor Body A is defined as rivers used for irrigation.

Receptor Body B is defined as urban rivers and surface bodies used for irrigation.

Receptor Body C is defined as rivers that protect aquatic life.

Note: Above standards vary for coastal waters and direct discharges to agricultural land.

Source: NOM-001-ECOL-1996.

ent standards depending on their population (Table 5.1), the types of discharge (Table 5.2), and the type of receptor body into which they discharge their wastewater. (Table 5.3.)

CNA is responsible for enforcing NOM-001-ECOL-1996 because it involves discharges into federal bodies of water. The regulation established compliance dates of 2000, 2005, and 2010, depending on the size of the municipality or urban area (see Table 5.1). The latest avail-

able information from CNA indicates that 139 localities have a population greater than 50,000 inhabitants; 181 have a population of between 20,001 and 50,000; and 2,266 have a population in the range of 2,501 to 20,000. More than 70 municipalities with populations greater than 50,000, including Mexico City, are now violating the requirement of having wastewater treatment in place. CNA has begun to penalize those violators by increasing fees for water discharge rights (essentially, fines). In practice,

however, it is still less costly for municipalities to pay the increased fees than to spend millions of dollars for wastewater treatment facilities. Further, only about 10 percent of the municipalities are currently paying discharge fees; the rest argue that they lack the resources to pay.

NOM-002-ECOL-1997

NOM-002-ECOL-1997 sets the standards for discharges into municipal sewage systems, placing special emphasis on limiting pollutants, such as oils, copper, nickel, and other metals and chemicals, that could damage municipal wastewater systems. Those limits are shown in Table 5.4.

Enforcing NOM-002-ECOL-1997 is the responsibility of the municipalities. Local authorities are allowed to impose fines or even to close the polluting companies. Still, in most cases municipal enforcement capabilities are weak. Municipalities that have already constructed wastewater treatment plants have by far the greatest incentive to verify industrial compliance within their systems because illegal industrial discharges could seriously harm the facilities. For example, the Monterrey water utility (SADM) has increased its verification efforts by investing in both technology and personnel to detect and fine polluters. This trend is expected to increase as more municipalities install wastewater treatment plants. The Mexico City government is considering installing a sewage-monitoring system to ensure industrial pretreatment before building its own municipal wastewater treatment facilities.

NOM-003-ECOL-1997

NOM-003-ECOL-1997 sets the standards for wastewater treatment reuse in public services. It states the maximum limits of polluting agents allowed, depending on whether the reused water will have direct or indirect contact with the population.

Potable Water and Sewage

According to CNA, Mexico has a potable water coverage rate of 87.4 percent and a sewage coverage rate of 73.1 percent. Those rates are high compared with other Latin American countries, and the progress made in potable water supply during the past decade has been outstanding. The main problem Mexico faces is lack of funds for new investments. Almost all those funds currently must come from the federal government because local water utilities are generally inefficient and unable to generate sufficient cash flow. In 1999, 59 percent of Mexican government spending in the water sector came from the federal government, whereas cash flows generated by municipal utilities covered only 7 percent of the total investment.

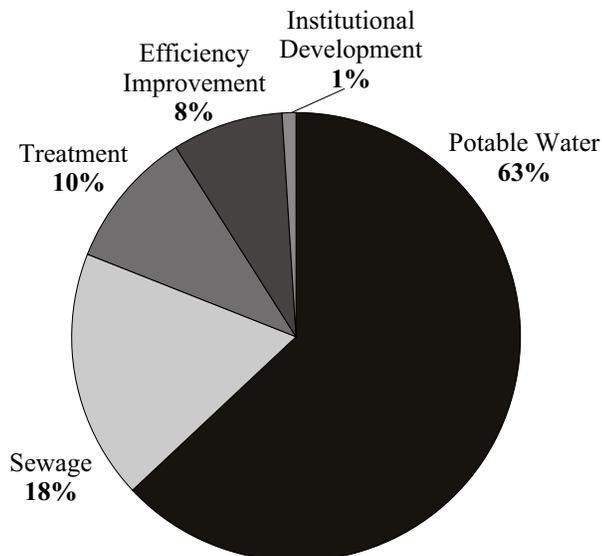
Of all potable water produced in Mexico, almost 40 percent cannot be accounted for, whether it is lost through leaks, theft, or poor metering. Of the water that can be accounted for, 60 percent is billed to users, with the users paying about 65 percent of what they owe. Thus, of the total water produced in Mexico, users pay for only 23.4 percent. The federal government, in combination

Table 5.4 Discharge Limits for Municipal Sewage Systems

<i>Parameter</i>	<i>Monthly Average</i>	<i>Daily Average</i>	<i>Instantaneous</i>
Greased oils (mg/l)	50	75	100
Sedimentary solids (mg/l)	5	7.5	10
Total arsenic (ml/l)	0.5	0.75	1
Total cadmium (ml/l)	0.5	0.75	1
Total cyanide (ml/l)	1	1.5	2
Total copper (ml/l)	10	15	20
Total chromium (ml/l)	0.5	0.75	1
Total mercury (ml/l)	0.01	0.01	0.02
Total nickel (ml/l)	4	6	8
Total lead (ml/l)	1	1.5	2
Total zinc (ml/l)	6	9	12

Source: NOM-002-ECOL-1997.

Figure 5.1 Water Investment Breakdown, 1999



Source: CNA.

with multilateral and bilateral agencies, has carried out a series of efforts toward improving the collection indexes and reducing the amount of water that is unaccounted for. Preliminary success from these efforts is just beginning to be realized.

Investment in the potable water sector accounted for \$182 million in 1999, which represents approximately 63 percent of the total government investments in the water sector (see Figure 5.1). Potable water will continue to be the focus of direct government spending, but the amounts destined to be used for efficiency improvements and institutional development will increase dramatically because the Fox administration will place special emphasis on strengthening municipal water utilities.

Two important initiatives strengthen and provide federal monies to state and municipal water utilities. The most important is APAZU, a potable water program for urban zones that provides federal monies to municipal water utilities for infrastructure development and efficiency improvement. The other is FORTEM, a program for strengthening of state and municipal authorities. FORTEM, which promotes decentralization efforts, is described further in Chapter 10.

APAZU

APAZU allows states and municipalities to request federal financial assistance for the improvement or construction of potable water, sewage, and wastewater treatment

infrastructure. To receive federal monies under APAZU, the states or municipalities must sign an agreement whereby they commit to having their municipal water utilities become financially solid or at least reaching a “break even point” on their operations within five years. The main goals of the program are as follows:

1. To support municipalities and states in strengthening their water utilities as well as to increase coverage of their services
2. To gradually eliminate federal subsidies granted for the construction of water infrastructure
3. To focus subsidies on improving physical, commercial, and financial operations of the utilities

The program is available for localities with populations greater than 2,500 inhabitants, whereas in smaller localities CNA will continue to directly finance the development of infrastructure. The program provides the largest federal subsidies to poorer municipalities. The maximum financial participation of the federal government through CNA is shown in Table 5.5.

States or municipalities entering the program must provide CNA with a schedule for completing the works as well as a plan demonstrating how the utility will become profitable in five years. The local congress must authorize the plan so that any tariff increases that are part of the plan will be approved.

The program supports an important market at the local level for efficiency-related equipment and services, including equipment for metering, leak detection and control systems, equipment for detecting water sources, user registration services, and billing control software. Investments for potable water will be especially strong in Mexico City, Guadalajara, and the northern border as well as in other large cities where APAZU is driving municipal water utilities to increase efficiency.

Private Participation in Water Infrastructure

Most potable water and sewage projects funded with government monies are contracted as public works projects. The key players in this segment include large Mexican construction firms, mostly in partnership with international water groups and technology suppliers.

In addition to the growth of direct government spending in the water and sewage sectors, private participation in providing these services is expected to grow as states and municipalities seek to gain efficiency and to attract private capital. At present, municipalities have tried several different models of private participation in

Table 5.5 Federal Government Participation in Funding Water Infrastructure Projects under APAZU

<i>Size of Municipality and Type of Work</i>	<i>Participation (percent)</i>	
	<i>Federal</i>	<i>State and Municipal</i>
Population of 2,500–500,000:		
Efficiency improvements:		
High poverty index	Up to 60	40
Medium poverty index	Up to 48	52
Low poverty index	Up to 42	58
Potable water:		
High poverty index	Up to 48	52
Medium poverty index	Up to 30	70
Low poverty index	Up to 18	82
Sewage and wastewater treatment	Up to 42	58
Population of more than 500,000:		
Efficiency improvements	Up to 42	58
Potable water	Up to 18	82
Sewage and wastewater treatment	Up to 42	58

Source: Hanhausen & Doménech Consultares, S.C.

the water sector. Although the experience has mostly been a positive one, municipalities are moving only slowly into this area.

Integrated Concessions. Under the integrated concession scheme, the government grants a concession title to a private operator to operate the entire water system, from water extraction and supply through the treatment of wastewater. The private company is in charge of financing all required infrastructure improvements and is usually required to meet certain water coverage goals. The private company is also in charge of billing customers and collecting those bills.

The cities of Aguascalientes and Cancún have adopted integrated concessions. The concessions have suffered problems, but generally they are considered successful. It is not a certainty that the integrated concession model will work in other cities, as both Cancún and Aguascalientes are somewhat unusual in character. In Cancún, most water customers are luxury hotels; and Aguascalientes enjoys one of the highest living standards in Mexico.

Currently, the best prospects for other integrated concessions are in Mexican tourist cities where strong revenue flows could exist to support private investment. At the same time, local municipal authorities have been reluctant to give up control to private operators.

Management Contracts. Another scheme involving private participation in providing water services is the management contract. Under a management contract, a

private company is paid a fee for achieving certain benchmarks or improvements, such as a set payment for each meter installed or each leak fixed. Such arrangements have proven effective in Mexico City and Puebla. Management contracts have been less controversial than integrated concessions and have been better accepted by local municipal authorities.

The most successful management contract is the one in Mexico City, which survived two government changes, including a change in the party governing Mexico City. The scheme has increased the metering, billing, and collection indexes and has minimized water losses in the secondary distribution network. Management contracts are likely to be implemented in other large Mexican cities and represent an opportunity for U.S. firms that have experience with water system management or that sell efficiency-enhancing equipment, services, or software.

Partial Concession. The partial concession scheme for private participation is similar to the integrated concession, except that the operator does not have responsibility for wastewater treatment. Rather the private company is responsible for providing potable water services and sewage collection, as well as for billing and collection. The private operator has to accomplish an ambitious investment plan and establish an efficient collection system. The revenues obtained are first used to cover repayment of the required investment program, and any excess goes to the municipality to finance wastewater treatment services.

Table 5.6 Municipal Wastewater Treatment Plants, 1992–1999

Year	Total		In Operation			Out of Operation	
	Plants	Design Capacity (lps)	Plants	Installed Capacity (lps)	Water Treated (lps)	Plants	Installed Capacity (lps)
1992	546	N.A.	394	N.A.	30,554	152	N.A.
1993	650	N.A.	454	N.A.	30,726	196	N.A.
1994	666	42,788	461	N.A.	32,065	205	N.A.
1995	680	54,638	469	48,172	41,706	211	6,466
1996	793	54,765	595	51,696	33,745	198	3,069
1997	821	61,653	639	57,402	39,389	182	4,251
1998	914	63,151	727	58,560	40,855	187	4,591
1999	1,000	67,547	777	61,559	42,397	223	5,988

N.A. = not available lps = liters per second

Source: CNA.

Municipal Wastewater Treatment

Mexico has a great need to improve the treatment of its municipal wastewater. Of the 239 m³/s of wastewater generated by urban systems, only 42.4 m³/s receive any kind of treatment and only 29 m³/s, or 12 percent of the wastewater generated, is treated in compliance with the standards in NOM-001-ECOL-1996.³

According to the National Institute of Ecology,⁴ Mexico will generate nearly 360 m³/s of wastewater with 2.81 million metric tons of BOD by 2010. Generation of wastewater at this level will create a treatment deficit of 318 m³/s over current treatment levels. To achieve full compliance, Mexico will have to invest on the order of \$7.2 billion and spend about \$1 billion per year to operate this treatment capacity.

The Zedillo administration at its start had set a goal of treating to standard up to 82 m³/s of municipal wastewater. That goal was not achieved because both political and financial difficulties stalled a number of major planned investments in new wastewater treatment capacity. For example, major wastewater facilities were put on hold in both Mexico City and Guadalajara largely for political reasons and because of the inability of the parties involved to agree on a technical solution.

In the rest of the country, a number of wastewater facilities were scheduled to be built by the private sector under BOT arrangements. The peso devaluation in 1994 severely affected those projects. Improved economic conditions, along with financial support from both the Mexi-

can federal government and bilateral institutions, has led to the successful financial restructuring of a few of those stalled projects, and several have been built and are operating. In general, however, the pace of building new wastewater plants under BOT schemes continues to be slow because the cost of the infrastructure exceeds the capacity of many local communities to pay. Table 5.6 summarizes the situation through 1999.

To meet the standards set by NOM-001-ECOL-1996, most medium-sized cities need to construct only a primary wastewater system. On Mexico's northern border and in large metropolitan areas, secondary systems will be required. At present, 49 percent of the wastewater treatment plants operating in Mexico are stabilization lagoons (see Figure 5.2). Those lagoons generate large amounts of sludge.

CNA estimates that \$2.2 billion is needed for communities of over 50,000 inhabitants to comply with NOM-001-ECOL-1996. The compliance date for those larger communities was 2000. For other communities, the compliance dates are either 2005 or 2010; CNA estimates that those communities will need to invest \$5 billion by 2010 to reach regulatory compliance.

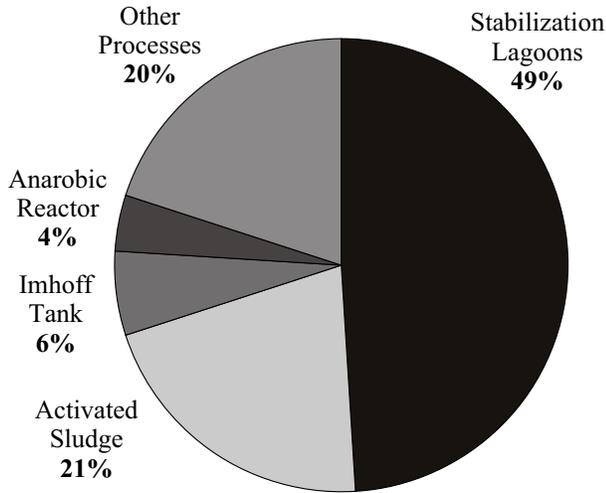
Priority municipal wastewater projects include those in Baja California, Mexico City, and Guadalajara, which alone represent approximately \$1 billion of investment. Although financing has been secured for the Mexico City and Guadalajara projects, political disputes between the federal and local governments have stalled those projects.

By far, Mexico's largest wastewater project is in Mexico City. If this project were to move forward, it would generate important opportunities for U.S. companies. The current impasse is over differing local and federal views of the appropriate technical solution. The

3. *Compendio Basico del Agua en México* (Mexico City: CNA, 1999).

4. *Areas de Oportunidad en el Sector Ambiental de la Economía* (Areas of Opportunity in the Environmental Sector of the Economy) (Mexico City: SEMARNAP, February 1997).

Figure 5.2 Treatment Plants by Process, 1999



Source: CNA.

federal government favors a limited number of major facilities, whereas the municipal government proposes to build many small wastewater treatment plants within the city and reuse the water for irrigation and industrial purposes. With new governments recently elected at both the federal and local levels, it is hoped that the project can move forward in the next several years.

The city of Guadalajara's investments in wastewater treatment have also been delayed. The city drew up an investment program that combines potable water, sewage, treatment, and efficiency improvements. Local authorities decided to prioritize efficiency improvements because such improvements would create an income flow to pay for other needed investments. The government of Guadalajara, in collaboration with the federal government, has designated over \$20 million for this plan, with most resources designated to efficiency improvements.

A third major project opportunity will soon come to fruition in the state of Baja California. Baja California has signed a loan agreement with the Japanese Bank for International Cooperation (JBIC) for an integrated water supply and sanitation project. The loan was signed on March 30, 2000, for 22.2 billion yen (approximately \$200 million). The loan monies are being administered by a BANOBRAS trust, and although work has begun, all major aspects of the project were still to be tendered in 2001.

Municipal wastewater project opportunities exist in other cities with more than 50,000 inhabitants. Those cit-

ies are under pressure to comply with NOM-ECOL-001 by having treatment facilities in place. The best projects are in those municipalities that have secured federal monies from APAZU or that are partially funded by FINFRA. Specific project opportunities are included in Appendix A.

The efforts to comply with regulation NOM-001-ECOL-1996 have started to open an important market for sludge treatment and disposal. A regulation for sludge treatment and disposal issued by INE is under review. The passage of this regulation would open an important market for sludge treatment and disposal technologies.

The Border Market

The market for municipal wastewater treatment on the U.S.-Mexico border is substantially different from that in the rest of the country. Stricter treatment standards often apply, and bilateral institutions (specifically, BECC, NADBank, and the U.S. EPA) offer technical and financial support.

The border area covers 100 kilometers north and south of the boundary and includes a combined Mexican and U.S. population of 10.6 million in 10 states. The area's population has registered impressive growth rates in the past five years and is expected to double by 2015. Much of the border growth is attributed to implementing of NAFTA and installing assembly plants (maquiladoras) on the Mexican side of the border. These manufacturing facilities represent more than 4,000 companies and employ more than 850,000 workers.

The border region will represent an important environmental market in municipal wastewater and other areas for years to come because of a huge backlog of environmental needs and because the region is expected to continue its rapid growth. Some estimates place this growth at higher than 8 percent per year in many metropolitan areas.

According to a 1999 assessment by the U.S. General Accounting Office, 12 percent of the border population lacks access to potable water, 30 percent to wastewater treatment facilities, and 25 percent to solid waste disposal facilities. An estimated \$3.2 billion is needed to correct those infrastructure deficiencies on both sides of the border; about 77 percent of that amount is needed for wastewater treatment.

Since 1994, the United States and Mexico have provided about \$3.1 billion to address border environmental infrastructure needs. The United States has contributed about 80 percent of that amount. Many barriers exist to overcoming the environmental infrastructure problems

of border communities, key among them the lack of human capital to plan, implement, and maintain environmental infrastructure and the limited ability of communities to obtain affordable financing to build needed projects.

Industrial Wastewater Treatment

The industrial sector offers excellent opportunities for sales of U.S. technology and services, especially in the wastewater treatment sector. As local communities build municipal wastewater facilities to comply with NOM-001-ECOL-1996, they also increase their efforts to limit industrial discharges into their sewage systems. Further, industries that discharge directly into federal water bodies face CNA fines if discharges are not curtailed. Those factors, combined with the volunteer audit program and incentives for environmental investment, as well as improved economic conditions, have created a dynamic market for industrial wastewater treatment.

Identifying industrial wastewater treatment projects is not easy because polluting companies are careful to protect their image. One method for finding industrial wastewater treatment projects is to have constant communication with chambers, associations, and industrial groups in Mexico. Industrial sectors that are among the worst polluting, and thus in need of wastewater treatment technologies, include the following: sugar, beverages, chemical, pulp and paper, textile, leather and tannery, food, basic metals, and petroleum and petrochemical.

In recent years, the giant state-owned petroleum company PEMEX implemented an exhaustive plan to protect the environment and to be recognized as a clean industry. PEMEX applied to the volunteer environmental audit program for approximately 70 percent of its facilities, and to date 50 percent of its facilities have been awarded clean industry certificates. The other 20 percent are in the process of making investments so that they may comply with the action plans resulting from their environmental audits.

Water-Monitoring Equipment and Services

CNA is developing a laboratory network to meet the increased demand for improved water monitoring and testing. One function of the laboratories will be to monitor drinking water supplies, including surface waters,

Case Study 5.1 PEMEX Refinación, Integrated Wastewater Project

PEMEX Refinación, the division in charge of refining activities, has made significant investments in wastewater treatment and reuse, especially at its six refineries. In 1996, PEMEX began operating a new wastewater treatment plant in the Salamanca refinery. That plant treats 100 percent of the municipal wastewater generated by the nearby city of Salamanca and then provides the treated water as process water for the petrochemical complex. The plant has eliminated the refinery's need to extract 20,000 m³/s daily from natural sources by substituting the treated municipal wastewater.

In 1999, a wastewater treatment plant to service the Cadereyta refinery came into operation under a services contract with a private company. The plant treats and recycles 21,600 m³ of water per day.

PEMEX has also built wastewater treatment facilities at its Madero and Salina Cruz refineries. Treatment plants for the Tula and Minatitlán refineries are in the final stages of construction. The Minatitlán facility is expected to enter operations in mid-2001.

wells, and aquifers, and to identify pollution sources. The second purpose of the network will be to certify public and private laboratories under a program called Project for the Modernization of Water Management. The laboratory network program is being partially funded by a World Bank loan and by the federal government.

Important progress has been made on that project. CNA has completed its National Reference Laboratory in Mexico City and now is upgrading its network of 13 laboratories, of which 6 will be equipped with Betex filtration and monitoring systems. CNA will also procure mobile laboratories to provide coverage to cities where no permanent laboratories exist.

At the state and municipal levels, water-monitoring and testing equipment will also represent good opportunities for U.S. companies. For example, the Mexico City government is beginning to install a sewer-monitoring network to detect illegal hazardous waste dumping. So far, only one monitoring station has been tendered, and it was to have been installed before the third quarter of 2001. The monitoring network will consist of 18 stations (fixed and mobile), which will measure metals, oils, and other hazardous materials in the water.

One of the Fox administration's priorities is to increase private participation in providing water services. Success in this effort will further fuel the demand for monitoring and testing equipment. Private operators will be particularly diligent in monitoring to protect their investments.

Best Prospects

Engineering and Construction

In the short term, projects with financial assistance from multilateral and bilateral institutions and the Mexican federal government will represent the best opportunities for construction and engineering services and equipment. It is recommended that U.S. firms participating in this market seek Mexican partners so that they will be eligible to participate in national tenders and can use the local partners' knowledge to more effectively bid on public works projects.

Some upcoming opportunities for engineering and construction projects are described in Appendix A. Other projects are listed in Table 5.7. The discussions for the Mexico City wastewater treatment project have not finished, and the project is not expected to move forward in the short term.

Water Service Providers

Water utility operators have opportunities in the short term to provide consulting services to municipal water utilities. Some utilities have received or will receive funding through APAZU and FORTEM to improve their efficiency. In the medium term, integrated concessions and management or service contracts similar in nature to the ones in Mexico City, Cancún, and Aguascalientes are expected to be implemented in other Mexican cities. The Mexico City contract will terminate in 2003, and the government has yet to announce if the contract will be renewed or if a new tender will take place. The city of Saltillo, Coahuila, is evaluating the convenience of creating a mixed company (50-percent public and 50-percent private) to take over the water and wastewater operations. The selection of the private partner was expected to be tendered in late 2001.

Table 5.7 Engineering and Construction Projects

<i>Project</i>	<i>Funding</i>
Torreon-Oxidation Lagoons	FINFRA
Sewage System in Tlalnepantla State of Mexico	FINFRA
Municipal and Industrial Wastewater Collection and Treatment Project in Poza Rica, Veracruz Feasibility Study	U.S. TDA
Manantiales, Coahuila, Wastewater Treatment Plant	BECC/NADBank
Reynosa, Tamaulipas, Sanitation Project (\$83.4 million)	BECC/NADBank
Tecate, Baja California, Water and Wastewater Improvement	BECC/NADBank

Source: Hanhausen & Doménech Consultares, S.C.

Equipment Firms

Equipment firms will find opportunities in several distinct areas of the marketplace, including opportunities to sell to Mexican and international companies that win bids to build and operate major water infrastructure projects. The demand for inspection, verification, laboratory, and testing equipment will continue to be strong. The Mexico City sewage-monitoring network represents an important opportunity for suppliers of that type of equipment. Other cities will also strengthen their sewage monitoring in order to identify polluters that could damage municipal systems.

As the new administration pushes efficiency gains at the local level, the market for meters, digital readers, billing software, and other devices will expand, as well as that for the training of system operators. The best sales opportunities will occur in the larger cities, which have the financial capacity to invest in the more technologically advanced solutions.

Chapter 6

Solid Waste

The solid waste market in Mexico is perhaps the least developed environmental segment in Mexico, with a limited but expanding market for U.S. companies. According to SEDESOL, Mexico generates 84,200 metric tons per day of solid waste, out of which 83 percent is collected and 53 percent receives an adequate disposal. As shown in Table 6.1, the percentages are higher in large metropolitan areas and much lower in small cities and rural areas, where most garbage is deposited in open dumps.

The characteristics and composition of municipal solid waste in Mexico vary depending on the income and consumption patterns of the population. SEDESOL estimates that 42 percent of the waste generated in Mexico is organic waste, 16 percent is cardboard or paper, 7.4 percent is glass, 3 percent is metal, 2 percent is textile, and the remaining 29.6 percent represents other materials. Industrial solid waste streams are neither well documented nor classified in Mexico, and usually they are not treated apart from municipal waste.

Mexico City is the largest waste generator on a per capita basis, generating 1.37 kilograms per day (kg/d) per person. In the northern border region, waste generation is estimated at 0.98 kg/d per person. Those two areas have the best potential for waste recycling facilities.

Waste recycling is very limited in Mexico, with only about 8 percent of municipal waste recycled in large cities. The best metropolitan areas recycle up to 12 percent of their municipal waste. The most important impediment to developing an adequate municipal waste infrastruc-

ture in Mexico is financial. Municipal waste collection and disposal has historically been free, and, therefore, cities are always short of cash to fund new infrastructure. Some city governments have tried to charge for collection and disposal services, but those efforts have failed because of local protests. For example, when Puebla granted a concession to a private company that involved a fee for service, local residents began throwing their garbage in the streets rather than paying the fee.

The lack of adequate waste disposal infrastructure is creating a host of related pollution problems. Landfill pollutants are leaching into and compromising groundwater supplies. Landfill gases and landfill fires are releasing toxic pollutants into the air. In addition to those problems, uncontrolled access to dumps invites illegal dumping of hazardous wastes and puts at risk the health of the scavengers who work the landfills.

Several attributes of the solid waste management market hinder its development:

- The Mexican federal government plays a minimal role in managing solid waste. This responsibility rests almost completely at the municipal level.
- The predominance of labor unions and scavenger unions that oppose modernization impede efforts to collect and dispose of municipal solid waste.
- In Mexico, an environmental ethic is just emerging, and most Mexican households and businesses do not separate wastes, thereby increasing recycling costs.

Table 6.1 Solid Waste Collection and Disposal

<i>Location Type</i>	<i>Number of Locations</i>	<i>Population (millions)</i>	<i>Generation (metric tons/day)</i>	<i>Collection (percent)</i>	<i>Appropriate Disposal (percent)</i>
Metropolitan areas	7	31	37,400	95	85
Cities in the 100 Cities Program	126	31	28,600	80	43
Small cities	267	29	11,600	70	6
Towns and rural areas	199,600	8	6,600	60	0
Total	200,000	99	84,200	305	134

Source: SEDESOL.

Despite those complex social and financial issues, progress is being made. Some municipalities now subcontract waste collection and disposal to private operators. The private sector also plays an increasingly important role in the transportation, reuse, and recycling of construction materials and other industrial waste that is not part of the regular municipal waste stream.

Regulatory Framework

The responsibility for providing municipal waste collection and disposal services remains at the municipal level. The federal government plays a regulatory role and provides technical support to those municipalities that request assistance for project development.

State and local officials apply their own regulations to the collection of solid waste and the construction and operation of landfills. Those regulations vary depending on the size of the city, local environmental policies, and monies available. At the federal level, only one current regulation and one proposed regulation deal with municipal landfills, as follows:

1. **NOM-083-ECOL-1996.** This regulation sets the conditions and characteristics for the sites where final disposal facilities can be built. It sets parameters as to the quality and characteristics of the soils, minimum distance to underground aquifers, and minimum distances from populated areas.
2. **Proposed Regulation NOM-084-ECOL-1994.** This proposed regulation sets the specifications for designing, constructing, operating, and monitoring a sanitary landfill. The regulation was published in June 1994 but has not yet been approved because of complaints from municipal authorities who believe that the standards outlined are too strict and costly to implement. The Fox administration will review all pending regulations and will likely cancel those facing stiff opposition or modify them in order to gain approval. INE believes that regulation NOM-084-ECOL-1994 is not likely to be approved but rather will be replaced by one that sets lower standards.

The federal government will work with state and municipal authorities to develop a comprehensive regulatory framework for municipal solid waste. This framework will be combined with a public education campaign to include information on waste separation and the dangers of dumping hazardous waste in municipal landfills. The effort will include developing regulations

and public awareness campaigns to encourage the collection and disposal of batteries, the operation of recycling facilities, and the use of garbage trucks instead of open trucks. The plans also include developing regulations to control the leaching of polluted waters from landfills.

Sector Investments

Mexico needs additional landfill capacity for the 17,233 metric tons per day of municipal solid waste that is currently being deposited in open-air dumps or being illegally dumped. Existing collection infrastructure is similarly inadequate; most cities lack transfer stations or even trucks equipped with compactors.

Developing the necessary infrastructure to handle and appropriately dispose of Mexico's municipal waste is estimated to require more than \$1.7 billion of new investment. Currently, Mexico spends only about \$200 million per year in this area.

With federal and local resources so limited, some municipalities are likely to look to the private sector to bring in additional capital. U.S. firms entering the solid waste market should be aware of the risks of this sector and whenever possible should seek payment warranties and look at the business from the recycling side rather than from fees collected from the municipal government. At present, according to SEDESOL, 15 cities have opted for private participation as a solution to their waste management problems: Agua Prieta, Sonora; Cancún, Quintana Roo; León, Guanajuato; Los Cabos, Baja California; Los Mochis, Sinaloa; Mérida, Yucatán; Monterrey, Nuevo León; Nuevo Laredo, Tamaulipas; Piedras Negras, Coahuila; Puebla, Puebla; Querétaro, Querétaro; Reynosa, Tamaulipas; Tijuana, Baja California; Tlalnepantla, México; and Torreón, Coahuila.

There is no standard model for private participation, and a number of arrangements exist, including the following:

- **Integrated Concession.** Under an integrated concession arrangement, the municipality contracts with a private company to manage the entire solid waste system, from collection and cleaning of the streets to final disposal in controlled landfills. Under such a scheme, the municipality pays a fixed fee to the concessionaire, which has to meet a set of requirements such as collecting domestic garbage three times a week, cleaning the streets every day, and disposing of the waste using transfer stations and landfills that comply with international standards.

Parameters vary depending on the municipality or city, and the scheme is not common. It is most appropriate for areas able to support a high level of service.

- **Fee Contracts.** Fee contracts are the most common arrangement in Mexico, usually with different contractors being assigned to different parts of the city or being assigned to perform different services. The municipality pays the service supplier a fixed fee for the service provided. According to SEDESOL, collection fees range from between \$14 to \$23 per metric ton. For final disposal, fees vary from \$5 to \$15 per metric ton, depending on the quality and operational costs of the landfill.

In addition to the market for waste collection, hauling, and disposal services, there is a small, but growing market to supply solid waste equipment to municipalities. In the past four years, over 30 sanitary landfills were built in Mexico using financial assistance from the federal government under a program called the 100 Cities Program. Although the program expired in 1999, financial assistance is now being provided to municipalities through BANOBRAS. BANOBRAS is administering a \$400 million credit line provided by the Inter-American Development Bank for the strengthening of state and municipal entities. A portion of those funds is available to support solid waste efforts in the municipalities that were enrolled in the 100 Cities Program. (See Chapter 10 for details on the program.)

Currently, landfills of several large cities are reaching full capacity. According to SEDESOL, Mexico City's largest landfill, Santa Catarina, is reaching full capacity and needs to be replaced. The Mexico City government believes that the landfill has further capacity and will continue to operate it for at least another four years. Plans for the new landfill are at an early stage. Thus, an opportunity exists for consultants who specialize in analyzing soils to define a possible location for the new facility. In the mid term, construction of the landfill will represent opportunities not only for engineering firms that specialize in building this type of infrastructure, but also for firms that would develop recycling units surrounding the landfill. The local government believes that closing the Santa Catarina landfill will be a unique opportunity for creating recycling infrastructure and avoiding problems with scavengers.

Other cities with opportunities for landfill construction and related studies include Veracruz, where the state government is planning the construction of five controlled landfills to serve the state's largest cities. The government of the state of León is planning to grant concession

for the construction and operation of a new landfill. Both Guadalajara and Querétaro are in the early stages of designing and building new landfills. (See also Appendix A.)

Waste-to-Energy Pilot Project

Waste-to-energy projects are new to Mexico, with only one project operating under such a scheme. That project is a small power plant located next to the wastewater treatment plant in Monterrey. The facility generates electricity using the gases expelled by the sludge of the Monterrey wastewater treatment plant.

The Sistema Metropolitano de Procesamiento de Desechos Sólidos (SIMEPRODESO, Metropolitan System of Processing Solid Waste) is developing a new initiative. SIMEPRODESO is the entity in the state of Nuevo León responsible for the landfill serving the city of Monterrey and its surrounding municipalities. SIMEPRODESO is in the process of tendering a gas-to-energy project, which has also received support from the Global Environmental Fund. The SIMEPRODESO waste-to-energy project is a pilot project that, if successful, could be repeated in other cities in Mexico, particularly Mexico City and Guadalajara. The U.S. Trade and Development Agency partially funded a study to determine the project's feasibility.

The Border Area

NADBank plays an important role in financing municipal infrastructure projects on Mexico's northern border. It currently has three solid waste projects in the pipeline, which have already received their BECC certification and are candidates for NADBank funding: (1) a solid waste collection and disposal project in Agua Prieta, Sonora; (2) a similar project in Puerto Peñasco, Sonora; and (3) a project to develop a paper recycling facility in Cinco Manantiales, Coahuila. In addition, BECC has four projects that are currently under Step 1 evaluation: (1) a project to construct a solid waste facility in Santa Ana, Sonora; (2) a solid waste transfer station and municipal landfill project in Mexicali, Baja California; (3) a comprehensive solid waste project in Magdalena, Sonora; and (4) a project to close a municipal open landfill in Agua Prieta, Sonora. A summary of these projects and contact information are available on NADBANK's Web page at www.nadbank.org.

In late 2000, the BECC's board of directors voted to expand BECC's mandate to certify a wider range of project types and areas. The new areas include recycling projects, pilot projects, municipal planning projects, and

projects to develop hazardous waste infrastructure. This new BECC initiative should increase both the number of projects in the pipeline and new market opportunities.

Best Prospects

U.S. equipment dominates the municipal waste market for imported products in Mexico, and the quality of American equipment is well accepted among municipal authorities. The number of private companies offering waste collection and disposal services in Mexico is limited because it is a relatively new market. U.S. firms entering this market will not have many foreign competitors; however, local competitors compete well on price. U.S.

companies entering the market are advised to consider partnering with local companies with previous experience in providing services to municipal or state governments.

The market for municipal waste treatment and disposal equipment will continue to be limited to those projects funded by BANOBRAS and NADBank and to opportunities spread among the larger Mexican municipalities.

U.S. firms should track the evolution of regulatory reform that the Fox government will propose for municipal waste. The approval and implementation of several regulations, especially those that set parameters for the construction of controlled landfills, could spur the solid waste management market.

Chapter 7

Hazardous Waste

The Mexican government estimates that the country produced 8 million metric tons of hazardous materials in 1997.⁵ Other private sources estimate that the country generates between 6 million and 10 million metric tons of hazardous waste per year. In general, reliable and detailed information on hazardous waste generation in Mexico is still difficult to obtain.

To better define the scope and nature of hazardous waste generation, INE is undertaking a major effort to identify and register all generators of hazardous waste. By May 2000, INE had registered over 27,280 companies as hazardous waste generators, and those companies reportedly generated 3.7 million metric tons per year. The current register is estimated to represent only 40 percent of the total market because Mexico has more than 100,000 manufacturing firms that generate some type of hazardous waste.⁶ Of those firms, 98 percent are small and mid-sized companies, and 2 percent are large corporations.

The register is considered an important driver to boosting the levels of adequate handling and disposal of hazardous waste. Once registered, firms must continue to report their production of hazardous waste to the government and must demonstrate that they are following proper storage, treatment, or recycling practices.

According to a U.S. Foreign Commercial Service report, of the estimated 8 million metric tons of hazardous waste produced per year, at present only 26 percent receives adequate handling, treatment, disposal, or confinement.⁷ The remainder is improperly stored, is illegally dumped in municipal landfills or vacant locations, or is discharged into sewer systems. This situation creates a severe public health and environmental problem for which authorities are attempting to find solutions.

At the heart of the problem is a lack of adequate confinement, treatment, or disposal facilities to handle the volumes and types of wastes generated. For example, only one company in Mexico operates a hazardous

waste confinement facility. That company is located in the northern state of Nuevo León. Meanwhile, most hazardous waste is generated in the central portion of the country.

Solutions to Mexico's hazardous waste problem have been difficult to design and implement because of reasons such as the following:

- Industrial activity is growing at rates upward of 7 percent; hence, the level of waste generated continues to increase.
- A lack of coordination exists between the three levels of government, particularly regarding the siting of new confinement or treatment facilities.
- The government has limited capacity to enforce hazardous waste regulations, particularly within mid-sized and small companies.
- The regulatory framework is weak and has significant gaps, and the permit approval process for confinement or treatment facilities lacks transparency.
- The costs of market entry and associated market risks are high because of opposition by community and environmental groups to new confinement or treatment facilities.
- Government policies are constantly evolving.
- Reliable information on the market is scarce, making it difficult to estimate returns on possible investments in the sector.

Still, Mexico has made some important progress, particularly in the area of the treatment of bio-hazardous waste. Since the coming into effect five years ago of a regulation for the management of bio-hazardous waste, Mexico has developed significant treatment capacity.

Recycling of hazardous waste in Mexico is also showing promise. Currently, 140 companies provide recycling services, with a total installed capacity of 2.5 million metric tons per year (see Table 7.1). Treatment capacity was only 500,000 metric tons per year just five years ago.

The Fox administration plans to launch a major restructuring of the hazardous waste sector. The primary change will be to move all hazardous waste policy-

5. *Residuos Industriales Peligrosos en Mexico: Una Torre de Babel Ecológica* (CESPEDES, 1998), 22.

6. "Hazardous Industrial Waste Equipment Market—Industry Sector Analysis" (Mexico City: U.S. Department of Commerce, 1999), 2.

7. *Ibid.*, 22.

Table 7.1 Companies Authorized to Provide Hazardous Waste Services

<i>Type</i>	<i>Number</i>
Collection and transportation	320
Temporary warehouse	105
Reuse	16
Recycling	140
Treatment	64
Incineration	11
Confinement	4
Total	660

Source: INE.

making and regulatory responsibilities from INE to SEMARNAT.

Although no formal announcements have been made, it is expected that SEMARNAT will undertake an extensive review of the existing regulatory framework and will seek to better coordinate efforts with related ministries, as well as with state and municipal authorities. Increased coordination is expected to reduce uncertainty for potential investors in new facilities as well as to improve information exchange and enforcement activities. SEMARNAT is expected to continue strong efforts to identify and register hazardous waste generators.

In addition to the federal government's efforts, the local level is expected to increase enforcement. The sewer-monitoring system being installed in Mexico City will play a particularly important role in detecting the discharge of hazardous materials into the sewer. Such hazardous materials could damage Mexico City's soon-to-be-built wastewater treatment system.

Institutional and Regulatory Framework

The federal government is responsible for regulating the hazardous waste sector in Mexico. At present, INE regulates the sector through its Dirección General de Materiales, Residuos y Actividades Riesgosas (General Directorate of Hazardous Materials, Wastes, and Activities). The directorate is responsible for coordinating the government's hazardous waste policy-making and implementing strategies. Its most important responsibilities include:

- Providing official classifications to identify highly hazardous activities and hazardous waste

- Granting permits to develop and operate facilities to collect, recycle, store, transport, treat, dispose, and confine hazardous waste
- Promoting private-sector involvement in developing infrastructure for the proper handling of hazardous waste and materials

The most important program undertaken by INE is the Programa para la Minización y Manejo Integral de Residuos Industriales Peligrosos en Mexico 1996–2000 (Program for the Minimization and Integrated Management of Industrial Hazardous Wastes 1996–2000). Although the government officially completed the program in 2000, it will continue as the main directive for hazardous waste policy until a new program is announced. The 1996–2000 program has three main directives:

1. To register and develop information on all hazardous waste generators
2. To reduce the volumes and hazard levels of wastes generated by encouraging industry to adopt better cleaning technologies and improved feedstock selection
3. To develop the infrastructure for incineration of bio-hazardous wastes as well as to promote the development of integrated industrial waste treatment and disposal centers

Achievements of the program include the register of hazardous waste generators in Mexico and the creation of a national network among the federal government, waste generators, research centers, and local authorities. The network is called REXEMAR and is part of an international network of the Pan American Health Organization. The goal is to promote interaction among generators, enforcement entities, and institutions to exchange information and develop adequate management systems for hazardous waste.

REXEMAR has a technical group that reviews, evaluates, and promotes the use of minimization and recycling technologies. REXEMAR was instrumental in improving the management of bio-hazardous waste and in promoting private investment in the sector. U.S. companies entering the Mexican hazardous waste market can participate in the technical meetings of REXEMAR as a vehicle to promote the use of their technology in Mexico.

On the hazardous waste transportation side, the Mexican Secretariat for Communications and Transportation (Secretaría de Comunicaciones y Transportes, or SCT) is responsible for publishing and maintaining the regulations related to the transportation of hazardous materials. The SCT's regulations are fairly consistent with

recommendations of the United Nations (UN). Official Mexican standards are based on the eighth revised edition of the UN Recommendations on the Transport of Dangerous Goods and are fairly consistent, although with a few differences, with U.S regulations.

NAFTA includes a provision requiring Canada, Mexico, and the United States to harmonize hazardous materials standards on the basis of the UN Recommendations on the Transport of Dangerous Goods by Jan. 1, 2000. Mexico is still reviewing and modifying some regulations to incorporate a multi-modal approach. The current status of Mexican regulations relating to the transport of hazardous materials in English can be found at <http://hazmat.dot.gov>.

Regulations

The General Law of Ecological Balance and Environmental Protection sets forth the regulatory framework regarding hazardous wastes. Specifically, article 4 in Chapter VI is dedicated exclusively to hazardous waste regulation. This law establishes the general rules for the handling of hazardous wastes and materials and SEMARNAT's role in permitting and developing programs. Article 8 delineates the reporting and handling obligations of hazardous waste generators.

In addition to complying with the General Law and its regulations, generators, equipment manufacturers, and authorized hazardous waste confinement companies must comply with the regulations outlined in Table 7.2.

A regulation proposed in January 2000 for PCBs could positively affect the market for treatment technologies.

Proposed NOM-133-ECOL-1999 would regulate all phases of PCB processing and disposal and is largely based on the U.S. standard set forth in the Code of Federal Regulations, Title 40, Part 761, Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce and Use Prohibition, 1995. It is estimated that Mexico generates 10,000 metric tons of PCBs. The largest generators are the national electricity companies (CFE and Luz y Fuerza del Centro) and PEMEX.

The proposed regulation states that all companies that have equipment, whether in operation or out of service, that uses solid or liquid PCBs; that have contaminated equipment; or that have residues of PCBs will have to present a generation manifest, including an inventory of PCBs no later than three months after the regulation comes into effect. Companies using machinery or equipment that contains PCBs will have to take the equipment out of service or reclassify it no later than six months after the enactment of the regulation. After enactment, only equipment containing a concentration of less than 50 parts per million PCBs will be allowed, and certified laboratories will have to inspect the equipment every three months to ensure compliance.

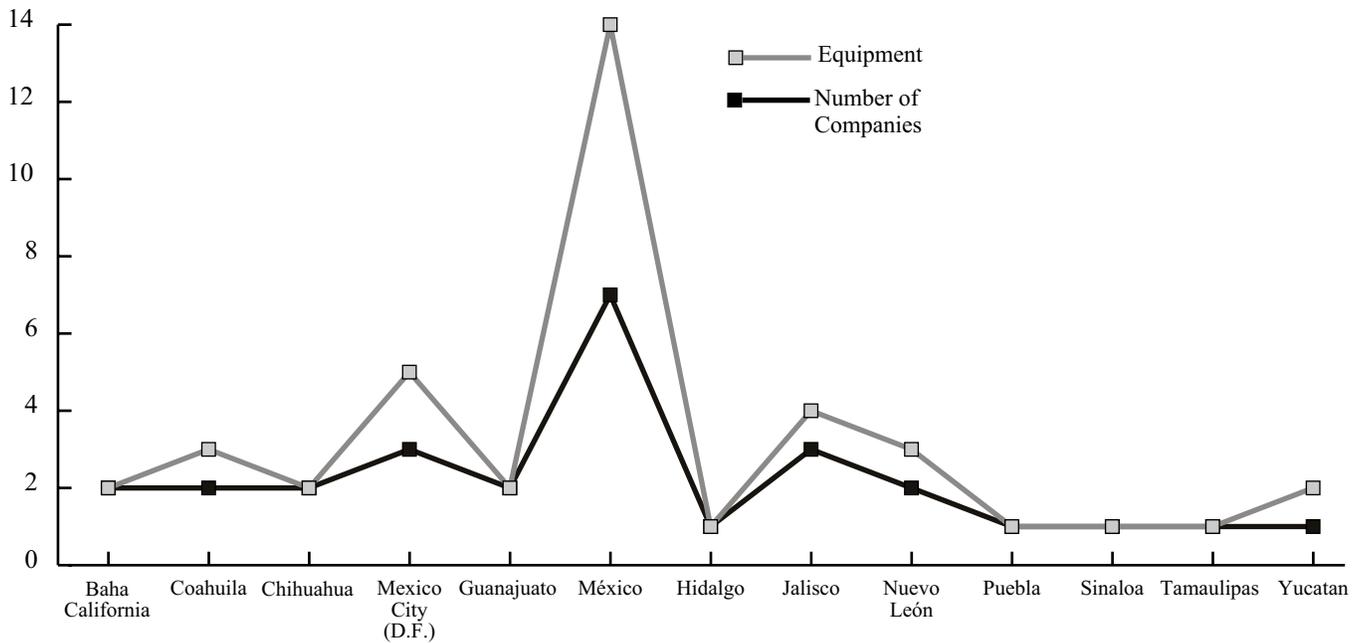
The regulation sets the maximum permissible emissions for the treatment of PCBs. Maximum limits are 0.5 parts per billion for air emissions, five parts per billion per liter of water discharged, and less than 50 milligrams per kilogram of solid waste. In addition, generators of polychlorinated biphenyls (PCBs) have to declare the amounts generated and the treatment provided in the INE's register of hazardous waste generators.

Table 7.2 Regulations for Hazardous Waste

<i>NOM</i>	<i>Regulation</i>	<i>Effective Date</i>
NOM-052-ECOL-1993	Lists hazardous wastes by their toxicity to the environment	Oct. 22, 1993
NOM-053-ECOL-1993	Determines wastes that are hazardous by their toxicity to the environment	Oct. 22, 1993
NOM-054-ECOL-1993	Concerns incompatibility among two or more hazardous wastes, excluding radioactive materials	Oct. 22, 1993
NOM-055-ECOL-1993	Regulates controlled confinement of hazardous wastes, excluding radioactive materials	Oct. 22, 1993
NOM-056-ECOL-1993	Regulates complementary works of a controlled confinement of hazardous wastes	Oct. 22, 1993
NOM-057-ECOL-1993	Concerns design, construction, and operation of controlled confinement cells for hazardous wastes	Oct. 22, 1993
NOM-058-ECOL-1993	Regulates operation of controlled confinement of hazardous wastes	Oct. 22, 1993
NOM-087-ECOL-1993	Covers separation, packaging, storage, collection, transportation, treatment, and final disposal of hazardous biological Infectious wastes generated by medical establishments	Nov. 7, 1995

Source: INE.

Figure 7.1 Distribution of Companies Authorized for Treatment of Hazardous Waste



Source: Hanhausen & Doménech Consultares, S.C.

Biological Waste and Infectious Materials

Mexico produces approximately 54,750 metric tons per year of biological infectious wastes. Currently, treatment capacity exceeds demand. This capacity was spurred by the coming into effect of NOM-087-ECOL-1993 in 1995. That regulation laid out procedures for the proper disposal of bio-hazardous wastes by hospitals, laboratories, and other generators.

Existing disposal infrastructure in Mexico's central zone (especially in Mexico City) is working below its capacity, and some companies have closed or moved their facilities in response. One factor that contributed to the building of this excess capacity was market estimates that exaggerated the quantity of waste generated.

While overcapacity exists in certain regions in Mexico, a deficit exists in other regions, creating an opportunity for U.S. companies. Out of 31 states and one Federal District, only 13 have authorized facilities for the treatment and final disposal of biological infectious waste (see Figure 7.1). Hospitals and other generators located in the states where no infrastructure exists must transport their waste to other states. In some instances, transportation costs exceed the cost of treatment. The opportunity in these regions in deficit is primarily for small incinerators or sterilization facilities.

According to Mexican regulations, several technologies are acceptable for the treatment or destruction of bio-hazardous waste. Authorized capacity is 24,870 kilograms per hour using chemical, incineration, sterilization, and radiowave technologies (see Figure 7.2).

U.S. suppliers entering this market should be aware of several market constraints. First, waste generation per hospital bed in Mexico is less than half of the waste generated per hospital bed in the United States. Mexican hospitals commonly sterilize latex gloves and other materials that in other more-developed countries are disposed of after a single use. Another factor is that budgetary constraints, especially in public-sector hospitals, lead to the selection of the least-expensive disposal option.

At the end of 1998, Mexico had 938 hospitals and 16,684 consultation centers.⁸ An estimated 80 percent of those facilities comply with disposal regulations.

Hazardous Waste Storage, Treatment, and Disposal

Hazardous waste confinement and treatment infrastructure is urgently needed in Mexico. At present, only four companies have federal authorization to confine hazardous waste, and only one facility is operating. That facility is located in the northern state of Nuevo León, whereas over 55 percent of the hazardous waste is generated in the central zone.

Two U.S. firms have tried but failed to build and operate hazardous waste disposal facilities in Mexico. Chemical Waste Management abandoned plans for projects in Mexico City and Guadalajara when local op-

8. *Infraestructura Física por Institución de Salud* (Mexico City: Sistema Nacional de Salud, 1998).

position grew. Later, the company built a \$32 million incineration facility in Tijuana, but the federal government shut down the facility after deciding that Tijuana would be off limits for hazardous waste incineration.

The U.S. company Metalclad also made an unsuccessful foray into the market for hazardous waste treatment. Metalclad made a multimillion-dollar investment in a disposal facility after receiving all federal permits. The local government shut the project down by withholding the requisite building permits.

The company filed a claim under the dispute resolution provisions of NAFTA, arguing that it was treated differently from local companies and contrary to international laws. After three years, the NAFTA panel determined that the acts performed by the San Luis Potosí government, and especially the Guadalcázar municipality, violated Mexico's NAFTA obligations. The panel imposed an indemnization payment of \$16.68 million in favor of Metalclad. Mexico has appealed the decision, and a review of this appeal is under way.

Other international companies have also faced problems in the hazardous waste sector. The company Centro de Confinamiento y Tratamiento de Residuos Peligrosos (CYTRAR), which operates 10 controlled hazardous waste facilities in Europe, has a facility in the northern state of Sonora, near the city of Hermosillo. The facility operated without major problems since 1987, but it came under scrutiny after a minor contamination incident. Lo-

cal protests grew until the facility was forced to close in 1997, and it has remained closed.

The cases of Metalclad and CYTRAR made international investors wary of involvement in Mexico's hazardous waste confinement and treatment market. The Fox administration is aware of the uncertainty that these negative experiences have created. The problem will take considerable time to resolve and will require better federal and local cooperation, along with better public understanding of the risks and benefits of new facilities. One risk not adequately perceived by the public is the risk of continued illegal dumping or improper on-site confinement.

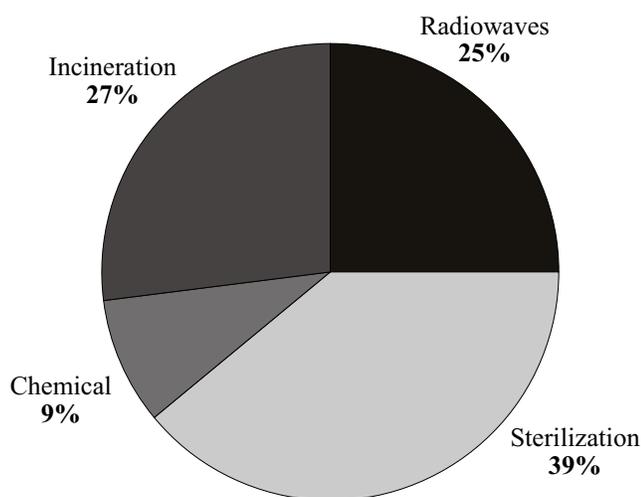
At present only two companies are seeking to develop new landfills; one project is in Sonora, and the second is in Puebla.

Minimization and Recycling Technologies

In an attempt to slow the growth of the volume of hazardous wastes generated, INE has prioritized efforts to promote hazardous waste minimization technologies and the recycling of hazardous materials. Such efforts attracted 140 companies into the market, which now have a combined recycling capacity of 2.5 million metric tons per year. (Approximately 1.3 million metric tons correspond to energetic recycling in cement kilns; see Figure 7.3.) Six companies have been authorized to recycle used lubricants, 22 to recycle used metals, and 34 to recycle used containers. Thirteen others are authorized to generate alternative fuels. Two are authorized to recycle photographic liquids, and two others, car batteries. In addition, INE has also promoted using hazardous materials as combustibles for cement kilns. The market for minimization and recycling technologies is expected to continue to grow at rates in excess of 15 percent per year. Investors should be aware, however, that if, over the long term, new confinement or treatment capacity is built, this new capacity could cut into the future market for recycling.

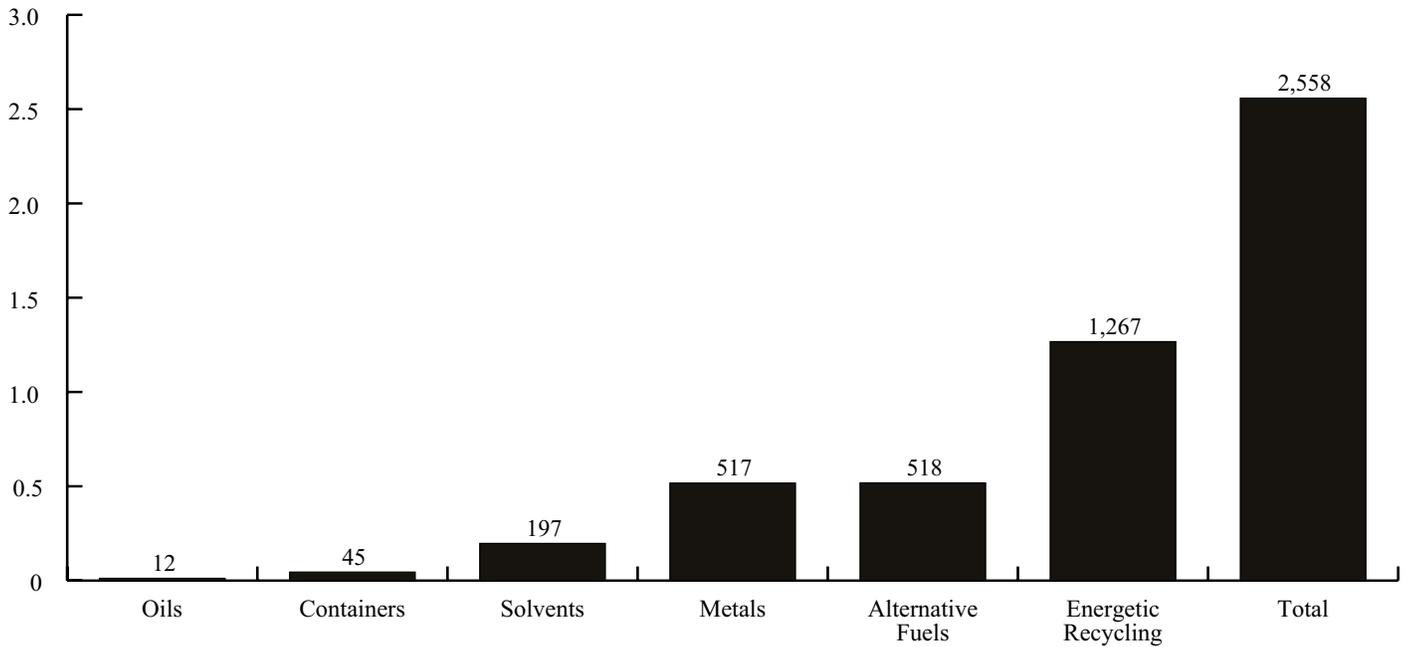
Two important local initiatives could serve as pilot projects for all of Mexico. In the first case, the state of Guanajuato, in conjunction with both SEMARNAP and PROFEPA and along with several universities and research centers, developed an agreement with 600 tanneries located in the state. Under the agreement, the authorities and the research centers analyzed the discharges and materials generated by the tanneries and developed a manual for the adequate management and disposal of the tanneries' residues. The program also designed methods for consolidating wastes among the tanneries to improve the economics of either disposing or recycling of the wastes, making such practices viable for

Figure 7.2 Treatment Technologies for Bio-hazardous Waste



Source: INE.

Figure 7.3 Hazardous Waste Recycling Capacity (millions of metric tons)



Source: INE.

even small tanneries. The program demonstrated some inexpensive recycling techniques that saved the tanneries on their material costs.

The second case involves a concerted effort by PROFEPA, INE, Mexico City, and the state of Mexico to promote the recycling of used oils. A government review of hazardous waste generators showed used oils to be a major part of the waste stream in Mexico City. First, the program promoted the development of storage and recycling facilities. Second, it involved an education campaign informing generators that they needed to register and report all hazardous waste generated and to dispose of such waste properly. That campaign also provided generators with alternatives for recycling used oils.

The program is still active and the number of companies that are registered and that report generation of hazardous wastes continues to increase. The program has demonstrated not only that recycling oils protects the environment, but also that it is economically viable because companies offering the service do not charge (or charge very little) for picking up used oils. The program is still at an early stage, and the number of vehicle repair shops and oil-change service stations coming into the program continues to grow. Local authorities believe that growing demand could support the entry of at least five new recycling companies within the next two years. INE has recommended promoting this program at the national level; however, SEMARNAT has not yet made an official announcement.

Soil Remediation

A study performed by the U.S. Foreign Commercial Service estimates that the market for soil testing technologies is growing at a rate of 27 percent per year, with a total market value of \$30.4 million by the end of 2000.⁹ The total market for soil remediation services is estimated at over \$120 million per year.

Under Mexican environmental law, polluters must clean up sites that they have contaminated. At the same time, the regulation that sets the parameters for remediation efforts has yet to be approved. Although soil remediation has not been a priority for the federal government, some important work has been done in recent years on the U.S.-Mexico border and by PEMEX. The government will likely increasingly prioritize the sites that risk contaminating aquifers.

In 1997, PEMEX designed and implemented an aggressive effort to elevate its environmental practices to meet international standards. The program, called the Integrated Management System for Safety and Environmental Protection (Sistema Integral de Administración de la Seguridad Industrial y la Protección Ambiental, or SIASPA), has been a tool to identify and evaluate the steps needed to improve environmental protection. As of the first quarter of 2000, PEMEX had replaced 317

9. "Environmental Testing and Laboratory Services—Industry Sector Analysis" (Mexico City: U.S. Department of Commerce, 1999).

Table 7.3 Illegal Abandoned Sites Polluted with Hazardous Materials

<i>State</i>	<i>Sites</i>	<i>Main Polluting Agents</i>
Baja California	2	Solvents, heavy metals, dust from smelting, oils
Chihuahua	2	Hydrocarbons, chemical compounds, waste oils
Coahuila	1	Heavy metals, residual oils, hydrocarbons, bio-hazardous waste, chemical compounds
Guanajuato	6	Oil, heavy metals, chlorinated organics, sludge, smelting dreg, waste oils
Hidalgo	12	Smelting dreg, dried paint
Jalisco	3	Tetrachloride, sludge, bacterial residues, soil polluted with diesel and fuels
México	17	Smelting dreg, bio-hazardous waste, chemical compounds, waste lubricants
Morelos	2	Metallic containers empty and full of toxic and flammable hydrocarbons
Nuevo León	5	Smelting dreg, aluminum, lead, cadmium, nickel, hydrocarbons, cyanides
Puebla	2	Hydrocarbons
Querétaro	16	Chemical waste, heavy metals, hydrocarbons, process sludge, bio-hazardous and smelting dreg
San Luis Potosí	8	Bio-hazardous waste, nickel, sludge, paint cans, asbestos, smelting dreg
Sonora	2	Bio-hazardous waste
Tamaulipas	3	Silicon sands, smelting dreg, chemical compounds, empty containers
Tlaxcala	3	Textile paints
Veracruz	12	Bio-hazardous waste, sulfur
Zacatecas	9	Heavy metals, reactive chemicals
Total	105	

Source: INE.

kilometers of pipeline, restored 116 pits containing drilling cuttings and muds, and restored almost 85 hectares affected by hydrocarbons. PEMEX spills have decreased to a level of 20,000 barrels of hydrocarbons per year. Approximately 95 percent of those spills are on land.

Under SIASPA, PEMEX now documents all spills and immediately completes an action plan for cleanup and remediation. Thus, PEMEX has become an important consumer of soil remediation technologies, and this importance will continue as the company continues to implement its environmental plan and as it attempts to receive ISO 14000 certification in all its facilities.

PROFEPA, in collaboration with the U.S. EPA, has identified 105 abandoned sites with soil contamination (see Table 7.3). Those sites are being studied to determine the types and quantities of hazardous waste and the risks they represent. Thus far, PROFEPA has been able to study the type and quantities of hazardous materials present at only 15 of the sites. Because of the resource cost of doing full remediation on those sites, PROFEPA is working with the U.S. EPA to evaluate the possibility of brownfield redevelopment. If the program goes forward, U.S. companies will be able to perform soil remediation work on several of the sites.

The Border Zone

The border zone is home to more than 4,000 maquiladoras, which employ over 800,000 people.¹⁰ Much of the growth of the border zone is attributed to the maquiladora industry, which has doubled in size over the past decade alone. Maquiladoras are the main generators of hazardous waste in the border region. Under Mexican law, hazardous waste produced by maquiladoras has to be returned to the country of origin, which in most cases is the United States.

Since the signature of NAFTA, environmental authorities on both sides of the border have increased enforcement efforts in the border region. One cooperative effort, the U.S.-Mexico border Hazardous Waste Tracking System (Haztraks), tracks shipments of hazardous waste across the border and alerts local, state, and federal officials on both sides of the border of potential violations. Since the signature of NAFTA, the amount of hazardous waste returned to the United States has increased from 27,500 metric tons in 1994 to 58,400 metric tons in 1999. CONIECO estimates that this volume of hazardous waste represents less than 50 percent of the total generated in the border area.

10. *Maquiladoras* are product assembly factories, most of them subsidiaries or part of international corporations.

Opportunities for installing hazardous waste facilities in the border area face challenges similar to those faced elsewhere. At the same time, because the United States and Mexico are working closely together to resolve hazardous waste issues, the border could represent a zone where clear rules emerge earlier than in other parts of the country.

The United States and Mexico signed an agreement for a consultative mechanism for the exchange of information on new and existing facilities for the management of hazardous and radioactive waste within 100 kilometers of the U.S.-Mexico border. That mechanism was developed by the U.S.-Mexico Hazardous and Solid Waste Workgroup in recognition of the public concern on both sides of the border regarding past, current, and proposed waste storage, treatment, and disposal facilities. The mechanism is consistent with article 6 of the La Paz Agreement, which allows the United States and Mexico to undertake “periodic exchanges of information and data on likely sources of pollution in their respective territory which may produce environmentally polluting incidents.” The mechanism recognizes the sovereignty of each country to make siting and permitting decisions on proposed waste treatment, storage, and disposal facilities within its borders in accordance with its domestic laws, regulations, and policies.

The following types of facilities are covered under the agreement:

- Commercial facilities that treat or dispose of hazardous waste generated off site
- Commercial facilities that incinerate hazardous waste generated off site
- Commercial facilities that recycle hazardous waste generated off site
- Commercial facilities that temporarily store hazardous waste generated off site
- Facilities that incinerate or dispose of hazardous waste generated on site
- Facilities that dispose of radioactive waste

Through the consultative mechanism, U.S. and Mexican authorities will exchange information on proposed facilities for hazardous waste management. The information exchanged will describe the company or entity willing to develop the project, the types of hazardous materials to be handled, principal regulatory agencies that will be making permitting or licensing decisions, and the permits needed.

Because, according to Mexican law, hazardous waste produced by maquiladoras must be returned to its country of origin, the market for hazardous waste management facilities is limited. The mechanism described,

Table 7.4 Best Sales Prospects

<i>Harmonized System Number</i>	<i>Product</i>
3925.10.01	Polymer deposits
3926.90.16	Filtration membranes
6909.11.07	Corrosive liquid containers
7017.10.11	Condensing crystallizers and refrigerators
7309.00.01	Enameled containers
7309.00.99	Other steel containers or deposits
8416.20.01	Burners
8419.89.21	Industrial autoclaves
8421.19.03	Refining turbinators
8465.99.05	Fiber crushers
8474.20.03	Blade-crushing machine
8474.20.06	Hammer of percussion crushers
8479.82.03	Garbage compactors
8479.82.99	Mixers, crushers, mills
8479.89.14	Tubular catalytic reactors
8705.90.99	Special vehicles
9609.00.01	Bulk transport containers
8514.30.03	Industrial ovens
8609.00.01	Deposit containers, cisterns
8609.00.00	Containers for transportation

Source: “Hazardous Industrial Waste Equipment Market—Industry Sector Analysis” (Mexico City: U.S. Department of Commerce, 1999).

however, will create clearer rules for building such facilities because of the information-sharing requirements.

The New Government’s Position

The new government is aware of the importance of resolving the environmental and public health issues associated with hazardous waste in Mexico and will strive to continue progress on a number of fronts. The government will continue to build on its early success by promoting waste minimization along with the recycling of oils, batteries, and other waste. The government will develop more precise information on the nature and quantity of hazardous materials generated. SEMARNAT and PROFEPA will strengthen efforts to register and monitor hazardous waste generators. SEMARNAT will review and rationalize the legal framework for hazardous materials and will work with local authorities and research centers to define the most viable alternatives for confinement and treatment.

The new government believes that past problems with building hazardous waste treatment facilities were caused by a lack of consensus on possible solutions among the different levels of government, environmentalists, local communities, and industry. The government believes that a consensus must first be established before moving toward a solution. To avoid a repeat of the situations in San Luis or Hermosillo, SEMARNAT will first have to put in place clear rules, work with local governments, and regain public and investor confidence in the process.

Best Prospects

While the market for hazardous waste confinement and treatment will be slow to develop, the best market opportunities will lie in other subsectors of the hazardous waste market. Recycling and minimization technologies will continue to exhibit strong growth, especially in the areas of oils, car batteries, and industrial wastes.

The market for treatment of bio-hazardous materials is limited because a large number of companies have

opened facilities in Mexico's most important cities. Small facilities are needed in some states that currently lack treatment infrastructure and that have to pay large sums to have their waste transported to out-of-state facilities.

Testing equipment to detect hazardous materials in water and soils will see the greatest growth of all hazardous waste technologies. The Fox administration considers the protection of water bodies and forests to be its main environmental concern, and technologies identifying pollution sources or existing contamination will show strong demand.

The U.S. EPA will continue working with PROFEPA to detect, evaluate, and restore contaminated sites, especially on the northern border. Because of PROFEPA's budgetary constraints, Mexican authorities are evaluating the possibility of performing brownfield redevelopment. U.S. companies with experience in this field should follow closely the development of this program sponsored by U.S. EPA and PROFEPA.

Table 7.4 presents some of the best sales prospects for industrial hazardous waste equipment.

Chapter 8

Air Pollution Monitoring and Control

The far-reaching policies implemented in Mexico to combat air pollution continue to be dwarfed by the magnitude of the widespread air-quality problem. This is especially true in the major urban areas and most notably in the valley of Mexico's metropolitan area, home to more than 17 million people and 3.5 million vehicles. Mexico City's air pollution problems are exacerbated by its circumstance of having a highly concentrated population living in an enclosed valley 7,500 feet above sea level.

The ambitious plans implemented in Mexico City have yielded some results, but whether those results have been major or marginal is open to debate. Although the overall level of pollutants released into the air has been reduced, a severe threat to public health remains.

Because air pollution problems have a direct impact on over one-third of Mexico's total population, this sector will continue to be an important market for environmental technologies and services. It is also the area where the government thinks it has achieved the greatest progress.

Mexico City remains the principal air-quality challenge, but other regions have also suffered degradation in air quality. Lessons learned from tackling the problem in Mexico City have served as the basis for developing plans to address similar conditions in other cities.

Pollution levels in Mexico are measured through an index called the Metropolitan Index for Air Quality (Indice Metropolitano de la Calidad del Aire, or IMECA), which tracks the level of sulfur dioxide (SO₂), carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), total suspended particles (TSP), particles under 10 microns (PM10), and lead (Pb). For each of these contaminants, there are specific regulations, which stipulate that the IMECA should not go over 100 points (see Table 8.1).

Table 8.1 Air-Quality Ratings under the IMECA

<i>Air Quality</i>	<i>IMECA</i>
Satisfactory (complies with NOMs)	0–100
Unsatisfactory	101–150
Bad (contingency phase 1)	151–200
Very bad (contingency phase 2)	200 and over

Source: INE.

On a national level, the most important plans to abate air pollution have been to create regional air-quality programs called PROAIRE. Those programs work toward establishing local infrastructures to monitor air quality, creating an inventory of pollution sources, and creating specific solutions to mitigate emission levels from fixed and mobile sources.

At present, seven PROAIRE have been implemented in the following cities: Mexico City, Guadalajara, Monterrey, Toluca, Juarez, Tijuana, and Mexicali, which have shown consistently high pollution levels.

Because air pollution results mostly from burning fuels, improving fuel quality has been the cornerstone of Mexico's air-quality improvement programs. A focus of reducing industrial emissions has been increasing the availability of natural gas. Mexico is making major investments in its capacity to transport and distribute natural gas nationally.

On the mobile sources side, the national oil company, PEMEX, has also made better fuels available, but improved fuels have been only a partial solution because of the average age and inefficiency of the country's vehicle fleet. A proposed alternative has been retrofitting vehicles for the use of compressed natural gas (CNG). This area is expected to experience significant growth in the near future.

Overall investment in improving air quality comes from both the private and public sectors. The public sector's investment comes in the form of establishing and enforcing a regulatory framework, along with developing cleaner fuels. Private-sector investment results from regulatory enforcement and particularly the threat of shutdown from declared air-quality emergencies.

The new administration is expected to continue promoting the development of additional PROAIRE in various Mexican cities. PROAIRE will continue to be a market driver for environmental technologies, services, and equipment. Particularly important will be technologies that help quantify and define the air-quality problem, as well as specific technologies to mitigate the problem.

Mexico City is developing an extension of its PROAIRE, which will result in a series of steps to be implemented over time. This new program is expected

to be presented in July 2001. The program will differ from the previous PROAIRE of 1995–2000 in that it will cover a 10-year horizon and will be dynamic, allowing for modifications as air conditions change.

Regulations, Standards, and Enforcement

SEMARNAT and the Secretariat of Health are responsible for creating air-quality regulations. Those regulations relate both to emissions and to exposure levels and define the permissible pollution levels for each contaminant (see Table 8.2). Most Mexican air regulations are developed following the criteria set forth by the World Health Organization or are developed following EPA standards. A complete description of regulations is available in Spanish at the INE Web site, *www.ine.gob.mx*.

Regulations for industry are mostly targeted to specific industrial sectors. Some of the most important criteria include the volume of an industry's emissions as well as the potential of its processes to produce pollution and the quantity of fuels it consumes. Those regulations are targeted to control particles, sulfur oxide, nitrogen, and hydrocarbon emissions. Regulations for specific sectors are not complete, and several industries are still not regulated. The new SEMARNAT will analyze whether to continue regulating specific industrial activities or to issue general regulations that set emission standards for all industries.

Regulations for mobile sources are based largely on U.S. standards, but Mexico lags behind the United States in applying its regulations. For example, in 1994, the regulation for new vehicle emission was modified to adopt values similar to those that have been used in the United States since 1981. The Mexican regulation issued in 1999 sets TIER I standards, which have applied in the United States since 1994. Under current regulations, TIER II vehicles will be introduced in Mexico in 2006, whereas in the United States such vehicles will be introduced in 2004.

All air emission and exposure regulations are under constant review with the objective of making them more stringent. One recent change was for the regulation on ozone that reduced the accepted level to 0.08 particles per million (PPM) every eight hours. Regulations for vehicles circulating in Mexico City were also made stricter.

Similarly, regulations require an improvement in fuel quality. Regulations will require a lower sulfur content, reaching less than 30 PPM for 2006 and allowing the introduction of TIER II vehicles.

The cities with PROAIRE have stricter regulations than cities that are experiencing less severe pollution.

Table 8.2 Federal Regulations for Air Quality

<i>Source or Pollutant Regulated</i>	<i>Number of Regulations Enacted</i>
Fixed sources	13
Mobile sources	10
Monitoring systems	5
Fuels	1
Sulfur composites	6
Nitrogen oxides	6
Suspended particles	8
Volatile organic compounds	10
Carbon monoxide	6

Source: INE.

Table 8.3 shows some of the measures and projects implemented in cities with PROAIRE.

Under the past administration, a National Information System on Air Quality (SINAICA) was developed to evaluate the air quality in various regions and to assist in developing air-quality improvement programs in the cities where pollution indexes were high. At present, 15 cities have permanent monitoring systems (see Table 8.4). Cities where monitoring systems were installed tend to follow that measure by developing a PROAIRE.

According to Mexican law, local air improvement plans are the responsibility of local authorities, as is law enforcement. Many local governments have not yet developed programs and are in violation of the law. In any case, the federal authorities will continue moving forward developing regional PROAIRE. The federal government provides grants to several Mexican states for installing monitoring systems in their metropolitan areas (see Table 8.5).

PROAIRE

PROAIRE are programs to improve air quality in specific cities. Developing such programs requires the combined efforts of federal, state, and municipal authorities, as well as the participation of local interest groups such as industry and other sectors. PROAIRE work in a similar fashion to State Implementation Plans (SIPs) in the United States.

SEMARNAT's role in PROAIRE has been to control air emissions that are under federal jurisdiction, which is the case for industries in the pulp and paper, cement, chemical, petrochemical, oil, and power sectors. SEMARNAT also defines emission standards for new vehicles and acts as coordinator among the three levels

Table 8.3 Air Pollution Reduction Measures in Cities with PROAIRE

<i>Sector</i>	<i>Measure</i>
Industry and Services	Stricter emission limits (NOM-085)
	New regulations (NOM-122 and NOM-123)
	Programs for self-regulation
	Contingency programs
	Air emission control equipment for priority sources
	Regulations for better fuels (NOM-086)
	Economic incentives for equipment
Transportation	Inspection and enforcement within primary pollution sources
	Program for restriction of use of polluting cars
	Stricter emission limits (NOM-042)
	Modernization of vehicle verification centers (NOM-041 and NOM-047)
	Regulations for better fuels (NOM-086)
Environmental Recovery	Vehicle fleet renovation program
	Promotion of safe and efficient public transportation systems
	Recovery of green areas
	Paving programs
	Urban and rural reforestation program

Source: Hanhausen & Doménech Consultares, S.C.

of government (federal, state, and local). SEMARNAT also contributes to PROAIRE by developing regulations, creating and updating the inventory of emissions, formulating programs to reduce air pollution, and approving local control programs.

Table 8.4 Cities with Air-Monitoring Systems

<i>City/State</i>	<i>Equipment</i>
México, Distrito Federal	25A, 100Mx
Guadalajara, Jalisco	8A
Monterrey, Nuevo León	5A
Toluca, México	7A
Ciudad, Juárez, Chihuahua	3Mx
Tijuana, Baja California	4Mx
Mexicali, Baja California	4Mx
Manzanillo, Colima	3A
Aguascalientes, Aguascalientes	2Mx
Salamanca, Guanajuato	1Mx
San Luis Potosí, San Luis Potosí	2A, 10Mx
Villahermosa, Tabasco	1Mx
Zacatecas, Zacatecas	1Mx
Cananea, Sonora	5A
Nacorazi, Sonora	3A

Source: Hanhausen & Doménech Consultares, S.C.

Each PROAIRE is custom made. It addresses specific conditions within the city and lays forth a specific action plan, which includes an estimation of the environmental improvement that will result from each suggested measure. The program must include a cost-benefit analysis of the proposed measures and must define the responsible authorities for each portion of the program. Each proposal is also evaluated for its possible social and political impact, and it must be viable under this criterion as well.

PROAIRE's purpose is to define specific measures for areas such as public transport, local transit infrastructure, improvements in fuel quality, urban development programs, strategies for substituting newer vehicles for older ones, vehicle emission inspections, development of air emergency plans, education, and reforestation. Under PROAIRE, letters of intent are signed that bind industries to limits on their operations imposed during air-quality emergencies.

PROAIRE are developed based on information obtained through a monitoring program and an inventory of air pollution sources. The information used to compile the inventory is managed under guidelines supplied by the U.S. EPA and the Western Governors Association.

Once monitoring systems have been established, an inventory of sources has been developed, and the magnitude of the pollution problem has been quantified, the program defines specific emissions goals for each type

Table 8.5 States That Have Received Federal Grants for Air-Monitoring Equipment

<i>State</i>	<i>Amount*</i>
Aguascalientes	192,000
Baja California	218,000
Baja California Sur	44,000
Chihuahua	154,000
Coahuila	225,500
Colima	69,000
Durango	164,000
Guanajuato	121,500
Guerrero	5,000
Hidalgo	128,500
Jalisco	49,000
México	10,500
Morelos	18,500
Nayarit	73,500
Nuevo León	40,000
Puebla	14,000
Querétaro	18,500
San Luis Potosí	162,500
Sinaloa	10,000
Sonora	211,500
Tabasco	102,500
Tamaulipas	157,000
Tlaxcala	60,500
Veracruz	126,500
Yucatán	12,000
Zacatecas	104,000
Total	2,492,000

* In U.S. dollars.

Source: INE.

Table 8.6 Mexico City PROAIRE 1995–2000 Investment (millions of U.S. dollars)

	<i>Public</i>	<i>Private</i>	<i>Total</i>
Industry	865	249	1,114
Vehicles	2,871	1,824	4,695
Transportation	6,547	802	7,349
Reforestation	292	—	292
Total	10,575	2,875	13,450

Source: CONIECO.

of pollutant. Those goals must be achieved by a certain date. The program outlines specific action items and measures that should be implemented by the city to achieve each goal. Some measures that are commonly found in PROAIRE include:

- Establishing a permanent air-monitoring system
- Developing a pollution sources inventory
- Producing a target list to present the principal fixed sources of air pollution and to define specific measures at each site such as use of a cleaner fuel; installation of air emissions control equipment; and incorporation of gas cleaning systems, electrostatic precipitators, and other control technologies
- Installing vapor recovery systems in the area's gasoline stations
- Evaluating federally controlled sources like PEMEX and CFE facilities, including developing suggested measures
- Producing a target list that presents the principal groups of mobile sources of air pollution and defines specific measures to mitigate emissions such as using cleaner fuels like CNG, establishing a local independent vehicle emission testing program for both automobiles and heavy vehicles using diesel, and improving the city's public transport system and general transport infrastructure
- Reducing suspended particles from land erosion by reforestation and road pavement programs
- Strengthening an industrial emissions inspection program
- Implementing incentive programs for cleaner technologies in mobile and fixed sources
- Implementing traffic engineering and management programs

The first PROAIRE in Mexico was issued in late 1995 for Mexico City and covered five years (1995–2000). Under this program, over \$13 billion was invested in air pollution monitoring and control equipment. Table 8.6 illustrates the breakdown of such investments.

Other PROAIRE have been developed for Guadalajara, Monterrey, Toluca, Ciudad Juárez, Mexicali, and Tijuana. These plans have been the main driver for the installation of “clean air” technologies and have also boosted the demand for air-monitoring and consulting services.

The new administration will continue to support the development of these plans in the most polluted cities. Although much investment has already occurred, suppliers of air-quality technologies and services will continue to find good opportunities in Mexico.

Mexico City PROAIRE, 2001–2010

Because Mexico City continues to provide a major air pollution challenge, its PROAIRE program will continue. Recently, a new metropolitan environmental committee was formed that will be responsible for dealing with air-quality issues.

In the past, one of the big obstacles to air-quality improvement has been inadequate coordination between the local and federal authorities. For example, SHCP was unwilling to expand the life of the environmental trust fund that financed environmental projects in Mexico City through a two-centavo surcharge on local gasoline prices. Further, vehicles with federal service license plates, mostly buses and trucks, are still not subject to emissions verifications because of lack of coordination between the federal Secretariat for Communications and Transportation and the local government. The new Mexico City government has pledged to build better coordination with the federal government.

Mexico City's government has commissioned Dr. Mario Molina, a chemistry Nobel Prize laureate, and his research team from the Massachusetts Institute of Technology to produce a study that will serve as the basis for a new air-quality program for Mexico City for 2001–2010. Molina's research group is developing a current assessment of air-quality conditions in the valley of Mexico's metropolitan area. That research was to be presented in June 2001. Some preliminary findings and specific recommendations indicate that air-quality conditions are deteriorating and that new types of pollution, such as PM10 and PM2.5, are reaching critical levels and are affecting the mortality of vulnerable population groups.

Molina indicated that the most urgent first step is updating the last emission inventory produced in 1998. Updating the inventory and constant monitoring of sources are the only real ways to evaluate the progress being made by the various air-quality improvement measures. He has indicated that micro particles caused by diesel and land erosion require immediate action.

Another preliminary recommendation calls for developing new vehicle emission infrastructure to verify the compliance of heavy cargo and passenger vehicles with five emission criteria. That recommendation also calls for PEMEX to reduce the sulfur content in its gasoline and diesel fuels. For this purpose, Molina suggests forming a special committee to work with the federal government to develop an investment program for PEMEX refineries that will allow the production of low sulfur content fuels.

Development of the pollution-source inventory should also address a problem currently faced by the authori-

ties, who lack precise information on the number and type of vehicles circulating in Mexico City. An updated inventory will help the authorities develop specific actions to target each type of emission source. The information obtained from monitoring the sources will be combined with meteorological information to generate short-term air-quality forecasts that will allow the authorities to implement immediate actions to control emissions on a day-by-day basis.

Among the sources identified as a continuing problem are thermoelectric facilities. The program calls for investments aimed at reducing those facilities' nitrogen oxide emissions. The recommendations also call for SHCP to reestablish Mexico City's environmental trust fund, funded by a two-centavo surcharge on local gasoline prices, and for the government to establish measures to limit the expansion of the urban area and to modernize the city's public transportation system by developing non-polluting public transportation. Another important recommendation is to implement the measures under a strict time schedule.

Mobile Sources

Mobile sources are the biggest contributors to air pollution in Mexico's metropolitan areas. In Mexico City, the problem is more evident because vehicles generate 85 percent of the pollution. To mitigate the problem, the city restricts the use of old cars one day per week and has developed several programs for fining polluters and for promoting the use of cleaner technologies. Mexico City also has a mandatory emissions testing program for cars; however, trucks and buses are not tested. The need to establish a new mandatory emissions testing program for buses and trucks that use federal license plates will be addressed shortly as a result of Molina's recommendations. Such a program would open new opportunities for companies selling emissions testing equipment for diesel-fueled vehicles.

The measures implemented thus far by the environmental authorities in Mexico City have had a limited success rate. For example, prices of older, nonconforming vehicles dropped after the imposition of measures to restrict the circulation of older cars, so many people simply purchased a second used car to get around the restriction.

A program introduced in 1989 to reduce by 30 percent the air emissions generated by vehicles in Mexico City has also met with limited success. This Natural Gas Vehicle Conversion Program was aimed at converting high-use vehicles, such as taxis, to CNG. The initial goals

called for converting 80,000 taxis, 2,000 buses, and 16,000 official cars and trucks. To date, despite having the city government's backing and funding for its early stages from the World Bank, only two CNG service stations are operating in Mexico City, and the number of vehicles converted has yet to reach 5,000. If the government is to achieve success in this and other initiatives, it will have to dedicate additional resources. It is estimated that by 2003 Mexico City will have expanded its natural gas distribution network, thus providing a boost to efforts to substitute natural gas for existing vehicle fuels.

In addition to the emission testing centers for buses and trucks and the Natural Gas Vehicle Conversion Program, other opportunities exist for clean technologies in Mexico City. In 1999, the city's government issued a regulation that exempted from use restrictions vehicles whose catalytic converters were replaced after five years. That regulation has created a huge market for catalytic converters in the city. An expected 170,000 converters should be replaced each year.

Other local governments, including Guadalajara, Mexicali, Ciudad Juárez, and Tijuana, are considering issuing regulations for obligatory emissions testing as well as some measures that have proven to work in Mexico City. The problem of older cars with poor emission standards is particularly severe along the U.S.-Mexico border because of the importation into Mexico of older U.S. cars.

Fixed Sources

SEMARNAT is responsible for supervising federal fixed sources of air pollution, which include manufacturing companies in the chemical, petroleum and petrochemical, paint and dye, automotive, paper and cellulose, metallurgy, glass, power generation, asbestos, cement and gypsum, and hazardous waste treatment sectors. Those industries must comply with the emission standards set in federal NOMs.

Because of complex air pollution problems, air-quality contingency plans apply to industries located in Mexico City and Guadalajara. The Environmental Contingency Program of Mexico City covers 450 companies that have to reduce their operations between 30 percent and 40 percent for phase 1 contingencies and up to 50 percent for phase 2 contingencies. Table 8.1 defines these contingencies. Clean companies are exempt from air-quality contingency plans. This exemption has created an incentive for investment in cleaner technologies, which has strengthened as permissible pollution levels continue to be lowered.

To be exempt from such plans, companies must comply with air emission regulations, especially for sulfur oxide. Facilities that use natural gas as fuel and can show compliance with regulations on low PM10 emissions can also be exempted. Development of a natural gas distribution network in Mexico City will make it possible for medium-sized industries to switch to natural gas. Technologies allowing companies to switch to natural gas will continue to have good potential in Mexico City and Guadalajara in spite of the recent steep increase in natural gas prices. The shock caused by the significant increase in natural gas prices might make some companies consider alternative pollution control investments so that they will be able to continue using other fuels.

PEMEX

Up until the early 1990s, PEMEX, the government-controlled oil monopoly, was one of the major contributors to environmental degradation in Mexico. PEMEX's operations and products were environmentally damaging in two ways. First, they were a major source of pollution, and, second, the company was supplying its customers with highly polluting fuels.

Because of enormous social pressure, PEMEX started having a more responsible attitude regarding its direct impact on the environment. The company implemented a series of plans and projects to improve its environmental performance and to reduce the harmful effects of its products.

One program was launched in May 1998 under the name Integrated Management System for Industrial Safety and Environmental Protection with the objective of turning PEMEX into an environmentally friendly enterprise. A first step of the program was to inscribe each of PEMEX's facilities into the voluntary environmental audit program. The audits of each facility have produced individualized assessments and generated a list of corrective actions to be implemented at each site. At present, almost half of all facilities have produced their action lists and are working on obtaining clean industry certificates. Some are trying to achieve ISO 14001 certification.

Air emissions were the most important environmental problem generated by PEMEX facilities, with almost 85 percent of pollution produced by PEMEX released into the air. Close to 70 percent of that problem was caused by sulfur oxide emissions, followed by volatile organic compounds (VOCs), which accounted for 20 percent. The most important sources of sulfur oxide were the flares at offshore platforms (33 percent), followed by

boilers using fuel oils (25 percent), and gas-processing centers (23 percent).

Over 90 percent of the VOC problem was caused by evaporation of hydrocarbons at storage facilities. Corrective measures have included installing internal floating roofs and improving filling stations for tanker trucks, including installing vapor recovery equipment. Over \$270 million has already been invested in this area from a budget of \$420 million that was allocated to the 1999–2002 period.

PEMEX has also tried to improve its fuel products. It has begun constructing sulfur recovery facilities, which are expected to achieve a recovery rate of 98.5 percent by 2002. This performance will exceed the U.S. EPA's standard of 97 percent and will represent an improvement of 80 percent over 1994's level.

Those actions continue the process initiated by PEMEX in 1986 to improve fuel quality in Mexico. During 1998, leaded gasoline was completely phased out, and sulfur content on diesel fuels was reduced to 0.05 percent. Because hydrocarbon compounds are precursors to the formation of ozone, the company has, especially in Mexico City, supported the government's efforts for fuel switching in the industrial sector. In 1998, natural gas accounted for 58.5 percent of the total fuel used for industrial purposes; that figure is expected to grow to 68.2 percent by 2007.

PEMEX presents large opportunities for U.S. manufacturers of air pollution control devices. Although the company has already made important investments over the past three years to improve its environmental record, it needs to continue investing if it is to obtain clean certificates in at least half of its facilities. The company has a budget of over \$150 million for these investments for 2001 and 2002.

CFE

The National Electricity Commission (CFE) generates over 90 percent of all electric power in Mexico. In past years, the company has made important investments to improve its environmental performance. Most of those investments were aimed at switching from burning fuel oils to natural gas.

Some of the utility's power plants are in areas with critical air-quality conditions. This circumstance will compel CFE to continue to invest in additional cleaning technologies, particularly at facilities that cannot be converted to natural gas.

Best Prospects

Although the Fox administration has declared that its environmental priority will be the water and forest sectors, air-quality improvement will continue to be a top priority because air pollution directly affects a large portion of the population. The air-quality program will also continue to be one of the Mexico City government's two top environmental priorities as results from Dr. Molina's studies are expected to indicate that the situation is deteriorating. Thus, the Mexican market for U.S. environmental technologies will continue to be strong.

The federal government is developing its plans for the next six years. Priorities are expected to include:

- Developing adequate coordination between different levels of government and different federal authorities, including transport, energy, and urban development authorities
- Consolidating the progress made so far in the installation of monitoring systems
- Further improving the quality of fuels produced by PEMEX and creating a growing awareness among the population of the magnitude of the investments that will be required to modernize the public transport system in Mexico City
- Continuing to update environmental regulations, while improving enforcement efforts
- Initiating monitoring programs in every Mexican city with more than 500,000 inhabitants (including cities such as León, Guanajuato; Culiacán, Sinaloa; Acapulco, Guerrero; and Morelia, Michoacán)
- Increasing the number of cities with air-quality management programs, which should include very strong programs for vehicle emission testing
- Publishing a regulation covering PM_{2.5}¹¹

PROAIRE will continue to be the main drivers for investments in Mexico's air pollution control sector. Because those programs set stricter standards, implement contingency plans for polluting industries, and issue fines to polluters, industries and vehicle owners in cities with PROAIRE have strong incentives to invest in cleaner technologies.

11. Available information indicates that Mexico City, up to 310 days per year, will exceed the acceptable limits set by such a regulation.

Products with good sales potential in Mexico include:

- Software development for monitoring systems
- Monitoring equipment
- Laboratory equipment
- Computerized systems for urban traffic flow management
- Solar heaters for domestic use
- Electric transport equipment
- CNG transport and conversion systems
- Services and equipment for the reduction of nitrogen oxide in thermoelectric power plants
- Pressure regulators
- Gas-air mixture controllers
- Catalytic converters
- CNG storage tanks, including tanks for CNG storage in vehicles
- Pumps for CNG service stations
- Security systems
- Vapor control systems
- Vehicle emission verification systems (especially for diesel-powered cargo and passenger transport)
- Items related to the updating of a pollution-source inventory
- Services to update air-quality monitoring software to include weather forecasting variables
- Data bases for tracking the number of vehicles

Chapter 9

Services

The environmental services market has grown at higher rates than the overall environmental sector in Mexico. Companies that specialize in developing feasibility, risk, and tariff impact studies, as well as other environmental consulting firms, will find important business opportunities, not only at the federal level, but also increasingly at the municipal level, where many decisions will be made regarding local environmental projects.

The volume of environmental impact studies, environmental audits, and other consulting services for implementing environmental management programs within large and medium-sized corporations has grown tremendously; in the case of risk studies, from 73 in 1992 to 449 in 1999. Stronger enforcement programs that will be enacted by federal and, especially, local authorities are expected to rapidly increase the demand for those services.

By the end of 2000, new administrations were in office not only at the federal level but also at the state level and in Mexico City. The Fox administration is now producing the National Development Plan 2001–2006, which will define the administration's actions and activities to be carried out during its six-year term. Although many specific actions have yet to be announced, Fox's commitment to the environment is clear.

Environmental Studies

The Fox administration will strongly promote private participation in the development and operation of environmental infrastructure, which will result in a much greater demand for environmental studies necessary to evaluate the feasibility of environmental projects. At the municipal level, there will also be an increase in the demand for such studies and services, which in many cases will be paid for with monies from FORTEM.

SEMARNAT recently announced the National Crusade for Forests and Water. The National Crusade for Forests and Water will become a driver for environmental studies to identify and assess opportunities to protect

and restore forests, aquifers, and superficial waters. Monitoring services and water-quality analysis technologies, such as inspection equipment, are expected to face increased demand.

The Mexico City government is also redefining its environmental policies and priorities. Several opportunities are expected to derive from the new PROAIRE being developed by Dr. Mario Molina (see Chapter 8).

Like SEMARNAT, Mexico City's Secretariat for Environment was restructured, and a new Directorate for Water, Soil, and Municipal Waste Projects was established. This new office will require numerous environmental studies, which will be contracted mainly to private companies. The directorate has the following functions:

- To provide technical guidelines for the development or modification of regulations
- To coordinate and review the progress of environmental projects and programs
- To evaluate the technical feasibility of projects and programs
- To design strategies and action plans
- To follow up with existing projects and programs
- To perform or contract-out integral studies
- To promote technological exchange between national and international institutions
- To promote and evaluate new technologies
- To operate the pilot station for real time sewage water monitoring

The directorate has the following short-term plans, which will require assistance from private consultants and research centers:

- To implement the Program for Integrated Hazardous Waste Management 2001–2010
- To develop regulations for soil and municipal waste pollution control
- To install and operate the first sewage water monitoring station
- To develop and install a laboratory for certification

Environmental Audits

The Fox administration will modify the voluntary environmental audit program described in Chapter 4 to strengthen the program and increase its efficiency. Plans include creating consumer awareness about which companies have received certification for being environmentally friendly. These changes will increase the number of business opportunities for consultants in the short term and could open opportunities for U.S. auditors in the mid term.

The new deputy attorney general responsible for the environmental audit program has identified some deficiencies in the existing program that need to be corrected:

- The environmental audit process lacks an established methodology or procedural guidelines. Critics of the program argue that the audits could result in a subjective evaluation and contribute to confusion in developing an environmental management plan. Such criticism has made companies afraid of such audits because they do not know the precise parameters of the audit and the implications for developing an investment plan.
- Participation in the program has necessarily been limited because only 130 certified auditors are available to examine the 28,000 companies in sectors under federal enforcement responsibility. Certain regions do not have enough auditors; most auditors are located in central and northern Mexico. PROFEPA is working to increase the number of auditors, but it will promote the use of qualified companies instead of individual auditors, who are difficult to monitor on a regular basis. PROFEPA will recommend using consulting companies with vast experience in industrial processes and environmental technologies.
- PROFEPA considers that certified companies have not seen any benefits from participating in the voluntary audit programs. To create an added incentive for certification, PROFEPA is considering developing a campaign recommending to consumers that they purchase products from certified companies. PROFEPA will also develop a clean industry logo to be placed on the products of certified companies that have shown excellence in using environmentally friendly processes. PROFEPA expects that an added benefit of this campaign will be an increased social awareness of the importance of sustainable development.

Besides correcting the deficiencies of the auditing process, PROFEPA will take additional steps to improve the program and further industry compliance with environmental regulations. Specific actions being contemplated include developing closer working ties with municipal and local governments to promote clean industries in their regions and developing certifications for clean municipalities. Also, audit programs covering complete industrial parks will be promoted. Under that concept, once all companies in a given industrial park have demonstrated compliance with the regulations, the park will be certified as a clean industrial park and all companies in the park will be allowed to use the clean industry logo. PROFEPA is interested in expanding the program to cover other economic activities besides industry. For example, it is considering offering certification to hotels and other tourist developments.

Because developing an adequate pool of auditors is critical to the success of the program, PROFEPA plans to create a specific entity, comprising representatives of government, industry, and research centers, and which will be responsible for certifying auditors. PROFEPA also plans to limit the role of auditors to performing the audits and require that a different consulting company be responsible for developing the environmental management and investment plans. That measure seeks to ensure the independence of the audit process.

PROFEPA is willing to open the audit market to U.S. firms—both auditors and other consultants—but before doing so will require reciprocity from the United States to open its doors to Mexican auditors and consultants. That process will take time because the certification standards will need to become similar. While this topic is debated within PROFEPA, U.S. companies can participate in the market by establishing a Mexican subsidiary and obtaining local certification.

Best Prospects

Six principal sources for environmental consulting service projects are as follows:

1. Developing federal environmental programs. Priority areas in the short term will include studies to assist in the National Crusade for Forests and Water and in reviewing regulations for hazardous waste.
2. Developing state and municipal environmental projects. A priority area is the strengthening of municipal fee collection systems to allow for in-

creased environmental investments, especially on water and waste projects. Assisting the development of PROAIRE in cities with more than 500,000 inhabitants is also a priority.

3. Developing programs and projects in Mexico City. Such projects include specific projects for improving air quality, studies for recharging the aquifers, evaluations of contaminated sites, and site selection of a new solid waste landfill.
4. Developing environmental investment programs for private- and public-sector companies. Opportunities include environmental consulting to PEMEX, consulting to reduce air emissions at CFE's facilities, and consulting to define necessary investment programs to abate pollution in specific industrial facilities.
5. Performing consulting assignments financed by multilateral institutions. Programs financed by such institutions include IDB and BANOBRAS's FORTEM and IDB's Aquifer Recharge Program in Mexico City.
6. Performing consulting and feasibility studies financed by U.S. government agencies. Such agencies include U.S. TDA and U.S. AID.

Chapter 10

Financing Programs and Resources

Mexico's overall financial situation has improved in recent years. Private environmental investment has benefited from this recovery, but major public environmental infrastructure investments have lagged behind, even during the recent period of robust economic growth.

Many factors explain why those urgent investments have not materialized at the required speed. Mexico, despite being the 14th largest world economy, is a highly heterogeneous country where a modern vigorous export-led economy coexists with extreme poverty. Therefore, environmental programs and projects in Mexico take place not at the pace resulting from their urgent nature, but at a pace based on the country's capacity to afford them. Significant environmental progress was made during the last administration, but there is simply not enough government funding to pay for all the necessary programs and infrastructure.

To complement government expenditures for the environment with other monies, Mexico has always been able to access long-term multilateral financing lines, which have supported top environmental projects. Private-sector participation in environmental expenditures works under a different logic. Large national, multinational, and quasi-governmental corporations view the investment required to comply with environmental regulations as an added cost to doing business and as necessary to being environmentally responsible. Smaller companies, however, have a great deal of difficulty financing such investments. Gaining access to credit is critical if those companies are to comply. At present, financing for environmental projects is not readily available from the Mexican private-sector banking system.

Other environmental infrastructure projects require a clear pay-back structure to attract private investment, and this requirement has been a limitation for many municipal water and waste projects. To correct these deficiencies, the government has created programs such as APAZU and FORTEM to develop the necessary conditions for attracting private investment.

Domestic Financing

Local financing for environmental infrastructure and equipment comes from many sources including directly

from federal secretariats, from federal funds destined for local governments, and from special programs implemented specifically to finance environmental protection.

BANOBRAS

BANOBRAS, the national public works bank, is the most important player offering financing to support environmental investments. The bank is also the principal conduit for infrastructure-related loans and grants from bilateral and multilateral institutions. BANOBRAS has various programs to support state and municipal authorities. The most important are described below.

Program for Potable Water, Sewer, and Sanitation.

The goal of the Program for Potable Water, Sewer, and Sanitation is to offer financing for municipal infrastructure expansion. The program can be accessed by state and municipal water authorities, as well as by private concessionaires providing municipal services. Under the program, BANOBRAS provides loans at attractive rates for developing new infrastructure or for efficiency improvements. The program also offers a credit enhancement guarantee program to support municipalities in promoting private investment in BOT or concession structures. The guarantee consists of a revolving contingency trust with a credit line for up to six months for paying the concessionaire if the municipality fails to do so. BANOBRAS has the right to recoup these payments from the municipality's federal revenue sharing.

FORTEM. Under FORTEM, the program for strengthening state and municipal authorities, BANOBRAS provides technical assistance and collaborates in developing preinvestment studies for state and municipal environmental and other infrastructure projects. The program's objective is to improve the financial management and collection structures of state and municipal governments. Most of this funding comes from the Inter-American Development Bank, and the priority areas are potable water, sewer, and sanitation; basic infrastructure; urban equipment; paving and transportation; and institutional strengthening.

FORTEM represents a good opportunity for U.S. companies offering training, consulting, and technical services, as well as for suppliers of water metering systems;

equipment to fix leaks; budget administration software; verification and monitoring equipment; and municipal waste transportation and disposal technologies, equipment, and services.

FINFRA. Managed by BANOBRAS, FINFRA, the Fund for Infrastructure Investments, has been an important support for the development of infrastructure projects, especially water-related projects. FINFRA offers equity for BOT or concession projects, thus reducing the risk to the concessionaire.

FINFRA provides subordinated capital for up to 40 percent of the total investment cost of the project, and venture capital for up to 35 percent. FINFRA can also combine subordinated and risk capital and can finance up to 49 percent of the total investment. Finally, FINFRA can combine both instruments with other BANOBRAS credits for up to two-thirds of the total project cost.

FINFRA provides advisory services and works with local authorities to structure viable projects. Some municipalities believe FINFRA is not a good option, because structuring a project using the fund's capital can take more than a year. FINFRA's position is that a detailed analysis is necessary to ensure project viability by defining the correct project size and capital structure.

FINFRA played an important role in restructuring municipal water concessions that were severely affected by the 1994 economic crisis. The fund managers were able to successfully restructure most projects even after the high-interest-rate period following the steep peso devaluation of 1994. Since 1995, FINFRA has restructured projects worth over \$270 million and continues to be active in this area. FINFRA remains the best financing option for BOT or concessions in Mexico.

NAFinsa

Nacional Financiera (NAFinsa) is another government-owned bank active in managing funds obtained from multilateral institutions. Its focus has been on industrial promotion, and it has financed some environmental equipment. Its current role is to support small and medium-sized industries in Mexico. NAFinsa is not active in major environmental project financing.

Multilateral Institutions

Multilateral financial institutions have traditionally supported the Mexican government by financing projects at the federal, state, and municipal levels, as well as by financing private companies implementing the environmental and other infrastructure projects that contrib-

ute to the country's economic, social, and sustainable development.

By law, only the federal government can receive these credit lines and is the entity responsible for repaying the credit extended. Those funds are then transferred to the government's banking institutions, where they are managed on behalf of the specific objectives for which the credits were granted. BANOBRAS is the main entity responsible for channeling the financing to states and municipalities. Multilateral funds are obtained in foreign currencies, and BANOBRAS issues lending in Mexican pesos. BANOBRAS does charge an interest rate premium to protect the capital base of these loans from potential exchange rate fluctuations. Therefore, funds obtained from BANOBRAS are more expensive than those offered by the multilateral institutions, but they are less expensive than those offered by commercial banks in Mexico. Lending rates in Mexico have traditionally cost up to 2,000 points over inflation.

The three most important multilateral institutions active in providing loans to Mexico are the World Bank, the Inter-American Development Bank, and the Overseas Economic Cooperation Fund through the Japan Bank of International Cooperation.

World Bank

The World Bank is the world's largest source of development assistance, providing nearly \$16 billion in loans annually to its client countries. Traditionally, the World Bank has been the dominant multilateral lender to Mexico. Although in recent years the number of loans to the Mexican government has decreased, World Bank lending to the private sector has increased, and this experience has been very successful (see GIRSA case study). All World Bank loans to Mexico are provided through the International Bank for Reconstruction and Development (IBRD) and the International Finance Corporation (IFC). The instruments offered include cofinancing, trust funds, guarantees, and money grants for pilot projects. The World Bank also provides training and cooperation programs.

Within projects that have World Bank support, the executing agency is responsible for organizing the tenders as well as for selecting the contractors. World Bank-funded projects are bid through international tenders, making those projects attractive to U.S. equipment and service suppliers.

Inter-American Development Bank

IDB is the second largest multilateral agency providing financial support to Mexico. Within the environmental

sector, the IDB has been focused on financing water infrastructure, including important loans to the Valley of Mexico Sanitation Project, the Aquifer Recharge Project in the Federal District, and PEMEX's program to treat wastewater at its petrochemical complexes. In addition to these specific projects, IDB has been the main source of funding for FORTEM.

Bilateral Financing

NADBank

NADBank is one of the most important sources of bilateral public-sector credit at a low cost. The bank provides long-term loans and loan guarantees for environmental projects within 100 kilometers of the U.S.-Mexico border. NADBank's mission is to leverage private- and public-sector investment in environmental infrastructure projects in the border region. NADBank must charge an interest rate that is at least one percentage point above U.S. Treasury rates for securities with comparable maturities.

NADBank can lend only to projects certified by the Border Environmental Cooperation Commission and only in U.S. dollars. As with multilateral loans, those funds are channeled through BANOBRAS, typically raising the cost of capital to municipalities.

Case Study 10.1 Girsá Group

In February 2000, with financing from the World Bank through IFC, Girsá, a Mexican diversified chemicals producer, obtained an investment grade rating that allowed the company to tap U.S. institutional investors for the first time.

IFC provided \$105 million toward a \$240.6-million project to enable the company to make more specialized products and thereby improve its competitiveness in international markets. The investment included a loan of \$45 million from IFC's own account and a B loan of up to \$60 million. The B loan was privately placed by Crédit Suisse First Boston with a group of U.S. insurance companies. Duff and Phelps Credit Rating Company assigned a BBB- rating to the transaction (above Mexico's sovereign rating at that time) on the basis of Girsá's underlying credit quality and the preferred creditor status of IFC, which helped mitigate substantially sovereign transfer and convertibility risk.

Girsá is using the financing to modernize, expand, and undertake an investment program to enhance global competitiveness in its business units, which include synthetic rubber, phosphates, consumer products, laminates, polystyrene, carbon black, phenol, and acrylic sheets.

The investment was IFC's second in Girsá. The first was to finance the company's efforts to improve its environmental standards, close obsolete plants, and become a more efficient producer.

NADBank's resources come mainly from the U.S. and Mexican governments. In addition, the U.S. EPA has provided funds to NADBank to construct wastewater infrastructure. NADBank and BECC also operate different programs and funds for infrastructure development. The most important is the Project Development Assistance Program, which provides funds for technical assistance in project preparation, and the Border Environmental Infrastructure Fund, which provides grants to environmental projects. Most of the funds administered through PDAP and BEIF are provided by the U.S. EPA. Thus far, those funds have totaled more than \$211 million.

Border Environmental Cooperation Commission

BECC provides technical assistance to municipalities and localities on the border and assists in preparing projects. During 2000, BECC had a budget of \$3,068,000 (\$1,534,000 provided by each country). In 1998, 1999, and 2000, this budget remained the same; however, for 2001, the U.S. Congress authorized \$1,995,000 to increase technical assistance to municipal waste projects. The Mexican side is in the process of approving that budget. That increase, combined with funds from PDAP, represent important opportunities for U.S. companies willing to provide technical assistance for the development of municipal waste and wastewater projects in the border area. Active projects are listed in Table 10.1.

Currently, BECC has over 150 project certification requests, with an estimated value of \$1.5 billion. This amount represents only one-third of the environmental needs in the border region, according to a study by the Southwest Center for Environmental Research and Policy and the University of Texas in El Paso. BECC estimates it will require additional funds of \$17 million through PDAP and \$350 million through BEIF to develop all these projects.

BECC/NADBank Program, 2001–2005

The board of directors of NADBank expanded the institution's mandate with the objective of increasing its participation in developing environmental infrastructure in the border area. According to the expansion agreement, BECC and NADBank will be able to certify and finance, respectively, a wider range of environmental infrastructure projects. The new range will allow the institutions to consider infrastructure for hazardous waste disposal, improvement of air quality through more efficient transportation systems, and domestic water taps and wastewater connections, among other areas. The border institutions are also planning to increase their territorial coverage by expanding the border region from 100 kilo-

Table 10.1 Active BECC-Approved Projects (in U.S. dollars)

City	Technical Assistance from BECC	Project		U.S. Subsidies (millions)
		Type ^a	Total Cost (millions)	
Finished construction:				
Agua Prieta, Sonora	69,049	MW	2.01	—
Matamoros, Tamaulipas	—	WW	1.10	—
Puerto Peñazco, Sonora	132,789	MW	2.25	—
Ensenada, Baja California	—	WW	8.19	—
Under construction:				
Ciudad Acuña, Coahuila	85,000	WW	80.35	16.73
Cuidad Juárez, Chihuahua	77,664	WW	31.16	15.66
Matamoros, Tamaulipas	145,100	MW	12.98	—
Mexicali, Baja California	250,267	WW	57.36	20.62
Naco, Sonora	98,678	PW/WW	1.10	0.60
Nogales, Sonora	491,344	PW	39.00	—
Piedras Negras, Coahuila	85,500	WW	57.42	8.40
Tijuana, Baja California	51,849	WW	19.52	18.50
Under design:				
Manantiales, Coahuila	—	WW/MW	17.50	—
Reynosa, Tamaulipas	—	WW	83.40	33.50
San Luis Rio Colorado, Sonora	495,000	WW	13.50	5.93
Tecate, Baja California	150,000	PW/WW	7.81	3.71
Tijuana, Baja California (Ecoparque)	38,704	WW	0.18	—
Total, all projects	2,170,944		434.83	123.65

a. Project types are: WW = Wastewater; MW = Municipal Waste; PW = Potable Water.

Source: BECC.

meters from the boundary to 300 kilometers in each direction.

The border institutions will also promote the completion of a strategic plan to prioritize actions for infrastructure development. In 2000, the U.S. General Accounting Office published a document on environmental challenges in the border region. This study analyzed the performance of BECC and NADBank over the past few years and determined that a strategic plan would improve the operation of those entities. The proposed plan includes a deep diagnosis of the environmental infrastructure needs, the definition of strategies to overcome obstacles for the development of new projects, and the identification of measurable goals to evaluate progress.

For 2001–2005, BECC and NADBank will seek to better coordinate their efforts with other government and non-government institutions as well as to promote their experiences in other regions of Mexico and Latin America.

NADBank is expected to become more active in financing projects because of the expansion of its mandate. The number of opportunities for environmental projects in the border is still large, and projects in this area mature faster than in the rest of Mexico.

U.S. ExIm Bank Financing

Mexico has been the U.S. ExIm Bank's largest customer in Latin America for the past seven years, but its experience dates back to the 1930s. The U.S. ExIm Bank has a long and successful history with the Mexican government, Mexican financial institutions, and Mexican industries. The bank offers short-, medium-, and long-term loan guarantee, credit, and project-financing programs to support U.S. exports to Mexico. It has supported projects in the environmental, telecommunications, oil and gas, electricity, and transportation sectors.

Exports of environmental equipment may be supported by the U.S. ExIm Bank's long-term loans and guarantees (up to 10 years' repayment) or medium-term loans, guarantees, and insurance (up to seven years' repayment). The U.S. ExIm Bank lends to creditworthy private entities, as demonstrated by their financial statements, commercial track record, and credit history. The bank will accept public-sector entities on their own if they are creditworthy.

Much of the U.S. ExIm Bank's support for Mexican businesses buying U.S. goods has been through its insurance program, the Credit Guarantee Facility Program. A credit guarantee facility is a line of credit extended by a U.S. bank to a public- or private-sector Mexican bank or large corporate borrower. The line is then guaranteed by the U.S. ExIm Bank. Mexican companies wishing to purchase U.S. goods or services on credit can approach participating Mexican banks for credit. A list of credit guarantee facilities is available from the U.S. ExIm Bank.

The U.S. ExIm Bank will consider the following private banks as borrowers or guarantors: Banco Serfin/Santander, Banco Inbursa, Banco Internacional (Bital), Bancomer/BBV, Banco Mercantil del Norte (Banorte), Banco Nacional de México (Banamex), and Banco Regional de Monterrey. U.S. ExImBank will also consider the following three Mexican government-supported banks: Banco Nacional de Comercio Exterior (BANCOMEXT), BANOBRAS, and NAFINSA. Other banks may also be acceptable, but they are reviewed on a case-by-case basis.

Exporters can apply for a letter of intent from the U.S. ExIm Bank when negotiating a sale of capital goods or services. The letter of intent will be issued within seven business days and indicates the bank's willingness to finance a potential sale. The U.S. ExIm Bank will also consider making limited recourse project loans in Mexico where reasonable assurance of repayment is based on the project's cash flow rather than a guarantor.

The U.S. ExIm Bank has established an environmental exports program, which increases the level of support it provides to exporters of environmentally beneficial goods and services, as well as to exporters participating in environmentally beneficial projects. That program affords exporters a special level of support in conjunction with either the U.S. ExIm Bank's insurance program or with its loan and guarantee programs. The program underscores the bank's resolve to reach out to small and large exporters alike with qualifying exports. Interested companies can request further information from the Engineering and Environment Division of the bank.

Private Financing

Except for some multilateral financing earmarked for specific projects, nonrecourse financing of environmental projects is not available in Mexico from any source. Environmental projects in Mexico have not been able to produce an attractive pro-forma revenue stream to attract private financing. Under previous schemes, most notably in the water-sector BOT program, there was a tacit payment warrantee from the federal revenue-sharing allotment of the state government. Those schemes have since been eliminated, leaving municipal and state environmental projects without a viable payment-guarantee structure. Environmental projects of major corporations have moved forward because of the strength of a company's balance sheet, but such projects are rarely financed against the projects' own expected cash flow.

A priority of the Fox administration is to promote private participation in all sectors of the environment. To do this, the new government plans to financially strengthen municipal institutions while at the same time helping them expand coverage of their services. The government's ultimate goal is to create the necessary conditions to attract private financing for environmental projects.

Some private environmental funds have been active in Mexico financing projects sponsored mainly by private corporations. In the mid term, as municipal authorities become stronger, those funds may expand services to finance municipally sponsored projects. Opportunities are not widespread, but there are good examples of creditworthy municipal service providers, such as the Monterrey water authority and Monterrey solid waste authority (SIMEPRODES).

Credit Enhancements

Because strengthening the financial structures of municipal authorities will take considerable time, most environmental projects in Mexico will continue to require federal support. Support from multilateral and bilateral institutions will also assist in the development of projects by reducing project risk and financing costs.

BANOBRAS, through FINFRA, provides credit risk enhancement to municipal and local governments to support projects being planned under the Potable Water and Sanitation Program. FINFRA will pay the concessionaire for up to six months if the local authority fails to do so. Although concessionaires should try to include the FINFRA guarantee in their contracts, they are advised not to use it. A direct negotiation with the local govern-

ment is better in the long run because if the guarantee is used, FINFRA will impose heavy penalties on the local government and will pay itself directly from the federal revenue-sharing funds going to that local government. Those terms can strain a long-term relationship between the concessionaire and the local government.

Another proven method of reducing project risk is use of a multilateral or bilateral bank guarantee program. Such programs generally provide private investors with an assurance of repayment.

U.S. companies interested in developing environmental infrastructure projects under concession or BOT schemes in Mexico must pay special attention to the repayment clauses in their contracts. Most municipalities in Mexico are financially weak. Although many can cover operational costs, only a few have enough resources to guarantee repayment of long-term investments.

Chapter 11

Government Programs

U.S. Department of Commerce

Office of Environmental Technologies Industries

The Office of Environmental Technologies Industries (ETI) serves as the main point of contact at the Department of Commerce for U.S. environmental technologies and services firms. This office is charged with increasing the international competitiveness of the U.S. environmental technology industry and its exports. ETI trade specialists and representatives of the U.S. and Foreign Commercial Service provide an array of information, counseling, trade promotion, and advocacy services to help U.S. companies that specialize in pollution control, prevention, monitoring, and remediation to successfully enter and compete in the rapidly expanding international environmental market. These include:

- **ETI Online**, ETI's home page www.environment.ita.doc.gov, provides the latest news, country environmental market plans, research reports, a trade events calendar, and links to key environmental resources.
- **Environmental Export News**, ETI's quarterly newsletter, informs U.S. companies about developments in international markets and programs that help exporters.
- **Regional and industry-specific market research reports**, feature detailed analyses of key countries, regions and industry subsectors.

The ETI trade specialist for Mexico is Ellen Bohon Zeytoun. Ms. Zeytoun may be contacted at (202) 482-0359, or via e-mail at ellen_zeytoun@ita.doc.gov.

U.S. Department of Commerce in Mexico

The Department of Commerce has four offices in Mexico that can assist U.S. firms in promoting their exports to Mexico. The main office is part of the U.S. Embassy in Mexico City, and the other offices are in the U.S.

consulates in Guadalajara, Monterrey, and Tijuana. The Mexico City office has designated an environmental attaché to offer U.S. firms interested in the Mexican market a number of services, including provision of business counseling, technical assistance, regulatory information, and introductions to Mexican government officials and Mexican businesses. All four offices can offer U.S. companies matchmaking services, background checks, and market research, among other services. The offices also maintain information on Mexican firms, including those interested in doing business with U.S. environmental firms.

In addition, the U.S. Trade Center in Mexico City is available to U.S. firms interested in promoting their products and services to Mexican representatives and buyers through sales seminars, videoconferences, receptions, and similar types of events. U.S. firms can promote their goods and services through local trade shows and exhibitions supported by the U.S. Commercial Service. In particular, the U.S. DOC recommends the EnviroPro Show, which usually takes place in September of each year in the World Trade Center in Mexico City.

The Mexico City office of the Commercial Service may be contacted at (phone) +52 (5) 140-2600 or (fax) +52 (5) 535-1139. The Web site is www.usatrade.gov.

U.S. Agency for International Development

The U.S. Agency for International Development (USAID) administers a number of programs that provide economic, technical, and humanitarian assistance to countries around the world. As part of its goal to protect the environment, USAID created the USAID/Mexico environment program. The program assists Mexico in defining and implementing approaches to promote the long-term economic growth necessary to address Mexico's poverty problems, while conserving and restoring the environment. The program has two main strategic objectives: (1) conserving critical ecosystems, and (2) reducing CO₂ and pollution through improved technologies.

USAID/Mexico supports those objectives through programs aimed at improving the use and management of natural and energy resources, building the capacity of partners in the public and private sectors to address those issues, and working to define and address policy limitations to improving resource use in Mexico. Specific projects within the USAID/Mexico program are as follows:

- **Management of Coastal Resources in the MesoAmerican Reef Area of Mexico.** The MesoAmerican reef is the second largest reef system in the world, stretching along the coast of Quintana Roo in Mexico to Honduras. USAID works with other international and local organizations to provide technical assistance and training in coastal management in two key areas of the reef. USAID and the Embassy of Japan began collaborating on research and training, as well as on the development of a coastal management station that is centrally located in Quintana Roo. Japan is funding initial infrastructure construction; a consortium of local organizations is providing the management structure; and USAID/Mexico is supporting the administration of the center, is providing some key equipment, and will support specific research and training activities within the center.
- **Sea of Cortés Regional Planning Activities.** The Sea of Cortés in the Gulf of California is Mexico's most abundant fishery source and contains rich biodiversity. The National Institute of Ecology has initiated a regional management plan for the Gulf of California, and the Global Environmental Facility is currently reviewing a 10-year, \$70-million proposal to advance marine conservation and sustainable development in the region. USAID, building on its success in Quintana Roo, is encouraging the University of Rhode Island (and its Coastal Resources Center) to partner with another long-term USAID partner, Conservation International Mexico (CI-MEX), to assist in designing a management plan for the Santa María Bay on the state of Sinaloa's gulf coast.
- **Management of the Selva Lacandon and Regional Planning.** The Selva Lacandon is Mexico's most important rain forest and is part of the Selva Maya. USAID, through CIMEX, proactively promotes sustainable income-producing activities that are adapted for the area, participates in environmental monitoring, and is working to establish participatory land-use plans and programs. It has promoted the use of agro-ecological methods such as maize-velvet bean cultivation, shade coffee production, and

organic vanilla cultivation with communities around the reserve, and it has worked to establish two biological stations, Ixcán and Chajul, in the reserve.

- **Building Capacity for Regional Planning.** USAID is encouraging local non-governmental organizations to support local environmental concerns addressed in Mexico's decentralization programs.
- **Endowment Fund to Strengthen Mexican Conservation Efforts.** USAID/Mexico established a new Mexican institution in 1994, providing \$20 million to the Mexican Nature Conservation Fund (Fondo Mexicano para la Conservación de la Naturaleza, or FMCN), with the Mexican government providing an additional \$10 million. FMCN has matured and is leading a network of environmental funds throughout Latin America. FMCN has reached over \$50 million in capitalization and has provided loans for \$7 million to local non-governmental organizations, conservation groups, and other institutions throughout Mexico.
- **Forest and Fire Management Program in Mexico.** In 1998, fire destroyed more than 200,000 hectares of forest in Mexico. USAID and the Office of Foreign Disaster Assistance developed an immediate disaster cooperation program for \$7 million, which provided fire-fighting aircraft and helicopters, infrared overflights, and equipment and technical assistance in the use of ground and air attack fire-fighting techniques. In the wake of this disaster, USAID and Mexican institutions are working to design a timely response aimed at fire prevention and mitigation schemes, restoration of burnt areas, and environmental education programs. This program has a budget exceeding \$8 million.
- **Mexico Renewable Energy Program.** USAID/Mexico's energy program supports Mexico's efforts to reduce greenhouse gas emissions through programs in energy efficiency, pollution prevention, and renewable energy. The objectives of the energy program are accomplished by using pilot projects to demonstrate the viability of technologies, supporting selected sector policy reforms, strengthening institutional capacity, and promoting financial sustainability. Under USAID/Mexico's energy program, a comprehensive project with the Delegation of Tlalpan in Mexico City and the Autonomous University of Mexico is demonstrating how municipalities can apply sound energy and natural resource use by adopting energy efficiency and pollution prevention practices and technologies.

The Tlalpan project works with local hospitals, small- and medium-sized industry, and residents to introduce

water efficiency, solar energy, and improved energy efficiency. This program excellently demonstrates the cost-effectiveness of programs to improve steam efficiency and of new technologies that lower both energy and water use. Replication of this municipal-level program will assist local governments in responding to decentralization. Information gained by the project will also be used to respond to demands for reducing the growth of CO₂ emission to help mitigate climate change.

In addition to the Tlalpan project, USAID implemented a program to demonstrate the technical, economic, and financial viability of renewable energy systems. Through the program, more than 400 small solar energy systems have been installed throughout Mexico. More than 40 U.S. companies have been involved in this technology transfer and have helped increase economic, social, and health benefits in off-grid, rural communities.

For more information on the Mexico Renewable Energy Program, visit the Web site of the U.S. Department of Energy National Renewable Energy Laboratory at www.re.sandia.gov.

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency works actively in Mexico with the Secretariat of the Environment and Natural Resources to reduce pollution, especially in the border area. In addition to providing technical assistance, EPA has provided over \$230 million in funding for wastewater and municipal waste projects through the Project Development Assistance Program and the Border Environmental Infrastructure Fund.

Border XXI Environmental Program

The U.S.-Mexico border area has seen a rapid growth in population and industry, placing profound stresses on the region's natural resources and environment. The 1983 Agreement on Environmental Cooperation in the U.S.-Mexico Border Area (the La Paz Agreement) established a broad framework for binational cooperation to address environmental protection in the border area, defined as 100 kilometers north and south of the border. The details of cooperation have been established through binational border environmental plans. The most recent plan, known as Border XXI, operated from 1996 to 2000. Under Border XXI, nine binational working groups addressed a range of environmental issues: water, air, hazardous waste, natural resources, emergency response, pollution prevention, enforcement and compliance, environmental health, and environmental information resources. The program strived to involve state and local governments,

communities, non-governmental organizations, industry, and academia as partners in implementing cooperative efforts to promote sustainable development. Efforts were also launched to develop environmental indicators to measure the program's success.

U.S. and Mexican environmental authorities recently initiated discussions to develop the next phase of implementation for border environmental cooperation. Although the precise structure of a new border plan is yet to be determined, clearly the new effort will need to (1) be results driven and (2) enhance the involvement of state and local governments, industry, non-governmental organizations, and communities on both sides of the border.

Many of the Border XXI work groups have engaged industry in individual projects to encourage improved environmental management (and thereby create markets for environmental goods and services). The following two efforts that emerged from Border XXI and that are likely to carry over into the next phase of border environmental cooperation are worthy of particular note:

- 1. Seven Principles of Environmental Stewardship for the U.S.-Mexico Business and Trade Community.** Signed in June 1999 by the U.S. EPA, SEMARNAP, BECC, and the U.S.-Mexico Chamber of Commerce, the Seven Principles are a binational public-private commitment to promote sound environmental stewardship practices by companies operating in both countries. The principles support U.S. business by helping make U.S. companies that implement the principles more competitive, while at the same time promoting markets in Mexico for U.S. suppliers of environmental goods and services. A number of major Mexican trade associations and non-governmental organizations, as well as, most recently, DuPont of Mexico, have endorsed the Seven Principles. A copy of the principles is included in Appendix E.
- 2. U.S. EPA-SEMARNAP Joint Policy Statement on the Remediation and Redevelopment of Contaminated Properties in the U.S.-Mexico Border Area.** Signed in May 2000, this binational statement declares the intention of the environmental authorities of the two countries to work together to address the problem of contaminated sites in the border area, including exploring the concept of brownfield redevelopment in Mexico. The U.S. EPA and SEMARNAT are planning a binational seminar in a selected border sister-city pair in 2001 to exchange expert information on approaches to remediation and brownfield redevelopment. As such, the U.S. EPA is stimulating in Mexico the development of a market

for American site remediation, land-use development, and financial and legal services associated with the restoration and redevelopment of contaminated property.

Global Climate Change

The United States and Mexico cooperate on a number of environmental issues beyond the border area. For example, the U.S. EPA and the U.S. Agency for International Development work with SEMARNAT on a number of cooperative projects to address global climate change. U.S. EPA projects include assisting Mexico in updating its national inventory of greenhouse gas emissions, analyzing the dynamics of carbon capture in humid tropical forests, exploring models for evaluating the economic impacts of global climate change and mitigation strategies, evaluating integrated strategies for maximizing the reduction of greenhouse gas and local contaminant emissions, and improving understanding of vulnerabilities to global climate change. Market opportunities will be presented for U.S. companies as Mexico gears up to undertake meaningful commitments to address global climate change.

Mexico City Air Quality

Under a 1989 agreement, the U.S. EPA provides technical assistance to state, local, and federal authorities in Mexico City in their effort to address air pollution in the metropolitan area. U.S. EPA experts have periodically audited and provided training to personnel in calibrating Mexico City's air-quality monitoring system. Local, state, and federal authorities are developing a new, 10-year integrated program to improve Mexico City's air quality, with cooperation from the U.S. EPA and other international experts and with financial assistance from the World Bank. Strategies in the new plan are likely to include using alternative fuel vehicles, improving fuel quality and vehicle emissions standards, enhancing the city's public transportation system, improving land-use policies and transportation networks, and ratcheting down industry emissions. Many of these strategies will present market opportunities for U.S. companies. (See also the discussion of the Mexico City PROAIRE in Chapter 8.)

Gulf of Mexico

A new area for binational cooperation is the Gulf of Mexico, which is a priority for SEMARNAT, the U.S.

EPA's Gulf of Mexico program, the National Oceanographic and Atmospheric Agency, and other U.S. federal agencies, as well as for U.S. and Mexican states along the coast of the gulf. Cooperative efforts are likely to include ecological monitoring and assessment, as well as efforts to address industry and other land-based contributions to pollution in the gulf.

North American Commission for Environmental Cooperation

In addition to their environmental cooperation with each other, the United States and Mexico participate, along with Canada, in the North American Commission for Environmental Cooperation (NACEC). NACEC facilitates a trilateral work program of cooperation on a range of environmental issues. Key projects of potential interest to U.S. suppliers of environmental goods and services include a program to develop sound management plans in all three countries for targeted chemicals; an effort to assist in developing national pollutant release and reporting registries; the development of a trilateral guidance document describing 10 elements of a performance-focused environmental management system; and a program on trade and the environment, which includes a project to stimulate trade in environmentally beneficial goods.

U.S. EPA Attaché Office Support of Foreign and Commercial Service Trade Facilitation Mission

Because of the importance of environmental cooperation with Mexico, the U.S. EPA maintains its only Environmental Attaché Office in a bilateral diplomatic mission in the U.S. Embassy in Mexico. The office supports the Foreign Commercial Service's business facilitation efforts by providing consultation and advice to U.S. companies seeking to enter Mexico's environmental goods and services market. The office provides information about Mexico's general environmental requirements and policy to U.S. companies of all types that are exploring investment in Mexico. The office has consistently supported environmental trade missions in Mexico and annually speaks on environmental topics of interest to U.S. business at CONIECO's EnviroPro environmental trade show and seminar.

To assist exporters, the U.S. EPA sponsors the activities of the U.S. Environmental Technical Institute and the Vendor Information System for Innovative Treatment Technologies (VISITT) in Mexico.

U.S. Trade and Development Agency

The U.S. Trade and Development Agency (U.S. TDA) assists in creating jobs for Americans by helping U.S. companies pursue overseas business opportunities. By funding feasibility studies, orientation visits, specialized training grants, business workshops, and various forms of technical assistance, the U.S. TDA enables American businesses to compete for infrastructure and industrial projects in middle-income and developing countries. Currently, the U.S. TDA is funding feasibility studies for two environmental projects in Mexico:

1. Integrated Municipal and Industrial Wastewater Collection and Treatment Project in Poza Rica, Veracruz. The U.S. TDA has provided a grant of \$265,000 to the Comisión Estatal de Agua y Saneamiento (CEAS, Veracruz State Water and Sanitation Commission) for a feasibility study on the Integrated Municipal and Industrial Wastewater Collection and Treatment Project in Poza Rica, Veracruz. The project, which is estimated to cost about \$92 million, will involve constructing a new wastewater collection system (including installing service lines, gravity mains, pump stations, force mains, and trunk lines) and constructing an integrated municipal and industrial wastewater treatment system.

2. SIMEPRODESO Solid Waste Management Project in Monterrey, Nuevo León. The U.S. TDA provided partial funding (\$188,700) for a feasibility study for the Sistema Metropolitano de Procesamiento de Desechos Sólidos on its solid waste management project in Monterrey. SIMEPRODESO selected Brown, Vence and Associates Inc. of Roseville, California, to perform the study. That company will provide the remaining \$188,700 required to complete the terms of reference for the study. SIMEPRODESO is contributing in-kind services to the study. The study will involve preparing the tender documents for a landfill gas-to-energy project that has received the support of the Global Environmental Facility/World Bank. The study will assist SIMEPRODESO in improving its solid waste management operations in Monterrey by offering guidance in planning landfill improvements, installing environmental controls, and building a tire recovery facility.

The U.S. TDA facilitates exports by targeting specific project opportunities. The agency publishes many use-

ful documents, such as definitional mission and specialized reports, including a 1998 document profiling several infrastructure opportunities in Mexico. To review or obtain copies of the reports, U.S. companies should contact the U.S. TDA or purchase them through www.fedworld.gov/ntis. U.S. companies willing to perform feasibility studies or conduct definitional missions should visit the TDA Web page www.tda.gov. The “Pipeline” section details upcoming opportunities to work with U.S. TDA.

To receive U.S. TDA funds, a project must meet the following criteria:

- The project must be a development priority.
- U.S. firms or a U.S. consortium must perform the feasibility studies.
- The project must represent an opportunity for substantial sales of U.S. goods and services, and it must represent a significant multiplier on the cost of the requested assistance.
- Subsequent procurement for the project must be open to U.S. firms, including the feasibility study contractor.

U.S. TDA projects in Mexico are identified by agencies of the Mexican federal, state, and local governments; by U.S. TDA staff; by U.S. embassy commercial staff; and by private-sector firms. The sponsoring recipient Mexican agency plays an active role in developing the scope of work for the study, in selecting on a competitive basis the U.S. firm to complete it, and in monitoring progress of the study. The bids are advertised in *Commerce Business Daily*.

U.S. Department of Energy

The U.S. Department of Energy offers programs that affect the development and export of environmental technologies through technology development and commercialization initiatives, conference cosponsorship, and overseas demonstrations of technologies in Mexico. The environmental technologies that the Office of Environmental Management is actively seeking to promote in Mexico include site remediation, site characterization, environmental restoration, and waste management. The office is considering expansion of a joint science and technology cooperation program with Mexico to advance environmental technology systems that can improve environmental management efforts in the United States and Mexico. The office will assist U.S. companies in identifying sites in Mexico where their technologies can be applied.

Other U.S. Government Agencies

A number of U.S. government agencies and organizations have active programs with Mexico, focusing mostly on collaborative scientific research and information exchanges. Most of those programs do not have any direct commercial focus, so further details are not provided here. The agencies may be contacted as follows:

- U.S. Department of the Interior, U.S. Bureau of Reclamation. Tel: (202) 208-5640. Fax: (202) 208-3394.
- U.S. Department of the Interior, U.S. Fish and Wildlife Service, Office of International Affairs. Tel: (703) 358-1804. Fax: (703) 358-2202.
- National Science Foundation, International Research Department. Tel: (703) 306-1710. Fax: (703) 306-0476.
- Smithsonian Environmental Research Center. Tel: (301) 261-4190.
- U.S. Department of Agriculture, Foreign Agriculture Service. Tel: (202) 690-2867. Fax: (202) 690-0892.
- Department of Health and Human Services. Tel: (202) 619-0257.

Appendix A

Project List

Many potential environmental projects are under consideration in Mexico at any given time; however, compiling an accurate list of such opportunities is difficult. Because financing is limited, many projects are competing for a set amount of available funds, and only a handful from any list are likely to be constructed. Efforts to determine the precise status of any specific project can be frustrating because different sources have different points of view. Nevertheless, some good project opportunities, trade leads, and project lists are available.

The most accessible sources of project information are produced by the U.S. Department of Commerce, the U.S. Agency for International Development, the U.S. Trade and Development Agency, the Border Environmental Cooperation Commission, and the North American Development Bank. Projects or programs promoted or sponsored by those institutions are described in Chapter 10.

In producing this report, in addition to obtaining information from the sources described above, Hanhausen & Doménech Consultores S.C. contacted more than 50 local water utilities of major cities in Mexico and several municipalities to obtain information on their procure-

ment plans for municipal waste equipment. Results in the water area were encouraging; most cities and municipalities responded with information on their projects. After analyzing information provided by the utilities, however, the firm noted that several of the opportunities were not realistic because they lacked a financing source and because internal resources were insufficient.

In addition, Hanhausen & Doménech Consultores met with several construction and environmental companies to evaluate their interest in participating in hazardous waste projects in Mexico. Two companies showed interest in developing such projects and could be good potential partners for U.S. technologies and service providers.

The following list contains information on the specific projects that Hanhausen & Doménech consider to have the greatest potential to be realized or built. The selection criteria were based on financial capability or access to financing for the development of the project. It is important to note that project maturity periods in Mexico are very long, and the likely bid dates are estimates from the tendering agencies. Actual timetables may vary from these estimates.

Baja California Water Supply and Sanitation Project

Estimated Investment: \$390 million

Location: Mexicali, Tijuana, Rosarito, and Ensenada

Source of Financing: JBIC: \$201 million; CNA: \$111 million; Baja California and, possibly, NADBANK: \$78 million

Likely Bid Date: Several projects to be tendered between 2001 and 2004

Project Type: Engineering, procurement, and construction (EPC); turnkey; and consulting services

Brief Project Description: This is an integrated project that includes several projects in the areas of potable water, sewage, and wastewater treatment. The program covers four major cities of Baja California. The project will be tendered in eight major packages as EPC or turnkey projects and several small works as EPC contracts.

Four packages correspond to Mexicali:

1. Rehabilitation and construction of a potable water network, including the construction of new potable water pipelines and rehabilitation works for the existing network
2. Construction of sewage systems to feed the future wastewater treatment plant
3. Rehabilitation of two existing potabilization plants with a capacity of 1.1 and 2.2 m³/s, respectively, and construction of four additional plants, one with a capacity to purify 700 lps and another three with capacities of less than 50 lps
4. Rehabilitation of an existing anaerobic wastewater treatment plant with a capacity of 1.3 m³/s, and construction of a new wastewater treatment plant to treat 840 lps with an anaerobic lagoon system

Three packages correspond to Tijuana and Rosarito:

1. Construction of a potable water system, collectors, and pumping stations to serve 20,000 inhabitants
2. Construction of collectors and sewage to serve 20,000 inhabitants
3. Construction of four wastewater treatment plants with capacities of 340, 150, 100, and 75 lps with secondary biological treatment

One package will be tendered for Ensenada and will include works in potable water and sewage, as well as the construction of one pumping station and a wastewater treatment plant for 100 lps.

Consulting services for the coordination of the tenders will also be contracted.

Project Status: The Japan Bank for International Cooperation signed the loan agreement with BANOBRAS in March 2000. CNA also signed an agreement with the state for the provision of funds. Preinvestment studies are under way, and the state and municipal water authorities are evaluating water reuse in most wastewater facilities. The state water commission plans to release the tender for the first works by April 2001. In the last quarter, the state water authority plans to bid

most wastewater treatment plants, and at the beginning of 2002, it plans to bid the Ensenada package.

Project Drivers: In recent years, the northwestern state of Baja California has experienced the fastest growth in the country, with an average growth rate of more than 8 percent per year. The maquiladora program has attracted a great number of foreign companies, mainly from the United States, creating a significant concentration of population. Water supply and sanitation infrastructure has lagged behind population growth, and concern is growing that this lag might create a bottleneck for economic development. In addition, untreated water has flowed into the neighboring Salton Lake and the Gulf of California, degrading the environment and thereby causing a bilateral problem with the United States.

Key Contact Information:

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Guadalajara Integrated Water System Upgrade

Estimated Investment: \$360 million

Location: Guadalajara, Jalisco

Source of Financing: Mix of resources from federal, state, and municipal governments, plus possible JICA credit

Likely Bid Date: Several projects to be tendered between 2001 and 2004

Project Type: EPC, turnkey, and consulting services

Brief Project Description: This integrated project includes several works and will be developed in stages. The first stage began in 1999 and is still under way. It involves potable water and efficiency improvement investments and actions. The local water utility, *Sistema Intermunicipal de Agua Potable y Saneamiento* (SIAPA), is improving its metering, billing, and collection indexes and, in doing so, is receiving money from the federal government under APAZU. More than \$20 million has been invested in improving efficiency.

Efficiency Improvement: This component includes micrometer supply and installation services. Technology for fixing leaks in the secondary network will be installed, as well as monitoring and collection equipment and software in SIAPA's offices.

Water Supply Works: Works for potable water supply include construction of a new aqueduct with a length of 60 kilometers, enlargement of a potabilization plant, expansion and maintenance of the distribution system, and rehabilitation of the Chapala-Guadalajara aqueduct. Those works have an estimated cost of \$103 million.

Sanitation: The city of Guadalajara lacks municipal wastewater treatment systems. Three wastewater treatment plants with a combined capacity of 8 m³/s are under design, but the local government lacks sufficient resources to build them or grant a concession. The government applied for a JICA credit to build the plants, but the federal government refused to provide the warranties, and the credit was not closed. SIAPA is improving its efficiency so that it will be financially solid and able to apply for a new credit. Water reuse alternatives are also being analyzed as a source of repayment for the plants.

Project Status: SIAPA is making progress in improving its efficiency and, thus, its financial condition. Minor potable water works are being tendered, but the largest projects still await financing.

Project Drivers: Guadalajara is the second largest city in Mexico, with a population of 3 million inhabitants within the city and surrounding areas. The city sources water from Lake Chapala, which has shown a disturbing decrease in its level in recent years. The city has high indexes of water that is unaccounted-for because of lack of maintenance to existing infrastructure and a high rate of illegal taps. In addition, the city produces close to 8 m³/s of wastewater, almost none of which is effectively treated. Under the National Crusade for Forests and Water, the federal government will assist Guadalajara in expanding its wastewater treatment systems and apply measures to increase water infiltration into the basin.

Key Contact Information:

Sistema Intermunicipal de Agua Potable y Saneamiento
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San Luis Río Colorado Wastewater Project

Estimated Investment: \$13,500,547 for the total project; \$8,000,000, approximately, for the wastewater treatment plant

Location: San Luis Río Colorado, Sonora

Source of Financing: BEIF: \$5.7 million; mix of federal, state, and municipal resources: \$8 million

Likely Bid Date: May or June 2001

Project Type: EPC and turnkey

Brief Project Description: The project consists of the construction of an interceptor for a sanitary sewer system (6,000 meters), two pump stations, one pressurized emitter, and an 800-lps stabilization lagoon wastewater treatment plant with chemical processes. The Municipal Water and Sewer Operating Body (Organismo Operador Municipal de Agua Potable y Saneamiento, or OOMAPAS) has received a \$5.7 million grant from NADBank through its BEIF, which is funded by contributions from the U.S. EPA, to apply toward the cost of the projects included in the Wastewater Collection and Treatment Program for San Luis Río Colorado. The remaining cost of the project will be financed by a mix of federal, state, and municipal resources.

Project Status: OOMAPAS released a tender to contract construction management and supervision services so that it could monitor project performance and the use of funds provided by NADBank. The consultant will be expected to follow up on technical and administrative aspects of project progress, prepare reports and project-related documents, and participate in meetings with OOMAPAS and the construction contractors, as well as to supervise the work of the contractors. The estimated budget for this work is approximately \$380,000, including 10 percent for contingencies. OOMAPAS published the request for bids for management and supervision services on March 6, 2001.

The tender for the construction of the wastewater treatment plant, sewer collection system, pumping stations, and pressurized emitter will be released in May or June 2001. It will be an international public tender and will be published in the *Official Gazette*, as well as in local newspapers.

Project Drivers: San Luis Río Colorado is located in the northwestern region of the state of Sonora. It borders Arizona to the north, the Sea of Cortés to the south, the municipalities of Puerto Peñasco and Plutarco Elías Calles to the east, and the state of Baja California and the Colorado River to the west. It has an estimated population of 170,000, of which 96 percent receives water service and 40 percent receives sewage service; however, the untreated wastewater is discharged into the Colorado River. The plant will be located five kilometers outside the city, next to the Colorado River.

Key Contact Information:

OOMAPAS San Luis Río Colorado
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General Director/Technical Director
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Morelia Wastewater Treatment Plant

Estimated Investment: \$27 million

Location: Morelia, Michoacán

Source of Financing: FINFRA and private concessionaire

Likely Bid Date: End of 2001

Project Type: 20-year BOT

Brief Project Description: The municipal water utility of Morelia will tender the executive project, which is the construction and 20-year operation of a biological filters wastewater treatment plant with a capacity of 1.2 m³/s. The plant site is located in a 20-hectare area 9 kilometers away from the city of Morelia in the Apanteo town. The plant will be partially funded by FINFRA, which is assisting the municipality in the development of a tariff impact study.

Project Status: The Morelia water utility concluded the basic engineering studies, which were financed by FINFRA. Currently, FINFRA is assisting the municipality in developing the tariff impact study, and when the study is concluded, the utility will request subordinated capital for construction of the plants.

Project Drivers: Morelia, the capital of Michoacán, is approaching a population of 1 million. At present, Morelia is discharging most of its wastewater without appropriate treatment and is not complying with NOM-001-ECOL-1996. The water utility is analyzing water reuse for irrigation purposes, which could be a good driver to move ahead with the investment.

Key Contact Information:

Organismo Operador de Agua Potable y Alcantarillado de Morelia
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Jalapa Wastewater Treatment Plant

Estimated Investment: \$8.5 million

Location: Jalapa, Veracruz

Source of Financing: FINFRA and concessionaire

Likely Bid Date: 2002

Project Type: Public works—collectors
20-year concession—wastewater treatment plant

Brief Project Description: The plant will be divided into modules. The first module will treat 300 lps on its first stage. Prior to building the plant, the municipal water utility will need to build the collectors, one with a length of 16 kilometers and an estimated cost of \$4.5 million and the second with a length of 11 kilometers and an estimated cost of \$2.3 million. The technology of the plant has not been defined yet, and water reuse is being considered for industrial purposes.

Project Status: At present, the U.S. company Montgomery is developing the executive project for the wastewater treatment plant and related infrastructure. This study was scheduled to be delivered to the Water Commission in May 2001. The municipal water utility will then contract a private company to develop a tariff impact study with funds from FINFRA.

Project Drivers: Jalapa, one of the most important cities in Veracruz, is discharging most of its wastewater without treatment.

Key Contact Information:
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Project Coordinator
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Tehuacán Wastewater Treatment Plant

Estimated Investment: \$10 million to \$15 million

Location: Tehuacán, Puebla

Source of Financing: FINFRA: 40 percent,
Concessionaire: 60 percent

Likely Bid Date: End of 2001

Project Type: Tender is divided into two parts. The first part will include construction as a turnkey project, and the second part will include operation for a 20-year period.

Brief Project Description: The plant will have an overall capacity of 450 lps (0.45 m³/s) out of which 150 lps will receive primary treatment. The remaining 300 lps will receive secondary treatment and will be destined for four types of reuse: in agriculture, in the construction industry, in the irrigation of urban green areas, and in exchange for potable water with landowners who hold water concession titles.

Project Status: The site for construction of the plant has not been selected; however, the negotiations with FINFRA are very advanced, and most studies have been concluded. The plant is expected to be tendered in late 2001 or early 2002.

Project Drivers: Tehuacán has a population of close to 200,000 inhabitants. Industrial development has been strong.

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Tuxpan Wastewater Treatment Plant

Estimated Investment: \$1.5 million for the first module

Location: Tuxpan, Veracruz

Source of Financing: Municipal funding

Likely Bid Date: Not defined yet; could be in late 2001

Project Type: EPC and concession for operation

Brief Project Description: The project consists of a three-module 125 lps plant (oxidation lagoons). The first module is estimated to cost \$1.5 million, and the remaining two modules, which will be added later, are estimated to cost \$500,000 each.

Project Status: The municipal water utility concluded the basic engineering studies and recently acquired the land where the plant will be located. The municipality is seeking credit options to partially finance the plant.

Project Drivers: Tuxpan is not in compliance with NOM-001-ECOL-1996.

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Comisión Municipal de Agua Potable y Saneamiento de Tuxpan
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Mexico City Sanitary Landfill

Estimated Investment: N/A

Location: Mexico City

Source of Financing: Possibly JICA funds; other alternatives being analyzed

Likely Bid Date: Not defined yet; government seeking financing and negotiating with scavenger unions

Project Type: EPC and, possibly, contracts for operation

Brief Project Description: Mexico City is home to close to 20 million inhabitants, out of which 9 million live in the Federal District and 11 million in the state of México. The city has severe problems in adequately disposing of its solid waste. The Federal District alone generates 4,169,000 tons of solid waste per year, out of which only 18 percent is recovered by scavengers. The remaining waste is disposed of in two landfills, Santa Catarina and Bordo Poniente.

Located over an inactive volcano, Santa Catarina has reached 100 percent capacity, but is still in use. The overloading of this landfill has created a great risk for it to fall apart and slide into the Mexico-Puebla highway, which passes just a few feet away from the landfill's boundary. The Bordo Poniente landfill is expected to reach full capacity by 2002.

A JICA-funded study, which was commissioned by the Mexico City government, reveals the urgency of building additional solid waste disposal infrastructure. JICA's recommendations include constructing a mega-plant for production of fertilizers from organic waste, promoting waste separation, building one new floor in the Bordo Poniente landfill, and building a new landfill in another area close to the city.

The Mexico City government is negotiating with scavenger unions so that the Santa Catarina landfill can be closed. The new landfill represents an opportunity to organize scavengers and provide them with a formal, efficient, and safe waste separation job.

Project Status: Authorities of Mexico City and the state of México are negotiating to define the optimal funding sources for the new infrastructure. The authorities are also evaluating hiring a consultant to determine the most appropriate site for the construction of the new landfill. New landfill construction will not be tendered until late 2002.

Project Drivers: Currently, Mexico City only recovers 18 percent of its solid waste through an inefficient and unhealthy scavenger method. None of the organic waste is used, and batteries, as well as other potentially hazardous materials, are disposed of in landfills. JICA considers that having new infrastructure and an organized method of waste separation could raise the recovery index to 37 percent and prevent health risks currently suffered by scavengers, who separate garbage using only gloves and mouth covers.

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Coatzacoalcos Sanitary Landfill

Estimated Investment: \$88 million

Location: Coatzacoalcos, Veracruz

Source of Financing: FINFRA: \$35.2 million
State and municipal resources: \$52.8 million

Likely Bid Date: Not defined yet; state and municipal resources being approved; could be tendered in 2002

Project Type: EPC and concession for operation

Brief Project Description: Coatzacoalcos, Veracruz, has a population of over 250,000 inhabitants, who, combined with the industrial activities of the zone, generate over 55,000 tons of solid waste per year. Most solid waste generated by the municipality is thrown into open-air dumps and landfills that do not meet the criteria established by NOM-083-ECOL-96. Scavengers take advantage of some recyclable materials.

The project consists of the construction of a sanitary landfill that will meet and exceed the criteria established by NOM-083-ECOL-96. The project includes the preparation of the land, installation of membranes to avoid spills into soils, and installation of bio-gas recovery systems and wastewater treatment and recycling facilities.

Project Status: FINFRA is evaluating the project. Once FINFRA approves the project, the local government will have to secure funding for the remaining \$52.8 million needed.

Project Drivers: Compliance with regulation NOM-083-ECOL-1996 is an important project driver, as is the prevention of health hazards to scavengers working on open-air dumps and to the population surrounding the dumps.

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Government of Coatzacoalcos
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Economic Development
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Agua Prieta Solid Waste Collection and Disposal

Estimated Investment: \$2 million

Location: Agua Prieta, Sonora

Source of Financing: NADBank: \$1 million;
municipality, SEDESOL, and state government: \$1 million

Likely Bid Date: Mid-2002

Project Type: EPC and equipment procurement

Brief Project Description: The project includes constructing a new landfill, acquiring garbage collection and disposal equipment, and closing an existing site for final disposal of municipal solid waste.

Project Status: NADBank approved a \$500,000 loan to procure equipment for the solid waste landfill. The loan agreement closed in March 1999 and was disbursed in August 2000.

Administrative, legal, and managerial organization of the solid waste utility was developed through NADBank's Institutional Development Cooperation Program. Further assistance from the program was approved for a user survey and a management information system for the utility. The management information system is under way and is expected to be concluded in December 2001. The survey is expected to be finished by November 2001. The project is expected to be bid by mid-2002.

Project Drivers: Environmental and health risks need to be reduced by covering and closing the existing open-air landfill and by meeting the city's solid waste infrastructure needs. Reducing smoke and odors will also help the neighboring city of Douglas, Arizona, comply with U.S. EPA standards.

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Ayuntamiento de Agua Prieta, Sonora
Professor Oscar Ochoa Patrón
Presidente Municipal
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Matamoros Solid Waste Management Project

Estimated Investment: \$3 million

Location: Matamoros, Tamaulipas

Source of Financing: NADBank, plus municipal, state, and federal resources

Likely Bid Date: Collection and transportation study to be bid in 2001; works and equipment to be bid after study is completed

Project Type: EPC and equipment procurement

Brief Project Description: The project includes improving and reorganizing the solid waste collection system through the creation of an autonomous utility. It also includes constructing a solid waste landfill and acquiring garbage collection and disposal equipment.

Project Status: NADBank is participating as an investment banker and potential direct lender. The Mexican federal government has agreed to provide partial funding. The bank approved assistance for the development of the utility once the city defines its service strategy. Institutional Development Cooperation Program assistance was also authorized for a collection and transportation study, which was expected to begin in the second half of 2001.

Project Drivers: Reduction of environmental and health risks related to inappropriate solid waste management is the primary driver.

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City of Matamoros, Tamaulipas

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Appendix B

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Mexico City Government

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Appendix C

Helpful Documents

Análisis del Desempeño Ambiental México (Analysis of Environmental Development in Mexico) (Mexico City: OCDE, 1999), 230 pages.

Áreas de Oportunidad en el Sector Ambiental de la Economía (Areas of Opportunity in the Environmental Sector of the Economy) (Mexico City: SEMARNAP, February 1997), 85 pages.

Calidad del Aire, Breve Historia Comparada y Futuro 1970–2020 (Air Quality, Brief History, and Comparison with the Future 1970–2020) (Mexico City: CESPEDDES, February 2000), 74 pages.

Ciudad de México “Enfrentar la Decadencia” (Mexico City “Facing Decadence”) (Mexico City: CESPEDDES, August 1998), 104 pages.

Compendium of EPA U.S.-Mexico Border Activities (Washington, D.C.: U.S. Environmental Protection Agency, 1999), 257 pages.

Contaminación Atmosférica por Vehículos Automotores (Air Pollution by Automobiles) (Washington, D.C.: World Bank, 1997), 306 pages.

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Derecho y Políticas Ambientales en América del Norte (Laws and Environmental Policies in North America) (Mexico City: Commission for Environmental Cooperation, Winter 1998), 216 pages.

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Appendix D

Summary of the National Crusade for Forests and Water

On March 7, 2001, President Vicente Fox, joined by his minister for the environment, Víctor Lichtinger, presented the country with a new, ambitious environmental program that was conceived for reversing the severe depletion rate of Mexico's water resources. As the program was being developed, the government confirmed the close relationship between water and forest resources and considered the need to develop measures covering both areas. The program is called the National Crusade for Forests and Water. The severity of Mexico's overall environmental degradation, but especially the diminishing availability of water, made the program the first environmental initiative unveiled by the new administration.

The importance of the crusade is that it recognizes the severity of a problem that requires immediate attention and stresses that the deterioration cannot be allowed to continue, because the chaotic management of forests and water resources has started taking its toll in a growing number of regions in Mexico.

The crusade is based on the need to raise consciousness among the general population that managing sustainable development is a must for securing the long-term availability of forests and water resources in Mexico. The program calls for the participation of every sector in this endeavor. It outlines responsibilities for both the government and the private sector, and it invites every sector to contribute to developing the specific measures that the crusade will require.

The official information on these sectors, which was offered during presentation of the program, gives a daunting picture of the situation. According to SEMARNAT, the economic loss caused by environmental degradation in Mexico reaches 10.6 percent of the country's GDP every year. That degradation is also causing an increase in the severity of the consequences of natural disasters at a time when the cost of disaster mitigation is much higher than that of disaster prevention.

Some of the principal problems mentioned during the presentation of the program were that 78 percent of municipal wastewater and 85 percent of industrial wastewater are returned to water bodies without adequate treatment. Water supply networks lose up to 50 percent through leaks in the distribution networks, and 55 percent of the water used for agriculture is lost to evapora-

tion or infiltration because of lack of appropriate technology. As a result, 15 percent of Mexico's aquifers (including Mexico City's aquifer) are considered severely overexploited, whereas 12 million Mexicans remain without easy access to potable water, and 24 million live with no sewage infrastructure.

In addition to squandering, another direct cause for water scarcity is the continued loss of forests. That loss has altered the rain cycle and has reduced the soil's capacity to allow water to filtrate back into the aquifers. Every year Mexico loses about 600,000 hectares of forest, and 40 percent of the remaining forest resources are in immediate danger because of inadequate conservation practices and the proliferation of various types of plagues. Additionally, over 20 million hectares of soils have lost between 40 percent and 60 percent of their capacity to retain water because of erosion, fires, and other degradation processes.

The National Crusade for Forests and Water has identified the most critical regions suffering water pollution and deforestation. Those regions will be the central focus of the crusade and are where most actions and investment will be concentrated.

Water Pollution Caused by Wastewater Discharges

SEMARNAT has identified 15 basins that receive the largest quantities of polluting discharges. Investments toward cleaning those basins and enforcing regulations will be encouraged. The basins are Moctezuma, Papaloapan, Jamapa, Bravo-San Juan, Soto la Marina, Atoyac, Lerma-Salamanca, Lerma-Toluca, Santiago-Guadalajara, Santiago-Aguamilpa, Grande-Amacuzac, Tamuín, Pánuco, Yaqui, and La Laja.

Deforestation

Areas where deforestation is critical include Selva Lacandona, Selva Uxpanapa-Chimalapas-El Ocote, Bosques Mesófilos de la Sierra Madre Oriental, Valle de

México, Sierra Madre de Chiapas, Altos de Chiapas, Los Tuxtlas, Región de la Mariposa Monarca, Cuenca del Lago de Pátzcuaro, Sierra Tarahumara, Sierra de Manantlán, Sierra Sur de Oaxaca, Sierra Norte de Oaxaca, Sierra Sur de Guerrero, Región Huasteca, and Sierra la Giganta-Magdalená.

Water Shortages

In addition to finding that 12 million inhabitants lack potable water service, the crusade identified 34 Mexican cities that face growing water shortages. Causes of water shortages are diverse and include lack of rainfall, aquifer overexploitation, fast economic and population growth, and lack of investment in new infrastructure. Solving water supply problems in the cities identified is considered priority under the crusade and will require new investment, water restrictions, and programs for promoting water conservation among the public. CNA officials consider those problems already to be severe and indicate that local government resources will be insufficient for financing the new required infrastructure. Thus, CNA is currently working with local governments to analyze urgent private investment participation schemes.

Cities facing severe shortage problems include the following:

- Border area cities—Ensenada, Mexicali, Tijuana, San Luis Río Colorado, Nogales, Ciudad Juárez, Ciudad Acuña, Piedras Negras, Nuevo Laredo, Reynosa, Río Bravo, and Matamoros
- Cities with greater economic development—Mexico City, Guadalajara, Monterrey, Puebla, León, Toluca, San Luis Potosí, Querétaro, Coatzacoalcos, Chihuahua, Carmen, Aguascalientes, and Hermosillo
- Cities with important tourism infrastructure—Acapulco, Cancún, Playa del Carmen, Mazatlán, Manzanillo, Los Cabos, and Ixtapa-Zihuatanejo
- Cities suffering water-quality problems—Zimapan, Torreón, and Saltillo
- Cities with conflict for irrigation channels—Culiacán and Los Mochis

Natural Disasters

The growing frequency and increased severity of natural disasters have been evident in recent years. Deforestation and water pollution are considered precursors of those disasters and the growing damages they produce.

The states of Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Tamaulipas, Veracruz, and Yucatán are considered critical areas and will implement Natural Disaster Management Programs with assistance of SEMARNAT and the World Bank.

Areas of Promotion

In addition to promoting the actions outlined in subsequent paragraphs, the National Crusade for Forests and Water includes actions focused on protecting and educating citizens living in extreme poverty in Mexico's forest areas, controlling overexploitation of aquifers, and launching a strong educational campaign to raise consciousness for protecting Mexico's forests and water bodies.

Several secretariats will participate in the main actions of the crusade, as will state and local governments. The crusade is expected to be a catalyst for environmental projects and investments, as well as a strong promoter of environmental attitudes.

The following actions will be promoted:

- Implementing natural resources restoration and recovery projects
- Changing public policies to improve regulatory framework and enforcement actions
- Creating the *Comisión Nacional de Bosques* (National Forests Commission), which will be responsible for solving the forest problems
- Strengthening local public and social institutions
- Improving coordination between the different levels of government with respect to implementation of environmental policies
- Promoting new infrastructure and enforcement capabilities at the local level
- Informing the public of actions being developed and the cost-benefit relationship of those actions, and inviting society to participate in the protection of the resources

Promotional Events

The crusade includes the coordination of 11 promotional events, which will involve the participation of President Fox as well as members of the different levels of government. Those events will be considered a starting point for solving specific environmental problems and will set the guidelines for concrete actions and projects.

The proposed agenda for the 11 events is as follows:

Pollution in Rivers and Lakes Caused by Municipal Wastewater Discharges. Participants will include SEMARNAT and CNA. The event's goal will be to show the relationship between forests and water bodies. The event will place special emphasis on setting lines of action for restoring those basins that suffer greatest pollution. During this event, the National Forests Commission will be created. In addition, SEMARNAT and CNA will present a detailed diagnosis of the lack of sanitation services and wastewater infrastructure. New policies to promote accelerated investment in wastewater treatment plants, as well as efficient operation of those plants, will be presented. At the local level, the project for the rescue of Lake Pátzcuaro will be presented.

Drought in the Northern Border. The principal government entities involved in this program are SEMARNAT, the Secretariat of Foreign Affairs, SEDESOL, and the National Institute for Housing Promotion. During this event, a new bilateral program fostering the sustainable use of the water resources in the border area will be announced. The program will involve the cooperation of the population on both sides of the border. At the event, other programs will also be announced covering zoning laws and water use for urban and agricultural regions. Various proposals for the optimization and reuse of the water resources will be made. The event will include a visit to a housing project of the National Institute for Housing Promotion. At that project, new devices for saving energy and water will be showcased. The government will also announce new regulations that will apply to new housing projects constructed in areas with limited water availability.

Deforestation. The principal government entities involved in this event will be SEMARNAT, the National Forests Commission, and PROFEPA. New national programs for combating deforestation will be announced. The National Forests Commission will present its objectives and programs. On a regional level, an official announcement will be made of the commencement of a program for the restoration of the Marques de Comillas region. Local communities will manage that commercial reforestation program.

Pollution of Water Bodies by Industries. The principal government entities involved in this event will be SEMARNAT, the Secretariat of Economy, SAGARPA, and CNA. The national program for the reconversion of the sugar industry will be presented. That program will include measures for eliminating the sugar industry's discharges into water bodies. Other control and incentive measures will be announced for promoting the minimization of water discharges by Mexican industry.

Tourism and Conservation of Bio-Diversity. The principal government entities involved in this event will be the Secretariat of Tourism, SEDESOL, CNA, and SEMARNAT. A new program will be presented addressing tourist infrastructure development and bio-diversity. The program's aim is to promote development of a sustainable development practice in the tourism area and to create awareness about this industry's potential impact on the environment.

Poverty and Degradation of Natural Resources. The principal government entities involved in this event will be SEMARNAT, SEDESOL, and the National Indigenous People Institute. A new program will be presented that aims to stop the vicious circle between poverty and environmental degradation. The government will develop social assistance programs that will require the population to protect the forests and water resources.

Overexploitation of Water Resources and Agriculture Practices with Intensive Use of Water. The principal government entities involved in this event will be SEMARNAT, the Secretariat of Health, SAGARPA, and CNA. The agricultural sector uses 76 percent of the available water resources in Mexico. Efficiency in the use of water resources is very limited because of a lack of investment in adequate infrastructure. Also, some agricultural practices in Mexico include the production of water-intensive crops in regions that have significant water shortages. That problem has caused Mexico to lose over 8 percent of its agricultural lands in the last few years because of salt formation and overexploitation of water resources. To address those issues, the government will announce new programs for promoting the efficient use of water in the agriculture sector. The programs will include measures for promoting the protection of soils and forest resources in agricultural regions. The government is interested also in protecting underground water reservoirs, which are being severely overexploited by agricultural practices. A local program, covering the protection of underground water resources in the region of La Laguna, will also be announced.

Natural Disasters. The principal government entities involved in this event will be SEMARNAT and CNA. A program will be announced for the prevention of natural disasters and reduction of risks associated with those disasters. The program will promote the protection of the mountainous regions surrounding 66 river basins. It will also help protect aquifers and prevent mud slides caused by deforestation and irregular housing development in those areas. A series of measures will be announced for achieving those goals.

Water Shortages in Major Cities. The principal government entities involved in this event will be

SEMARNAT and CNA. A new program, whose goal is to promote the recharge of the aquifers and the efficient use of water in major urban areas, will be announced. A specific program for the city of Guadalajara will be announced. The objective of that program is to promote additional water infiltration into the underground reservoirs.

Water and Health. The principal government entities involved in this event will be SEDESOL, CNA, and SEMARNAT. A new program dealing with health issues related to water quality will be announced. The program will include diverse actions on a national level to improve on the quality of sewage treatment throughout Mexico.

Culture and Education for Promoting Water and Forest Preservation. The principal government entities

involved in this event will be SEMARNAT, the Secretariat of Public Education, and the National Council for Culture and Arts. This program will work on incorporating the topics of environmental education and the need for the preservation of water and forests into various cultural programs and in information given to the media. The government will promote various artistic programs that will be geared toward promoting those topics on television programs, in photographic contests, and so forth.

SEMARNAT considers that the crusade's success will depend on society's willingness to work under a coordinated effort with the government to promote the crusade's stated goals.

Appendix E

U.S.-Mexico Business and Trade Community: The Seven Principles of Environmental Stewardship for the 21st Century

This is the text of the Seven Principles of Environmental Stewardship for the 21st Century, a historic private/public-sector agreement that was signed in Mexico City on June 4, 1999, by the U.S. Environmental Protection Agency, Mexico's Secretaría de Medio Ambiente, Recursos Naturales y Pesca, the Border Environment Cooperation Commission, and the U.S.-Mexico Chamber of Commerce (USMCOOC). Since that date, 10 more industry and environmental associations, at the invita-

tion of USMCOOC, have signed the Seven Principles. This proposal forges a strategic alliance and outlines an approach to implement the seven principles along both sides of the U.S.-Mexico border. Conceptually, the principles are a natural extension of sustainable development activities embraced by numerous stakeholders—including public entities, the private sector, and non-government organizations—in the border region.

In furtherance of the goals of the Border XXI Environmental Framework, these Principles have been developed through a public/private partnership to promote sustainable development in the U.S.-Mexico border area;

In recognition of the objectives of the North American Agreement on Environmental Cooperation to foster environmental protection and improvement throughout North America for the well-being of present and future generations, promote sustainable development, enhance environmental compliance, promote economically efficient and effective environmental measures, and promote pollution prevention;

In recognition of existing obligation to comply with domestic environmental laws;

The signatories below will work together, and in conjunction with other federal and state government agencies and industry representatives, to promote voluntary implementation of the following Principles of Environmental Stewardship by corporate entities and their affiliates throughout the United States and Mexico, at all of their operational locations, consistent with the domestic laws of each country:

1. Top Management Commitment: Make substantive top-management commitment to sustainable development and improve environmental performance through policies that emphasize pollution prevention, energy efficiency, adherence to appropriate international standards, environmental leadership, and public communications.

2. Compliance Assurance and Pollution Prevention:

Implement innovative environmental auditing, assessment, and improvement programs to identify and correct current and potential compliance problems and utilize pollution prevention and energy efficiency measures to improve overall environmental performance.

3. Enable Systems: Through open and inclusive processes, develop and foster implementation of environmental management systems which provide a framework for ensuring day-to-day compliance in process operations, pollution prevention, energy efficiency, and improved environmental performance. Encourage the use of environmental audits, pollution prevention assessments, and employee training and involvement as integral parts of the company's culture at home and abroad.

4. Measurement and Continuous Improvement:

Develop measures of environmental performance to demonstrate adherence to these Principles. Periodically assess the progress toward meeting the organization's environmental goals and tie results to actions in improving environmental performance.

5. Public Communications: Consistent with the sovereign host country's domestic laws and policies governing environmental protection and the protection of confidential business information, voluntarily make available to the public information on the organization's environmental performances and releases, as well as on the performance of its envi-

ronmental management systems relative to these Principles, based on established objectives and targets; and voluntarily provide avenues for receiving suggestions from and establishing dialogue with the public about the company's environmental performance.

6. Industry Leadership: Work with other companies operating in the same region or industry subsector to improve industrywide environmental compliance,

pollution prevention practices, energy efficiency, and overall environmental performance.

7. Community Environmental Stewardship: Promote and give support to environmental stewardship and sustainable development in the community in which the organization operates, for example, through investments in local environmental infrastructure, health, education, and improving public environmental awareness.