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**Business Focus Series**

**Energy and  
Environment  
Market  
Conditions in  
Mexico**



*Prepared by:*

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

**Office of Energy & Infrastructure**

*In Cooperation with:*

**Bureau for Latin America and the Caribbean**

# **Environment Market Conditions in Mexico**



**The Office of Energy and Infrastructure  
Bureau for Research and Development  
U.S. Agency for International Development**

**March 1992**

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# FOREWORD

This document was prepared by RCG/Hagler, Bailly, Inc. for the Office of Energy and the U.S. Agency for International Development. The report was written by Joseph Newman, Anne Riederer and Suzanne Goldstein Smith of RCG/Hagler, Inc., with substantial input from Louis Varela of ICM, Inc. and Alberto MENOR S.A. de C.V. Review comments and guidance were received from Robert Schweitzer and Mark Murray of the AID Office of Energy and Infrastructure, D.C. and Gerard Bowers and Frank Zadroga of AID in Mexico City. Review comments were received from the U.S. Environmental Protection Agency and the Department of Commerce. The authors gratefully acknowledge the review and comments by Bennett Jaffee of Consultants' Group Latin America, Beverly Johnson of the Economic Development Department, Wayne Weiss of Black & Veatch, Jim Guseman of UEC Environmental Systems, Bruce Wilson of Air & Water Technologies Corporation, R.J. Tondu of Tondu Energy Systems, Bruce Garthwaite of Brown & Root, Simon Cordery of Advanced Aquatic Technology Associates, Damon Greer of the U.S. Department of Commerce, and others.

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# EXECUTIVE SUMMARY

The opening of the Mexican economy is creating new markets for U.S. industry. Many of the largest and fastest growing market segments are in the energy and environmental sectors. U.S. companies, with their geographic proximity and long standing trading relationships, are well-positioned to further penetrate Mexican markets. To do so, they must continuously update their market information. This report provides a current review of market conditions, including economic, policy, legal, technical, and financial conditions, and how they relate to business opportunities in the energy and environmental sectors.

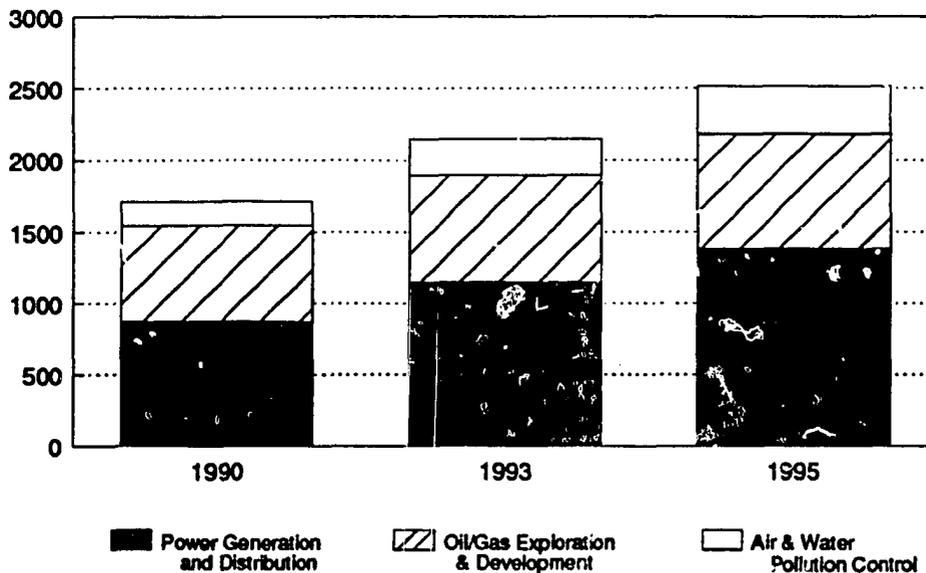
The U.S. Department of Commerce has estimated the market for energy and environmental equipment and services in Mexico at about \$1.7 billion in 1990. This market is characterized by the large size of both the oil and gas and the power segments, which represent over 90% of the market, and by the smaller-sized (\$167 million) but more rapidly growing market for air and water pollution control equipment and services.

Each of the energy and environmental market segments is projected to show significant growth over the next several years. The newly emerging air and water pollution control markets are expected to experience an average 15% growth rate per year through 1993. A slower, but still quite attractive, annual growth rate of 9.5% is anticipated for the power generation segment through 1994. The oil and gas exploration and development market is expected to grow at 3.8% per year over the same period. Projected growth rates for 1990 through 1995 by market segment are shown in Figure 1.

*The energy and environmental market in 1990 was \$1.7 billion*

**Figure 1**

**Mexico Market for Energy & Environmental Technology**  
Market Growth Projection  
(\$ million)

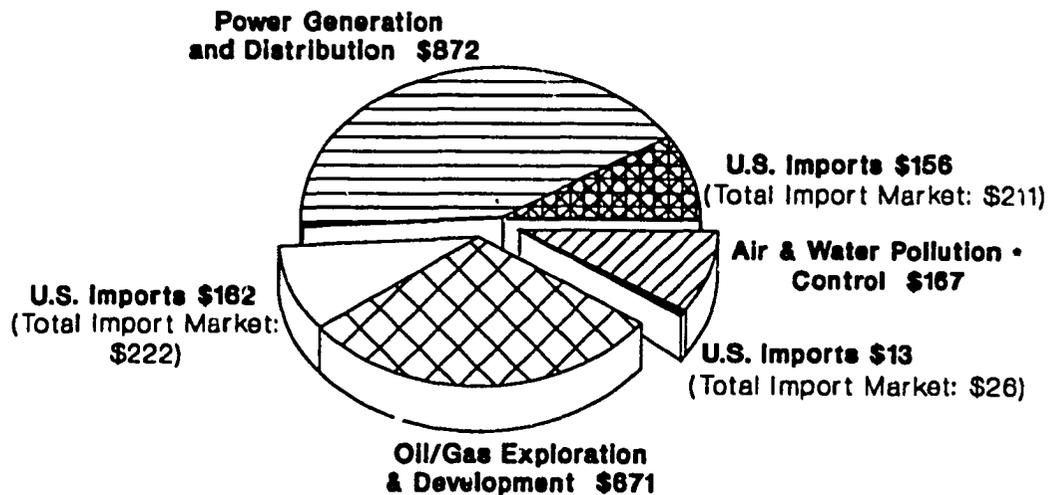


SOURCE: U.S. Department of Commerce.

Imports of foreign goods and services to Mexco represented approximately 28% of the energy and environmental market, or \$459 million in 1990. U.S. exporters dominated the oil and gas segment with a 73% percent share of the imports. The U.S. provided 74% of the power generation imports. In 1989, the U.S. accounted for 26.5% of the air pollution control and 53.8% of the water pollution control import markets. Figure 2 provides a breakdown of the market size by segment and the share of imports held by the United States (the U.S. import market share figures do not include Mexico's production of goods and services by U.S.-owned companies).

Figure 2

**Mexico Market for Energy & Environmental Technology**  
**Total Market and U.S. Share, 1990**  
 (\$ millions)



\* 1989 data  
 SOURCE: U.S. Department of Commerce.

The Mexican Government has already made major improvements to the country's business climate. Taxes and tariffs have been reduced, exchange controls eliminated, and foreign investment regulations eased. Large-scale privatizations have been completed or are well underway. Foreign investor confidence in Mexico, as evidenced by recent large inflows of capital, is at an all-time high. Expectations are that these very positive trends will continue.

**Oil and Gas Field Exploration and Development.** This market is entirely dominated by the national petroleum company, Petroleos Mexicanos (PEMEX). PEMEX contributes roughly 30% of Mexico's foreign exchange and 30% of the Mexican Government's revenues. Thus, the requirements of this industry are a national priority. Nonetheless, a decade of under-investment and constitutional restrictions on foreign participation have placed in doubt PEMEX's ability to sustain its export contribution in the future. Currently, oil and gas reserves are below optimal levels and infrastructure is in disrepair. It is thought that the failure to rapidly expand the country's oil and gas reserves and boost production could cause Mexico to become a net oil importer before 2000.

*PEMEX must invest up to \$30 billion before 1996 to modernize and expand*

PEMEX will require up to an estimated \$30 billion of new investment over the next five years to modernize and expand. Oil exploration is expected to attract about \$6 billion over the next five years; \$1.3 billion has been earmarked for U.S. firms operating in the

Campeche Sound through a \$1.6 billion credit line made available to PEMEX by the U.S. Export Import Bank. Additional investment will be required for expanded refining capacity.

**Electric Power Market.** This market consists almost entirely of the government-owned electric utility, the Comision Federal de Electricidad (CFE). However, industrial cogeneration facilities are expected to emerge as new market players over the next decade.

CFE's expansion plans call for 19,513 MW of new generation capacity between 1989 and 1999 to support a projected 6% to 7% growth in electricity demand. Capacity planning emphasizes the construction of 9,500 MW of new dual coal/oil-fired units plus the addition of hydro, coal, oil and gas, nuclear, and geothermal capacity. Given the limited availability of natural gas (not including the possible expansion of U.S. gas imports into Mexico), the application of combined cycle systems is not expected to play a major role in Mexico's expansion plans.

CFE's expansion plan is estimated to cost \$34 billion. Due to limits on internal and multilateral bank funding, CFE will need to obtain over \$8 billion, or 25% of its capital requirements, from private sources. Such sources will include the private funding and ownership of 1,000 to 2,000 MW of industrial cogeneration and the turnkey construction and leasing to CFE of power generating units under build-lease-transfer arrangements.

In the power generating segment of the market, the United States commanded a 74% share of a \$400 million market in 1990. Recently, however, new large equipment purchases by CFE, such as turbines, have largely been made from Spanish and Japanese companies that offered turnkey projects with attractive financing packages.

**Air Pollution Control Market.** Mexico faces serious air pollution emissions from industrial (fixed) and transportation (mobile) sources. Vehicular emissions are the largest source of air pollution in Mexico, and present an especially serious problem in Mexico City. Other significant air pollutants are sulfur dioxide, nitrous oxide, ozone, carbon monoxide, and particulates.

The Mexican Government is committed to a multi-billion dollar air pollution control program that emphasizes the production of clean fuels, the installation of catalytic converters, and improved automobile efficiencies. For pollution from industrial (including power generation) facilities, the government's priority is to substitute low-sulfur fuel oil and coal.

The immediate need for new pollution control technologies currently unavailable in Mexico represents an important window of opportunity for U.S. companies. New business opportunities will be in the sale of air pollution monitoring equipment, technologies for converting fuels, tailpipe equipment, and technologies for reducing particulate levels at both fixed and mobile sources. Competition will continue to come from German, Japanese, French and Swiss companies.

**Water Pollution Control.** The Government of Mexico is paying more attention to its water pollution and water scarcity problems. Stricter water pollution laws affecting municipalities and industrial point sources have been enacted. The enforcement of these laws has also greatly increased.

Strong market demand exists for aerators, chlorinating equipment, pumps, clarifiers, cooling towers, sludge filtering equipment, monitoring equipment, and water treatment chemicals. In the service area, good business opportunities include the preparation of feasibility studies and environmental impact assessments.

Opportunities also exist for U.S. companies to work with municipal agencies and industry associations in the construction and operation of wastewater treatment facilities. This will require innovative arrangements to build, operate and transfer new or rehabilitated facilities and/or to enter into medium to long-term service contracts.

*Capital shortages at CFE boost demand for industrial cogeneration and turnkey power projects*

*The Mexican government is investing billions in air pollution control*

*Severe water pollution and shortages create large demand for wastewater treatment*

# 1. COUNTRY OVERVIEW

## 1.1 Macro-Economic Trends and Policies

In the 1970s, Mexico experienced high economic growth, driven primarily by lucrative oil exports and heavy borrowings in external markets. This expansion occurred under an economic development strategy of import substitution and protectionist policies. The Government of Mexico's massive support for state-run enterprises was an especially important stimulus to the country's economy during this decade.

The economy's expansion, however, was halted in the early 1980s by falling world oil prices and rising interest rates in international capital markets. These two factors helped trigger the 1982 crisis during which the government announced that it could not meet the interest payments on its foreign debt. Severe recession and negative growth quickly ensued and lasted into the middle of the decade.

This downward trend was reversed by the orthodox economic policies of the de la Madrid administration, which were inaugurated at the height of crisis in 1982. De la Madrid's reforms were directed towards trimming public spending, controlling inflation, reducing corruption, and creating conditions to foster domestic investment. The succeeding Salinas administration has continued to successfully implement these policies, with the aim of creating a market-driven economy based on strong private sector participation. As a result, trade liberalization, subsidy reduction, incentives for foreign investment, and debt reduction have bolstered the recent gains in economic growth and led to the return of around \$5 billion in flight capital over the last three years.

*Mexico has rapidly emerged from a severe economic slump*

The economic turnaround was also boosted significantly when Mexico joined the General Agreement on Tariffs and Trade (GATT) in 1986. Membership in the GATT prompted the dismantling of Mexico's tariff barriers and restrictive trade practices. The average weighted import tariff dropped from 16.4% in 1982 to 10.4% in 1991. Furthermore, the number of tariff items subject to import duty codes dropped from almost 8,000 in 1982 to 329 in 1988. The total value of merchandise trade (sum of imports and exports) grew from \$27 billion in 1986 to \$58 billion in 1991.

Table 1

### Key Economic Indicators

	1989	1990	1991 est.
Population (millions)	79.5	81.1	82.7
Total GDP (\$bn)	208.5	238.5	271.3
Real GDP growth (%)	3.1	3.9	4.0
Total Trade Balance (\$bn)	-0.6	-3.0	-8.0
U.S. Exports to Mexico (\$bn)	25.0	28.4	7.1
U.S. Imports from Mexico (\$bn)	27.2	30.9	7.1
U.S. - Mexico Trade Balance	2.2	2.5	0
Foreign Debt (% of GDP)	48.6	42.6	37.6
Government Deficit (% of GDP)	5.6	3.5	1.9

SOURCE: U.S. Embassy Mexico, *Economic Trends Report*, August 1991.

## Positive Trends in Mexico's Leading Economic Indicators

Salinas' development policies have created very positive trends in Mexico's leading economic indicators (Table 1). In 1990, Mexico's \$170 billion GNP was among the highest in Latin America, second only to that of Brazil. With the exception of some Caribbean states, Mexico's 1990 per capita income of \$2,010 ranked fifth among the major economies in the Latin America and Caribbean region (behind Uruguay, Venezuela, Brazil and Argentina).

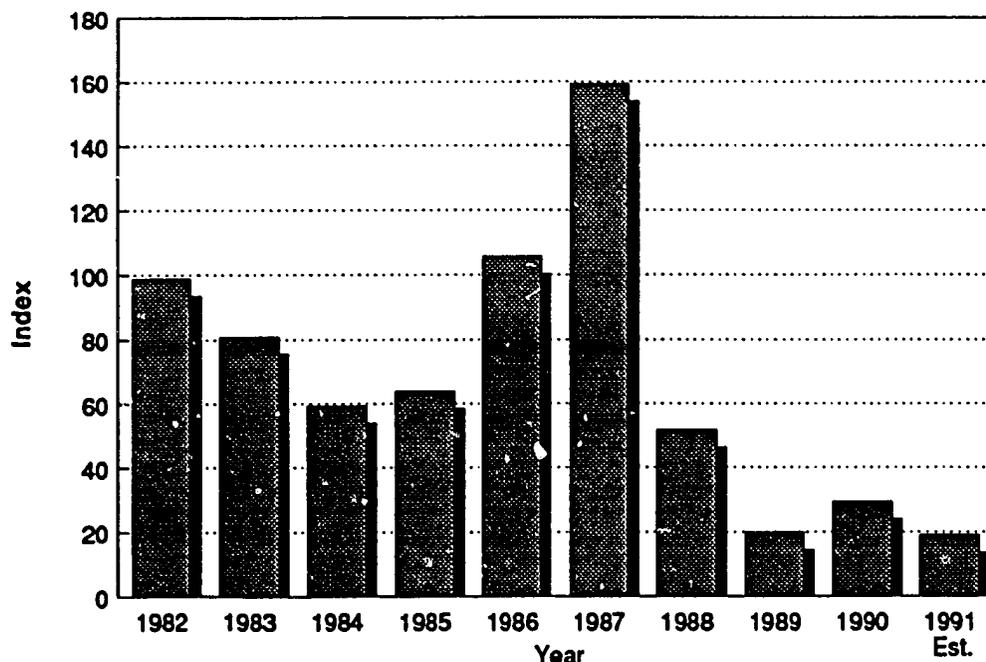
### Tackling High Inflation and Fiscal Deficits

Inflation proved to be a persistent problem for Mexico during the 1980s, approaching 160% in 1987. Recognizing the dangers of chronic inflation in a sluggish economy, the Mexican Government and International Monetary Fund (IMF) devised a package of economic stabilization measures consisting of tight fiscal and monetary policies, wage and exchange rate controls, and a pledge to increase the rate of trade liberalization. Since the measures' implementation, inflation gradually receded to about 19% in 1991 (Figure 3).

*The economic stabilization program succeeds*

Figure 3

### Trends in Mexico's Inflation



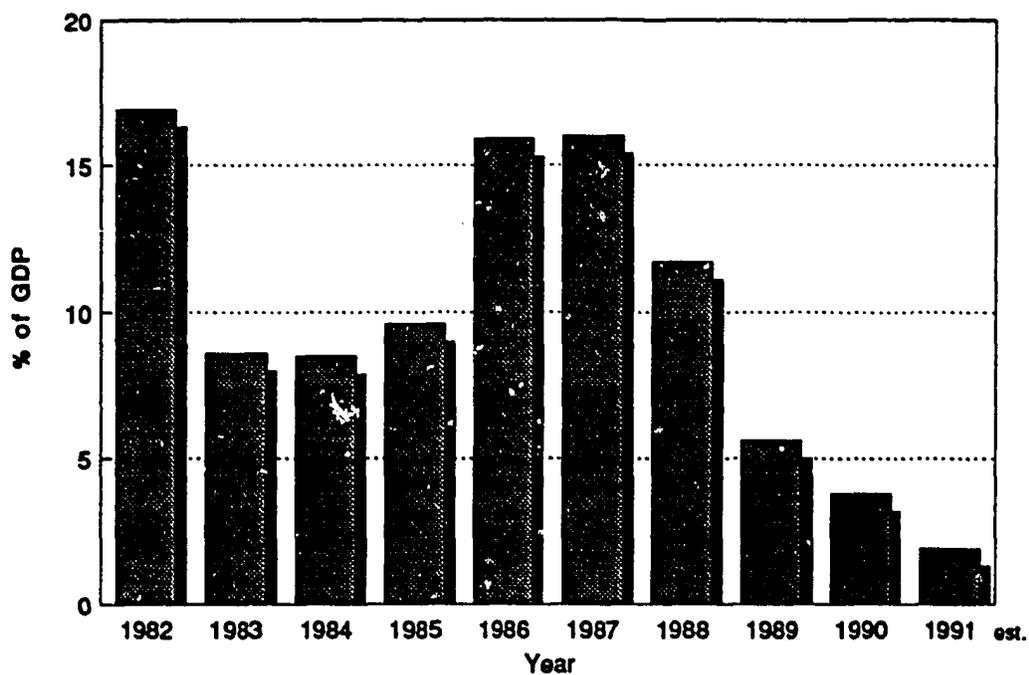
SOURCE: Banco de Mexico, 1991.

The stabilization measures and their subsequent renewals have proved to be successful, achieving the administration's primary goal of improving the image of Mexico among potential investors.

Similar results were obtained with the public sector deficit. The total deficit, expressed as a percentage of GDP, dropped from 16% in 1987 to around 1.9% during 1991 (Figure 4). Bank interest rates and international currency reserves have also responded positively to the reduction in public sector borrowing requirements. Mexican commercial bank interest rates have dropped from 58% in mid-1989 to around 20% at the end of 1991 (Figure 5). International reserves have almost tripled since mid-1989, to around \$15 billion in 1991.

**Figure 4**

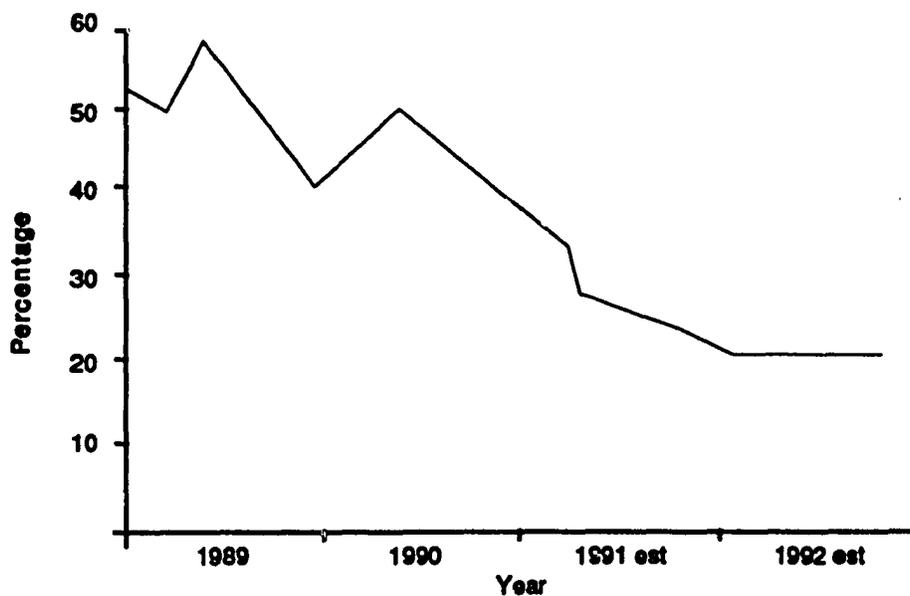
### Mexican Public Fiscal Deficits



SOURCE: Shop, Mexico, 1991.

**Figure 5**

### Recent Trends in Mexican Commercial Bank Interest Rates



SOURCE: Macro Asesoría Económica, Mexico, 1991.

**The government's role in industry is shrinking**

As part of the drive to reduce the fiscal deficit and create a dominant private sector, the government has coordinated the privatization or outright closure of over 900, mostly money-losing, public enterprises. Corporate icons of the Mexican state, such as the airline industry (Mexicana and Aero Mexco), the telephone company (Telmex), the steel industry (SICARTSA, AHMSA) and eight of the 18 commercial banks, were sold at attractive prices. These trends lay the foundation for the increased private sector participation envisioned by Mexico's economic planners. Between 1982 and 1991, the total number of parastatal companies privatized by the government was about 388.

### **Winning Back Investor Confidence**

As a result of the government's reforms, investor confidence in Mexico has skyrocketed. Foreign investment has increased almost fifteen-fold since 1985. While total foreign investment amounted to about \$500 million in 1985, it reached nearly \$7.2 billion in 1991. The U.S. is the leading source of direct foreign investment (DFI) in Mexico by an order of magnitude, reflecting decades of investment in Mexican industry and tourism. In 1990, the U.S. represented 63% of all DFI, followed by the UK, Germany and Japan, respectively. About 38% of recent foreign investment has been in Mexican treasury bills, about 32% in the stock market, and 30% has been in direct investment in industry. Such liquid investments could be more susceptible to capital flight if the Mexican economy were to experience a downturn.

**NAFTA increases investor confidence in Mexico**

The prospects of a North American Free Trade Agreement (NAFTA) with Mexico's most important trading partners, the U.S. and Canada, have also boosted investor confidence (Table 2 gives a breakdown of Mexico's major external trading partners). Direct foreign investment will be needed to service Mexico's current account deficit, which the U.S. Department of Commerce estimates at around \$6 to \$8 billion dollars. Another far reaching effect of NAFTA will be to solidify the free-market policies that stimulate private sector growth.

**Table 2**

### **Major Trading Partners (Percent of Total Trade in 1991)**

	Exports	Imports
USA	73.1	70.4
European Community	10.2	12.6
Japan	5.4	5.1
Others	11.3	11.9

SOURCE: IMF, *International Financial Statistics*, October 1991.

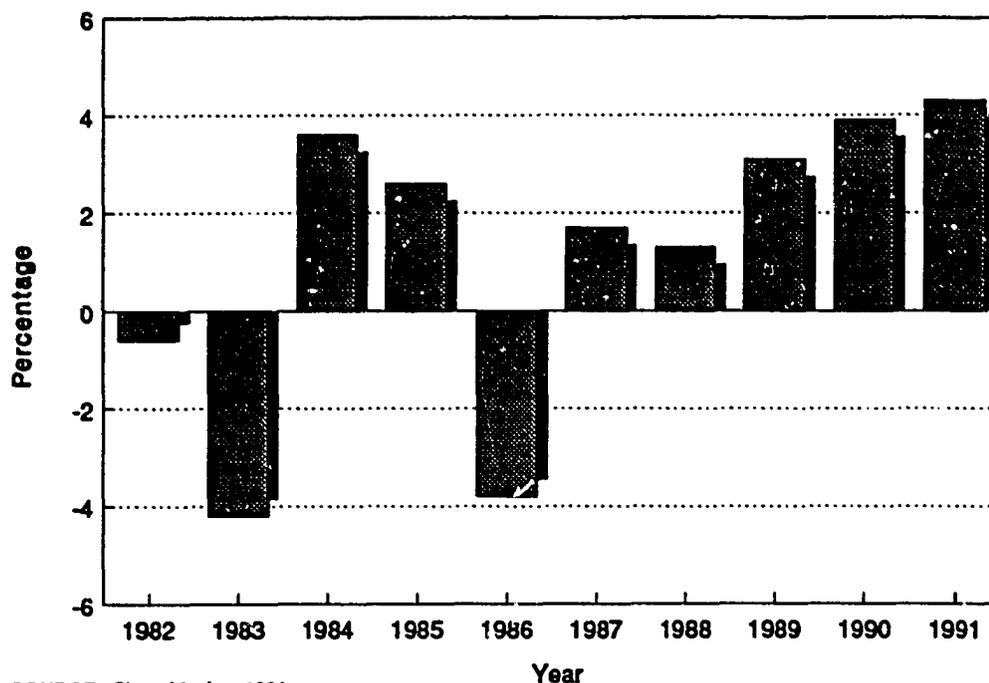
### **Future Economic Performance**

Mexico's GDP has grown steadily since stabilization in the late 1980s (Figure 6). According to the Government of Mexico's annual budget report released in the fall of 1991, real GDP will grow by 4% in 1992. Despite variations in its predicted GDP growth rates, Mexico should easily outperform most of its southern neighbors.

The government's annual budget report predicts that inflation will fall to 9.7% in 1992 and that the current account deficit will rise to almost \$13 billion. The report also predicts that the government will run a budget surplus next year and authorizes the public sector

Figure 6

## Trend in Real GDP Growth



to borrow up to \$2 billion in international capital markets. When considering official forecasts, however, it is important to note that the past three budgets have grossly underestimated three major indicators: the GDP growth rate, the rising current account deficit, and inflation. Independent experts estimate that inflation will hit the double digits in 1992. The Mexican finance minister appears unworried by the rising current account deficit, saying that it reflects private rather than public spending, and can easily be financed by rising levels of foreign capital. Standard and Poors, however, released a report in late 1991 stating that Mexico's ability to service its trade deficit was "only adequate."

Two important variables that will affect Mexico's macroeconomic performance in the longer term are population growth and access to international development assistance. Mexico's population has more than doubled since 1960 and is increasing by almost 2% per year. Over the next decade, population growth has been projected to drop to 1.3% per year. This population growth alone, if not appropriately managed, will be a substantial burden on Mexico's future economic success.

External official assistance is still of vital importance for Mexico's reforms. The IMF has strongly supported the Mexican macroeconomic program from its inception and considers Mexico to be a stellar student of "stabilization" and "structural adjustment" programs. The country continues to remain a very important client for the World Bank Group; it attracted most 38% of the net Bank transfers to the Latin America and Caribbean region during 1990-91. While most of the World Bank loans went to infrastructure projects, an increasing proportion of its funds are going towards human resource development and technology enhancement. The Mexican power utility (CFE), for example, has received substantial management and organizational assistance focused on increasing service ability, productivity, and improving its overall management structure.

## 1.2 Energy and Environmental Profile

The Mexican Government's management of the country's energy resources and environment could not be more different. Mexico has half a century of experience in managing its energy resources and has developed sophisticated policies, databases and industries. A serious attempt to manage environmental issues is something new in Mexico, and only now are substantial resources being devoted to quantify the problems and implement new policies. These differences have a direct bearing on the markets for energy and environmental technologies in Mexico, where the role of government is a key factor.

### The Energy Sector

*Mexico has abundant energy resources*

An oil exporting nation with abundant energy resources, Mexico has relatively abundant reserves of oil, gas, uranium, hydro, geothermal and biomass. Its large proven hydrocarbon reserves include 46.2 billion barrels of crude oil and 6.8 billion barrels equivalent of natural gas (mostly associated gas). The country has coal reserves as well -- about 3 billion barrels of oil equivalent -- but they are mostly of poor quality; only 3 of 16 major deposits are economically recoverable. The most substantial renewable energy resource to have been exploited is hydropower, which could potentially provide the country with about 22,000 MW of electricity (35% of which has already been installed). Geothermal resources have an estimated potential of 3,900 MW, with 700 MW already installed. Mexico also maintains a low but steady level of commitment to nuclear generation; its 675 MW of installed capacity is scheduled to double with the installation of a new plant by 1995.

*Key government agencies play a major role*

Extensive government resources are devoted to managing the energy sector. The Secretaria de Energia, Minas y Industria Paraestatal (SEMIP) is the key government ministry responsible for formulating the country's energy policies. This ministry has direct oversight over the Comision Federal de Electricidad (CFE, the national electric utility), Petroleos Mexicanos (PEMEX, the state oil monopoly), the Comision Nacional Para el Ahorro de Energia (CONAE, the national energy conservation commission), and several energy-related research institutes. Between them, CFE and PEMEX are responsible for the country's electricity, oil, and gas production.

Besides being an oil producer, refiner and distributor, PEMEX is a major electricity generator and consumer. The twelfth-largest industrial firm in the world, PEMEX had 1,683 MW of capacity at the beginning of 1991, accounting for 7% of the national total. All of this capacity is designed to satisfy the industry's own requirements. In recent years, PEMEX has begun to more carefully scrutinize opportunities to sell excess capacity to CFE. Other private industries in Mexico also produce electricity for their own use. While they too are beginning to enter into arrangements with CFE to sell excess electricity to the grid, only PEMEX is in the vital position of providing CFE with fuel for its many oil- and gas-fired power plants.

The other major player in the Mexican energy sector is the Compania de Luz y Fuerza del Centro (CLFC), a subsidiary of CFE responsible for distributing power in the greater Mexico City area. This represents a significant responsibility since some 20% of the country's inhabitants live in this metropolitan area.

*CFE plans to install over 19,000 MW by 1999*

Though under constant revision, the government's strategic plans provide some indication of the type and level of equipment procurement that Mexico's energy sector will require in the years ahead. For example, CFE developed a plan entitled "Electric Works and Investment Plan" (POISE) covering the 1989 to 1999 period. This plan calls for installing 19,513 MW of generating capacity and 19,000 kilometers of high-tension transmission lines with transformer capacity of about 60,000 MW. The expectation is that CFE will add some 6.7 million new customers to the grid at a cost of over \$34 billion dollars.

This planned surge in investment is indicative of the cyclical nature of public investment in Mexico's electricity sector. During the 1970s, CFE's investments represented an average

of about 13% of total power generation expenditures. During the 1980s, they dropped to 10% -- even less when accounting for the impact of high rates of inflation. Now, as a result of shortfalls in the 1980s, CFE must both bring on additional capacity for the 1990s and upgrade existing infrastructure and power plants.

In response to CFE's investment needs, Mexico has negotiated major loans from the World Bank and the Inter-American Development Bank to help finance POISE. IDB loans, in particular, are intended to help finance CFE's generation, transmission and distribution system; recondition existing thermoelectric plants; maintain system reliability; rationalize CFE's investment plans; and improve the environmental impact of CFE's electric power generation.

*Multilaterals  
respond to  
Mexico's  
needs*

PEMEX plays a special role in Mexico's energy sector. PEMEX is not only responsible for 31% of total exports and 30% of government revenues, but the corporation has also been a symbol of Mexican economic independence since the oil industry was first nationalized in 1938. By law, PEMEX has a complete monopoly over the exploration and extraction of all hydrocarbons in Mexico, as well as crude oil refining and the production of 19 basic petrochemicals. It owns nine refineries (eight operational) and 21 basic petrochemical complexes. PEMEX also handles domestic sales at the wholesale level and through its subsidiary Petroleos Mexicanas International (PMI), handles the export and import of crude oil and various secondary products.

PEMEX is divided into eight sub-directorates including construction, primary production, industrial transformation, sales, planning and petrochemicals. The Petrochemical and Natural Gas Sub-Directorate was created in 1990 in response to PEMEX's increased emphasis on petrochemicals and to consolidate the management of these activities throughout the company.

Under the Salinas administration, the role of the state in petroleum and petrochemical production and distribution has come under increasing scrutiny. The government has begun to privatize downstream, secondary products in the PEMEX empire (see Chapter 2). Nonetheless, it has decided to explicitly exclude the petroleum sector from free trade negotiations with the U.S., suggesting Mexico's continued desire to retain state control over this "strategic" sector for the time being.

### **The Environmental Sector**

As in the U.S., the Mexican market for environmental technologies is driven by the implementation and enforcement of national pollution control laws. In Mexico, however, implementation and enforcement present a particular challenge given the country's limited environmental infrastructure.

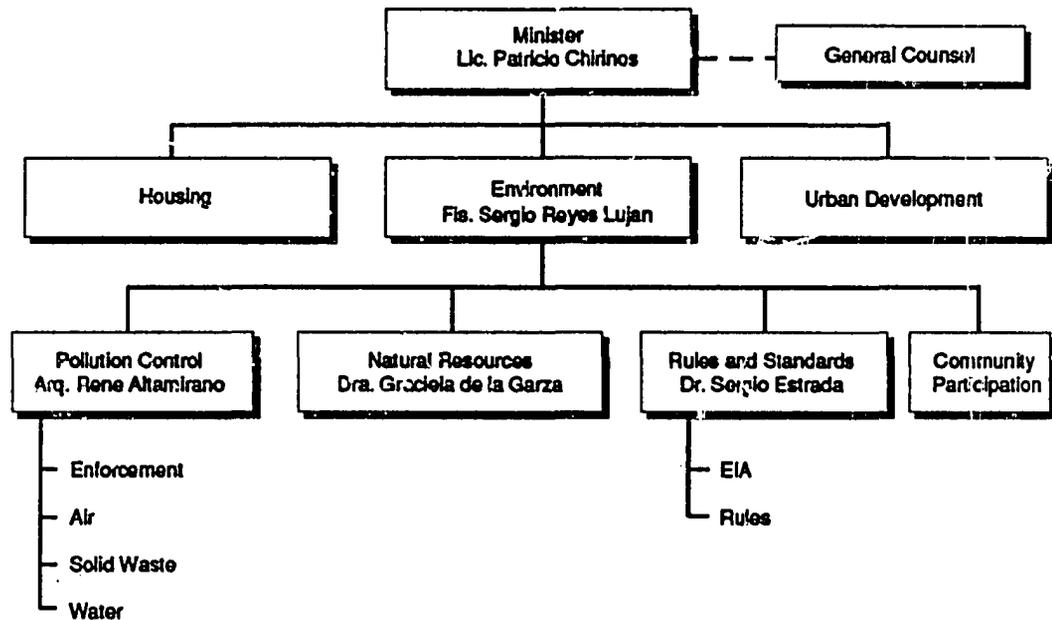
*Regulatory  
enforcement  
drives the  
market*

The key regulatory institution responsible for implementing Mexico's environmental laws is the Secretaria de Desarrollo Urbano y Ecología (SEDUE). While its mandate encompasses housing and urban development, SEDUE primarily focuses on the environment in general and on air, water, and hazardous and solid waste pollution control in particular (Figure 7). As of February 1992, 26 of Mexico's 31 states have drafted their own environmental laws. In some cases, these state laws are more strict than the national standards.

The key elements of the Salinas administration's anti-pollution strategy involve the expansion of SEDUE's legal mandate, financial resources, and political clout. In 1988, the government passed the landmark General Ecology Law, which established the framework for environmental regulation in Mexico (Figure 8).

The General Ecology Law grants SEDUE authority to develop and implement national regulatory schemes (*reglamentos*) and maximum emission limits (technical environmental standards, or NTEs). Since 1988, SEDUE has enacted five major *reglamentos* and over 70 laws for a range of air, water, and solid waste pollutants.

**Figure 7**  
**SEDUE Organization**



SOURCE: U.S. Environmental Protection Agency, 1991.

The development of the Mexican environmental protection regime involved much cooperation between the U.S. EPA and SEDUE; as a result, the Mexican laws reflect many regulations common in the U.S. While Mexican emissions limits are less strict on average than those in the U.S., it is generally recognized that the new regulations represent a major strengthening of the pollution standards in Mexico.

*SEDUE budget and program grow rapidly*

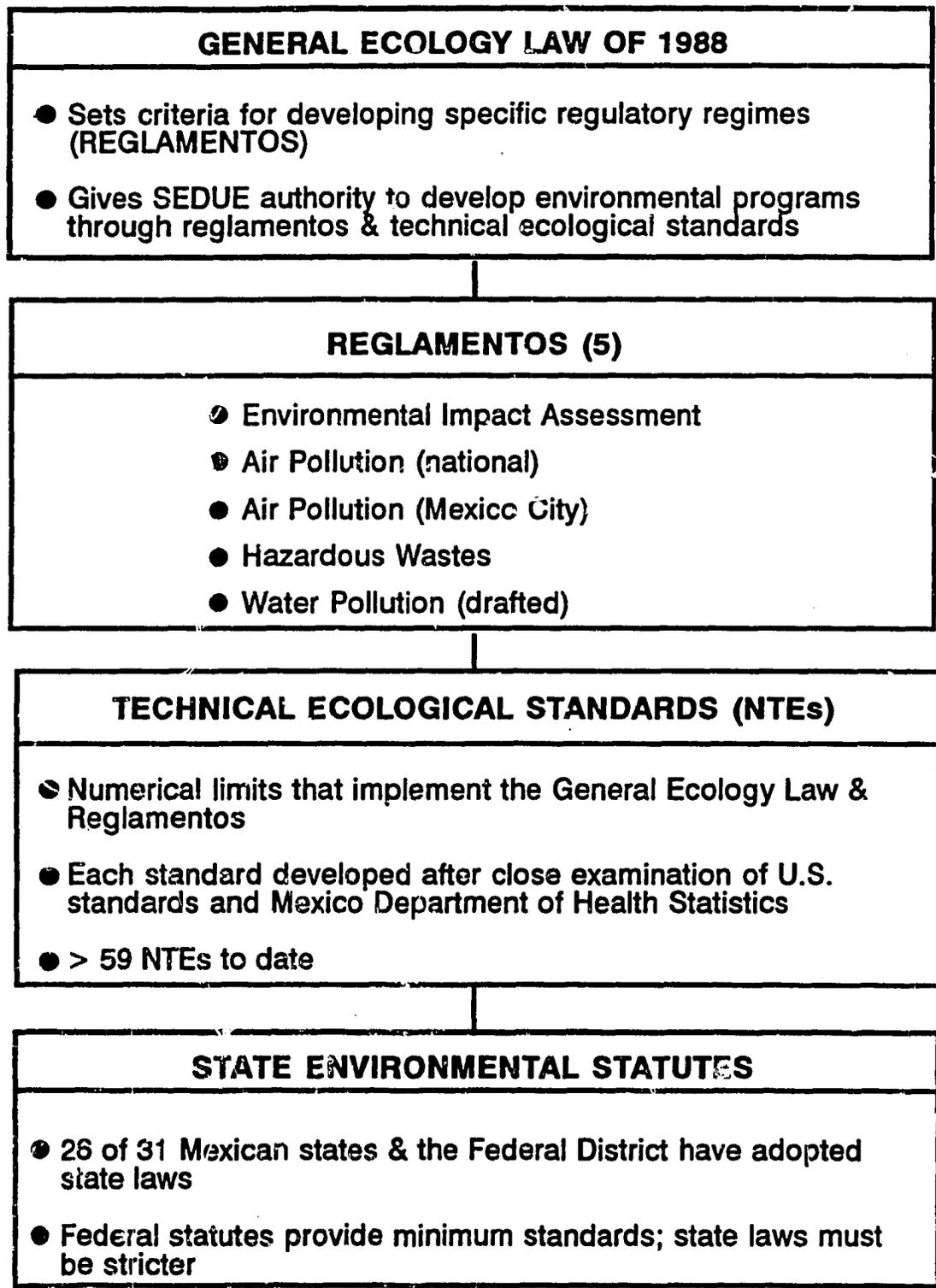
As in the U.S., Mexico has enacted a national regulation requiring that an environmental impact assessment be conducted for major new buildings and modifications to existing facilities. The law also requires a risk assessment for all projects involving hazardous procedures or materials. Unlike the National Environmental Policy Act in the U.S., the Mexican regulation applies to both public and private sector activities. This law has already compelled both public agencies and private industries in Mexico to contract with consultants to conduct environmental impact assessments for their large-scale projects.

*National strategy aims to increase private sector participation in pollution control*

Beyond the implementation of new environmental regulations, SEDUE has designed a four-year strategy to reduce air, water, solid waste, and noise pollution throughout Mexico. The National Program for the Protection of the Environment (1990-1994) focuses on the general objectives of improving coordination between national, state, and local development agencies; decentralizing responsibility for environmental management from federal authorities to municipalities; and increasing private sector participation in pollution control. The program also defines general targets in the areas of environmental education, information dissemination, and social participation.

SEDUE's annual budget has grown from \$8.6 million in 1986 to \$38.9 million in 1991, representing an increase of about 35% per year. As of April 1991, SEDUE had a staff of 408, with 116 people dedicated to air, 36 to water, 31 to solid waste, 135 to enforcement, and 90 to technical and administrative support. In addition, SEDUE has committed \$88

**Figure 8**  
**Framework of Environmental**  
**Regulation in Mexico**



SOURCE: U.S. Environmental Protection Agency, 1991.

million to two institutional strengthening programs. One will focus on decentralizing the management of federal environmental projects, and the other will promote private sector participation in the environmental sector. These programs are funded, in part, by a \$50 million World Bank credit covering the reorganization of SEDUE to improve policy development, compliance monitoring, inspection, and enforcement. The Mexican Government is contributing the other \$38 million.

**Enforcement poses the greatest challenge**

A fundamental question facing Mexico is: how will the new environmental laws and decrees be enforced in the face of a poor pollution monitoring infrastructure, a limited number of inspectors, and a tradition of industry circumventing the law? While all industrial facilities in Mexico are required to register for an environmental permit, it is estimated that about 90% have not done so. Of the estimated 32,000 industrial and commercial establishments in greater Mexico City, only about 2,000 are reported to be in direct contact with SEDUE. Through 1991, SEDUE only had 109 inspectors nationwide, 9 for Mexico City and 100 for the rest of the country. Without a sufficient number of inspectors, SEDUE has had to rely on the voluntary civic responsibility of industry or the threat of possible discovery and action. SEDUE's enforcement capabilities improved recently, however, when 50 additional inspectors for Mexico City and some 250 inspectors for the border region were hired.

For those industries that SEDUE identifies as flagrant violator of the national pollution regulations, the penalty typically has been complete, partial, or temporary plant closure. Plant closures are intended to force serious negotiations between SEDUE and the violating company; reopening is permitted only after a compliance agreement and timetable are worked out. While SEDUE periodically fines violators up to \$80,000 per violation, the agency typically resorts to forced plant closures because of the difficulty involved in administering and collecting the fines. Between 1989 and 1991, SEDUE forced the closure of some 900 factories. In Mexico City alone, SEDUE performed around 275 inspections between March and May of 1991, resulting in 102 partial closings, 104 temporary closings, and two permanent closings. The Mexican periodical *El Nacional* reports that as of October 1991, SEDUE had closed 1,686 plants and concluded 1,239 agreements with industrial facilities. Environmentalists in the U.S. and Mexico charge that SEDUE often allows closed plants to reopen a few days later without requiring adequate compliance. Nevertheless, these closures do result in substantial lost revenues to industry and thus lead to greater compliance.

**EPA and SEDUE cooperate on policy development**

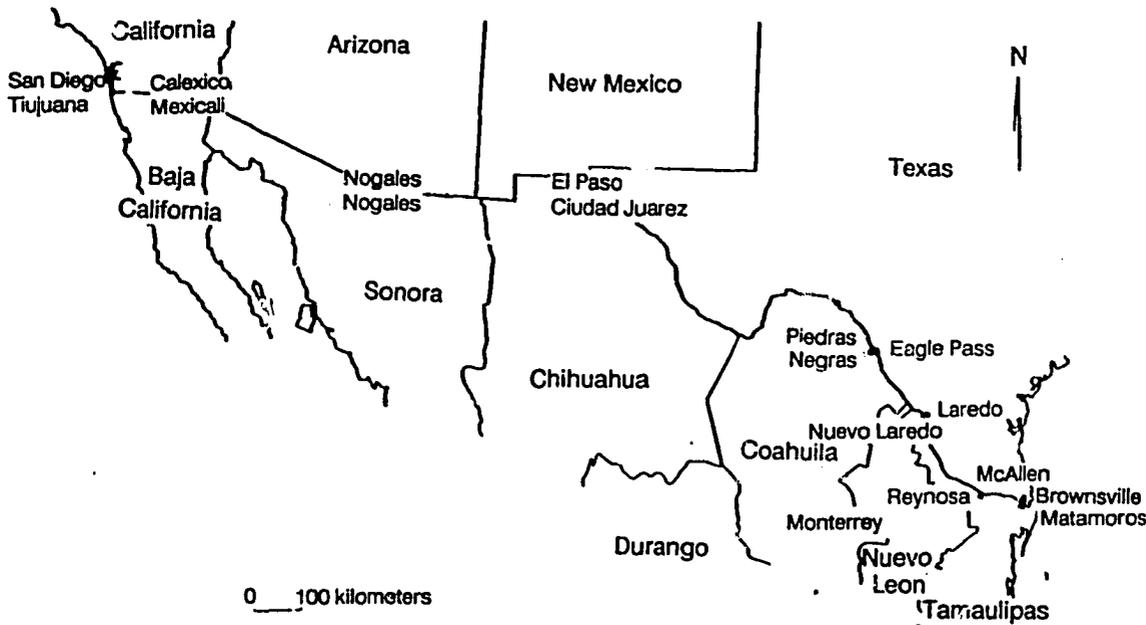
Close cooperation between the U.S. EPA and SEDUE has played an important role in the development in Mexico. EPA's International Activities Division is conducting a comparison of U.S. and Mexican environmental laws, entitled *Evaluation of Environmental Laws and Regulations: Report of EPA Findings*. This report states that "Mexico has both a strong commitment and a growing capability to implement," as demonstrated by stricter laws, budgetary and staff increase and more enforcement actions. The lack of adequate resources and the slow speed at which needed resources become available are cited as the key constraints to more progress. Some environmental advocates and industry members have described this report as diplomatic, and thus incomplete in its description of the problems and Mexico's environmental policy implementation record. SEDUE is currently in the process of privatization of part of its monitoring and enforcement functions through the hiring of environmental companies.

**Environmental disputes along the border set priorities**

A particular bone of contention between the U.S. and Mexico has been pollution in the major border cities. Rapid population and economic growth in Mexicali, Ciudad Juarez, Nuevo Laredo and other urban areas on the border (Figure 9) has strained the available infrastructure to the limit. Air, water, and hazardous waste pollution have been severe in the border cities and in many of the 1,700 *maquiladora* (free-trade) zones, where little or no compliance monitoring and enforcement took place before 1991. Because massive quantities of air pollutants and wastewater discharges from Mexican towns and factories cross the border each day, the U.S. Government is pressuring Mexico to increase enforcement of the new pollution laws in the region. On the other side of the border, the

Mexican Government has complained that U.S.-owned *maquiladora* firms do not comply with the long standing requirement to take their hazardous waste back to the U.S. It is now pressuring U.S. industry to treat and dispose of the growing *maquiladora* hazardous waste in the United States.

**Figure 9**  
**U.S. - Mexico Border Region**



Source: U.S. Environmental Protection Agency, SEDUE, 1991

To address these border pollution concerns, EPA and SEDUE have held meetings to prepare the *Integrated Environmental Plan for the Mexico-U.S. Border Area (First Stage, 1992-1994)*. The plan proposes a bilateral strategy to cooperate in regulatory enforcement, protect trans-boundary environmental resources, expand financing of environmental protection, mobilize private sector support, prepare border emergency plans, and promote public awareness. The initial draft was criticized extensively by both Mexican and U.S. community activists and environmental groups during public hearings held by EPA and SEDUE in several border towns in the fall of 1991. Specifically, the draft was cited as being inadequately researched, incomplete, and lacking sufficient funding commitments to the environmental projects it proposed. In order to address these concerns, EPA and SEDUE are inviting further public comment before the expected release of the final draft report in February 1992. In addition to the border plan, a bilateral EPA/SEDUE working group is drafting the framework for an initiative to promote pollution prevention in industry. Details on this initiative were not available at the time this report was written.

## 2. SECTORAL MARKET ASSESSMENT

### 2.1 Oil and Gas Sector

Petroleos Mexicanos (PEMEX) was created in 1938 when President Lazaro Cardenas nationalized the oil industry, confiscating mostly U.S. and British interests. Today, PEMEX is the eighth-largest oil company in the world and the fifth-largest foreign supplier of oil to the United States. In 1990 PEMEX had sales of \$19.6 billion, \$13.1 billion of which was paid to the Mexican Government in taxes. This state-owned monopoly generates one third of Mexico's foreign exchange revenues.

PEMEX is facing a number of fundamental challenges. Increasing domestic demand is outstripping PEMEX's production capacity. Inadequate investment and inefficient management have limited the growth of known reserves and production output. Mexico's hydrocarbon reserves of oil, condensate, and gas at the end of 1989 were 66.45 billion barrels of crude oil equivalent. This level represented a 1.7% drop from one year earlier and a continuation of the decline from reserves of 72.5 million barrels in 1983. Recent news reports are also casting some doubt on the credibility of PEMEX's reserve estimates. Mexico's crude oil production has also declined: from 2,747 million barrels in 1982 to 2,513 thousand barrels in 1989. These circumstances now threaten to make Mexico a net importer of oil and petroleum products before the end of the century. The Salinas administration understands the implications of this trend. Politically, it would mean a public humiliation for the ruling party (the PRI), which has been in power since the oil industry was nationalized. Economically, Mexico would lose its most important source of foreign revenue.

*Oil demand could outstrip PEMEX production capability*

In his attempts to ensure that PEMEX can compete in the international market as a modern enterprise, Salinas issued a mandate that the firm conduct itself as a "corporate" entity. As a result, a number of actions were taken. In August 1989, for example, the definitions of secondary products were revamped, resulting in the opening up of an unprecedented number of these products to 100% private investment (foreign participation is limited to 40%). Innovative financing schemes have been undertaken to accelerate the development of facilities and infrastructure, and PEMEX's internal operations have been streamlined to meet international standards of professionalism and efficiency. The following are additional changes undertaken by PEMEX under its new mandate:

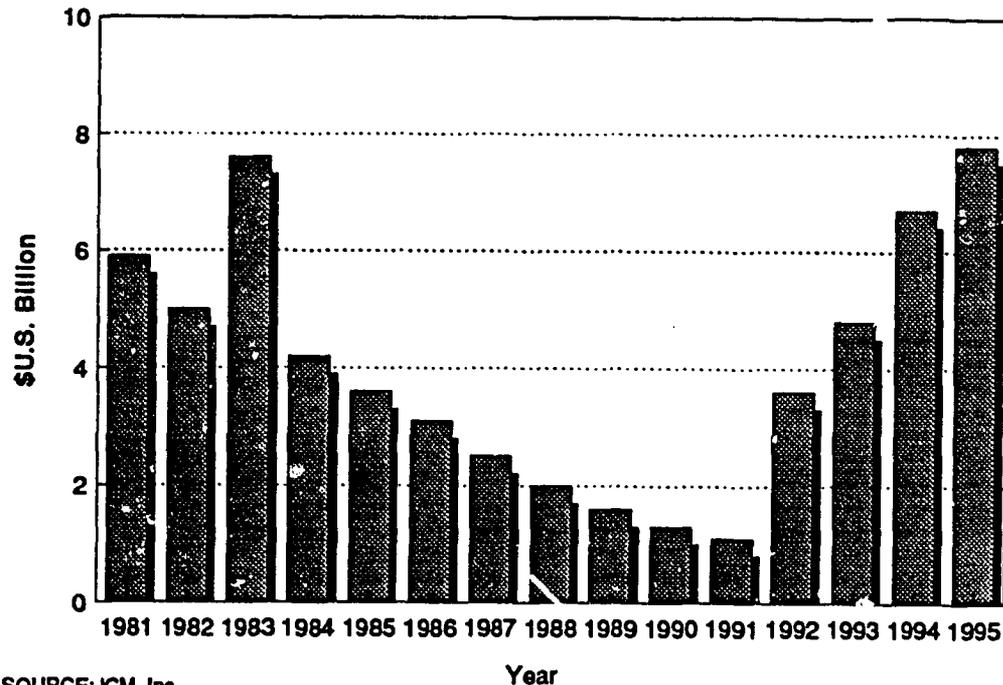
*A new program tackles PEMEX's investment, labor, contracting, and organization structure*

- **Foreign Investment.** PEMEX has returned to the international credit markets (most notably the Eurobond market) and international lending organizations (e.g., the U.S. ExIm Bank) to raise funds.
- **Exploration/Refining Capacity.** The Mexican oil giant is engaging in more frequent use of service contracts to enlist foreign participation in specific functions, including exploration, drilling, infrastructure and the construction of refinery capabilities.
- **Labor Force.** From a high of 213,000 employees in 1988, the PEMEX labor force has now been reduced to fewer than 150,000.
- **Union Relations.** The use of non-union labor in PEMEX construction contracts has increased as the influence of the Petroleum Workers' Union has been reduced. The new labor union leaders have come to recognize that oil workers' wages and benefits must be consistent with international industry standards.
- **Organizational Structure.** Once the bulwark against "imperialism" and the subsidizer of Mexico's social welfare system, PEMEX is transforming itself into a profit-conscious corporate enterprise. It has become leaner and more competitive, opened its secondary

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Figure 10

### PEMEX Investment in Oil Exploration and Infrastructure



SOURCE: ICM, Inc.

markets to foreigners, introduced creative financing schemes, and channeled its resources into its core activities of exploration and extraction.

#### Possible Future Scenarios

*The 1980s was a lost decade in terms of oil sector investment*

The Salinas administration faces a key challenge in the petroleum sector. It is committed to both its constitutional mandate requiring state control of the oil sector and to ensuring that Mexico remains an active participant in the international oil market. These goals remain elusive, however, for three reasons. First, the Mexican economy is growing so fast that it is out-stripping PEMEX's ability to supply many of the nation's oil and gas needs. Second, the 1980s was a "lost decade" in which few capital investments were made (Figure 10). Third, Mexico has not been able to attract risk capital associated with equity investment, which undermines its ability to remain an oil exporting nation after 1996 (for example, Mexico currently imports 42.5 million cubic feet of natural gas per day from the U.S and is not expected to be able to export natural gas before the year 2000). Mexico can adopt one of three scenarios to deal with this situation.

**Scenario One: Reactionary.** Taking a protectionist approach to its oil sector is incompatible with the development model of economic liberalization and free trade adopted by Miguel de la Madrid (when Carlos Salinas served as budget director) and accelerated by Salinas. It would undermine, and possibly derail, the NAFTA negotiations, precipitate capital flight (75% of capital inflow since 1988 is in liquid portfolio investments) and sabotage the economic modernization schemes currently in place. This unworkable approach can thus be discounted.

**Scenario Two: Aggressive.** The logical conclusion of the Salinas modernization program would be to change the constitution and privatize the oil industry. "Privatization" can mean different things, from the Mexican Government becoming a minority owner in PEMEX, to PEMEX withdrawing entirely from such markets as petrochemicals or gasoline retailing. Any interpretation of privatization, however, includes equity participation. An equity company assumes risk and is thus entitled to an ownership share of what is found. But unlike telephones, airlines or banks, oil is intrinsically linked to Mexico's nationalistic aspirations, as stated in the constitution and ingrained in the national consciousness. It may thus be politically impossible for any Mexican president to change the constitution in the near future. This does not preclude the possibility that the Mexican peoples' attitudes will change, but at least in the next five years, it is highly unlikely that they will accept the withdrawal of the state from the oil industry and PEMEX's complete privatization.

*Aggressive privatization is not politically feasible*

**Scenario Three: Pragmatic.** Mexico can work to make PEMEX a modern entity, trying to strike a balance between the intrinsic requirements of the Mexican nation and the realities of economic development. Taking into account the convictions of Salinas, only this scenario is likely.

*A balanced pragmatism will rule in the near term*

Under the Salinas administration, a strategy is emerging that is designed to return PEMEX to its original constitutional mandate of state responsibility for oil exploration and production, while divesting and withdrawing from other markets. It also re-enforces the Mexico's commitment, as re-iterated numerous times by PEMEX's director general Francisco Rojas, to remain a player in the international oil market. The actions taken include:

- *Reclassification of Petrochemicals under PEMEX Control.* The government has reclassified the "basic" petrochemicals reserved for state control to 19, and plans to further reduce this list to 8 in the near future. (A "basic" classification indicates that a product is considered strategic to the economy, such as gasoline or diesel fuel.) This new classification has opened large parts of the petrochemical sector to private investment and ownership (Table 3).
- *Expansion of Service and Subcontracts.* The expansion of service contracts and subcontracts is underway to secure the services PEMEX is unable to perform itself (e.g., Triton's turnkey project in Campeche Sound, Smith Industries' horizontal drilling in the Chicontepec field).

**Table 3**

### Reclassified Petrochemical Products Open to Private Investment

acetic acid	carbon tetrachloride	nonene
acetic anhydride	chloroform	oxo alcohols
acetylene	ethyl chloride	polybutylene
acrolein	ethyl hexanol	dichloride
acrylic acid	ethylene chlorhydrate	propylene oxide
aliphatic solvents	ethylene dibromide	polypropylene
allyl alcohol	hydrogen	resins
allyl	cyanide	propylene
chlorides	isopropane	tetrachlorethylene
aromin 150	lauryl alcohol	trichlorethylene
butyl alcohols	methyl chloride	trichlorethane
butyraldehyde	methylene chloride	vinyl acetate
chloroprene	naphthalene	vinyl toluene

SOURCE: U.S. Department of Commerce, PEMEX.

- *Expanded Joint Ventures.* In order to access new technology and experience, PEMEX is entering strategic joint ventures.
- *Environmental Protection.* Environmental protection requirements necessitated by the continuing air pollution crisis in the Valley of Mexico means that PEMEX must produce unleaded gasoline and low-sulfur fuels.
- *Inability to Meet Demand.* PEMEX's inability to meet domestic demand for gasoline, natural gas, certain petrochemicals, and fuel oil is placing major pressures on it to reform.

*Do risk contracts compromise Mexico's energy sovereignty?*

Despite these concrete actions, a number of obstacles remain. Foremost among them is Mexico's constitutional mandate barring equity interest to anyone but the State. Because Mexican officials, and the public in general, interpret risk contracts as a disguised form of selling petroleum reserves, it is not generally expected that PEMEX will award them. This will limit the role that equity investors (e.g., U.S. oil companies) can play in the production of oil. It is believed, however, that the Salinas administration is interested in taking a more liberal interpretation of constitutional restrictions in order to accelerate the nation's economic development (this can be accomplished because the Mexican constitution charges the State with sole responsibility for the exploration and production of oil, but it does not describe *how* this is to be accomplished).

Mexico lacks the resources to duplicate the technological advances of the past fifteen years. Thus, while crude oil production will remain with PEMEX, it will gradually withdraw from secondary products (making all petrochemical products "non-basic," for example) and markets, including refining and gas retailing.

*Attracting new technology is a critical requirement*

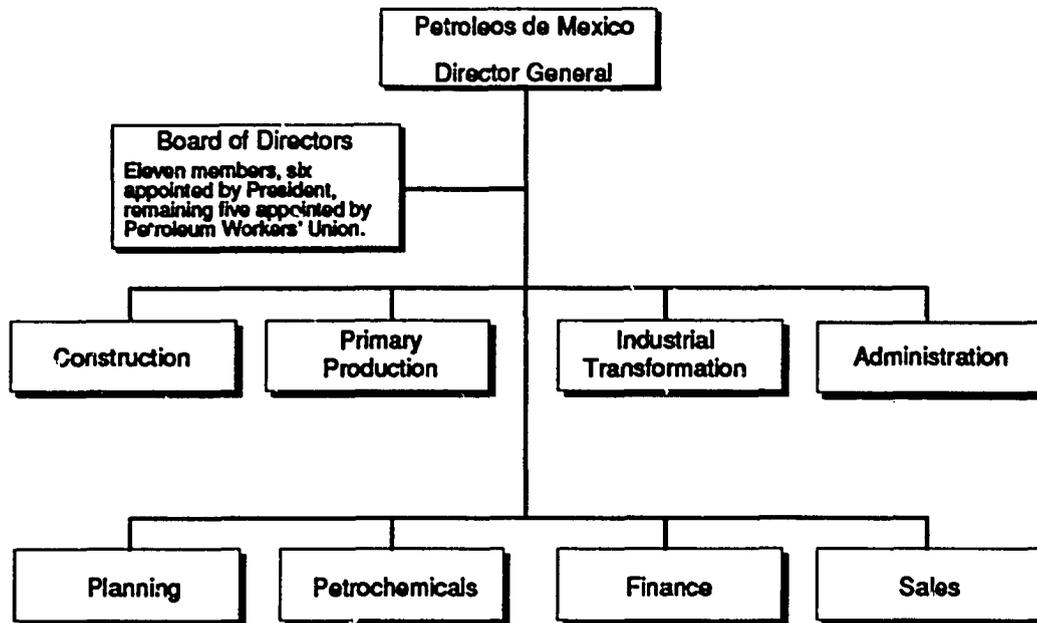
Another problem confronting Mexico is the question of know-how. Multi-national firms are increasingly reluctant to share their knowledge at any price. This gives technologically-advanced firms a bargaining advantage, which may prove instrumental in developing payment schemes that take into account the amount of oil found in a specific venture, thereby creating a de facto equity situation. Multinationals with the right technology also have more leverage to develop creative financing schemes, or to enter joint ventures and service contracts. Mexican experts indicate that PEMEX may be willing to redefine the limits of risk contracts by allowing for royalties based on discoveries.

An arrangement in which total compensation is based on the size of the find may prove inviting to both PEMEX and foreign oil companies. Foreign firms could assume risk and provide risk capital in exploration and production, which is important for cash-strapped Mexico. For foreign oil companies, the assumption of risk is acceptable if the total compensation reflects the size and value of a find. This sidesteps the issue of risk contracting or selling oil reserves because legal entitlement remains with PEMEX. Such a development, of course, would analytically be the same as "selling" oil reserves. But if it is done in a more disguised way than a risk contract, it may be politically acceptable. This development would be a natural evolution of changes already taking place within PEMEX.

In summary, PEMEX is structurally withdrawing from certain markets such as non-basic petrochemicals and is using more service contracts and joint ventures in its construction, industrial transformation, and petrochemical divisions (Figure 11). This move signals a growing emphasis on its core functions of oil exploration and production. It appears that the Salinas administration, which is unable to privatize PEMEX per se, is narrowing its mandate. This represents opportunities as PEMEX divests and withdraws from certain markets. By 1994, the PEMEX structure could likely change to reflect the contracting out of most construction projects, a further opening of the petrochemical markets, and increased joint ventures/service contracts for industrial transformation functions.

Figure 11

## PEMEX Organizational Diagram 1991



SOURCE: ICM, Inc.

### Government Investment

PEMEX is now emerging from a decade that saw its investment fall from nearly \$6 billion in 1981 to just over \$1 billion in 1990. This trend was reversed in 1991 when PEMEX director general Rojas announced investment goals totalling \$20 billion over the next five to six years. (Based on discussions with various officials and individuals familiar with the inner workings of PEMEX, these spending objectives are shown in Figure 12.)

The 1991 *Annual Petroleum Report* prepared by the U.S. Embassy in Mexico City states that in 1990, PEMEX revenues totalled \$23 billion, of which \$12 billion was paid to the government in taxes, \$2 billion was spent on investments, and \$9 billion was paid in interest. This includes a one-time windfall of about \$3 billion due to the Iraqi invasion halt. In 1989, by comparison, total revenues were \$15 billion, \$8 billion of which was paid in taxes, \$1 billion was spent on investments, and \$6 billion was paid in interest. PEMEX is unable to use its profits to finance its investments given the enormous amounts it pays in taxes.

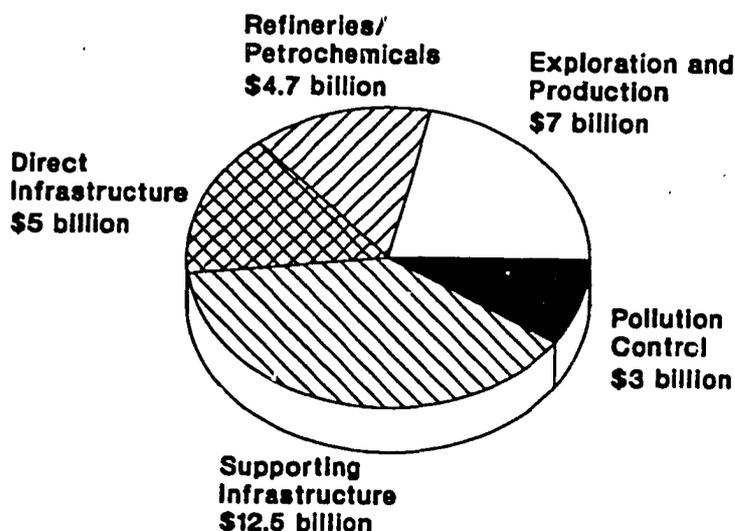
*A capital shortage is looming*

The PEMEX investment plan could prove inadequate. Sources outside the company believe Mexico will more realistically require an investment of \$30 billion. This investment schedule would consist of:

- Exploration and Production \$10 billion
- Refineries/Petrochemicals \$5 billion
- Direct Infrastructure \$6 billion

Figure 12

## PEMEX Investment Plan 1991 - 1994



SOURCE: ICM, Inc.

- Supporting Infrastructure (includes housing, roads) \$4 billion
- Integrity (includes pollution control, know-how) \$5 billion

*Major expansions in infrastructure investment are planned*

The last two items include projects to develop Mexican highways, port facilities, and other infrastructure, and environmental protection programs. These projects encompass an array of objectives necessary for Mexico to compete effectively once the NAFTA is implemented. Members of the U.S. Congress have raised the issue of border infrastructure and one scenario, voiced in the spring of 1991, envisions the U.S. Treasury backing bonds issued by the Mexican Government for a multi-billion dollar infrastructure program.

The question of funding also casts doubt on the investment plan. If PEMEX has not secured funding for its proposed \$20 billion investment goals, it is not clear from where it could raise the \$30 billion believed necessary to completely modernize the Mexican oil industry. To date, PEMEX has raised \$8 billion through Eurobond issues or loan guarantees from the U.S. ExIm Bank (it does not raise money in the U.S. capital markets; its role in the U.S. is largely limited to loans contracted on a government-to-government basis). Despite having raised substantial amounts of capital and credit, it has also announced expenditures that will use up these funds (e.g., \$1.6 billion for exploration in Campeche Sound, \$4.7 billion in a replacement refinery and expansion of existing refineries, \$2.5 billion in supporting infrastructure).

Because Mexco is so dependent on PEMEX for its federal budget, the company's ability to self-finance its investment requirements is difficult. The \$12 billion funding shortfall in the stated PEMEX investment goals is problematic and reveals that PEMEX is cash-starved. As a result, the government may be willing to engage in innovative financing schemes that will compensate for Mexican unwillingness to allow equity participation.

*PEMEX is around \$12 billion short of reaching its investment goals*

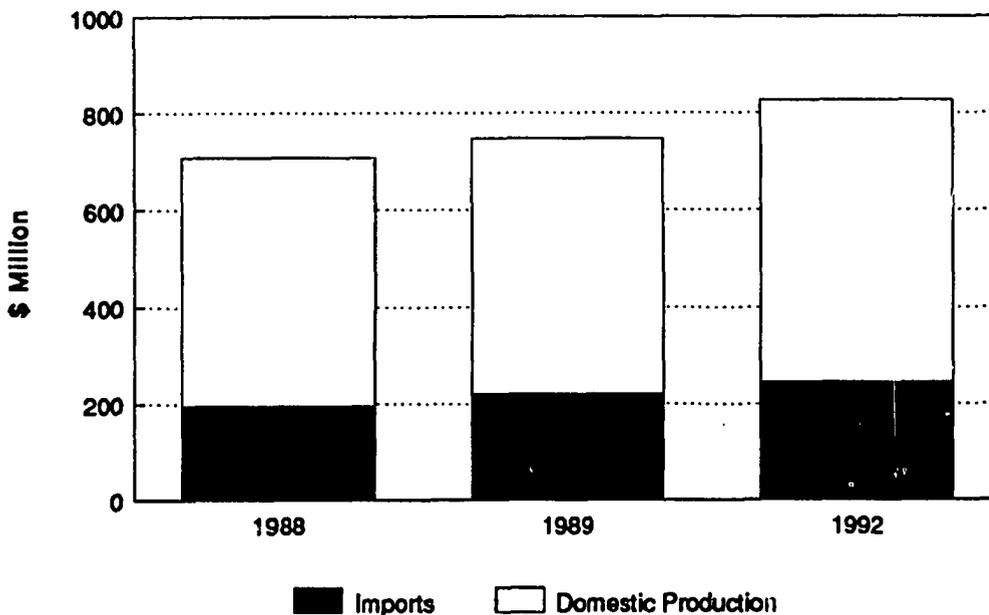
### Current Market Estimates

After a decade of austerity, PEMEX outlays are growing under its aggressive investment program. In the area of exploration, for example, \$6 billion will be spent over the next five years to find, develop and exploit oil reserves. An additional \$1.6 billion has been earmarked for exploration throughout Campeche Sound in 1992. In accordance with the terms of a loan from the U.S. Exim Bank, Mexico has agreed to use this money to issue service contracts and hire U.S. firms.

In addition to oil exploration, the Mexican market for oil and gas field equipment is growing at a healthy rate (Figure 13). The U.S. Department of Commerce's (DOC) *Industry Sector Analysis* predicts that this market will increase from \$636 million in 1988 to \$795 million in 1994. The prospects for U.S. companies in this market, who are already the dominant suppliers to PEMEX, are further brightened by the propensity of PEMEX to purchase U.S. goods. The DOC document states that U.S. sales of this equipment have increased from \$439 million in 1987 to \$491 million in 1989, representing a market share increase from 69% to 73% over this period (Figure 14). In 1992, the Mexican oil and gas equipment import market will be \$743 million, of which U.S. firms will supply 76%, for total sales of \$562 million. The remaining Mexican market share is divided among Japanese, German, Italian, Canadian and Spanish firms.

Figure 13

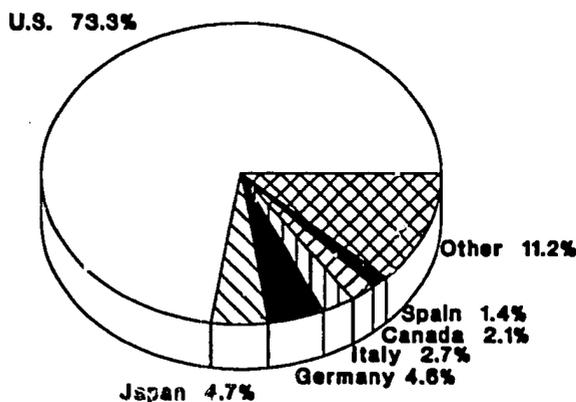
### Oil and Gas Field Equipment Market Growth in Mexico



SOURCE: U.S. Department of Commerce.

Figure 14

## Oil and Gas Field Equipment Import Market Share in Mexico 1989



SOURCE: U.S. Department of Commerce.

### Competition

*Japanese  
competition is  
limited*

**Japan.** The Japanese presence in Mexico represents less than 5% of the total foreign investment in Mexico. The most discomfoting experiences for the Japanese in Mexico have related to major financial losses and risks. Under the Brady debt-reduction plan, Japanese lenders lost \$4.3 billion, which represented about 60% of their Mexican portfolios. The Japanese have also complained about Mexico's lack of competitiveness due to its sub-standard infrastructure.

Mexican-Japanese relations could deteriorate further following the January 1992 unilateral decision by Japan to reduce its imports of Mexican oil. On December 12, 1991 *The Nihon Keizai Shimbun* reported that because of on-going disagreements between PEMEX and Japanese oil importers, Japan would reduce its Mexican oil imports from 150,000 per day to 100,000 per day.

Nonetheless, the Japanese are actively monitoring many investments and are poised to re-enter the market when it is opportune. It would not be prudent to count the Japanese out of the Mexican oil and gas sector.

*The  
European  
competition is  
substantial*

**Europe.** Mexico's ability to raise capital in Europe has been diminished given the developments in Eastern Europe and the former Soviet Union. In European capital markets, Mexico must now compete with an array of nations that urgently need foreign investment, making it more difficult to attract the money it needs to modernize its oil industry. In the near term, Mexico will concentrate on trade and investment development with three European countries: Spain, France and Italy. In particular, observers have stressed the growing importance of Spanish companies in Mexico's development; Mexico entered into a new series of agreements with the Spanish oil company, Respol.

Many of these and other developments point to a competitive advantage for the U.S. The major U.S. ExIm Bank line of credit to PEMEX will enable U.S. companies to increase their exports to Mexico. Adding to this, the level of U.S. involvement in Mexico's oil industry will reach unprecedented levels within the next 36 months as announced investment plans are put into action. Last, major opportunities will emerge as PEMEX further withdraws from its support functions -- infrastructure, housing, non-basic petrochemical markets -- and as increased service and joint venture programs are developed.

### **Major Project Opportunities**

**Refineries/Petrochemicals.** The Azcapotzalco refinery in Mexico City was shut down on March 18, 1991, and a budget of \$2.5 billion has been earmarked for its replacement (however, the new refinery's location has not been announced). A second refinery will be very much needed in the near term.

Between 1992 and 1994, Mexico is expected to import \$9 billion in petrochemicals. The U.S. Embassy in Mexico City estimates that Mexico needs to invest between \$5 and \$7 billion (a third of which should go for the purchase of imports) if it is to move towards self-sufficiency in petrochemicals.

**Oil Exploration.** During 1991-1994, \$880 million will be spent on the Cantarell Project alone. Because of loan guarantees negotiated between PEMEX and the U.S. ExIm Bank, outlays during the next five years could total \$6 billion. Also, \$1.6 billion has been budgeted for exploratory wells in the Gulf of Campeche and the Yucatan.

**Pipelines.** At present, Mexico has 37,000 miles of pipeline, which it wants to increase in order to reduce its dependence on truck transportation. A 164-mile long pipeline across the Isthmus of Tehuantepec (to bring oil from the Gulf of Mexico to the Salina Cruz refinery on the Pacific coast) was begun in 1987 with a \$500 million loan from Japan's Export-Import Bank. The desired expansion of the pipeline system throughout Mexico is believed to represent a \$750 million market during the next three years.

**Clean Fuels.** The air pollution crisis in the Valley of Mexico, industrial pollution from *maquiladora* industries along the U.S.-Mexico border, and oil industry pollution in and around PEMEX installations in Tampico and Coatzacoalcos are major environmental concerns. Mexico has been the beneficiary of foreign aid programs (most notably from Japan) earmarked to correct the air pollution problem. Some key PEMEX projects include:

- **Unleaded Gas.** In 1990, Mexico introduced "Magna Sin," an unleaded gas, to the Mexican market. Mexico is currently forced to import unleaded gasoline to meet domestic demand. PEMEX is now adapting its refineries to produce unleaded gas.
- **Low-Sulfur Fuel.** Expenditures totalling \$450 million have been earmarked for 1992 for the Salina Cruz, Tula Hidalgo, and Cadereyta refineries to reform naphtha and remove sulfur from fuel. Mexico contracted the U.S. firms of HRI, Texaco, and Foster Wheeler to provide it with the technology for parts of these projects.
- **Infrastructure.** It is expected that an increasing amount of secondary functions performed by PEMEX (mostly infrastructure) will be subcontracted to private concerns. Based on PEMEX projections, \$2.5 billion will be spent in 1992-1994 on basic infrastructure projects including roads, bridges, oil tankers, and worker housing. Of immediate concern are all supporting road and bridge work near PEMEX facilities, over 15,000 housing units scheduled to be built in the next 36 months, and Mexico's desire to increase its 35-tanker fleet to 40 by the end of the Salinas presidency in 1994. No budget is allocated for the purchase of the five tankers, but PEMEX is receptive to innovative financing plans from interested parties.

- **Retail Operations.** As recently as December 13, 1991, the subsecretary of energy, Jose Aburto, stated that allowing foreign firms to open gas stations in Mexico "is not on the negotiating table." Sources, however, indicate that once NAFTA is signed, foreign oil companies will face no legal barriers to establishing retail operations. Because PEMEX gas stations are concessions and because of the liberalization of investment laws, it is possible for a firm duly incorporated under the laws of Mexico to apply for a license to operate a PEMEX gas station. "The concern," Javier Barajas stated, "is that existing PEMEX gas stations won't be able to compete effectively." Dr. Barajas argued that the 3,000 gas stations in Mexico currently operate like franchises: they pay for the use of the PEMEX name and logo, buy exclusively from PEMEX, and are paid a royalty on what they sell. How these gas station owners would fare in direct competition with foreign gas stations is an issue for Mexican officials.

It is unclear whether foreign oil companies would be allowed to operate under their own names, or whether they would have to use the PEMEX name and logo. It is also unclear whether foreign oil companies would be allowed to import their own gasoline from U.S. facilities. Some legal experts indicated there are no legal obstacles once NAFTA is signed. Dr. Barajas stated that Mexico could easily double the number of gas stations by the end of the century and believes the retail sector market could be about \$750 million during the first 48 months following the signing of a NAFTA.

## 2.2 Electric Power Sector

Mexico's demand for electricity has been rising rapidly over the last several decades. Even during the 1980s when economic growth was slow, electricity demand grew by nearly 6% per year.

*Electricity demand is growing fast*

Today, with both its population and economy growing rapidly, Mexico faces a period of increased electricity demand. The national electric utility, the Comision Federal de Electricidad (CFE), estimates that demand is likely to grow at nearly 7% over the coming decade (Table 4). The World Bank, by contrast, projects electricity demand growth at 6.5% per year over this period. Both the World Bank and IDB expect that increased tariffs, loss reduction, and energy efficiency programs will somewhat restrain growth. Substantial growth rates are expected regardless.

**Table 4**

### Mexican Electric Energy Forecast (Thousands of GWh and MW)

Growth Scenario	1990		1995		2000		Growth Rate %
	GWh	MW	GWh	MW	GWh	MW	
High	---	---	185,900	28,700	236,800	40,500	7.8
Most Likely	111,800	19,133	158,400	27,400	218,500	37,400	6.9
Low	---	---	150,900	26,100	200,300	34,300	6.0

Note: MW figures refer to peak load forecast.

SOURCE: CFE, 1990.

Electricity pricing policies have also contributed to the fast growth in electricity demand. Since the late 1970s, CFE has, on average, been pricing power below cost. However, some sectors in some regions now pay realistic electricity prices; for example, some industrial customers pay 7 per kWh for peak power, giving them strong incentive to cogenerate their own electricity (Table 5).

**Table 5**

### Industrial Electricity Rates in Mexico

CFE Region	Demand Charge Cents/kW	Peak Rate Cents/kWh	Base Rate Cents/kWh
Baja California (summer)	0.82	6.84	4.27
Baja California (winter)	0.78	6.51	4.07
Southern Baja California	0.82	6.84	4.27
Central	0.80	6.71	4.19
Northeast	0.78	6.51	4.07
Northwest (summer)	0.82	6.84	4.27
Northwest (winter)	0.78	6.51	4.07
North	0.80	6.71	4.19
Peninsula	0.82	6.84	4.27
South	0.78	6.51	4.07

Note: Rates are for medium voltages with minimum demand of 1,000 kW.

SOURCE: *El Universal*, Nov. 10, 1991, pg. 18.

Under pressure from multilateral creditors, CFE is increasing its prices in real terms, and the 17% average subsidy in 1990 is diminishing. But continued strong growth in demand is expected regardless of price reforms.

Rates of growth in demand vary considerably by sector. In 1989-90, industrial demand grew most quickly, at 8.8%. This sector represents over half (56.5%) of all electricity demand in the country. Residential demand, which grew at an average annual rate of 10% in the 1980s, slowed somewhat to 8.3% in 1989-90. This sector is the second-largest consumer of electricity in the country (22.3%). The commercial sector, representing 9% of demand in 1990, grew 6.2% in 1989-90. Agriculture, consuming 7.3% of the country's electricity reserves in 1990, declined 7.1% in this period. Historically, this sector has consumed increasing amounts of energy, more than doubling between 1980 and 1990.

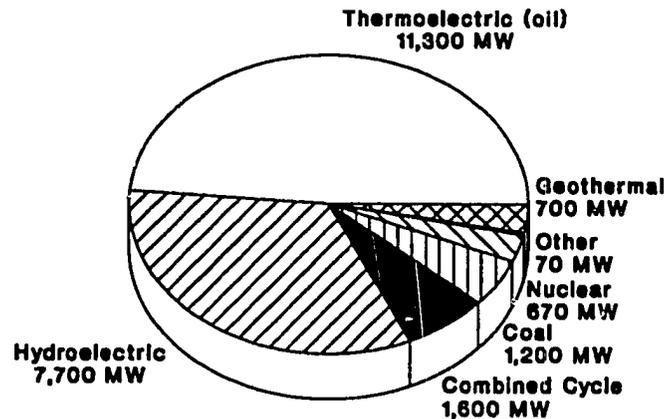
*Industry consumes 56.5% of the nation's electricity*

Mexico had an estimated 25,298 MW of installed capacity in 1990, supplying the nation with 111,800 GWh of electricity. The largest share of this capacity is oil fired (44% of capacity or generation); hydroelectric power plants also play a major role (30%), while natural gas plants only a minor role (7%) (Figure 15).

In addition to "firm" CFE capacity, Mexico has power resources in the form of industrial cogeneration. Installed industrial cogeneration capacity reached nearly 3,000 MW by the end of 1990 (Table 6), with all of this capacity being for captive use only. Petrochemical, oil, steel, sugar, chemicals, and pulp and paper are the principal industries engaged in cogeneration. It is estimated that the total cogeneration capacity will expand, at a minimum, to about 4,000 MW by the year 2000 (some estimates run as high as 10,500 MW).

Figure 15

## CFE Installed Capacity 1990



SOURCE: CFE.

*Industrial cogeneration holds significant potential*

Considering that the industrial sector consumes over half of CFE's electricity output, there is significant potential for expanded industrial cogeneration. Comisión Nacional Para el Ahorro de Energía (CONAE), a department of SEMIP, is conducting a study of the potential for cogeneration in Mexico, which should be completed in 1992. This study will lead to project feasibility assessments and could provide a major boost to industrial cogeneration activities in the country.

Table 6

### Installed Industrial Generation Capacity (Watts) December 1990

	Total	%	Hydro	Steam	Int. Combust.	Gas
Oil	1,554,820	52.4	-	836,445	30,021	688,354
Steel	373,975	12.6	-	220,100	-	153,875
Paper	259,868	8.8	7,268	214,100	-	38,500
Sugar	180,966	6.1	1,593	177,237	2,136	-
Ind. Group	151,500	5.1	-	109,700	-	41,800
Chemicals	147,120	5.0	-	143,920	-	3,200
Textile	111,440	3.7	31,295	79,370	774	-
Minerals	78,156	2.6	5,908	25,800	46,448	-
Others	66,828	2.2	23,526	13,193	30,009	100
Beer	43,657	1.5	6,140	34,900	1,617	800
<b>Total</b>	<b>2,968,330</b>	<b>100</b>	<b>75,731</b>	<b>1,854,765</b>	<b>111,205</b>	<b>926,629</b>

SOURCE: IMENOR S.A., 1991.

Cogeneration opportunities are dependent on economic growth to a much greater extent than in central station expansion. Should the Mexican economy stall, these opportunities will dry up quickly. Figure 16 shows the most promising states and sites for industrial cogeneration development in the 1990s. The petrochemical, chemical, and tourism industries are all good candidates for cogenerating power.

Mexico must not only expand its power supply to meet growth in demand, but also retrofit some of its existing aged power plants. Nearly 17% of existing power plants are more than 30 years old, 16% are between 20 and 30 years old, and nearly 43% are between 10 and 20 years old.

**Figure 16**

### Major Areas for Cogeneration Development



### Current Investment Plans in Power Generation

CFE has ambitious plans to bring on 19,513 MW of additional capacity between 1989 and 1999, representing a 77% increase over 1990 levels. With a capacity reserve of less than 6%, CFE is under much pressure to expand both its capacity and reserve margins. Most of the projected expansion plan budget of over \$34 billion will be spent on power plants (over 51% of the funds); significant amounts will also be spent on transmission (over 16%) and distribution (over 15%), while less will be devoted to conservation (under 8%). All expenditures are governed by the Electric Sector Works and Investment Plan (POISE), the government's 10-year master plan for the electricity sector. Tables 7 and 8 show CFE's expansion and investment plan between 1989 and 1999. Table 7 shows the continued reliance on hydropower and increasing reliance on coal. Investment in geothermal power is low but steady, and nuclear acquisition is limited.

*Over \$34 billion is budgeted for expansion in the 1990s*

**Table 7****CFE Electric Power Expansion Plan (MW)**

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Oil & Gas	508	0	1,583	118	0	1,020	320	38	0	0	38
Hydroelectric	0	0	350	0	640	600	88	200	0	609	160
Coal	0	0	0	700	0	0	700	0	0	700	0
Dual oil/coal	0	0	0	350	700	700	350	1,400	3,050	350	2,600
Geothermal	0	5	20	25	20	60	40	40	40	40	40
Nuclear	0	675	0	0	0	0	675	0	0	0	0
<b>Total</b>	<b>508</b>	<b>680</b>	<b>1,953</b>	<b>1,193</b>	<b>1,360</b>	<b>2,380</b>	<b>2,173</b>	<b>1,678</b>	<b>3,090</b>	<b>1,699</b>	<b>2,838</b>

SOURCE: CFE, 1991.

**Table 8****CFE Electric Power Investment Plan  
(U.S. \$ million)**

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Generation	725	926	1,598	2,089	1,000	2,077	2,175	2,124	2,486	2,618	2,774
Transmission	326	304	452	443	438	426	460	509	504	474	775
Distribution	281	441	594	582	440	355	413	471	533	603	483
Conservation	197	176	290	206	206	186	195	221	254	289	329
General	63	75	77	53	36	29	30	31	32	33	34
<b>Total</b>	<b>1,592</b>	<b>1,922</b>	<b>3,011</b>	<b>3,373</b>	<b>2,120</b>	<b>3,073</b>	<b>3,273</b>	<b>3,356</b>	<b>3,809</b>	<b>4,017</b>	<b>4,395</b>

SOURCE: CFE, 1991.

What these tables do not show is CFE's strategy to diversify away from conventional thermal systems, which are slated to drop from 52% of capacity in 1990 to 41% in 1999. The acquisition of oil-fired systems with fuel flexibility (either oil- or coal-fired) is a key trend (Table 9).

CFE continues to exploit renewable energy resources for large-scale applications. Clearly, hydroelectric power is the most important of these, with expansion plans calling for an additional 2,667 MW of new capacity between 1989 and 1999. (European firms are particularly competitive in this area.) A limited number of mini-hydro sites could also be developed in the near term, probably with significant private-sector participation.

Geothermal, another renewable energy resource, has been substantially exploited in Mexico, with 705 MW already installed and 330 MW of additional capacity planned by 1999. (Mexican, in addition to European firms, are very competitive in this market segment.) The resource potential for wind farms appears to be good in Mexico, and CFE is now examining this option as a possible medium-term generation option. (The U.S. and Europeans are competitive in wind technology.) Although Mexico appears to have resources suitable for the development of central station solar thermal power plants, CFE's interest at present is limited to becoming more familiar with U.S. RD&D efforts in this area.

**Table 9**

**Existing and Projected Resource Mix (MW)**

Type	1990	%	1994	%	1999	%
Convent. Thermal	13,156	52.0	17,694	53.6	18,081	41.2
Hydro	7,805	30.9	8,859	26.8	10,900	24.8
Dual (Oil/Coal)	1,687	6.7	1,687	5.1	9,250	21.1
Coal	1,200	4.7	2,600	7.9	3,300	7.5
Geothermal	705	2.8	830	2.5	1,030	2.3
Nuclear	675	2.7	1,350	4.1	1,350	3.1
Total	25,228	100.0	33,020	100.0	43,911	100.0

SOURCE: CFE, 1990.

A portion of CFE's investments in the 1990s is devoted to financing several specific initiatives, some of which will require significant levels of hardware acquisition. The first is the retrofit and modernization of existing plants (179 MW of capacity were upgraded in 1990 alone). The utility is also investing in upgrading the interconnection between regional systems to improve overall system reliability. A number of efficiency measures are also being implemented at power plants and along the transmission network.

CFE cannot finance all these plans by itself. Indeed, only about half the funds for system expansion, and upgrade and efficiency measures will come directly from the national utility. Multilateral banks are expected to lend CFE fully one quarter of the needed funds. The remaining 25% must be financed by the private sector, presenting a significant market opening for private power developers and cogenerators.

*One quarter of electric sector investments must come from the private sector*

**Other Planned Investments in the Energy Sector**

There are at least two important, newly emerging areas of energy sector investment/planning in Mexico: energy conservation and small-scale, off-grid renewable energy systems.

Several major activities are taking place in the field of energy conservation. The Comision Federal para el Ahorro de Energia (CONAE), a new agency under SEMIP, is identifying opportunities for reducing Mexico's growth in energy demand. This agency is taking initial

*Mexico invests in energy conservation and renewables*

steps to promote cogeneration and industrial- and transportation-sector efficiency. Within CFE, an energy conservation program called Programa para el Ahorro de Energia en el Sector Energetico (PAESE) is responsible for implementing energy conservation programs in the electric power sector. CFE has also allocated substantial sums of money for system-wide energy efficiency improvements. According to projected budget expenditures, CFE will be spending \$2,549 million on system-wide energy efficiency improvements over the period 1989 to 1999. In addition to these efforts, USAID is providing technical assistance to Mexico in designing demand-side management (DSM) programs. Under a cooperative agreement, priority DSM end-use energy efficiency measures will be identified and a program design and evaluation process developed.

These conservation efforts could lead to more cogeneration in Mexico's energy mix than current CFE forecasts would suggest. New lighting, building envelope, electrotechnology evaluation, power quality and conditioning, and other programs could lead to significant business opportunities. Although multilateral lenders are confident that DSM measures will significantly affect demand growth, these measures will not obviate the need for additional new capacity.

Small-scale renewable energy systems are also playing a more important role in Mexico. The government has included small-scale off-grid renewable energy services as a key component of its Programa Nacional de Solidaridad (PRONASOL), a poverty alleviation and rural development program. This program is directly managed by the Secretaria de Programacion y Presupuesto (SPP), perhaps the most powerful executive agency in the country, with input from CFE. Preliminary figures show that the government will be making a significant investment in the rural electrification program under PRONASOL: \$33 million in 1992, \$83 million in 1993, and \$145 million in 1994. These funds will primarily be used to deploy small-scale wind, solar photovoltaic, and micro-hydro systems in rural villages throughout Mexico. Mexico is implementing this program with technical assistance from selected U.S. industry associations, the U.S. Department of Energy and U.S. AID. This technical assistance effort, called the Programa de Cooperacion en Energia Renovable (PROCER), is intended to help ensure that projects are properly designed and configured for local applications. Projects under PRONASOL, with support from PROCER, will greatly accelerate an already expanding market in Mexico for small-scale, off-grid renewable energy systems.

### **Private Power Policy and Legal Framework**

The Mexican constitution prohibits private power generation for the grid, a right reserved exclusively for CFE. However, the need to keep up with growing demand, combined with insufficient financial resources, has led to three important market openings for private power developers and/or users.

*A major role for the private sector is envisioned*

The first is the government's willingness to buy back excess power produced by individual industrial cogenerators, and at increasingly favorable prices. Under pressure from multilateral creditors, CFE is better reflecting its generation costs in the prices it charges customers; in turn, it is now willing to buy excess power from captive power generators/cogenerators at the same price it charges its industrial customers. As CFE raises its prices to customers, independent generators will also receive higher prices from CFE for excess power sold to the grid. However, the sale of excess power to the grid continues to require private sector initiative: CFE is not actively shopping for this type of capacity.

*Captive power receives strong government support*

The second opening is the recent government endorsement of industrial park cogeneration. While cogeneration has always been authorized, it was not adequately encouraged due to legal limitations on the sale of excess electricity. In May 1991, the government issued the Electric Energy Public Service Law Regarding Captive Power Generation to establish clear government support for this type of private power development. The legislation emphasizes the need to avoid the constraints of electric power shortages on economic growth by relying on captive private power schemes as an important supplement to central station expansion.

sion. The schemes in question essentially represent mini-utilities servicing a family of industrial customers. Key articles include:

- Articles 7 and 8. These articles approve the formation of "mini-utilities" to satisfy the electricity demand of a set of local users (such as an industrial park).
- Articles 10 and 11. These articles establish the principle of and framework for selling excess capacity back to the grid.

CFE has actively promoted a third opening to private power development, which involves the application of the build, lease, transfer (BLT) mechanism. This kind of project development simply requires private investors to finance a power plant with the understanding, *a priori*, that it will be leased to CFE until the developers have recovered their investment. BLT plants must be operated by CFE.

*BLTs: an option for private investors*

Table 10 shows the existing BLT projects under construction or negotiation in Mexico. These plants are being developed by such multinational companies as Mitsubishi, Alstom, ABB and Foster Wheeler, usually together with a Mexican partner.

It is estimated that 6,000 MW of capacity will be financed under BLTs over the remainder of the decade. On average, the private contribution represents about 60% of the total plant cost, with the remainder provided by CFE. The duration of the lease contract is typically 8 to 19 years, with the plant then being sold to CFE at its salvage value.

In addition to these eight BLT projects, private investors are participating in substation and transmission line investments with 100% private investment. Once the construction has been completed, CFE will be in charge of facility operation and will pay a users fee to a specially established trust fund for a predetermined number of years.

**Table 10**

### Privately Financed CFE Projects Under Development

	Fuel Source	Capacity (MW)
<b>Under Construction</b>		
C.T. Petacalo U3, U4, U5, U6	Coal and Oil	1,400
C.T. A. Lopez Mateos U1, U2	Oil	700
C.T. Topolobampo II U1, U2	Oil	241
Carbon II U3, U4	Coal and Oil	700
<b>Under Negotiation</b>		
Merida III U3	Oil	160
Dos Bocas Tab. U1, U2	Coal and Oil	700
Ensenada U1, U2	Coal and Oil	700
Samalayuca II U1, U2	Coal and Oil	700

SOURCE: IMENOR S.A., 1992.

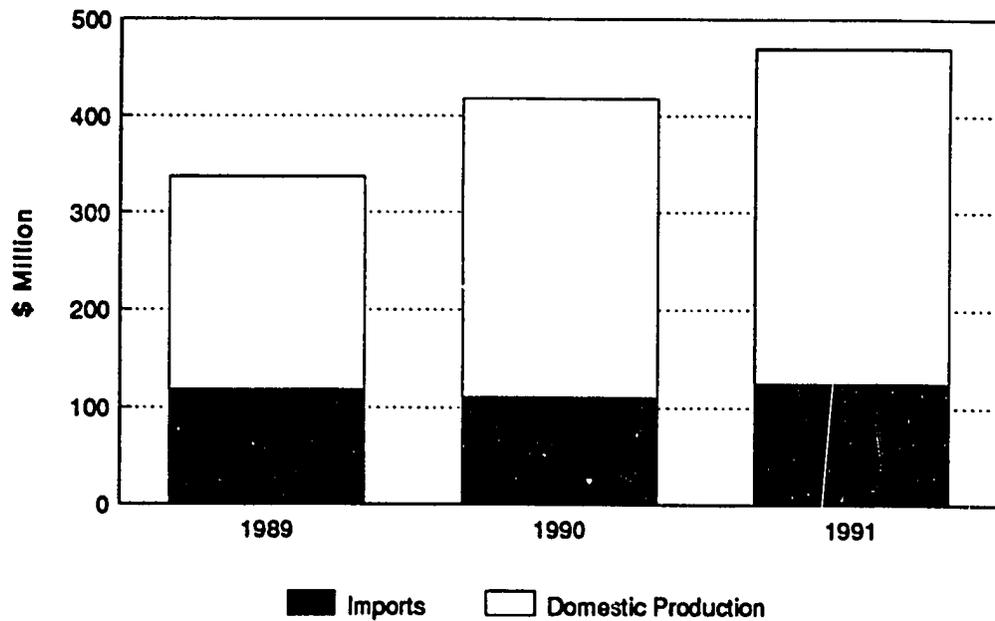
### Current Market Estimates

The U.S. Commerce Department (DOC) estimates Mexico's total market for electric power generating equipment at over \$418 million in 1990 and \$470 million in 1991 (Figure 17). This market will likely grow at an average annual rate of 9.5% over the 1992 to 1994 period.

*A \$1/2 billion power market is projected*

Figure 17

### Electric Power Generation Systems Market Growth in Mexico



SOURCE: U.S. Department of Commerce.

Growth in imports to supply this subsector will not be as brisk as overall market growth. Local production of major power generating equipment began decades ago and is highly sophisticated. Mexican companies (including foreign subsidiaries based in Mexico) satisfy approximately 73% of this market's needs, a figure that is expected to reach 75% by 1994. The import market, 27% of the total or \$125 million in 1991, is expected to grow at 7.2% over the next three years (see Table 11).

*The U.S. is strong, but faces stiff competition*

U.S. firms retain a dominant position in imported power equipment sales, with 74% of the market in 1990 (Figure 18). The U.S. share has shown considerable variation over time depending, in part, on CFE's schedule for procuring large power plant components. However, U.S. competitiveness in large component market segments has lagged in recent years. The Japanese and Europeans, for example, have been particularly strong in supplying large turbines, generators, and high-capacity transformers to Mexico. European firms have been very competitive in the Mexican hydroelectric power equipment market. According to the DOC, U.S. firms will have to provide attractive financing or leasing arrangements to continue to compete effectively with German and Japanese suppliers. When the North American Free Trade Agreement is signed, U.S. power equipment exporters will enjoy a needed competitive edge.

All foreign firms in Mexico work in a relatively transparent market where international tenders are evaluated on their merits. But these tenders represent market opportunities that domestic industry would not or could not pursue. All things being equal, CFE has an informal policy of procuring equipment locally, and foreign firms winning project development contracts in the future may be required to purchase some of their supplies and services in Mexico.

**Table 11**

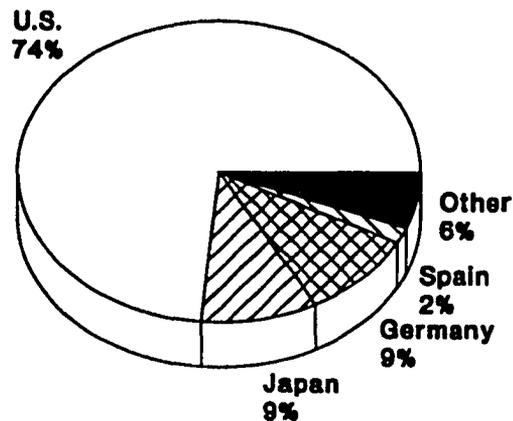
**Mexican Market for Electric Power  
Generation Systems (US\$ million)**

	1989	1990	1991 (est.)	Est. Avg. Annual Real Growth, 1992-1995 (%)
Import Market	118.5	110.3	125.0	7.2%
Local Production	218.3	307.9	345.0	
Exports	0.0	0.0	0.0	
Total Market	336.8	418.2	470.0	9.5%
Imports from U.S.	19.9	92.5	105.0	7.2%
Exchange Rates	2,684	2,899	3,106	

SOURCE: Department of Commerce, 1991.

**Figure 18**

**Electric Power Generation Systems  
Import Market Share in Mexico  
1990**



SOURCE: Imenor.

## Major Market Opportunities

A number of large-scale market opportunities exist in Mexico for U.S. exporters and power plant developers, according to U.S. DOC and Mexican sources. These include:

**Hydroelectric.** Two opportunities exist in the 1994-95 time frame. Various other hydroelectric facilities are scheduled to be completed toward the end of the decade.

- *Aguamilpa.* This plant will be located in the state of Nayarit, and will consist of three 320 MW units with average annual generation of 2,100 GWh. The first unit is scheduled to be completed in November 1994, the second in March 1995, and the third in June 1995.
- *Zimapan.* This facility, to be built in the state of Hidalgo, will have two units of 140 MW each and a projected annual generation of 1,297 GWh. The first unit is expected to begin operations in December 1994 and the second in February 1995.

**Dual Oil/Coal.** Several dual plants are scheduled for 1994-1995.

- *Merida II.* This 84 MW facility will be located on the Yucatan Peninsula and is scheduled to be completed in March 1994. (Note: Merida III, a 160 MW facility to be developed as a BLT, is under negotiation with private investors.)
- *Maritaro.* This small plant will produce 37.5 MW of power beginning in April 1994.
- *Lazaro Cardenas.* This 350 MW dual-fired facility will be completed in July 1994.
- *Puerto Libertad II.* This power plant will produce 350 MW beginning in September 1994.
- *Punta Prieta II.* This plant is expected to produce 37.5 MW beginning in October 1994.
- *COLMI.* A 550 MW unit is scheduled for completion in July 1995.
- *El Chico.* A 55 MW unit is scheduled to begin operation in February 1995.
- *Ensenada.* This 160 MW unit is expected to begin operation in December 1995. (Note: some of the plants to be developed at Ensenada will be leased under BLT arrangements.)

**Coal.** In an effort to free oil resources for export, The Department of Energy, Mines and Parastatal Industry (SEMIP) is considering the construction of ten additional coal-fired plants. In the medium term, the following plant is scheduled for completion:

- *Carbon II.* This 100 MW plant is scheduled for completion in July 1994.

**Gas.** CFE has plans to complete two gas-fired plants in 1994-1995.

- *Chetumal.* This small 30 MW gas-turbine plant should be completed by February 1994.
- *Playa del Carmen.* CFE plans to complete this 30 MW project for this resort town by February 1995.

**Geothermal.** Most of CFE's planned geothermal plants are under construction. Two more are scheduled for completion late in the decade.

- *Los Azufres II.* This 55 MW geothermal facility should be completed by January 1997.
- *Himeros II.* Another 55 MW unit, this plant is scheduled to begin service in April 1997.

**Cogeneration.** Numerous industrial park cogeneration opportunities may arise in the near term. The energy-intensive chemical/petrochemical industry is a prime candidate, as are some tourist resorts. Cogeneration in the petrochemical industry could take off if the government privatizes some major PEMEX facilities, as it is expected to do. Figure 16 showed the most probable locations for industrial park cogeneration projects. Estimates for the potential market in all the most promising sites and states (except for Cancun) total about 1,640 MW (Table 12).

**Build, Lease, Transfer.** The CFE periodically announces tenders for BLT projects. Some of the projects currently under construction or negotiation were listed in Table 10.

**Table 12**

**Near-Term Cogeneration Market \***

Region	Industry	Size (MW)	Number	Averaged Estimate (MW)
MINATITLAN Y COATZACOALCOS	Chemical and Petrochemical	100 - 200	4	800
ALTAMIRA	Chemical and Petrochemical	100 - 200	3	450
JALISCO	Assembly and Manufacturing	40 - 80	3	180
NUEVO LEON	Assembly and Manufacturing	40 - 80	4	240
GUANAJUATO	Agroindustry and Manufacturing	20 - 40	3	90
ESTADO DE MEXICO	Manufacturing	20 - 40	6	180
				1640

\* Assumes continued economic growth in 5% range.  
SOURCE: IMENOR S.A., 1992.

**2.3 Industrial Air Pollution Control Sector**

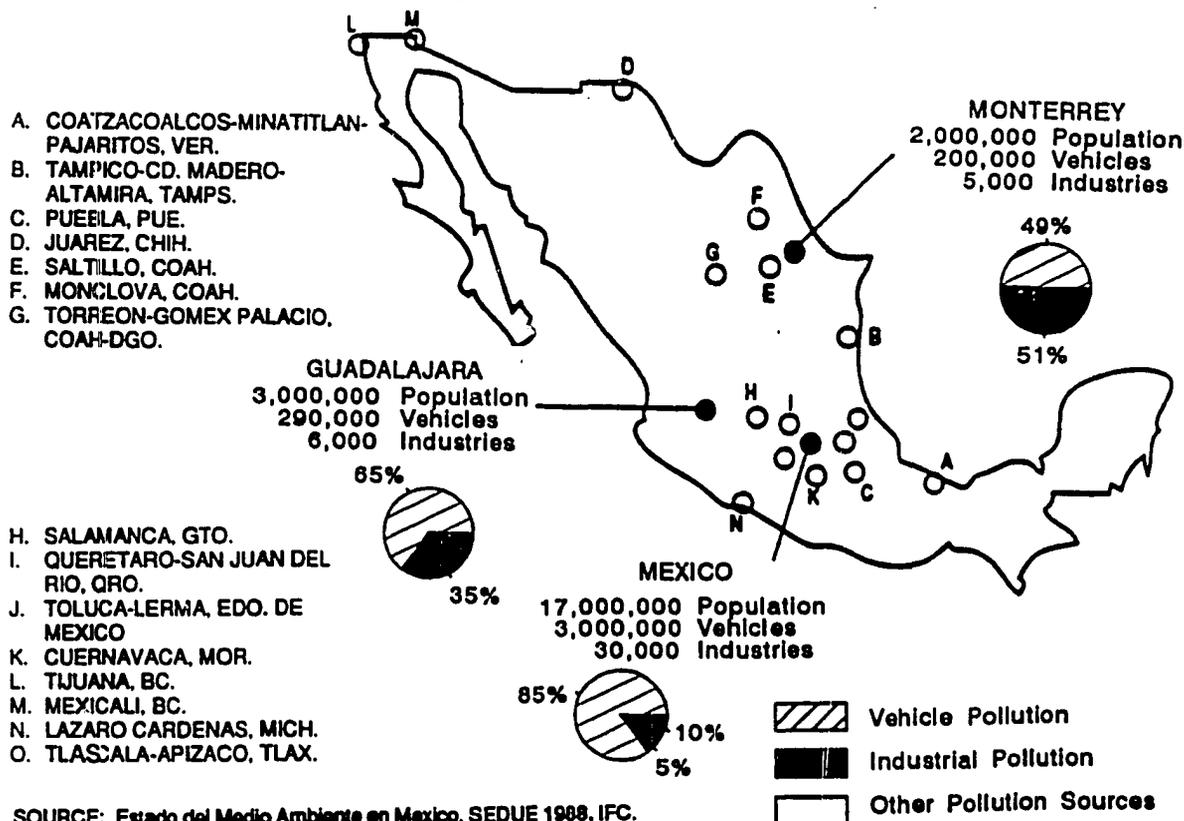
Mexico's air pollution problem has become a key issue in the country's economic development, domestic politics, and international reputation. The focus of attention has been on a limited number of critical pollution zones at major urban and industrial centers (Figure 19). The Mexican Government estimates that 40% of the country's air pollution is generated by the three major cities of Mexico City, Monterrey and Guadalajara. The transport sector accounts for about 85% of the air pollution in Mexico City, and about 65% and 49% in Monterrey and Guadalajara, respectively. The industrial sector accounts for a larger fraction of air pollution in the latter two cities because of their higher ratio of industrial to automobile emissions.

*Air pollution predominates in three urban areas and key industrial complexes*

The U.S./Mexico border region is another major source of air pollution, with the two largest cities of San Diego/Tijuana and El Paso/Juarez reaching crisis levels. Levels of criteria

Figure 19

## Areas of Significant Air Pollution in Mexico



pollutants (ozone, particulate matter (PM), NO<sub>2</sub>, SO<sub>2</sub>, and lead) are currently being measured at various border cities as part of a joint pilot monitoring program. The border communities that currently do not meet one or more of the U.S. National Ambient Quality Standards (NAAQS) are San Diego (ozone, CO), Imperial County, California (P El Paso County, Texas (ozone, CO, PM), Yuma, Pima, Santa Cruz, and Cochise counties in Arizona (PM), and Dona Ana County, New Mexico (PM). Visibility monitoring stations along the border in Arizona and New Mexico are also reporting a decline in visibility in certain U.S. national parks.

In addition to the three major cities and the border region, the industrial corridors along the Gulf of Mexico and those connecting the cities of Tula, Vito, and Apasco emit large quantities of air pollutants.

*Mexico City's air quality is among the worst in the world*

About 23% of the country's population of 82.7 million is concentrated in the metropolitan area of Mexico City, which presents the nation's most daunting air pollution problem. Geographic characteristics, such as its 7,500 foot altitude and volcanic basin location, exacerbate the city's air problems. The high altitude causes less efficient combustion of fossil fuels and the surrounding mountains trap the air in the Mexico City basin for extended periods. It is estimated that 85% of the air pollution in Mexico City comes from transport vehicles (on a per ton basis, taking into account SO<sub>2</sub>, NO<sub>x</sub>, HC, CO, etc.), whereas only 4.0% comes from fuel and electricity production, and 3.6% from industrial activities. The impact of fixed versus mobile sources on specific criteria pollutant levels varies substantially, however. Of the 243,290 tons of sulfur dioxide emitted in Mexico City during 1987, 97% came from fixed sources (i.e., power and industrial). Fixed sources also accounted for about 38% of the 179,324 tons of nitrous oxide emitted. In contrast, 98% of the 3,626,427 tons of carbon monoxide emitted came from mobile sources (i.e., automobiles).

The growing severity of Mexico City's air pollution problem has focused the population's attention on the daily air quality index (Indice Metropolitano de la Calidad del Aire, or IMECA). This composite index exceeded the danger level of 100 for at least one key air pollutant for all but 11 days during 1991; this level represented a 5% increase over 1990 and an approximate 20% increase over the air pollution during 1986. Ozone levels are of particular concern, exceeding international norms for a few hours of some 344 days during 1991. The IMECA reaches emergency levels continuously during the winter season, when thermal inversions trap toxic fumes under a blanket of cool air for long periods of time.

In addition, air pollutant-induced respiratory problems are receiving growing public attention, especially as they affect young children disproportionately. Plans are currently being proposed to shift school hours in order to minimize the children's exposure to air pollution generated during high traffic periods. Furthermore, wealthier families are increasingly moving out of Mexico City to neighboring towns such as San Luis Potosi and Cuernavaca. Another manifestation of the severity of the problem in Mexico City is the difficulty it is experiencing in attracting highly qualified foreign and domestic professionals to live there.

*Crisis air pollution levels have adverse social impacts*

### **The Government's Air Pollution Control Strategy**

Figure 20 presents a summary comparison between U.S. and Mexican air pollution regulations, implementation mechanisms, and monitoring systems. While SEDUE's regulations are often modeled after U.S. clean air laws, much remains to be done in the area of monitoring and enforcement.

The air pollutants that receive the greatest attention in Mexico are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulates, lead, volatile organic compounds (VOC), and partially-combusted hydrocarbons. As in the U.S., the Mexican Government targets for priority attention the major sources and centers of air pollution. Invariably, the emphasis is on reducing automobile emissions in the major cities; there is a regulatory regime, separate from the National Air Pollution Regulation, developed expressly for Mexico City. This regulation covers traffic patterns, motor vehicle emissions, and inspections in the greater metropolitan area. Elsewhere in the country, air pollution from power plants, oil refineries, and industrial facilities is monitored in regions where air pollution levels have become critical.

*Emergency response measures are being implemented in Mexico City*

Adequate enforcement of Mexico's air pollution regulations will require strengthening the national monitoring system. While the U.S. has a national air pollution monitoring network that measures criteria pollutants at many locations in all 50 states, most of the monitoring stations in Mexico are concentrated in Mexico City, with few installations in other parts of the country (Table 13). Most of the air monitoring stations in Mexico require manual operation; as of 1988, the only automatic stations were located in Mexico City, and new systems were set up in only a few border cities.

In Mexico City, the flagship monitoring network (called RAMA) consists of 25 automatic stations measuring seven pollutants (HCNM, O<sub>3</sub>, NO<sub>x</sub>, NO<sub>2</sub>, CO, H<sub>2</sub>S, SO<sub>2</sub>) and four meteorological parameters (wind speed and direction, humidity, and temperature).

In the U.S., the monitoring network is operated by state and local governments, and private companies are required to self-monitor their emissions. In contrast, the Mexican system managed by SEDUE at the federal level, with few if any companies presently measuring their own pollution output. Recognizing the urgent need to expand and upgrade its monitoring network, SEDUE plans to use the pending World Bank loan to establish automatic networks in some 20 cities, covering about 60% of Mexico's population. Industries are increasingly being pressured to install their own air pollution monitoring equipment.

**Figure 20**  
**Comparison of Air Pollution Regulation**  
**in the U.S. and Mexico**

	US	MEXICO
<b>NATIONAL LAW</b>	<p><b>1990 Clean Air Act</b></p> <ul style="list-style-type: none"> <li>• sets national ambient air quality standards (NAAQS) for criteria pollutants (O<sub>3</sub>, SO<sub>2</sub>, PM<sub>10</sub>, CO, NO<sub>x</sub>, Pb)</li> <li>• requires EPA to set technology-based controls for toxic air pollutants</li> </ul>	<p><b>1988 General Ecology Law</b></p> <ul style="list-style-type: none"> <li>• sets maximum permissible levels (MPLs) for O<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub> &amp; TSP (Pb and PM<sub>10</sub> to be covered)</li> <li>• requires prior authorization for air toxics emissions, but does not establish specific limits</li> </ul>
<b>IMPLEMENTING MECHANISM</b>	<p><b>State Implementation Plan</b></p> <ul style="list-style-type: none"> <li>• combines state &amp; local air quality planning to ensure NAAQS attainment</li> <li>• periodically reviewed and approved by EPA</li> </ul>	<p><b>National Air Pollution Regulation</b></p> <ul style="list-style-type: none"> <li>• sets technical ecological standards (NTEs) that limit emissions from stationary &amp; mobile sources</li> </ul> <p><b>Mexico City Air Pollution Regulation</b></p> <ul style="list-style-type: none"> <li>• covers traffic, motor vehicle emissions &amp; inspections in Mexico City</li> </ul>
<b>MONITORING</b>	<p><b>Extensive National &amp; Local System</b></p> <ul style="list-style-type: none"> <li>• National Air Monitoring System</li> <li>• State and Local Air Monitoring System</li> <li>• Toxics Air Monitoring System</li> </ul>	<p><b>National Network Not Fully Developed</b></p> <ul style="list-style-type: none"> <li>• few air quality monitoring stations outside Mexico City</li> <li>• SEDUE plans to establish networks in 20 cities</li> <li>• no toxics monitoring</li> </ul>
<b>KEY DIFFERENCES</b>	<ul style="list-style-type: none"> <li>• US states are responsible for ensuring NAAQs attainment with federal oversight; Mexico relies on source permitting program in which states have authority to regulate most types of sources without federal oversight.</li> <li>• 95% of EPA's administrative and civil judicial actions concluded as negotiated settlements; process of negotiating voluntary compliance agreements with SEDUE not clearly defined or adequately funded.</li> </ul>	

SOURCE: U.S. Environmental Protection Agency, 1991.

**Table 13****Mexico's National Air Monitoring System**

Location	State	Type of System
Reforma y Estacion Juarez	Chiapas	Manual
Huimantla-Cardenas-Macuspana	Tabasco	Manual
Coatzacoalcos-Minatitlan	Veracruz	Manual
D.F.-Zona Metropolitana de la Cd. de Mexico	Distrito Federal and Mexico State	Manual, Automatic and Meteorological
Toluca	Mexico State	Manual
Guadalajara	Jalisco	Manual
Saltillo	Coahuila	Manual
Torreón-Monclova	Coahuila	Manual
Chihuahua-Ciudad Juarez	Chihuahua	Manual and Automatic
Monterrey	Nuevo Leon	Manual
Tijuana	Baja California	Manual
San Luis Potosi	San Luis Potosi	Manual
Queretaro	Queretaro	Manual
Cuernavaca	Morelos	Manual
Tula-Vito-Apasco-Ajacuba-T, del Rio Pachuca-Tizayuca	Hidalgo	Manual
Puebla	Puebla	Manual
Salamanca	Guanajuato	Manual

SOURCE: Direccion General de Prevencion y Control de la Contaminacion Ambiental SEDUE, 1988.

While it will take decades to reduce air pollution levels in Mexico City, the Salinas administration has announced various measures to reduce its growth in the near and medium terms. A key component of the government's plan is the Comprehensive Pollution Control Program for the Mexico City Metropolitan Zone, which was published in April 1991. This program proposes measures in oil, transportation, industry, power, reforestation, research, and education. The key elements of this strategy in the fuels, power, and transportation sectors involve:

- development of gasolines of international unleaded, low volatility, and reactivity standards
- expanded production of low-sulfur diesel and fuel oil
- development of TAME and MTBE oxygenation compounds
- installation of floating membranes in all fuel storage tanks
- installation of equipment to recover vapors in fuel loading and distribution terminals, and gas stations
- closure of PEMEX's major oil refinery "18 de Marzo"
- conversion of CFE's "Valle de Mexico" oil-fired power plant to greater use of natural gas
- installation of continuous emissions monitors at power plants
- winter suspension of operation of at least two power generation units
- a requirement that all automobiles sold after 1991 use unleaded gas and be equipped with catalytic converters
- a one-day-a-week driving ban
- a 55% increase in gasoline prices
- rehabilitation of all R-100 public service buses to units with lower emissions
- expanded metro and light rail public transportation systems
- substitution of gasoline for LP gas in trucks distributing cargo
- improvements in traffic and parking patterns.

The government has also proposed a number of air pollution control activities in the industrial sector. They will involve inducing industry to adopt various pollution control measures while encouraging increased employment and the revitalization of the economy. A shift in the pattern of industrialization will be necessary to accomplish this. The key components of this strategy are:

- complete or partial closure of some 250 industrial facilities
- encouraging the industrial substitution of fuel oil with natural gas
- prohibition of new polluting industries in the metropolitan area of Mexico City
- shift industrial transport to night-time distribution
- improvement of combustion processes and installation of control equipment
- installation of continuous monitoring systems at the largest fuel consuming factories
- industry requirement to sign legal and enforceable agreements to install emissions control equipment by no later than October 1993
- immediate installation of emission control equipment at, or the relocation of, smelting plants.

In response to growing health concerns, SEDUE has announced a policy that will require partial reductions in industrial production when the IMECA index reaches levels of 350. When the index reaches 450 (this has not happened to date), the government decrees that all industries must be shut down and citizens must stay indoors. Enforcing this plan, however, will be extremely difficult.

Even though the energy and industrial sector only have about an 8% impact on Mexico City's air pollution level, these point sources are easier to control. Reducing the emissions from a growing population of over 3 million vehicles will take more time and effort than regulating the emissions of some 25,000 industries, which are primarily located in the north and northwestern sections of the city. Most of the pollution originates from a small fraction (about 500) of these industries. For instance, during 1987, a PEMEX refinery and CFE power plant near Mexico City combined to produce about 37% of the air pollution emitted from fixed sources in the city. For this reason, some of the first air pollution control steps taken by the Salinas administration involved closing the PEMEX refinery and forcing CFE to substitute natural gas for the highly polluting fuel oil it used. In addition, the policy involves targeting several key industries for air pollution control, such as those producing chemicals, refined oil products, asphalt, plastics, cement, steel, food, and textiles.

The air pollution strategy of the power sector in general, and CFE in particular, focuses on multiple fronts. About 40% of CFE's thermal capacity is located in critical pollution areas near Mexico City, Monterrey, and Guadalajara, along the U.S./Mexico border, and near the major tourist zones of Manzanillo and Mazatlan. CFE contends that its power plants are in compliance with SEDUE laws, and that pollution monitors are installed at their power plants to verify this. Independent industry members question CFE's assumption. Air pollution monitors have been found to be improperly installed and maintained. CFE is under increasing scrutiny, and as a result, has announced plans to expand air pollution monitoring and control.

#### **Government Investment Plans in Air Pollution Control**

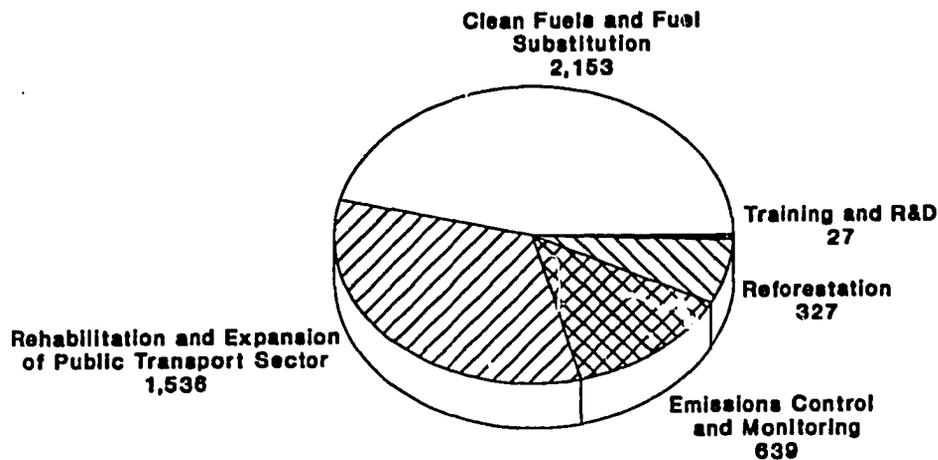
The Salinas administration has a comprehensive plan and budget for reducing transportation sector air pollution in major urban centers such as Mexico City. It has also targeted specific factories, oil refineries, and power plants for closure, modification, or fuel substitution. Many fixed air pollution sources in industry and the electric power sector do not appear to be part of a clearly defined plan and budget, however.

*While transportation sources are greater, industrial emissions are easier to control*

**Figure 21**

## Mexico City Air Pollution Control Program Breakdown of Funding by Category

(\$ Million)



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

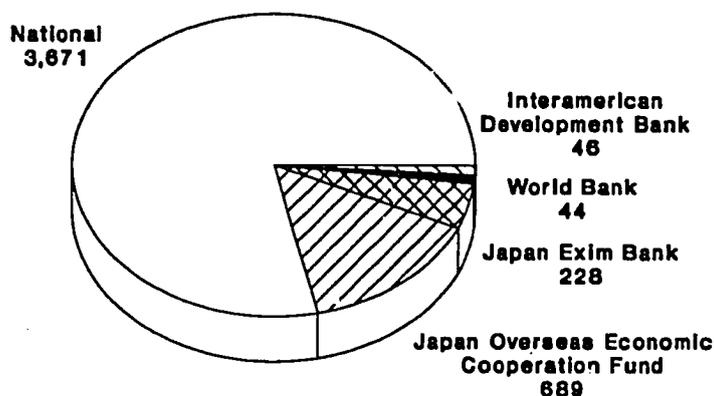
The budget for the Comprehensive Pollution Control Program for Mexico City is \$4.6 billion over a four-year period beginning in 1991. This program is primarily designed to reduce transportation sector-generated air pollution in Mexico City through clean fuel production or substitution, public transport expansion, and emissions control and monitoring (Figure 21). The funding for this program is primarily being provided by the Mexican and Japanese governments (Figure 22). This program is intended to restructure environmental policy administration, expand the production of unleaded and oxygenated fuels, and to promote the installation of emission controls (catalytic converters) on automobiles. The use of unleaded and oxygenated fuels reduces lead and carbon monoxide emissions, while catalytic converters reduce carbon monoxide, nitrous oxide, and hydrocarbon levels. PEMEX is playing a key role in this program through the conversion of various refineries at Tula, Salamanca, Cadereyta, Salina Cruz, Cangrejera, Madero, and Minatitlan.

CFE plans to reduce sulfur dioxide emissions at its power plants, primarily at the front end through increasing the use of low-sulfur fuel. An analysis by CFE has concluded that it is more economical to purchase low-sulfur fuel than to remove the sulfur at the tailpipe through the installation of scrubbers. Fuel oil and coal with a sulfur content of less than 1% are currently being imported for some thermal power plants. With a World Bank loan, PEMEX is in the process of building a plant to desulfurize fuel oil at its Tula refinery, which will be completed in 1995. The low-sulfur fuel oil output from this facility, however, will only be sufficient to supply one large (i.e., 600-800 MW) thermal power plant. Fuel substitution from oil to natural gas is being promoted in some instances, such as at the Valle de Mexico plant outside Mexico City. Particulates emissions reduction is being addressed through the use of electrostatic precipitators at CFE's two major coal-fired power plants. CFE is also focusing on optimizing the power plant combustion process to maximize efficiency and minimize emissions.

*The electric power sector is focusing on fuel substitution*

Figure 22

### Mexico City Air Pollution Control Program Sources of Funding (\$ Million)



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

#### Overall Market Estimates

*The total air pollution control market is estimated at \$78 million in 1990*

The DOC estimates that the 1990 total market for air pollution equipment and services is about \$78 million, with an anticipated growth rate of 15% between 1990 and 1992. The proportion of this market that depends on foreign imports has grown over the past three years, due to trade liberalization and a growing demand for foreign high technology that is not available on the local market. Between 1988 and 1990, the proportion of the market supplied by foreign imports grew from 14% to 23% (Figure 23).

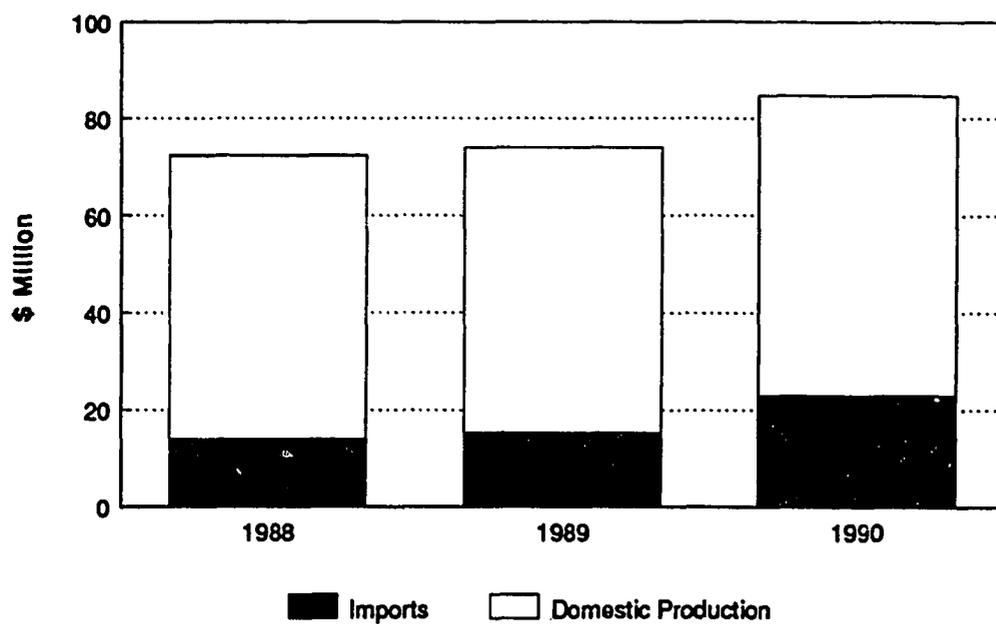
Of the total import market of \$15.3 million in 1989, U.S. industry commanded a 26.5% share (Figure 24). West Germany, Japan, France, and Switzerland represent major competitors in this market. The position of U.S. industry is strong due to the sophistication of its products and its proximity to Mexico. Nonetheless, European and Japanese companies are aggressively pursuing the air pollution control market. The European Community has jointly financed a market study with the International Finance Corporation (IFC) that examines business opportunities in the environmental sectors of Mexico. In addition, the Japanese Exim Bank has extended loans and grants to Mexico as part of its \$4.6 billion Program Against Air Pollution in Mexico City. While some of these loans are "untied," Japanese companies will clearly play a significant role in these projects.

*The best sales prospects involve monitoring and control equipment*

The DOC reports that equipment with the best sales prospects includes dust collectors and filters, silencers for exhaust gases, respirators, gas/particle sampling analyzers, air pollution monitors, mobile laboratories, metering instruments, electrostatic precipitators, oxidation systems, and gas absorbers. Industry representatives also see attractive sales opportunities for bag filters, electrostatic precipitators, and wet scrubbers. Some of the major companies established in the Mexican market are: Ajax International, Babcock & Wilcox, Beckman, Environmental Systems, Fisher Governor, Foxboro, Honeywell, Leeds

**Figure 23**

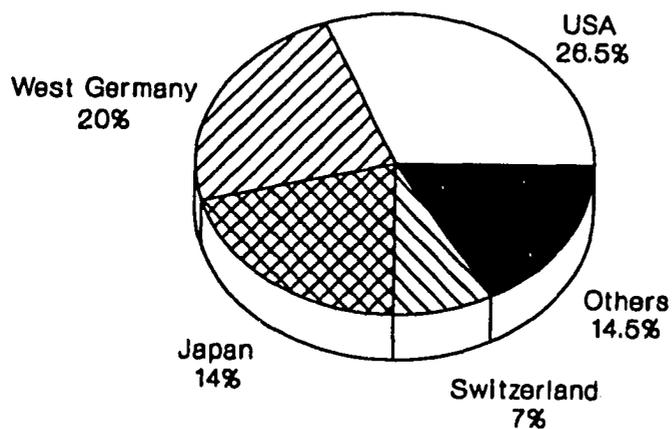
### Air Pollution Market Growth in Mexico



SOURCE: U.S. Department of Commerce.

**Figure 24**

### Air Pollution Import Market Share in Mexico 1989



SOURCE: U.S. Department of Commerce.

and Northrop, Marley International, Perkin Elmer, Rohm & Haas, Taylor Instruments, and Uniloc. A summary of the tariffs on some of the key products in the air pollution market is shown in Table 14. Those products with a low tariff rate generally indicate the lack of a Mexican manufacturer or a shortage of supply.

**Table 14**

**Mexican Import Duties on Selected Air Pollution  
Control Equipment  
September 1990**

Description	Duty %
Fuel and oil filters for motors	15
Oil filters for int. comb. eng	20
Cyclone Purifiers	20
Other filters	5
Gas filters	5
Air filters for air condition	15
Degasifiers	0
Other filters	5
Thermometers	0
Aerometers and densitometers	20
Gas flow meters	0
Gas and fume analyzers	20
Gas chromatographers	20
Electrophoretic analyzers	5
Ventilators	20

SOURCE: U.S. Department of Commerce, 1990.

**Major Market Opportunities**

The air pollution control market can be broken down by the transportation, power, and industrial sectors. Transportation sector emissions are primarily being addressed through the production of cleaner fuels, fuel substitution, and the application more efficient vehicles with catalytic converters. The power sector is shifting to cleaner fuels and efficiency improvements, and is cleaning emissions with such technologies as electrostatic precipitators. The industrial sector comprises a wide array of different emissions (depending on the inputs), which are being addressed through process changes, fuel substitution, bag houses, precipitators, scrubbers, etc.

- *Clean Fuels Production:* PEMEX is implementing three projects to reduce sulfur levels to under 1% in fuel oil and diesel fuel, for a total investment of \$650 million. In addition, PEMEX plans to invest \$549 million in building eight new plants and modifying seven existing ones in order to produce higher octane gasoline.
- *Power Plant Air Pollution Control:* While CFE contends that most of its power plants are adequately equipped with air pollution control technology, an independent assessment is underway. CFE and the Instituto de Investigaciones Electricas have commissioned a detailed environmental impact assessment of seven thermal power plants in Mexico: Tula, Valle de Mexico, Salamanca, Rio Escondido, Monterrey, Manzanillo, and Mazatlan. This study is being performed by the Spanish firm Hidroelectrica Espanola, with Battelle and Radian as subcontractors. It will be completed by November 1992.

- **Coal Power Plant Electrostatic Precipitators:** Six 350 MW coal-fired power plant units are expected to be installed over the coming eight years. Units 1 and 2 of the Carbon II power plant at Piedras Negras, Coahuila are expected to be operational in 1992. These units are conventionally financed and developed by CFE. Units 3 and 4 of Carbon II are to be installed by 1995. These units are being developed by Foster Wheeler, Mecanica de la Pena, and Bufete Industrial under a BLT arrangement. In 1998, two 350 MW units are expected to be installed at Sabinas. All of these power plants will require electrostatic precipitators.
- **Steel Industry Dust Collection:** Air pollution control, through the installation of equipment to collect dust and iron particles, is being considered by Mexico's largest private iron and steel company and the country's eighth-largest corporation (HYSLA S.A. de C.V.) according to a recent IFC study. Depending on the results of the engineering study, projects at various steel mills could be implemented, at a total investment of about \$15 million.
- **Chemical Industry Air Pollution Reduction:** The reduction of SO<sub>2</sub> and other emissions from a sulfuric acid and polystyrene plant is being considered by Industrias Resistol, S.A., Mexico's third-largest petrochemical company, with 25 plants nationwide, according to the recent IFC study. The company's strategy is to achieve zero emissions to air, water, and land by the year 2000. The air pollution investment currently being contemplated is about \$1.5 million.
- **Industrial Solvents Emissions Control:** An important air pollution source is the emission of various gases from the use of solvents in auto painting, the production of paints, glues, etc., and industrial cleaning, printing, etc. The implementation of these air pollution control measures awaits a definitive regulation from SEDUE. Indications are that this new regulation will take anywhere from one to three years to be issued, at which point stringent application is expected. Some companies are already considering adopting control measures.
- **Industrial Air Pollution Monitors:** SEDUE is increasingly requiring industry to install their own pollution control monitoring equipment. For instance, one steel mill was required to install six particulate monitoring stations throughout the local town and a meteorological tower within the plant.

## **2.4 Municipal and Industrial Water Pollution Control Sector**

Because Mexico's water supply constraints are severe, the sustainable management of water resources presents a major challenge to the country's federal and state governments. Serious water pollution problems negatively affect the health of the Mexican population and increase the cost of providing clean water for domestic consumption and industrial and agricultural use.

The Mexican Government currently places a high priority on the management of the water sector; this is reflected in the major sectoral reorganization that took place in 1990 for the purpose of improving coordination and promoting better financial management. In 1990, the National Water Commission (CNA) was created as an autonomous agency under the Ministry of Agriculture and Water Resources (SARH). While SEDUE retains authority for developing water pollution control regulations, CNA is now responsible for administering the use of water resources and supplying technical assistance to state and local agencies (Figure 25). It also plays a lead role in setting priorities for water sector management.

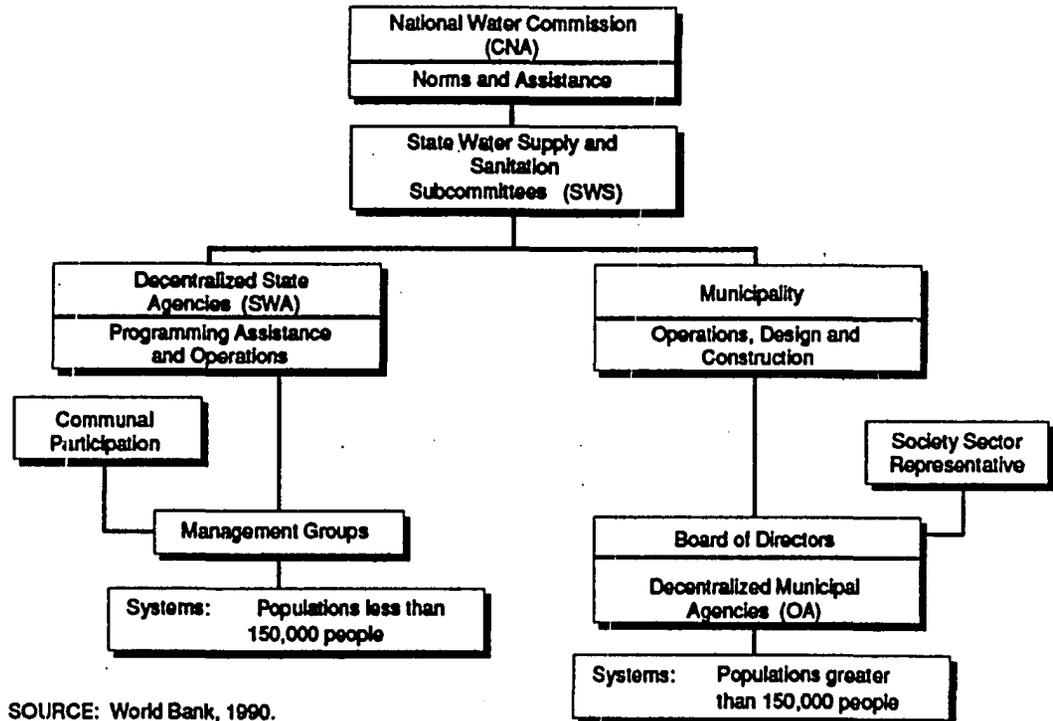
*Water resources management is top priority*

### **Wastewater Treatment and Water Supply**

The sources of wastewater discharge in Mexico are concentrated geographically: Mexico City, Guadalajara and Monterrey produce 40% of the nation's wastewater by volume, while

Figure 2E

## Organization of the Mexican Water Sector



SOURCE: World Bank, 1990.

Mexico City alone is responsible for 30% of the total. SEDUE estimates that the average volume of wastewater produced throughout the country was  $184 \text{ m}^3/\text{sec}$  in 1988. Of this, 57% flowed from municipal sources and 43% from industry (Figure 26). In November 1991, Sergio Reyes Lujan, SEDUE's subdirector for environment, announced that the average volume of wastewater produced in Mexico had risen to  $200 \text{ m}^3/\text{sec}$ ; less than 10% of the country's wastewater is treated.

*Mexico's most important watersheds are severely polluted*

Untreated flows from municipal and industrial sources have produced critical conditions in Mexico's most important watersheds. SEDUE has targeted five river basins with the most concentrated urban and industrial development as a high priority in its 1990-94 environmental strategy (Figure 27): the Panuco, Lerma-Santiago, San Juan, Balsas and Blanco watersheds. All of these basins receive the majority of their wastewater discharges from industrial sources.

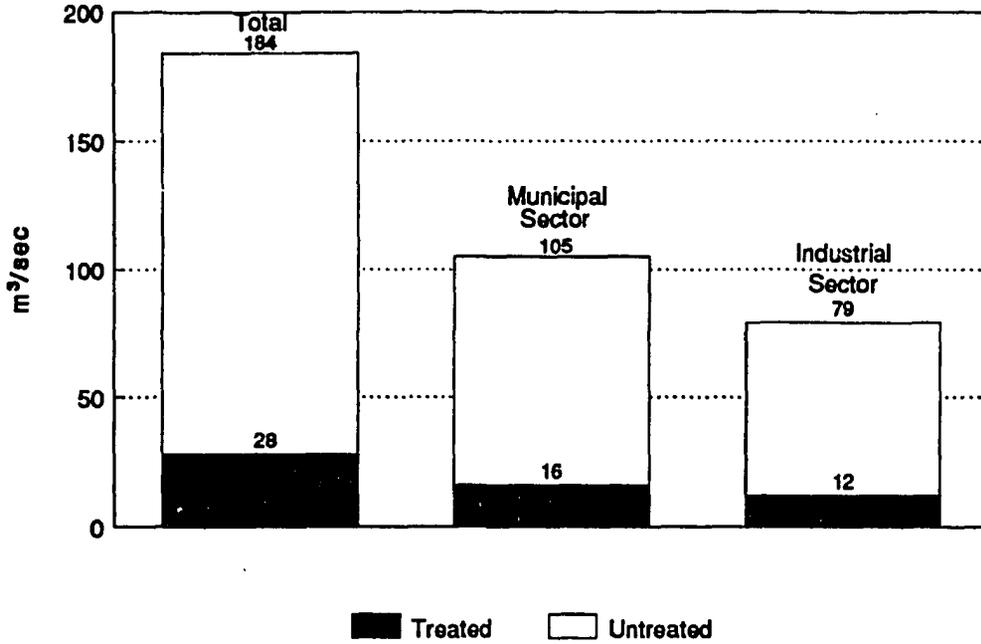
The Rio Lerma watershed received particular political attention in October and November 1991, with the establishment of a commission to address pollution problems in the region. In December 1991, pressure from national and state authorities to clean up the Lerma-Lake Chapala basin led PEMEX to sign a \$25 million contract with the Mexican firm Agua Mejor to build a wastewater treatment system for its refinery in Salamanca. In addition, a pilot integrated water management project, funded in part by the World Bank, was launched in the Rio Lerma basin. Besides these five watersheds, SEDUE places high priority on water pollution control in Acapulco, Coatzacoalcos, Ensenada, Salina Cruz, Lazaro Cardenas and Villahermosa in light of their importance as ports and tourist destinations.

*Investment requirements are skyrocketing*

The amount of investment needed for new municipal and industrial wastewater treatment plants and the rehabilitation of old treatment systems is overwhelming. Currently, low levels of investment in both sectors perpetuate the shortage of wastewater treatment

**Figure 26**

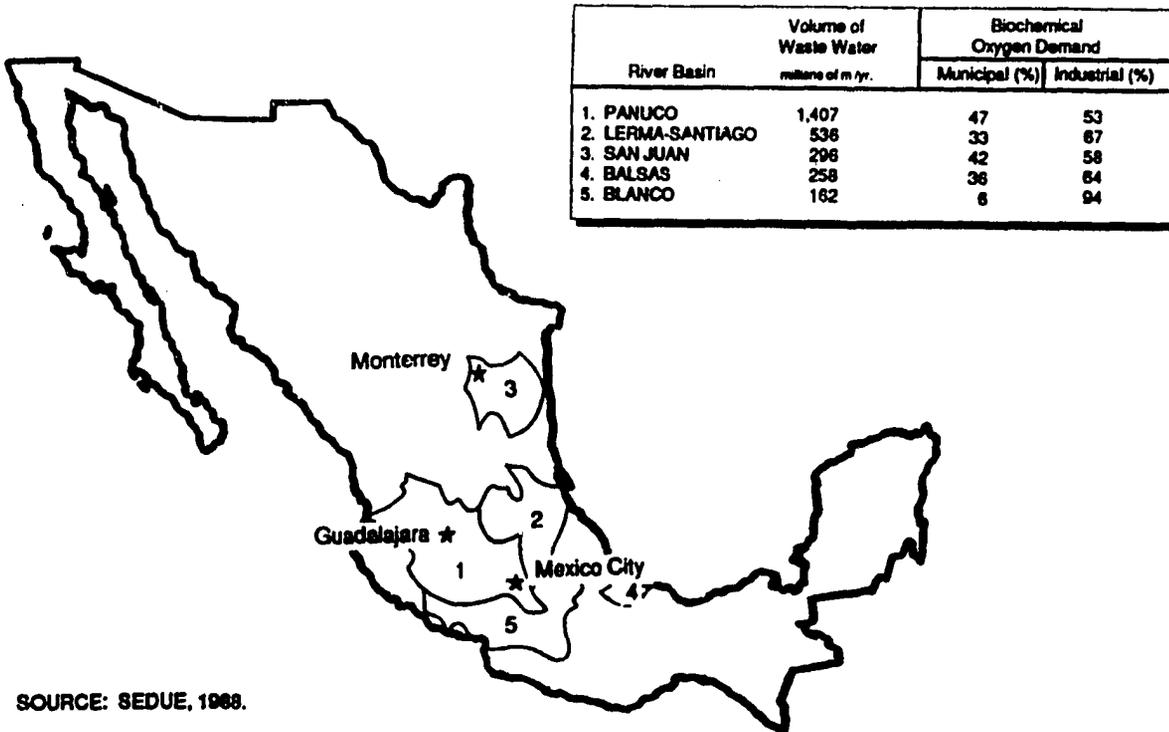
**Total Wastewater Discharges in Mexico (1988)  
Treated vs. Untreated**



SOURCE: SEDUE, 1988.

**Figure 27**

**The Five Most Polluted River Basins in Mexico**



SOURCE: SEDUE, 1988.

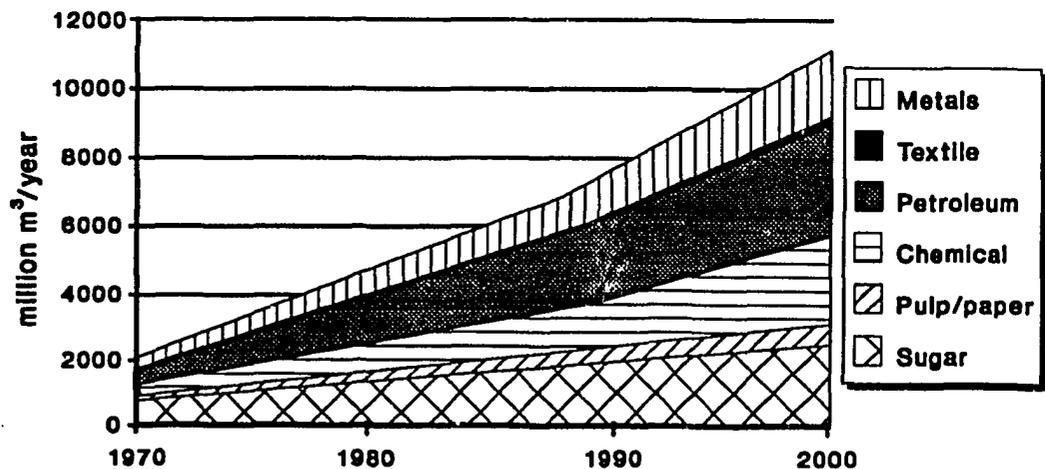
facilities and the inadequacy of existing systems. In October 1991, the Mexican periodical *El Universal* reported that only 110 of the country's 420 municipal and industrial water treatment plants were actually in service; less than half of them were operating efficiently.

In the municipal sector, the 223 wastewater plants that existed in 1988 had the capacity to treat only 15.7% of the national volume of domestic effluent. Although the number of municipal plants has increased since then, many continue to operate below capacity because they lack trained operations personnel, reliable equipment and security installations, and favorable topographic conditions. Of the limited number of municipal treatment plants that do function properly, many do not have the capacity to handle the volumes of effluent discharged by exploding urban populations. In December 1991, CNA estimated that the task of treating domestic wastewater discharged throughout Mexico, not including the Federal District and the State of Guanajuato, will require a \$2.4 billion investment.

Existing wastewater treatment capacity for the industrial sector is equally low. In 1988, 82.3% of total industrial discharges came from six highly polluting industries (Figure 28). The sugar and chemicals industries alone accounted for 60% of the total. In 1988, there were 177 industrial treatment plants with the capacity to treat only 15.5% of the total volume of wastewater discharged by the sector. Jaime Sancho y Cervera, undersecretary for administration at CNA, recently put a \$1.1 billion price tag on the job of treating the total volume of wastewater currently discharged by the industrial sector.

Figure 28

### Wastewater Discharges in Mexico by Industrial Sector



SOURCE: SARH.

*Water doesn't  
grow on trees  
in Mexico*

In addition to low levels of current investment in wastewater treatment, Mexico suffers from serious water supply constraints. Around 80% of the nation's existing and potential sources of water supply are found below 500 meters, while 75% of the population and 80% of industrial activity are located above this altitude. As a result, Mexico City and other major urban areas must pump water from lower regions at considerable expense. Rising water tariffs are beginning to be charged, both to reflect the high cost of transporting water

in certain geographic regions, and to increase demand for conservation and recycling. In 1989, the price of water was raised throughout the country; in Mexico City alone, water prices increased by 1,360% (water is still subsidized in Mexico City, however). In Monterrey, where water supply constraints are acute, the price of water is the highest in the country. A study commissioned by the IFC in 1990 concludes that the move to more realistic pricing has substantially increased investment in wastewater treatment, recycling systems and water meters.

### **The Government's New Water Pollution Laws and Enforcement Efforts**

The articles of the 1988 General Ecology Law covering water pollution address effluent discharges from industry, municipalities and federal facilities. The law requires that all sources discharging directly to receiving waters or indirectly to municipal sewer systems have prior authorization from the appropriate federal or state institution and must register their wastewater discharges with SEDUE. A recent EPA study of Mexico's environmental regulations claims that few sources actually have authorization or register their discharges.

Under Mexican law, point-source discharges must meet relevant national technical standards (NTEs). NTEs for water closely resemble the national effluent standards outlined in the U.S. Clean Water Act; they are industry-specific numeric limits on water pollutants set at the federal level by SEDUE, CNA and local authorities. Figure 29 shows a general comparison of water pollution regulation in the U.S. and Mexico.

A new national water pollution control regulation is currently being finalized by SECOFI and is expected to be released in April 1992. In the meantime, SEDUE applies existing NTEs governing point-source discharges on a case-by-case basis. Existing NTEs cover conventional pollutants such as biological oxygen demand, total suspended solids, fats and acids, and fecal coliform bacteria; regulations governing toxic metals and organics, which will resemble U.S. water toxics guidelines, have yet to be fully developed. A new technical standard covering discharges to municipal sewer systems is also being finalized by SECOFI and is due to be released in the spring of 1992. Both the new national water pollution regulation and the new requirements for discharges to municipal sewers will affect municipal water authorities and industry across the board.

In the fall of 1991, the Mexican Government drafted a new law that will require all industries to pay fees on wastewater discharges. The law is supposed to become effective on October 1, 1992, but some feel that it will take longer to implement. Under this new law, all industrial facilities will have to pay around 13 for every cubic meter of wastewater discharged, 15 for every kilogram of suspended solids, and 9 for every kilogram of COD (chemical oxygen demand). While it is not clear how the new law relates to the other water pollution regulations currently being drafted, it will certainly have a major impact on the market for water treatment and recycling equipment.

Point-source discharges are also subject to site-specific special conditions. These conditions were established by the General Ecology Law for the purpose of meeting water quality standards applicable to particular receiving bodies; in this way, they are similar to U.S. water quality standards. SEDUE imposes additional regulations in the case of discharges to sources of drinking water, underground injection, and discharges into marine waters through soft marine channels. Special conditions are developed in conjunction with environmental impact assessments and apply primarily to new sources. While existing sources are required to register their discharges with SEDUE, few actually have special conditions placed on them. EPA estimates that only 10% of the known discharge points in Mexico are actually subject to special conditions.

The enforcement of national and state water pollution laws relies in large part on SEDUE's ability to monitor the flow and composition of residual waters from known point sources. The Mexican National Water Quality Monitoring Network currently consists of 386 monitoring stations. Samples taken at each station are tested according to 20 different

*Mexico's effluent regulations are similar to U.S. standards*

*New discharge fees will have a major impact on the market for treatment and recycling equipment*

Figure 29

## Comparison of Water Pollution Regulation in the U.S. and Mexico

	US	MEXICO
<b>LAWS AND REGULATIONS</b>	<p><b>1972 Clean Water Act (CWA)</b></p> <ul style="list-style-type: none"> <li>establishes national technology-based effluent standards to be factored into permitting process</li> </ul> <p><b>1987 Water Quality Act (WQA)</b></p> <ul style="list-style-type: none"> <li>additional standards for individual water sources to be factored into permitting process</li> </ul>	<p><b>National Water Regulation (currently being drafted)</b></p> <ul style="list-style-type: none"> <li>sets Technical Ecological Standards (NTEs) limiting effluents and special conditions applicable to particular receiving bodies</li> </ul>
<b>IMPLEMENTING MECHANISM</b>	<p><b>National Pollutant Discharge Elimination System (NPDES)</b></p> <ul style="list-style-type: none"> <li>permitting process that combines national effluent &amp; water quality standards tailored to facility's conditions</li> <li>EPA &amp; state agencies share permitting responsibilities</li> </ul>	<p><b>Authorization to Discharge</b></p> <ul style="list-style-type: none"> <li>National Water Commission (CNA) authorizes discharges into continental receiving bodies</li> <li>state &amp; local authorities authorize discharges into drainage and sewer systems</li> <li>not clear if authorization equivalent to issuing a permit</li> </ul>
<b>MONITORING</b>	<p><b>Self-monitoring</b></p> <ul style="list-style-type: none"> <li>NPDES requires companies to report monthly and sometimes daily discharges</li> </ul>	<p><b>Federal Inspection</b></p> <ul style="list-style-type: none"> <li>most monitoring done by federal inspectors with limited resources for testing and reporting</li> </ul>
<b>KEY DIFFERENCES</b>	<ul style="list-style-type: none"> <li>EPA has strong jurisdiction over state permitting process; lack of strong federal oversight in Mexican system may weaken enforcement of NTEs</li> <li>In U.S., each water segment has designated use supported by water quality criteria, and permitting reflects these criteria and uses; not clear that every body of water is regulated in Mexico.</li> </ul>	

SOURCE: U.S. Environmental Protection Agency, 1991.

water quality parameters; these include temperature, dissolved oxygen, pH, biochemical oxygen demand, chemical oxygen demand, fats and acids, ammonium nitrate, total dissolved solids, and sulfates. The national system is supported, in turn, by a network of 21 state, 10 regional and 3 central analytical labs.

Whereas the U.S. National Pollutant Discharge Elimination System (NPDES) requires companies to monitor and report monthly averages of their discharges, Mexican law assigns the task of monitoring primarily to federal inspectors. Although SEDUE recently increased the number of its inspectors, the lack of resources for adequate testing, site visits and reporting reduces the effectiveness of its enforcement activities. The EPA reports that few facilities actually obtain authorization and are inspected.

Several additional factors weaken the strength of national water pollution regulations by reducing the effectiveness of SEDUE's efforts to obtain compliance. While each facility subject to special conditions must submit a monthly discharge report, it is not clear whether these reports are required from all registered facilities. The frequency with which SEDUE requires facilities to submit an effluent report is also ambiguous. Furthermore, SEDUE has not yet computerized its data collection system. Finally, SEDUE and CNA do not make discharge data publicly available, and citizen involvement in the process of identifying non-complying facilities is limited to filing complaints.

*The enforcement of new regulations is slow*

As in the United States, Mexico's state and local authorities are responsible for municipal wastewater treatment systems. Mexico's federal government, however, retains the responsibility for authorizing discharges into receiving waters other than municipal sewers (this power is held by the states in the U.S.). As is the case with the federal water pollution control laws, having the Mexican state regulations on paper does not guarantee that polluting sources will abide by them. In the state of Queretaro, for example, *El Universal* reports that a state environmental law exists, yet only 212 of the 1,500 enterprises that dump their effluent into the highly damaged Rio Lerma-Lake Chapala basin follow the effluent guidelines. In an attempt to enhance compliance, the state government plans to install five new water quality monitoring stations along the Rio Queretaro.

#### **Current Investment in Water Pollution Control**

The Interamerican Development Bank estimates that 30% of Mexico's population have no access to piped potable water and 51% have no access to a formal sewerage system. CNA aims to extend the supply of potable water to 94% of the population and the availability of sewerage services to 82% by the year 2000. This will cost an estimated \$17.2 billion, or \$1.7 billion per year. In 1990, CNA launched its mission to achieve this goal with the 1990-94 Water Supply and Sanitation Sector Plan. The Plan proposes a four-year total investment of \$4.5 billion (Table 15).

The 1990-94 Plan differs from previous plans in that it goes a step beyond increasing the population's access to clean water systems, and towards establishing an effective institutional framework for the water sector based on sound cost-recovery policies. A key principle underlying this strategy is the decentralization of financial authority from CNA to state and municipal water agencies. The 1990-94 Plan supports this objective by encouraging local water agencies to charge user fees in order to enhance their financial viability. In addition, it contains new lending directives that require borrowers to strengthen their operations and financial management, and sets more stringent standards for project eligibility for federal funding. CNA expects these changes to reduce the per capita cost of water sector investments.

*A four-year investment plan aims to decentralize financial responsibility*

A major source of financing for the \$4.5 billion sector investment Plan will come from a \$300 million World Bank loan to BANOBRAS (Figure 30). This loan will support institutional reorganization at the national level and finance the rehabilitation and expansion of water supply systems to poor areas in targeted cities. Although the World Bank program includes a pilot project in the Rio Lerma basin, which serves parts of Mexico City, the loan

does not cover water systems in Mexico City, Guadalajara, or Monterrey. These regions are covered in part by several large IDB projects, including a \$300 million loan to the Guadalajara Intermunicipal System of Water and Sewers and a \$325 million loan to the Water and Drainage Service of Monterrey. Domestic sources of financing for the Plan include CNA itself, the National Solidarity Program, state and municipal funds, user fees, and other BANOBRAS credits.

Additional investments in water pollution control have also been planned for the high-profile border region. This fall, the government announced its plans to invest 1.5 billion pesos, or about \$460 million, in border environmental projects. Around \$220 million of

**Table 15**

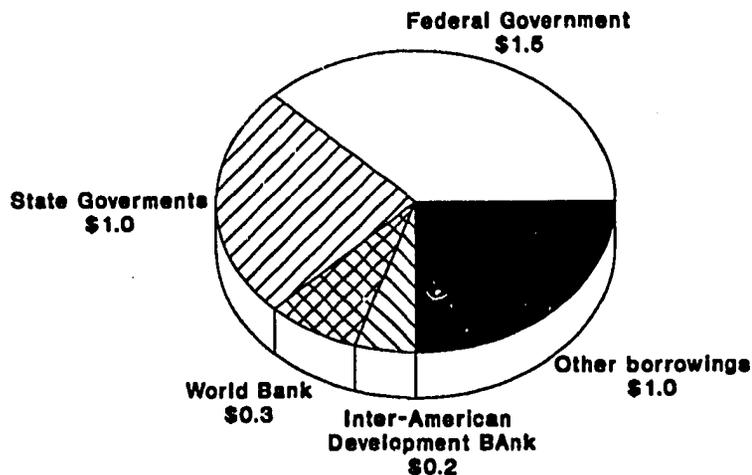
**1990-94 Water Supply and Sanitation Sector Plan  
Projected Investment Schedule  
(U.S. \$ millions)**

	1990	1991	1992	1993	1994	Total	%
Water Supply	206.1	674.1	695.6	690.8	728.1	2994.7	66.5
Sewerage	63.7	232.6	252.1	247.0	238.0	1033.4	23.0
Treatment	16.0	121.5	107.5	112.9	117.6	475.5	10.5
<b>Total</b>	<b>285.8</b>	<b>1028.2</b>	<b>1055.2</b>	<b>1050.7</b>	<b>1083.7</b>	<b>4503.6</b>	<b>100.0</b>

SOURCE: World Bank, 1991.

**Figure 30**

**1990-94 Mexico Water Sector Investment Plan  
Sources of Funding  
(Billions of US\$)**



SOURCE: World Bank, 1990.

This will go to wastewater treatment and recycling projects. As of January 1992, around \$30 million had already been programmed for sewerage extension projects and the construction of wastewater treatment plants. SEDUE has targeted eight cities on the border to receive the lion's share of this money: these are Tijuana, Mexicali, Nogales, Ciudad Juarez, Nuevo Laredo, Reynosa, Matamoros and San Luis Rio Colorado. Of these eight, Tijuana and Ciudad Juarez will receive the largest allotments: \$28 million and \$26 million, respectively. Significant progress has already been made on the border using bilateral funds: the first phase of construction of a wastewater treatment plant in Nogales was completed in October, the construction of a \$400 million facility serving Tijuana/San Diego is underway, and the construction of a plant covering Laredo/Nuevo Laredo is expected to be completed in February 1992. EPA and SEDUE are currently drafting a final border environmental agreement, which will include additional funds committed for a large water pollution control component. The plan is expected to be released on February 26, 1992.

*Major investments in wastewater treatment are planned for the border*

In addition to the border region, the Federal District (DF) of Mexico City has also received particular attention in the area of wastewater treatment. In order to address the severe problems of contamination and over-exploitation of the local aquifer, the Office of Hydraulic Construction and Operation in the Departamento del Distrito Federal (DDF) is implementing a more comprehensive water management strategy. This strategy focuses on private involvement in expanding the capacity of the 11 treatment plants in the DF and installing recycling systems in industries. In December 1991, Fernando Menéndez Garza, Director of Environmental Projects in the DDF, announced that all industries located in the Federal District will soon be required to install recycling equipment.

The DDF is also enforcing a more general policy of allowing only "clean" industries to be located in the Federal District. This policy is backed by a \$200 million line of credit from the World Bank for the installation of pollution control equipment in plants located in Mexico City.

Mexican states have also incorporated water pollution components in their development plans. The state of Jalisco contains the highly polluted Rio Lerma-Lake Chapala basin, which serves Guadalajara and the industrial zones outside Mexico City, and has a priority region for water pollution control investment. The State of Jalisco Development Plan for 1989-95 emphasizes increasing the construction of new wastewater treatment plants and the enforcement of existing water pollution control legislation. As of December 1991, 20 wastewater treatment plants were operating in the Lerma-Chapala basin and 17 more were under construction.

*Local governments mobilize resources for water sector investment*

Private sector investment in wastewater treatment is also increasing. In response to rising water tariffs, several groups of private manufacturers have taken collective initiatives to build their own wastewater treatment systems. The IFC cites as a good example a group of Mexican firms in Vallejo, Mexico City that rehabilitated an old municipal treatment plant. The Vallejo group treated wastewater flows from the local drainage system to a standard suitable to supply their own factories. An equally successful scheme was initiated in the state of Mexico by the Tlalnepantla Industry Association, which plans to build a plant to treat residential waste flowing into the Rio Tlalnepantla for industrial use. The Association expects to establish a separate utility to run the plant; the utility will recover operational costs by charging user fees to the Association members, which include 14 of the largest industrial water users in the Rio Tlalnepantla area. Although the number of examples is currently limited, the trend toward collective private sector initiatives in wastewater treatment appears to be growing.

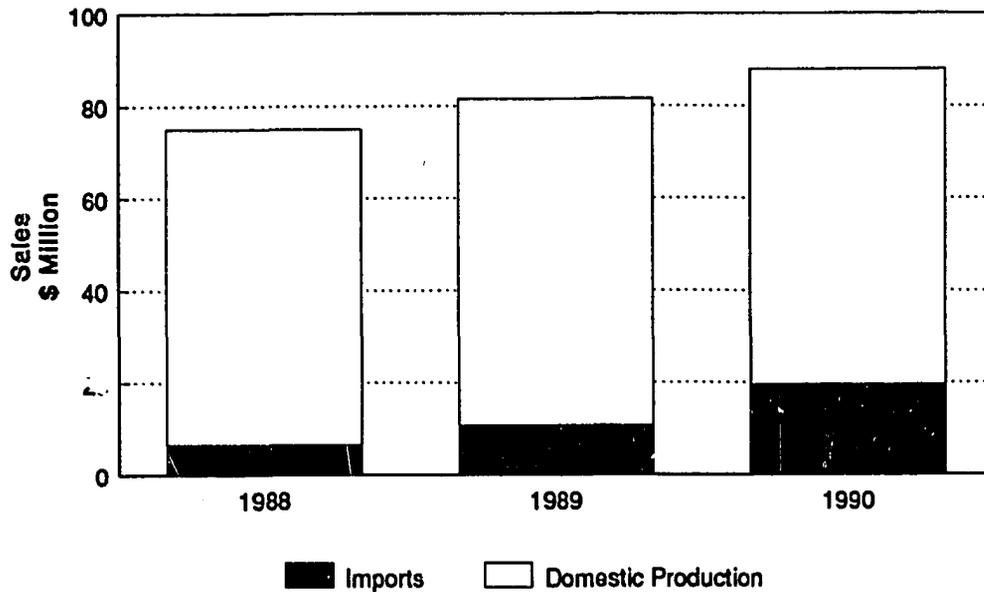
*Industry associations build their own wastewater treatment systems*

### **Current Market Estimates**

The DOC has estimated the total market for water pollution equipment and services in Mexico to be about \$88 million in 1990, with an annual growth rate of 15% from 1990 to 1992 (Figure 31).

Figure 31

### Water Pollution Market Growth in Mexico



SOURCE: U.S. Department of Commerce.

***U.S. suppliers dominate the import market***

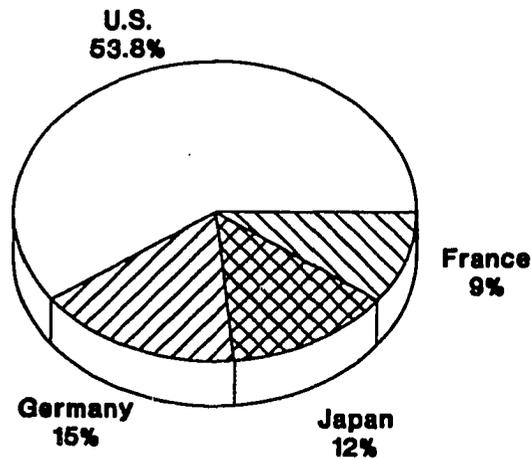
Until the late 1980s, high tariff barriers kept foreign companies out of the Mexican market for water pollution control equipment. As these barriers continue to be lowered by the Salinas administration, the share of imports in the Mexican water market is growing steadily. As a result of its geographic proximity, existing business networks, and reputation for quality products, the U.S. remains Mexico's principal external supplier of water pollution control equipment and services. The U.S. accounted for over half of all imports in 1989, while German, Japanese and French firms held smaller shares of the import market (Figure 32).

The categories of water pollution equipment imports with the best sales records in Mexico tend to be those based on conventional technologies that are not produced locally and can be transferred without modification. The DOC reports that products with the best sales potential include aerators, chlorinating equipment, screens, water clarifiers, pumps and filter presses. Table 16 summarizes the current tariffs on key products in the water pollution control market. Major U.S. water pollution control equipment suppliers to Mexico include Lawsc0, Babcock and Wilcox and Ecodyne. Non-U.S. firms with a strong presence in the Mexican water market are Degremont (France), Biwater (UK), and Compagnie Generale des Eaux (France).

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

**Figure 32**

**Water Pollution Import Market Share  
in Mexico  
1989**



SOURCE: U.S. Department of Commerce.

**Table 16**

**Mexican Import Duties on Selected Water Pollution  
Control Equipment  
September 1990**

Description	Duty (%)
Steam Boilers 4-5 ton capacity	20
Auxiliary equipment for boilers	5
Centrifugal pumps	20
Rotating pumps	20
Temperature exchangers	5
Evaporators	20
Centrifugates	15
Horizontal centrifugates	0
Clorinators	0
Inverse osmosis modules	5
Other water filters	5
Filters for beverages	20
Purifiers and desorators	20
Control valves	15
Hydraulic control valves	15
Barometers	5
Hygrometers	0
Porometers	0
Flow meters	15
Polarimeters, refractometers	5

SOURCE: U.S. Department of Commerce, 1990.

While wastewater treatment technology represents 90-95% of the equipment market, the DOC reports that measuring and control instruments hold a significant (5-10%) share of the market. The development of the local instrumentation industry is limited, however. The instrumentation market continues to be dominated by several large companies with home offices in other countries, including Thermo Electron, Leeds and Northrup, Foxboro, and Honeywell.

The water pollution control services market in Mexico consists mainly of pollution control utilities and consulting firms. In the utilities market, Mexican companies primarily service the labor-intensive components of large-scale engineering projects. Although there are a number of highly competitive Mexican construction firms, only a few have the capacity to manage large environmental jobs; these include Grupo Mexicano de Desarrollo and FINSA. In the consulting field, there are less than ten Mexican firms with licenses from SEDUE to operate in all of the environmental market segments. Of these, only two specialize in industrial pollution control; both have fewer than 25 engineers and technicians.

### **Major Market Opportunities**

The most established environmental market in Mexico is water pollution control equipment for municipal buyers, groups of manufacturers (including industrial estates and industry associations) and tourist developments. This trend will continue as SEDUE's monitoring and compliance efforts increase and as clean water for use in industry or the municipal sector continues to be expensive and scarce. In addition, several smaller market segments should be closely monitored. The following water market subsectors offer excellent sales potential for U.S. firms:

- **Water Pollution Monitoring Equipment.** Boosting existing capacity to monitor both municipal and industrial wastewater flows is a high priority for SEDUE right now. This translates into a significant sales potential for U.S. flow meters, spectrometers, sampling and laboratory equipment, and other components of water pollution monitoring systems. Because the self-monitoring requirements for Mexican industries are not well-defined by the national regulations, the most likely buyers of U.S. monitoring equipment will be SEDUE and state water agencies in high-profile regions like the border area.
- **Pretreatment Equipment for Highly Visible Industries.** The pending release of a new NTE regulating discharges to sewers will affect industries across the board, especially highly visible ones such as sugar, steel and petrochemicals. To the extent that it improves its monitoring and enforcement capabilities, the new regulation will force many smaller firms that discharge untreated effluent to public sewers to invest in water treatment technologies. In addition, SEDUE has cracked down on industry in particular lately; whereas the NTE regulating discharges from steel has traditionally not been enforced, SEDUE is now requiring the larger steel companies to comply with specified discharge limits and time schedules.
- **Consulting Services for SEDUE and CNA:** CNA and SEDUE are committed to decentralizing the authority for water supply and treatment services to municipal agencies. Both organizations are currently in need of technical assistance and training to strengthen their ability to provide effective financial management and more responsive leadership to local water agencies.
- **Wastewater Treatment Systems and Service Contracts for Industrial Estates and Tourist Developments.** The DDF's policy of not allowing new polluting industries to locate in Mexico City has led to the development of industrial estates housing only "clean" industries (those for which all environmental considerations are properly addressed). A good example is the Ixtapalapa Estate in Mexico City, which was built and serviced by FINSA, a Mexican industrial estate utility company specializing in border zone

developments. FINSA currently plans to construct a plant on the estate to treat not only effluent from the resident garment and electronics manufacturers, but also wastewater from a nearby municipal system for industrial use. Feasibility studies for the plant are being conducted by Degremont. If the Iztapalapa Estate is successful, FINSA will go ahead with plans for nine other estates in the area. Government agencies and private developers in high-profile tourist areas are also beginning to include water pollution control in their planning of infrastructure investments. For example, CNA and the Mexican contractor Grupo Mexicano de Desarrollo are currently engaged in a build-operate-transfer (BOT) water supply and treatment system in Cancun.

- *Wastewater Treatment Systems and Service Contracts for Industry Associations.* Rising water prices and the threat of SEDUE's inspections have driven several local industry associations to invest in collective water treatment systems. In the Rio Tlalnepantla area northwest of Mexico City where water prices for industrial customers currently range from about \$0.50-0.85/m<sup>3</sup>, the local industry association plans to build a \$4 million plant to treat residential wastewater for use in the members' factories. In addition, highly-polluting members of the Tianguistenco Industry Association in the Rio Lerma basin are financing feasibility studies for a \$700,000 collective treatment system in anticipation that SEDUE will crack down on them in the near future.
- *Build-Operate-Transfer (BOT) Schemes and Service Contracts with Municipal Water Authorities.* Because of the numerous competing claims on the central budget and the Salinas administration's continued fiscal austerity, the federal grant components of investments in municipal water pollution control will decline relative to credit components in the next few years. This should, however, promote more efficient management of water agencies at the state and municipal levels. It should also lead to increased demand for creative arrangements with private sector concerns, such as BOT schemes and service contracts. Several examples of these arrangements already exist. The municipality of Aguascalientes, for example, has contracted with a consortium of SISSA (a Mexican firm specializing in environmental services) and Compagnie G(n)rale des Eaux (France) to operate the local water supply and treatment system.
- *Feasibility Studies for Municipal Agencies.* With a reduced amount of federal grant funds available, local authorities will continue to promote the rehabilitation of existing wastewater treatment systems over new construction. This trend will increase the demand for technical evaluations of existing systems and feasibility studies for rehabilitation projects.

### 3. BUSINESS CLIMATE AND PROCEDURES

The Mexican Government has taken many positive steps to improve the country's business climate and to attract foreign investment to Mexico. In addition to its overall economic stabilization and liberalization programs, the Salinas administration has implemented policies that have made Mexico a more attractive place to do business. Many of these policies, especially those targeted specifically towards foreign corporations, have already resulted in significant increases in business activity. Briefly, these improvements are:

- increased ability of Mexican companies to import products without licenses or tariffs
- new intellectual property laws that provide more flexibility and protection for technology transfers and licensing agreements
- elimination of foreign exchange controls and cumbersome paperwork associated with currency exchanges
- expedited approval processes for investments in certain priority regions and sectors
- elimination of dividend withholding tax
- majority foreign ownership permitted in more manufacturing industries
- privatization of commercial banking sector
- financing of joint ventures and environmental projects through development banks.

In addition to these reforms, the Mexican Government intends to take further steps to improve the business climate. The North America Free Trade Agreement, for example, is anticipated to further improve the business climate and to dramatically increase the already high level of business between the United States and Mexico.

#### 3.1 U.S.-Mexico Trade Relations

Since the February 1991 announcement to bring Mexico into the North American Free Trade Agreement (NAFTA), much negotiation, analysis and lobbying have transpired. In May 1991, the U.S. Congress, despite opposition from environmental and labor groups, voted to extend "fast track" negotiating authority to the President until May 31, 1993. Since then, the Bush administration has established negotiating groups that are actively exchanging information and determining agendas with their Mexican counterparts. In addition, the U.S. Congress has held numerous hearings to debate how the NAFTA will affect various U.S. interests.

It is not clear when the U.S.-Mexico component of the NAFTA will be drafted or how, exactly, it will benefit U.S. trade and investment. Many analysts predict that the U.S. recession and the 1992 U.S. presidential elections will postpone any action until 1993. Such a delay would introduce further complications, as the Mexican and Canadian political schedules would inevitably become another factor.

It is commonly believed that NAFTA will ultimately benefit U.S. companies doing business in Mexico by institutionalizing the many trade and investment reforms begun in the 1980s by President de la Madrid and enhanced under the Salinas administration. The agreement is expected to help increase economic growth for Mexico, Canada and the United States, provide lower prices for consumer goods, and strengthen competitiveness. The creation of a North American trading bloc is expected to position all three countries to compete more effectively with the European Community, Japan and the Pacific Rim countries.

*NAFTA  
benefits  
include  
greater  
economic  
growth and  
competitive-  
ness*

Other benefits of NAFTA are expected to be sector-specific. The most difficult trade negotiations will involve the agricultural, textile, automotive, pharmaceutical, petrochemical, electronic, transportation, energy, and service sectors. Important non-sectoral issues will include tariff and non-tariff barriers, rules of origin, trade remedies, standards and testing, intellectual property, dispute settlements, investment, and environmental and labor issues.

The market for U.S. environmental goods and services will be favorably affected by the attention focused in the NAFTA on environmental regulations and enforcement. Demand for such U.S. goods and services is expected to increase. Currently, there are few trade barriers that specifically relate to the environmental goods and services sector. The trend is towards removing what few barriers exist, some of which are:

- existing tariffs on some products, ranging from zero to 20%
- restrictions on imports of some products, such as steel and electronic equipment
- Mexican government procurement preferences for Mexican businesses
- Inadequate procedures for determining standards, testing and certification.

### **3.2 Financing Foreign Trade and Investment in Mexico**

Financing foreign trade and investment in Mexico can be relatively straightforward if a business creates its own source of foreign exchange, and difficult when no hard currency source of repayment can be identified. With the exception of PEMEX projects, most environmental- and energy-related projects will not create their own source of foreign exchange and thus will be a challenge to finance.

As is generally the case worldwide, projects involving large, well-known corporations, either Mexican or foreign, easily obtain financing. Other borrowers must depend, in some way, on the Mexican Government for financing. Projects involving smaller companies are dependent upon government-sponsored programs that provide credits for small and medium-sized businesses. Projects involving municipalities or parastatal operations depend upon the government's ability to budget for major projects. Trade and investment activities that do not create their own foreign exchange ultimately depend on the government's ability to preserve the free exchange of pesos to dollars.

The financial institutions active in Mexico include Mexican commercial and development banks, foreign commercial banks (including some U.S. banks), export credit agencies such as the U.S. and Japanese Export-Import Banks, the International Finance Corporation, Mexican stock brokerage firms, and a handful of U.S. investment banks. The World Bank and the Inter-American Development Bank are both active in lending to the government for energy and environmental projects.

#### **Financial Institutions**

**Mexican Commercial Banks.** It is important for U.S. companies to establish long-term relationships with Mexican commercial banks. It is recommended that U.S. companies establish relationships with at least two or three Mexican banks.

Today, the Mexican financial sector is better able to provide credits to the private sector than it has been in many years. During the 1980s, the Mexican commercial banking sector suffered greatly from capital flight, the debt crisis, and the 1982 nationalization. Since 1989, bank performance has steadily improved. In addition, the Government of Mexico has significantly reduced the amount of borrowing for parastatal operations and has lowered reserve requirements. Liquidity in the banking sector is high, in part because

*The availability of foreign exchange drives financing decisions*

*Relationships with Mexican banks are recommended*

many corporations have placed their excess cash in commercial banks. Adding to the liquidity are short-term deposits placed by foreign money center banks in Mexican commercial banks. Short-term credit for the private sector is becoming increasingly available. However, a shortage of medium- and long-term financing still persists.

While Mexican peso financing is still more expensive than U.S. dollar financing, many companies are beginning to use Mexican credits for local operations where they had previously borrowed dollars. Short-term interest rates (30-day treasury rates, or CETES) have declined from a high in 1987 of 103% to a current low of 17% (Figure 33).

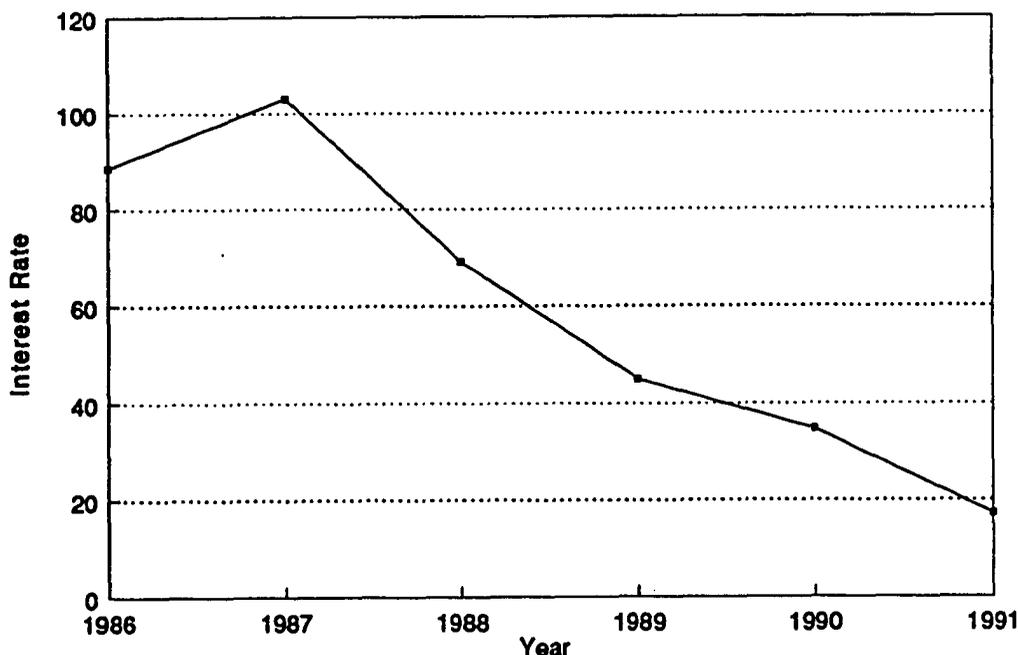
The Salinas administration is currently in the process of privatizing 18 commercial banks (Table 17). To date, the most active buyers have been stock brokerages, insurance companies, and consortia of Mexican investors positioning themselves to assemble large financial networks of commercial banks. Foreign interest is mixed; U.S. banks generally are not interested because they cannot acquire a controlling interest (30% foreign shareholding is the maximum). To date, a Spanish bank has been the only foreign purchaser of the offered shares. It is hoped that the privatization of the banks will improve bank management and staff training. At present, commercial banking personnel are inexperienced in evaluating credits for the private sector. This absence of credit expertise is a serious obstacle for companies attempting to obtaining financing.

*The privatization of commercial banks will improve credit availability*

The only U.S. bank operating branches in Mexico is Citibank, because it was never nationalized. Other U.S. banks have only representative offices. After the privatization of banks is completed in 1993, foreign banks are expected to be permitted to enter the financial sector. At that time, increased competition should make credit more available.

**Figure 33**

### Mexican Treasury Bill Rates



SOURCE: IMF International Financial Statistics 1991, El Financiero, 12/30/91.

Table 17

## Commercial Banks in Mexico

Bank	Total Assets (billions of pesos) *
Banco Nacional de Mexico (Banamex)	65,043
Bancomer	50,927
Banca Serfin	41,962
Multibanco Comermex	16,435
Banco Internacional	13,362
Banco Mexican Somex	10,523
Multibanco Mercantil de Mexico	7,048
Banco del Atlantico	6,812
Banco Contia	5,444
Banca Creme	5,239
BCH	4,777
Bancroser	4,381
Banorte	3,569
Banpais	3,316
Banco Promex	3,016
Bancan	2,206
Banoro	2,110
Banorie	1,016

\* At November 1990.

SOURCE: Business International Corporation.

*Some U.S. commercial banks are still reluctant to do business in Mexico*

**Foreign Commercial Banks.** Several U.S. commercial banks are still active in Mexico, although many (both large and small) will no longer provide loans to Mexico. Many banks lost money from the successive debt reschedulings of the 1980s and the more recent 1990 debt-relief agreement, called the Brady Plan, which was concluded under the direction of the U.S. Treasury Department, the IMF and the World Bank. The Brady Plan was a great deal for Mexico, but it left many U.S. banks with significant write-offs. Japanese commercial banks were also losers. Although Citibank and a few others made commitments to continue lending new money, most U.S. banks opted not to provide new funds, and instead settled for lower repayments with stronger collateral.

As a result, foreign commercial banks are funding only short-term interbank transactions or loans guaranteed by export credit agencies. Some short-term letters of credit are available for established importers. Commercial transactions that generate exports from Mexico are also possible to finance. Commercial banks are willing to accept hard currency accounts receivables as collateral security on loans, and in some instances have "securitized" such receivables. Other exports transactions can be financed through advanced export payment facilities, where the pre-purchase of an exportable commodity or service provides adequate repayment facilities. U.S. commercial banks that are still active include Citibank, Chase, Morgan Guaranty, First Interstate, and Bankers Trust.

*U.S. ExIm business doubled to over \$1 billion in 1990*

**Export Credit Agencies - the United States Export-Import Bank.** The United States Export-Import Bank (ExIm) is very active in Mexico, and currently has no restrictions on the amount of new business it will accept. In 1990, it committed \$1.1 billion of new loans, guarantees and medium-term insurance, representing an increase of over 200% from its 1989 commitments of \$377 million. Although figures for 1991 are not yet available, commitments in 1991 were much higher. Approved credits for PEMEX alone were over \$1.3 billion in 1991. Currently, more than \$7 billion in loans, guarantees, and medium-term insurance are outstanding. It is important to note that many of the committed credits have not yet been used and are still available to Mexican buyers of U.S. equipment.

ExIm has offered direct credit lines to large parastatal borrowers such as CFE, PEMEX and BANOBRAS (Banco Nacional de Obras y Servicios Publico, a Mexican development

bank). CFE's credit for over \$50 million was used to import hydroelectric turbines, nuclear fuel and equipment. Additional CFE credits are currently under consideration. A recent \$1.3 billion credit line was approved for PEMEX to import U.S.-manufactured oil field equipment and services for exploration and development in the Bay of Campeche. Credit lines to BANOBRAS were used to import trucks, minibuses, and automotive components.

*PEMEX and CFE have unused credit lines from ExIm*

When providing medium- or long-term trade credits (five to seven years), ExIm almost always requires the repayment guaranty of a Mexican commercial bank or the Ministry of Finance. In order to expedite such transactions, ExIm has introduced an innovative program called bundling. In bundling, ExIm has pre-approved certain Mexican commercial banks as acceptable guarantors of medium- and long-term credits. For trade transactions under \$10 million, buyers can approach these banks to arrange trade transactions without specific ExIm approval. Mexican banks participating in bundling are Bancomext, Nacional Financiera, Banamex, Banca Serfin, BANOBRAS and others.

Most Mexican commercial banks are unable to provide dollar funding for medium- and long-term loans. Actual funding for trade credits comes from ExIm directly or, more commonly, from a commercial bank with U.S. dollar funding sources, such as a U.S. commercial bank or a foreign bank operating in the United States. When ExIm does not provide funds, it provides a repayment guaranty to the financial institution that provides the funding. Such trade transactions can become complex and difficult to arrange since they often involve at least four other negotiating parties besides ExIm. Below is a list of the parties involved in organizing Mexican buyer credits and a diagram of a typical arrangement among them (Figure 34).

*Most Mexican banks have ExIm lines of credit*

**Mexican buyer:** PEMEX, CFE, private Mexican companies

**Note:** The buyer must rely upon its own credit availability to purchase U.S. manufactured products using export credit agency credits.

**U.S. supplier:** U.S. manufacturer or developer planning to use U.S. goods and services

**Note:** The U.S. supplier must make the sale to the Mexican buyer, and encourage the Mexican buyer to use its own credit to make the purchase.

**Funding source:** A financial institution with dollars -- usually a U.S. bank, but in the case of direct loans, can be ExIm. The funding source makes a loan to the buyer or to a Mexican bank that on-lends the funds. The funding source receives a repayment guaranty from ExIm.

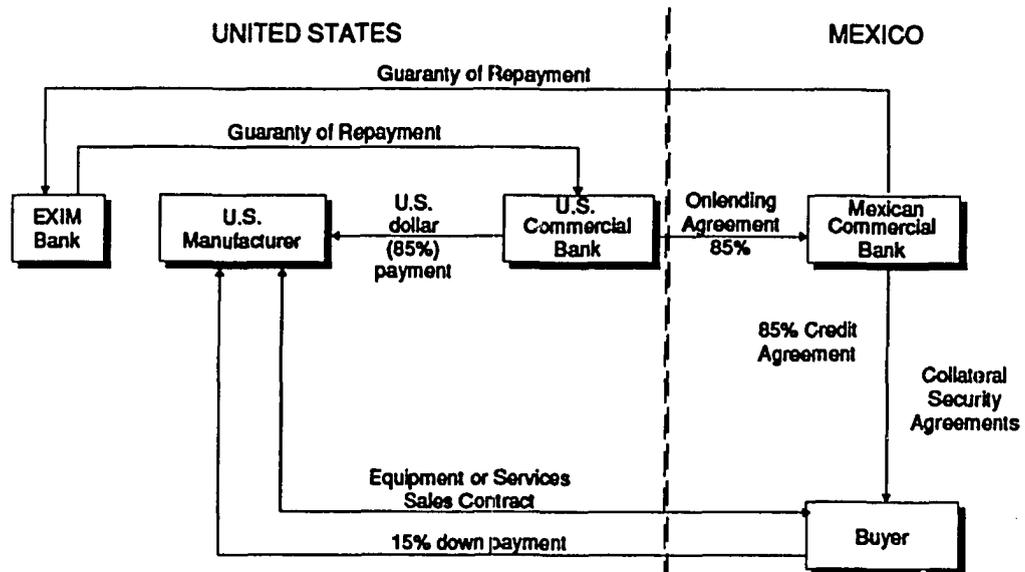
**Mexican guarantor:** A Mexican commercial bank that guarantees the repayment of the Mexican buyer. The beneficiary of the Mexican bank guaranty is ExIm.

In order to arrange financing for their export sales, U.S. exporters must work with commercial banks that take credit risks on Mexican buyers; these banks are most often located in Mexico. Unfortunately, the paperwork and the number of parties involved can be daunting. It is recommended that exporters consult with U.S. and Mexican banks that have already completed such transactions.

For large projects (over \$50 million of U.S. exports), ExIm Bank has the capability to evaluate transactions on a project finance basis, in which there is no requirement for a sovereign or Mexican bank guaranty. Thus far, however, ExIm has not concluded any

Figure 34

## Buyer Credits Under ExIm Bank Guaranty Program



NOTES: Under a direct credit, ExIm takes on added role of U.S. Commercial Bank.

ExIm works directly with some large buyers, such as PEMEX. Instead of a Mexican Commercial Bank guaranty, ExIm receives a Ministry of Finance guaranty.

project financing for Mexico. In addition, ExIm offers short-term (180 days or less) insurance on letters of credit or export sales. Guarantees of both finance and operating leases are also available.

The cost of doing business using ExIm credits varies depending upon the type of facility provided by ExIm (direct loan, guaranty, insurance), the level of "exposure risk," and the OECD consensus guidelines for Mexico. For guaranteed transactions, where ExIm is not providing funds, the cost will be related to the level of dollar interest rates for the length of the loan to be guaranteed.

### Options for Investment Financing

Medium- and long-term investment financing is available from U.S. and foreign capital markets, Mexican capital markets, multilateral development banks, and Mexican development banks.

*Mexico is accessing U.S. capital markets in new ways*

**U.S. and Foreign Capital Markets.** Since the Brady Plan debt reduction agreement was concluded in 1990, large public and private Mexican companies have been able to access the international capital markets in several new ways:

- New issues of dollar bonds, medium-term floating rate notes, and private placements have proliferated. Both PEMEX and NAFINSA (National Financiera, a Mexican development bank) have been able to arrange five-year bonds.
- New "country funds," established as closed-end mutual funds, have been created in the U.S. to accommodate strong institutional and individual investor interest in Mexico. Country funds invest in publicly traded companies in Mexico.

Several large Mexican companies such as Telmex (Telefonos de Mexico, the telephone company of Mexico) are now traded on U.S. stock exchanges through American Depository Receipts. Several Mexican brokerage firms have opened offices in New York and California to facilitate portfolio investment in Mexico.

CFE has been able to obtain nearly \$2.5 billion of investment financing to construct some 3,000 MW of new power generation facilities through build-lease-transfer (BLT) arrangements. These transactions are structured like turnkey construction contracts with a medium-to-long term payout under lease agreements. As operator of the plants, CFE acts as lessee. Japanese and Spanish banks have been particularly active in these types of transactions. Suppliers of equipment under BLT arrangements include Ahlstrom, Mitsubishi, General Electric and Bechtel.

**Mexican Capital Markets.** The Mexican capital market consists primarily of the stock exchange, which is the largest in Latin America, with a July 1991 market value of \$73.4 billion. Approximately 60% of the market activity is in the country's ten largest companies. The Mexican stock exchange boomed in 1991; especially successful was the large new issue of Telmex stock. Many of the country funds that purchased blocks of Telmex were able to realize sizeable increases in their net asset values in 1991. Bonds and mutual funds are also traded on the Mexican stock exchange.

*The Mexican stock exchange is booming*

**Multilateral Development Banks.** The World Bank is an important source of financing for the Government of Mexico and state-owned industries. Over the last three years, it has financed several projects in the energy and environmental sector (Table 18). Four new loans, totalling \$900 million, are currently under consideration. In addition, the Bank has a new fund, the Global Environmental Facility (GEF), through which loans and grants are available for projects that alleviate global environmental problems.

*The World Bank is planning new loans for energy and the environment*

**Table 18**

**New Multilateral Development Financing and Donor Grants**

Lender	Borrower/Grantee	Amt. (\$ millions)	Project
World Bank	SEDUE	\$ 50	To improve environmental policies and institutions
World Bank	CFE	\$450	To improve operation, maintenance and practices, investment in power generation and distribution
World Bank	SEDUE and DDF	\$200	Transport air quality management for Mexico City
World Bank	BANOBRAS	\$200	Urban transport improvement, including noise and air pollution abatement
OECD	PEMEX	\$530	Development of low sulfur diesel and fuel oils
Japan Exim	PEMEX	\$228	Development of unleaded gasoline
IDB	DDF	\$ 91	Urban reforestation program

SOURCE: World Bank and Consultants Group Latin America, 1991.

Procurement under World Bank-financed projects is facilitated through a variety of bidding practices including international, limited and local competitive bidding, international and local shopping, and direct contracting without competition. International competitive bidding is used for the largest procurements and is designed to provide all bidders with equal opportunities to compete. Preference may be given to Mexican manufacturers or service providers; in the past, CFE and other Mexican firms have restricted their sources of procurement to local suppliers and have permitted international competitive bidding only when no Mexican company could do the job. The World Bank has encouraged CFE to open up its procurement practices to international competitive bidding.

Limited competitive bidding, on the other hand, is international competitive bidding or direct invitation without open advertisement, and may be preferred for smaller contracts when there are a limited number of qualified suppliers. Local competitive bidding is competitive bidding that is advertised only in Mexico. This has been the route typically chosen by CFE, as it does not have the administrative requirements of international bidding. In addition, local competitive bidding involves limited advertising and no requirement to translate bidding documents into other languages and foreign currencies. Foreign firms may participate in local competitive bidding when they form a joint venture with a Mexican firm.

International and local shopping, and direct contracting require no bidding. Shopping is used when quotations are accepted from several foreign or local suppliers. Direct contracting without competition may be used to extend an existing contract when specific equipment is required in order to be compatible with existing equipment, or when competitive bidding fails to deliver an acceptable bidder.

The *International Finance Corporation*, the World Bank division that finances private sector investments, has long been active in Mexico. To date, the IFC has not supported any investments in the energy and environmental sectors, primarily because there has been no private investment in these areas. The IFC is, however, exploring ways in which wastewater treatment projects can be structured to allow for private sector delivery of such services to municipalities. Discussions have also been held with CFE regarding the financing of power generation facilities; nevertheless, this will not occur as long as CFE, a government-owned company, retains management control over its plants.

The *InterAmerican Development Bank* has also been lending to Mexico for energy and environmental projects. The IDB made its first loan to CFE in 1990 and is currently planning to provide funds for urban reforestation in Mexico City. The Interamerican Investment Corporation, a new private-sector oriented bank affiliated with the IDB, can also provide investment financing for projects in Mexico.

*Mexican development banks have money for environmental projects*

**Mexican Development Banks.** Two Mexican development banks, *Nacional Financiera* (NAFINSA) and *Banco Nacional de Obras y Servicios Public* (BANOBAS) are active in encouraging lending for environmental projects. Neither of these government-owned banks is scheduled to be privatized. Both banks are active borrowers from the World Bank. Some of the World Bank funds are borrowed on behalf of parastatal borrowers (CFE), and some funds are borrowed for onlending to commercial banks and small- and medium-sized commercial and industrial enterprises.

NAFINSA has initiated a loan program to finance projects that reduce or eliminate industrial air and water pollution or conserve energy. Financing is available at long-term preferential rates. The program is administered by NAFINSA and is managed in conjunction with SEDUE. NAFINSA also offers technical assistance and consulting for approved environmental projects.

Additionally, NAFINSA financing is available for air and water pollution control equipment, waste and water recycling equipment, and energy savings equipment. Applications must

be made through a Mexican bank. During the first nine months of 1991, \$13.2 million had been extended to approximately 38 companies.

Borrowers under the NAFINSA program include industrial, commercial, service enterprises, Mexican investors, municipalities, and states. The program is available to Mexican businesses only. In addition to equipment, financing may be requested for training and technical assistance, studies and consulting fees, and commercial and service activities. The maximum credit is \$15 million. If the project involves more than \$7 million, it must follow international bidding practices.

**Other Potential Financing Sources.** Debt-for-nature swaps are a potential source of funding for environmental projects in Mexico, although no large transactions have yet been approved. These swaps involve the government's agreement to allow local currency proceeds, obtained by redeeming discounted government debts, to be used for environmental purposes. Since the completion of the debt agreement, the Government of Mexico is no longer very active in the debt/equity exchange market. However, there are some exchange rights still available that could be used for environmental projects. The government recently approved a \$900,000 debt-for-nature swap to be used by the World Wildlife Fund to conduct environmental studies in Mexico. This method of financing could be expanded to include projects in the air and water pollution markets.

*Financing environmental projects requires innovative ideas*

The following are examples of other proposals under consideration for the financing of environmental projects:

- The Bush administration, under its proposed Enterprise for the Americas legislation, would make increased funds available to the IDB for investment reform and technical assistance, some of which could be used for environmental purposes. The United States has proposed \$1.5 billion of grant funds for Latin America between 1992 and 1996.
- The Enterprise for the Americas Initiative calls for the negotiation of environmental framework agreements where countries will be eligible to convert payments on official debt into local currency, to be used as seed money for environmental projects. For Mexico, several billion dollars of payments due to the U.S. Government under the PL-480, ExIm Bank, the U.S. Agency for International Development and the Commodity Credit Corporation could be used for environmental projects.
- The 1990 U.S. Farm Bill granted authority for the U.S. Government to reduce PL-480 debt for environmental purposes.
- Other potential funds include setting up a trilateral Superfund, charging user fees to U.S. investors in Mexico, and levying taxes on the transport of hazardous materials.

### **3.3 Mexican Investment: Laws, Barriers, and Incentives**

Since the late 1980s, Mexico has been one of the most successful developing countries in attracting new foreign investment. The Salinas administration has recognized that the future success of the country's economic programs and the ability to finance a growing trade deficit depend heavily upon greater inflows of foreign investment. Foreign investment also figures prominently in the government's ambitious privatization program. The Salinas administration's goal is to attract \$25 billion in foreign investment during the 1989-1994 period. From 1987 to 1990, an estimated \$13.3 billion of new foreign investment was realized (Figure 35).

*Mexico has been successful in attracting new foreign investment*

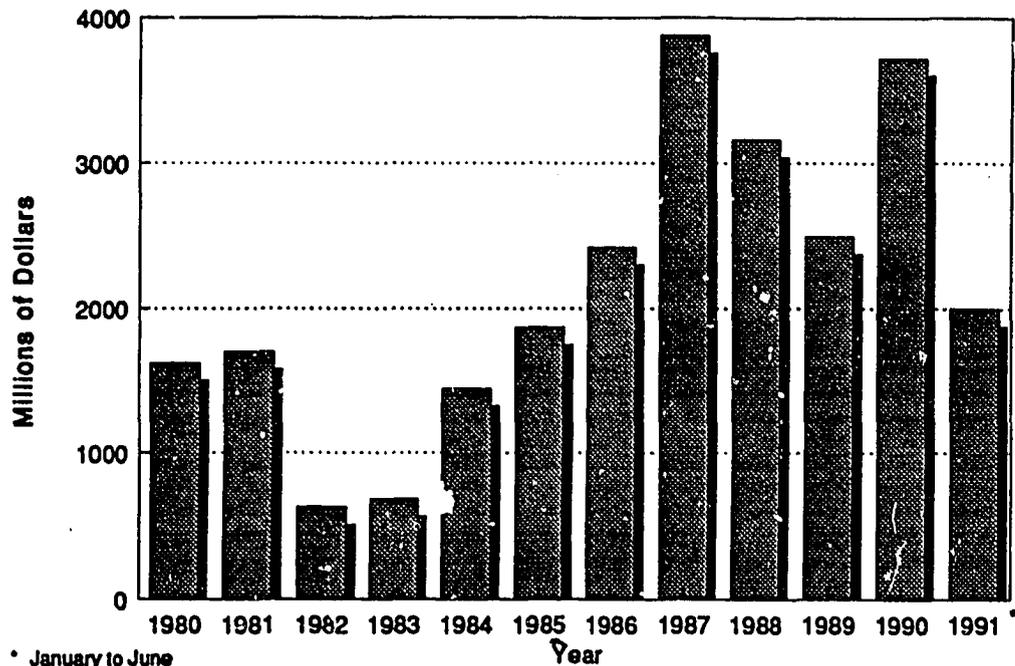
The United States has long been a dominant investor in Mexico. Three of the largest Mexican companies, Chrysler, Ford and GM, are wholly-U.S. owned. Other U.S.-owned companies, IBM, Celanese, and American Express, are among the top 20 Mexican firms.

*The U.S. continues to be Mexico's largest foreign investor*

In addition, the *maquiladora* industry along the Mexican-U.S. border is majority U.S.-owned. It is estimated that over 60% of the 9,000 foreign companies operating in Mexico are partially or wholly U.S.-owned (Table 19).

The Mexican Government first began encouraging foreign investment in 1984 when it liberalized its foreign investment regulations. Prior to this time, it had pursued a policy of restricting foreign ownership. Many of the government's actions, such as the 1982 nationalization of the banks and the 1973 law prohibiting majority foreign ownership, were decidedly against the interests of foreign investors. In 1989, however, significant changes (some of which were considered radical) were made to existing foreign investment laws.

**Figure 35**  
**Foreign Investment in Mexico**  
1980-1990



SOURCE: American Embassy, Mexico "Foreign Investment Report" 1991.

**Table 19**  
**Direct Foreign Investment in Mexico**  
1990

Country of Origin	U.S. \$ millions	Percentage
United States	\$19,204	63%
United Kingdom	2,065	7%
West Germany	1,896	6%
Japan	1,525	5%
Switzerland	1,351	4%
France	879	3%
Spain	757	2%
Canada	418	1%
Sweden	374	1%
Netherlands	323	1%
Others	1,595	5%
<b>Total</b>	<b>\$30,387</b>	<b>100%</b>

Foreign investment in previously closed industries and majority foreign ownership were allowed. At the same time, procedures to expedite foreign investment approvals were put in place.

With the exception of certain industry and ownership prohibitions, Mexican laws currently do not impose general restrictions or limitations on foreign investments. Dividend remittances and capital repatriation are unrestricted. Capital transfers may be effected through the free foreign exchange market at the free market rate. The U.S. Embassy in Mexico reports that foreign investors as a group have been treated fairly. In some ways, however, the Mexican economy still remains closed to foreign investment -- most notably in the Mexican Government's refusal to allow foreign investment in the energy sector, and its disinterest in allowing the U.S. Government, through OPIC, or the World Bank, through the Multilateral Investment Guarantee Agency, to offer investment insurance and guarantees to prospective foreign investors.

*Mexican laws restricting foreign investment and ownership are limited to a few strategic sectors*

Investments are generally encouraged in accordance with the government's economic development plans (e.g., projects that export, are capital or technology intensive, or are located in priority regions). It can be expected that such investments will continue to benefit from expedited approvals and various fiscal incentives. It can also be expected that foreign investments in sensitive sectors, such as oil and gas development and power generation, will be encouraged in more subtle ways. For example, while foreign companies are not allowed to enter into risk-sharing agreements with PEMEX, they have begun to enter into new drilling contracts that involve compensation based on their level of success. CFE, which will need an estimated \$30 billion of new investment between 1992 and 2000, has started to look to private companies to build and finance new power generation facilities. In addition, the topic of investment in the energy sector is certain to be on the agenda (informally, if not formally) in the NAFTA negotiations. Whereas a total opening up of the energy sector is not likely, it probably will not remain as closed as it has been.

#### **Laws Regulating Foreign Investment**

Existing regulation covering most foreign investment activities is the 1973 *Law to Promote Mexican Investment and Regulate Foreign Investment, as amended by 1989 amendments*. This law regulates foreign investment in capital and/or assets of Mexican companies and real estate. The 1973 law prohibited investment in certain sectors and restricted other investments to no more than 49% ownership. The 1989 amendments made three major types of changes: allowance for 100% foreign ownership, opening of new sectors, and expedited approvals.

Currently, foreign investors can invest in a wide range of operations and hold 100% ownership without the need for authorization. Included in this group are most manufacturing operations and tourism. "Trust" mechanisms also exist to allow majority foreign participation in regulated industries, capital markets, and the ownership of real estate in coastal and border regions. A smaller group of activities such as agriculture, livestock, publishing, construction, and certain services require the National Commission on Foreign Investment's (NCFI) approval. NCFI is an autonomous agency composed of representatives of major government ministries, and headed by SECOFI (the Ministry of Commercial and Industrial Development). Exemption from NCFI approval occurs under the following conditions:

*Majority foreign ownership is allowed*

*Some investments do not require approvals*

- the investment does not exceed \$100 million
- the project has direct external funding
- the facilities are not located in Mexico City, Guadalajara or Monterrey
- the investment will not require net foreign exchange over a three-year period

- permanent jobs will be created with job training
- technologies are appropriate and comply with environmental requirements.

For projects requiring NCFI authorization, a decision must be reached within 45 days or automatic approval will be granted. Many of the above exemptions also apply to existing foreign investors seeking to expand operations or increase ownership in existing corporations. It is likely that most new investments in energy and environmental improvement projects will require NCFI approvals.

### **Protection of Intellectual Property Rights**

Intellectual property is governed in Mexico by two laws, the *Industrial Property Law of June 28, 1991*, and the *Copyright Law of 1963, as amended through July 1991*. In the past, Mexico had a poor record of safeguarding non-Mexican intellectual property in Mexico. At one point Mexico was on the U.S.'s "Special 301 watch list" for intellectual property and copyright violations. The new 1991 law, however, represents a marked change in the Mexican Government's approach to industrial and intellectual property rights, and puts Mexico on a par with most developed countries.

*A new intellectual property law is expected to make licensing easier*

Under the new Industrial Property Law, patents are protected in Mexico for 20 years (increased from 14 years) from the date the application for registration is filed. Certain products that were previously unpatentable are now eligible for patent registration and protection. Under the new law, patent licenses or assignments of patent rights must be registered with SECOFI. It is anticipated that the registration procedure will not involve government review or approval.

An important aspect of the new law is its repeal of the Transfer of Technology Law where all agreements that involved technology transfers (i.e., patent and license agreements, know-how and technical assistance agreements) had to be approved by and registered with the National Registry of Transfers of Technology (NRTT). The NRTT traditionally hesitated to register agreements involving excessive royalties, foreign law, and others. These factors should no longer be a problem with technology agreements. Under the same law, trademarks are now protected in Mexico for 10 years (previously protection was for 5 years), and are renewable for successive 10-year terms. Trademarks also require SECOFI registration. The new copyright decree expressly recognizes computer programs as protected works and provides additional protection for other types of copyrighted documents. Enforcement procedures include new criminal penalties and fines. It will no longer be necessary to exhaust all administrative procedures with SECOFI before criminal or civil charges can be made.

### **Tax Laws**

Under the *Income Tax Law*, Mexican corporations are subject to corporate tax at the rate of 35%. Withholding taxes of 15% are charged on payments from royalties, license fees, or other compensation paid to non-residents for technology and technical assistance. If the technology is subject to a patent or trademark, the withholding tax is increased to 35%. Interest payments to non-residents are subject to withholding taxes of 15%, 21%, or 35%, depending on the type of payee. In general, the interest paid to foreign banks or other financial institutions is 15%; interest paid to other credit institutions, foreign suppliers or individuals is 21%; in other cases, the rate is 35%.

Dividends distributed to foreign corporations are not subject to withholding taxes if they are distributed from the company's net after-tax profit for each year. Taxes must be paid on the sale of shares (20%) and on assets owned (2%). Taxpayers may credit their income tax payments against asset tax liability.

Mexico imposes a value-added tax (VAT) on all purchases of goods and services. The general VAT rate was reduced in November 1991 from 15% of the value of the product or service (6% for many items purchased in border areas) to 10%. For exporters, the government refunds the full amount of the VAT tax. The tax is assessed on the customs value of the import plus the import duty.

Beginning in 1990, companies with revenues exceeding 5 billion pesos, assets over 10 billion pesos, or 300 workers or more will be required to hire an independent public accountant to perform an annual tax audit.

### **Investment Incentives**

According to the U.S. Embassy in Mexico, investment and development incentives in Mexico are complex. Both national and foreign companies qualify for accelerated depreciation on investments; this is often the most important investment incentive offered. Other incentives, mainly tax credits, are available primarily for investment in priority regions (seacoasts, ports and border zones), priority industries, or for job creation.

*Mexico offers a range of investment incentives*

First-year tax credits ranging up to 30% of corporate taxes are available to Mexican majority-owned companies. Under the 1986 Tax Law, one-time charges are allowed as follows:

36%	electrical energy production and distribution equipment, electronic transport equipment
51%	buildings
56%	metal production, coal
61%	pulp and paper fabrication, petroleum and natural gas
63%	scientific and professional machinery and instruments
67%	chemical and petrochemical production, pharmacobiological products, rubber and plastics, printing and publishing
84%	machinery and equipment for storage, computation, quality and inventory control, machinery with electronic circuits
87%	equipment to control atmospheric contamination, equipment to investigate new development or technological products

Other incentives include refunds of import taxes to exporters and a variety of inducements for in-bond processing productions.

## **3.4 Strategies for Entering the Mexican Energy and Environmental Markets**

### **Choosing a Business Strategy**

The choice of a strategy for entering the Mexican energy and environmental market largely depends upon a company's own characteristics -- whether it is a consulting engineering company, a civil works contractor, an independent power developer, an exporter of manufactured goods, or a company seeking to manufacture in Mexico for the Mexican market or for export. However, for every company, the choice of a strategy includes developing strong relationships with Mexican counterparts and a reliable network of contacts.

*A reliable network of Mexican contacts is essential*

Most of the business opportunities in the energy and environmental markets will lie in the domestic Mexican market, and not in manufacturing in Mexico for export to other countries. Many of the opportunities will be in the sales of energy and environmental services. Thus, the strategies will be geared towards identifying market opportunities and in determining the best methods of pursuing them.

**Sales of Services.** For sales of services, such as the preparation of environmental impact assessments, or engineering and design services, an important part of a Mexican business strategy is to identify project leads and to team with companies that have already done business in Mexico. In addition to some of the project leads mentioned in this report, tracking new activities of the World Bank, InterAmerican Development Bank, and Mexican government agencies is important. Selling new services to or teaming with existing contractors is another strategy.

For sales of services connected to large, capital-intensive projects, the sales of services are increasingly being bundled with the sales of equipment and with the arrangement of financing. This is particularly true regarding the strategies of non-U.S. competitors, such as the Japanese.

An important strategy for companies selling project-related services is to team with financiers, vendors and developers in the presentation of turnkey packages. Several consortiums have been successful in this way for the construction of power generation facilities, wastewater treatment facilities, and industrial waste treatment facilities.

**Sales of Products.** For companies that have not yet entered the Mexican market, or are new to international business, several entry strategies may be adopted.

*Indirect Exporting.* Indirect options give smaller U.S. companies the chance to take advantage of current opportunities in the Mexican market without assuming many of the financial risks involved in exporting.

- *Selling to Domestic Buyers.* This option typically involves a smaller company selling a particular product to a larger U.S. firm with an established sales operation in Mexico in order to fill gaps in the larger firm's product line. Sometimes called "piggyback manufacturing," this option offers small firms the chance to learn about the Mexican market without incurring marketing and distribution costs or without incurring currency exchange risks.
- *Exporting Through Intermediaries.* In this case, a smaller U.S. firm contracts the services of an export management company (EMC) or an export trading company (ETC) in the United States. EMCs are usually small firms that specialize either in a foreign market or product type, and draw upon a well-established network of in-country distributors. Export agents and remarketers are other types of intermediaries; they typically market products under their own name and assume all financial risks. Finally, small U.S. companies can use commission agents to indirectly market their products in Mexico. Commission agents, either independent or associated with the Mexican Government, are paid by Mexican buyers (private or official) to find U.S. products at the lowest cost.

*Direct Exporting.* These options involve greater risk, but a greater potential for higher profits. In choosing a direct strategy, a firm commits to devote more personnel and financial resources to the exporting process; this may involve changes in a firm's organizational structure (e.g., setting up an international marketing department). A considerable amount of time and money must be invested in targeting the best market, identifying market opportunities, developing distribution channels, and establishing the right contacts in Mexico to facilitate the process.

- **Direct Sales to Local Buyers.** In this case, the U.S. firm utilizes U.S. or Mexican sales representatives to market its products directly to buyers. The U.S. firm takes full responsibility for the cost of shipping, collection and product servicing.
- **Selling Through Mexican Distributors.** Under this strategy, the exporting company sells its product to a foreign distributor at a discount in exchange for sales and servicing support. It is recommended that U.S. firms enter short-term contracts with Mexican distributors initially, extending them later if the relationship works well.

**Establishing a Permanent Presence in Mexico.** This involves some form of direct investment in Mexico.

- **Technology Licensing.** For some companies, technology transfers may be the best method of entering the Mexican market. Technology transfers may make sense where a Mexican company requires access to new technologies, but for one reason or another, neither party wishes to enter into a joint venture arrangement. Technology licensing can be a way to enter a market quickly with fewer financial risks.
- **Joint Venture.** This arrangement has the most obvious advantage of giving a U.S. firm substantial control in the decision-making process of a particular operation. The number of U.S.-Mexico joint ventures has increased significantly with the recent lifting of restrictions on foreign ownership. With the lowering of import tariffs, U.S.-Mexican joint manufacturing operations no longer have to source all their raw and semi-finished materials in Mexico; necessary inputs can now be obtained from the U.S. at a lower import cost. A number of Mexican companies in the energy and environmental field have expressed interest in entering joint ventures with U.S. firms.
- **Local Acquisition.** This strategy involves the purchase of an existing independent Mexican operation. While the number of local acquisitions has been particularly high in the Mexican consumer goods industry lately, the effectiveness of this strategy in the energy and environmental industry is not clear at this time.

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# ACRONYMS

<b>BANOBRAS</b>	<b>Banco Nacional de Obras y Servicios Publicos (National Development Bank for Public Works and Services)</b>
<b>BLT</b>	<b>Build-lease-transfer</b>
<b>BOT</b>	<b>Build-operate-transfer</b>
<b>CETES</b>	<b>Certificados de la Tesoreria de la Nacion (Thirty-day Mexican treasury rates)</b>
<b>CFE</b>	<b>Comision Federal de Electricidad (the national electric utility)</b>
<b>CLFC</b>	<b>Compania de Luz y Fuerza del Centro (the electric utility serving Mexico City, a subsidiary of CFE)</b>
<b>CNA</b>	<b>Comision Nacional de Agua (National Water Commission)</b>
<b>CONAE</b>	<b>Comision Nacional para el Ahorro de Energia (National Energy Conservation Commission)</b>
<b>DDF</b>	<b>Departamento del Distrito Federal (the Federal District's Administrative Office)</b>
<b>DF</b>	<b>Distrito Federal (Federal District--Mexico City)</b>
<b>DFI</b>	<b>Direct foreign investment</b>
<b>DOC</b>	<b>U.S. Department of Commerce</b>
<b>EMC</b>	<b>Export management company</b>
<b>EPA</b>	<b>U.S. Environmental Protection Agency</b>
<b>ETC</b>	<b>Export trading company</b>
<b>ExIm</b>	<b>Export-Import Bank</b>
<b>GATT</b>	<b>General Agreement on Tariffs and Trade</b>
<b>GDP</b>	<b>Gross domestic product</b>
<b>GEF</b>	<b>Global Environmental Facility</b>
<b>GWh</b>	<b>Gigawatt hour</b>
<b>IDB</b>	<b>Interamerican Development Bank</b>
<b>IFC</b>	<b>International Finance Corporation</b>
<b>IMECA</b>	<b>Indice Metropolitano de la Calidad del Aire (Metropolitan Air Quality Index)</b>
<b>IMF</b>	<b>International Monetary Fund</b>
<b>kWh</b>	<b>Kilowatt hour</b>
<b>MTBE</b>	<b>Methyl tertiary butyl ether</b>

<b>MW</b>	<b>Megawatt</b>
<b>NAAQS</b>	<b>U.S. National Ambient Air Quality Standards</b>
<b>NAFINSA</b>	<b>Nacional Financiera (a Mexican national development bank)</b>
<b>NAFTA</b>	<b>North American Free Trade Agreement</b>
<b>NCFI</b>	<b>National Commission on Foreign Investment</b>
<b>NPDES</b>	<b>U.S. National Pollutant Discharge Elimination System</b>
<b>NRTT</b>	<b>National Registry of Transfers of Technology</b>
<b>NTE</b>	<b>Norma Tecnica Ecologica (national environmental standards)</b>
<b>OECD</b>	<b>Organization for Economic Cooperation and Development</b>
<b>OPIC</b>	<b>Overseas Private Investment Corporation</b>
<b>PAESE</b>	<b>Programa para el Ahorro de Energia en el Sector Energetico (Program for Energy Sector Conservation)</b>
<b>PEMEX</b>	<b>Petroleos Mexicanos (National Petroleum Company)</b>
<b>PM</b>	<b>Particulate matter</b>
<b>PMI</b>	<b>Petroleos Mexicanos Internacional (the export-import division of PEMEX)</b>
<b>PRI</b>	<b>Partido Revolucionario Institucional (the ruling party of Mexico)</b>
<b>PROCER</b>	<b>Programa de Cooperacion en Energia Renovable (Program of Cooperation in Renewable Energy)</b>
<b>PRONASOL</b>	<b>Programa Nacional de Solidaridad (National Poverty Alleviation and Development Program)</b>
<b>RAMA</b>	<b>Red Nacional de Monitoreo Atmosferico (the Mexican National Air Quality Monitoring Network)</b>
<b>SARH</b>	<b>Secretaria de Agricultura y Recursos Hidraulicos (Ministry of Agriculture and Hydraulic Resources)</b>
<b>SECOFI</b>	<b>Secretaria de Comercio y Fomento Industrial (Ministry of Commerce and Industrial Development)</b>
<b>SEDUE</b>	<b>Secretaria de Desarrollo Urbano y Ecologia (Ministry of Urban Development and Ecology)</b>
<b>SEMIP</b>	<b>Secretaria de Energia, Minas, y Industria Paraestatal (Ministry of Energy, Mines, and Parastatal Industry)</b>
<b>SPP</b>	<b>Secretaria de Programacion y Presupuesto (Ministry of Planning and Budget)</b>
<b>Telmex</b>	<b>Telefonos de Mexico (the Mexican telephone company)</b>
<b>VAT</b>	<b>Value added tax</b>
<b>VOC</b>	<b>Volatile organic compounds</b>

## **The Office of Energy and Infrastructure**

The Agency for International Development's Office of Energy and Infrastructure plays an increasingly important role in providing innovative approaches to solving the continuing energy crisis in developing countries. Three problems drive the Office's assistance programs: high rates of energy and economic growth accompanied by a lack of energy, especially power in rural areas; severe financial problems, including a lack of investment capital, especially in the electricity sector; and growing energy-related environmental threats, including global climate change, acid rain, and urban air pollution.

To address these problems, the Office of Energy and Infrastructure leverages financial resources of multilateral development banks such as The World Bank and the Inter-American Development Bank, the private sector, and bilateral donors to increase energy efficiency and expand energy supplies, enhance the role of private power, and implement novel approaches through research, adaptation, and innovation. These approaches include improving power sector investment planning ("least-cost" planning) and encouraging the application of cleaner technologies that use both conventional fossil fuels and renewable energy sources. Promotion of greater private sector participation in the power sector and a wide-ranging training program also help to build the institutional infrastructure necessary to sustain cost-effective, reliable, and environmentally-sound energy systems integral to broad-based economic growth.

Much of the Office's strategic focus has anticipated and supports recently-enacted congressional legislation directing the Office and A.I.D. to undertake a "Global Warming Initiative" to mitigate the increasing contribution of key developing countries to greenhouse gas emissions. This strategy includes expanding least-cost planning activities to incorporate additional countries and environmental concerns, increasing support for feasibility studies in renewable and cleaner fossil energy technologies that focus on site-specific commercial applications, launching a multilateral global energy efficiency initiative, and improving the training of host country nationals and overseas A.I.D. staff in areas of energy that can help to reduce expected global warming and other environmental problems.

To pursue these activities, the Office of Energy and Infrastructure implements the following seven projects: (1) The Energy Policy Development and Conservation Project (EPDAC); (2) Biomass Energy Systems and Technology Project (BEST); (3) The Renewable Energy Applications and Training Project (REAT); (4) The Private Sector Energy Development Project (PSED); (5) The Energy Training Project (ETP); (6) The Conventional Energy Technical Assistance Project (CETA); and (7) its follow-on Energy Technology Innovation Project (ETIP).

The Office of Energy and Infrastructure helps set energy policy direction for the Agency, making its projects available to meet generic needs (such as training), and responding to short-term needs of A.I.D.'s field offices in assisted countries.

Further information regarding the Office of Energy and Infrastructure's projects and activities is available in our Program Plan, which can be requested by contacting:

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