



The Demand for Environmental  
**Education and Training**  
in Mexico

A study on capacity building  
in environmental management  
from the Commission for  
Environmental Cooperation



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**Education and Training**  
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## ACKNOWLEDGMENTS

As part of this project, the CEC formed a trilateral working group to oversee the planning and data analysis of this study. Participants included Canadian, US and Mexican environmental experts from the public, private, academic and nonprofit sectors.

The group held three meetings, the first of which was in Mexico City, where the process and content of the survey were reviewed and approved. At the second meeting, in San Diego, California, the preliminary survey results were analyzed and the analytical process and format for the final report were agreed upon. The task for the final meeting, in Calgary, Alberta, was the review and approval of the contents of the final document. Comments and suggestions from this meeting were also used to refine the final document. The participants in the Trilateral Working Group were:

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The authors want to take this opportunity to thank the valuable overview and commentary from every one of the experts who participated in the trilateral working group. Special thanks are extended to the CEC's Capacity Building Program for guidance, encouragement, and financial support throughout the project, which ensured the quality of this final report.

Note: An \* designates participants at the first meeting, held in Mexico City.

## AUTHORSHIP

The present document is a condensation of two CEC studies reviewing various aspects of this important topic: environmental education and training programs in Mexico. In 1995 Dr. Edmundo de Alba and Biól. José Manuel Galindo completed a study for the CEC entitled, *Demand and Supply Services and Cooperation Opportunities for Environmental Education and Training in North America*. That document compared the supply and demand of current environment education programs in Mexico with the situation in the United States and Canada, suggested opportunities for future cooperation, considered the problems of accreditation and certification of such programs in Mexico and throughout the North American region, and presented a proposal for future activities in these areas. That work may be found in summary form in the appendix (section 5) of the present report. In 1996, Drs. R.A. Deju and J.A. Cuellar, and Ing. M.A. Sandoval prepared a related study on this topic for the CEC. Their report, which in abridged form constitutes the body of the present document, dealt with a survey conducted in various sized Mexican companies to quantify the demand for environmental education and training in Mexico's industrial sector, and the ensuing conclusions and recommendations.

## EXECUTIVE SUMMARY

The development of environmental education and training programs in North America is a priority for the Commission for Environmental Cooperation (CEC) and is an important part of its overall objective to encourage regional cooperation and public participation in conservation and environmental protection in North America. The present study's primary goals were to:

- Define the demand for environmental education and training in the Mexican industrial sector by means of an extensive survey;
- Assess the long-term trends in the delivery mechanisms for these services; and
- Analyze opportunities for the promotion of environmental education and training in Mexico's industrial sector, primarily through regional cooperation.

The survey was sent in the form of a questionnaire (summarized in section 2), and 528 completed responses were received. Analyzed to explore geographical differences as well as trends related to company size and type, the survey results (presented at greater length in section 3 and analyzed in section 4) revealed the high priority given by industrial sector to the environmental training of its personnel, particularly in the areas monitored by regulatory authorities and in which cost savings can provide economic incentives, for example, in waste management.

The overall priorities of the respondents were:

- The regulatory and legislative framework;
- Programs for pollution prevention and the operation of pollution prevention systems;
- Prevention of water pollution and the management of water treatment systems;
- Management of solid and hazardous waste;
- Energy efficiency;
- Health, safety and security;
- Air pollution; and
- Waste reduction, product reuse and recycling.

The most significant variations in the demand for environmental training were found as a function of the size and type of business, rather than geographical location. The chemicals, plastics and energy sectors indicated the greatest interest in all areas of environmental training, probably as a result of their increased awareness.

The following conclusions can be drawn from the survey:

- There is a spirit of cooperation along with a high level of interest in environmental education and training within the survey group.
- An understanding attitude toward environmental authorities and current regulations currently exists among the survey's respondents.
- There is clear dissatisfaction among the respondents with the quantity and quality of the curriculum presently available, coupled with a great interest in increasing the environmental training of their work force. This points out the need for the reassessment of the content, location and timing of the training programs currently offered in Mexico so that they better fulfill the needs of Mexican companies.
- The use of consultants is very low, especially by smaller companies, which would indicate that consulting firms need to do more to prove that they do indeed provide "value added" services.
- Respondents seemed to favor in-plant training while extension programs, or diplomado courses, were least favored, principally by the smaller companies. [Note: A "diplomado" course is of relatively long duration, usually several months, and is devoted to a specialized subject and designed to satisfy the continuing educational needs of professionals.] Self-study material was also considered to be an important alternative, especially for worker training.

As a result of environmental awareness campaigns, the environmental training market in Mexico should experience substantial growth, especially if financial or institutional incentives are implemented. It is thus of sufficient size to warrant the creation of both private and non-profit organizations to serve as delivery mechanisms. It is estimated that the overall market today will generate approximately US \$14 million dollars in annual revenue. Because there are likely to be significant differences between the amounts that respondents indicate they are willing to spend versus what they will actually spend, it should be emphasized that trends and market size tend to be more accurate than spending patterns.

The detailed analysis (section 4) of the demand for industrial environmental education and training in Mexico estimates longer-term needs and trends in supply,

and provides suggestions for increasing the speed of growth of environmental awareness. It also suggests various means by which environmental education and training may be promoted through regional cooperation. Finally, section 4 suggests both short- and long-term strategies for improving existing programs, in order to satisfy more fully the demand for environmental education and training services in Mexico.

Short-term recommendations are as follows:

1. Reinforce existing programs and institutions while continuing to support new programs, especially in areas of the country which currently lack them.
2. Give priority to the training of persons possessing many skills who can be rapidly integrated into the labor market.
3. Expand the dissemination of environmental awareness information through bulletins, posters and general training programs given at low cost or free of charge.
4. Give priority to the establishment of basic training programs for smaller companies, with the support of industrial and labor groups.
5. Continue the emphasis on audits and inspections to keep the focus on environmental protection in the industrial sector.
6. Emphasize “train the trainer” programs.
7. Encourage greater participation of both national and foreign-based institutions in the environmental training sector in Mexico.
8. Use regional cooperation programs to help: train educators and instructors, develop training materials, train auditors and inspectors, and exchange relevant information.
9. Continue and promulgate multinational cooperative programs between academic institutions, including the use of regional and international events to promote such cooperation.
10. Develop and implement an electronic system for the dissemination for information to specialists, particularly in areas of “clean” technologies and pollution prevention techniques.

Over the long term, the implementation of skill-based training is essential in order to enhance the human resources available to meet Mexico’s environmental needs. Not surprisingly, considering Mexico’s current economic crisis, the survey shows a great demand for short-term programs; however, the overall aim should be to ensure that Mexico has executives, technical staff and workers with the appropriate environmental skills to execute their respective job functions.

The CEC can serve as a catalyst in the development of short-term initiatives for regional cooperation. These initiatives can, at the same time, assist in the development and harmonization of environmental certification programs throughout North America.





## 1.0 INTRODUCTION

### 1.1 A BASIS FROM WHICH TO VIEW ENVIRONMENTAL EDUCATION AND TRAINING IN MEXICO

The Intergovernmental Conference on Environmental Education, held in T'bilisi, Georgia, in 1977, was undoubtedly the most important global event of its kind to that point. Born out of a series of documents produced by earlier conferences held in Stockholm, Sweden and Belgrade, the T'bilisi conference analyzed the major environmental problems of our world and established a strategy for the development of environmental education programs at regional, national and multinational levels.

The T'bilisi conference noted that all members of the human community should have access to environmental education and that these programs should encourage the public at large to involve themselves in both the comprehension and solution of environmental problems. Furthermore, it urged that environmental education programs must also serve professionals (engineers, urban planners, architects, doctors, teachers, industrial administrators and so on), researchers and environmental specialists, whose activities directly affect the environment.

In establishing its environmental program, the Mexican government has followed the steps outlined at the T'bilisi conference and has defined environmental education and training as "the mechanisms to achieve a code of conduct consistent with the enormous deterioration of many ecosystems that represent the biological substrate of industrial development." This program clearly defines the importance of environmental education as part of the process by which a society transmits the cultural heritage necessary to meet basic survival needs from one generation to the next. Environmental education and training in Mexico must therefore involve the entire population of the nation or a region (including those without formal education) and must include programs that not only increase environmental awareness but also provide new skills. In addition, companies need the resources that allow the adoption of new concepts and which will, in turn, permit an equilibrium between production and environmental protection. From this vantage point, environmental education and training provide the key that can permit sustainable development in Mexico.

References to environmental education and training in this report adhere to the definitions established at the T'bilisi meeting which were also used in the 1995 CEC report by Dr. de Alba and Biol. Galindo (see item 1, section 6). This definition includes a great diversity of programs and activities including: higher education, technical schooling, professional specialization, teacher training, environmental awareness training, public education and worker-training updates.

As noted in previous reports (see section 5, appendix), Mexican companies need environmental education programs that provide a technical backbone for its specialists and executives as well as awareness training, updating and broad-based environmental programs for all personnel whose work may affect the environment. The framework of the T'bilisi conference paves the way for a technical, political and social foundation from which these environmental education and training programs can evolve.

### 1.2 PREVIOUS STUDIES

The CEC-commissioned study by de Alba and Galindo, previously mentioned in section 1.1, presents a comprehensive summary of work previous to 1995 aimed at defining the supply and demand for environmental education and training services in Mexico. This document can be found in summary form in the appendix (section 5) to this study. Persons wishing more information should contact Dr. Hernando Guerrero at the CEC.

In 1993, the National Institute of Ecology (INE) developed the first survey assessing Mexico's environmental training needs. This survey is updated periodically by the environmental secretariat. A list of other published reports and analyses concerning both the supply and demand for environmental education and training in Mexico's industrial sector (items 1-14) as well as documents dealing with programs in the United States and Canada (items 15-30) can be found at the end of this section.

An analysis of these earlier studies coupled with a 1995 CEC roundtable on the subject suggest a series of priorities and a point of departure for the present report. Some of the most significant conclusions of these prior studies are that:

1. The Mexican private sector, especially the manufacturing and process industries, needs environ-

mental training regarding laws and regulations, administrative procedures of the regulatory authorities, opportunities to minimize hazardous waste, and pollution prevention. Companies need training to reduce the cost of production while enhancing environmental protection and waste reduction.

2. Although there is general interest among industrial leaders in having their workers participate in environmental training programs, the Mexican economic crisis has dramatically affected the resources available for such training. Previous studies, therefore, stress the availability of low-cost programs as well as those which promote cost reduction as a result of environmental improvements.
3. Because various companies have different priorities, new programs for environmental education and training must be geared initially toward technicians, specialists and executives of small and medium-size companies.
4. Mexico's needs with respect to environmental education and training must be thoroughly evaluated through the use of surveys, interviews and direct contacts with experts as well as chambers of commerce and labor. This being said, the experience and resources already available in the United States and Canada provide Mexico with an opportunity to build programs more rapidly in this area, primarily through regional cooperation programs.

Other conclusions drawn from the 1995 CEC roundtable suggest the following:

1. Consider options to strengthen "train the trainer" programs.
2. Achieve a better balance between the supply and demand for environmental education and training programs in both public and private sectors, including non-profit organizations.
3. Identify common environmental programs throughout North America that can be developed and promoted through regional cooperation.

The roundtable discussions served, in general terms, to illuminate the direction which the CEC needed to take to define more clearly the nature of the demand for environmental education and training in Mexico. That, in turn, formed the basis (i.e., terms of reference) upon which the scope of the present study is built.

### 1.3 OBJECTIVES OF THIS STUDY

The overall goal of this study was to define the demand for environmental education and training services in the Mexican industrial sector. In addition, the study sought to assess alternatives to satisfy this demand, using regional cooperation programs. Specifically the study's objectives were to:

1. Analyze the demand for environmental training and education in Mexico's industrial sector, taking into consideration both long- and short-term outlooks and paying special attention to the executive, professional and technical levels of both small and medium-size companies.
2. Identify areas of the Mexican industrial sector where environmental training is a high priority.
3. Assess long-term trends in both the supply and demand of environmental education and training services.
4. Analyze and identify opportunities for promoting priority activities in the Mexican environmental education and training sector, including financing considerations.
5. Define a foundation for both long- and short-term cooperative programs throughout North America, emphasizing the creation of market incentives.

The project, as defined above, involved conducting an extensive survey of both private and state-owned businesses of the Mexican industrial sector (except for micro industries). This survey complemented meetings held with selected industrial representatives, which attempted to better quantify their demand for environmental education and training services, especially in the short term. The survey was the principal means by which the information needed to fulfill the first two objectives above

was gathered. Objectives 3 to 5 used information from prior studies in addition to the survey data.

## 2.0 METHODOLOGY

As indicated in section 1, the fundamental objective of this study was to define the environmental education and training needs of the industrial sector in Mexico. To accomplish this, a survey was conducted to define the demand for environmental training, especially in the short term. This section describes the methodology used in developing this survey.

### 2.1 SURVEY CHARACTERISTICS

For the first part of this study the authors designed a survey with characteristics and a sample distribution such that meaningful conclusions about environmental education and training could be obtained for small, medium-size and large companies. The objective was to receive a sufficient quantity of completed questionnaires to assure a valid sample. The questionnaires were sent to a total of 3,000 companies—approximately 12 percent of the companies in the sectors considered. Companies were selected to ensure adequate representation by size, geography and sector. The goal was to receive at least 450 responses with a distribution comparable to that of the posted questionnaires.

In order to determine the relative percentages of companies of various size to be included in the sample, three equally weighted criteria were used:

- Number of businesses in the sector
- Number of jobs generated per sector
- Gross domestic product by sector (GDP)

The size distribution was determined using the data contained in **Table 2–1** as a basis. This distribution is as follows:

- Small companies 40 percent
- Medium-size companies 15 percent
- Large companies 45 percent

While the larger companies represent 69 percent of the GDP and over 55 percent of all employment, smaller companies represent 75 percent of all businesses but only 25

Table 2–1	THE NUMBER, EMPLOYMENT GENERATION LEVEL AND ECONOMIC SIGNIFICANCE OF BUSINESSES OF VARIOUS SIZES IN MEXICO		
<b>SIZE</b>	<b>NUMBER OF COMPANIES</b>	<b>%</b>	<b>CUMULATIVE %</b>
Small	16,831	75.4	75.4
Medium-size	3,204	14.4	89.8
Large	2,285	10.2	100.0
<b>TOTAL</b>	<b>22,320</b>		
<b>SIZE</b>	<b>JOBS GENERATED</b>	<b>%</b>	<b>CUMULATIVE %</b>
Small	643,691	25.1	25.1
Medium-size	498,699	19.5	44.6
Large	1,417,555	55.4	100.0
<b>TOTAL</b>	<b>2,559,945</b>		
<b>SIZE</b>	<b>GROSS DOMESTIC PRODUCT (thousands of pesos)</b>	<b>%</b>	<b>CUMULATIVE %</b>
Small	26,131,018.4	15.6	15.6
Medium-size	25,830,914.5	15.5	31.1
Large	115,189,351.4	68.9	100.0
<b>TOTAL</b>	<b>167,151,284.3</b>		

Source: XIV Censo Industrial, Censos Económicos 1994, INEGI

percent of the jobs. The distribution selected provides a sample that reflects the need to cover the breadth of smaller companies while recognizing that the majority of employees—and in particular laborers, those workers most in need of training—are engaged by the larger businesses.

The second variable considered was geographical distribution. Most desirable was a sample that included at least twenty companies for each major area of the country but that was weighted towards the areas of greatest industrial strength. **Tables 2–2 a** and **b** show the database of both the GDP and the overall economic productivity of each major metropolitan area. Based on these considerations the sample chosen included the following geographical distribution:

- Mexico City and surroundings 35 percent
- Monterrey–Saltillo 18 percent
- Guadalajara–Aguascalientes 12 percent
- Northern border states 15 percent  
(Juárez–Chihuahua and Tijuana–Mexicali)

- Other regions (Querétaro Centro, Tampico–Altamira, Coatzacoalcos) 20 percent

The last variable considered in designing the sample was the large range of production sectors. In order to simplify the process, all companies in the sample were separated into four categories:

- Metal bending/machinery/equipment;
- Food, beverages and tobacco;
- Chemicals, plastics, rubber and energy; and
- Other manufacturing industries.

This last category included textiles, leather, paper, printing, sculpture and jewelry fabrication, instrument making, toys and furniture. **Table 2–3** shows the economic and employment data which were used to define sample distribution by industrial sector.

After defining the distribution characteristics of the survey, experts from both the private and public sectors, as well as the databases of Semarnap, Profepa and others obtained through the Binational Environmental Business Committee, were consulted to assemble a list of 3,000 businesses to be surveyed. The format for the survey questionnaire was carefully developed by the authors of the study and extensively reviewed by the CEC and the trinational working group. **Table 2–4** presents a summary translation of the survey questions.

Incomplete responses to the questionnaire were followed up by telephone, after which the results of the survey were catalogued and analyzed as described in subsequent sections. Given the care with which the survey was designed and executed, the large number of companies sampled and the distribution of the respondents, the authors believe that meaningful conclusions can be extrapolated from the data, especially over the short term. It should be pointed out, however, that care must always be exercised when analyzing survey results, as responses may be affected by the manner in which the questions were drafted.

The trinational working group monitoring the project commented on the preliminary results and assured the inclusion of all components of the terms of reference in the study. The authors also met, both individually and collectively, with experts in the areas of environmental education and training. It has been the authors' intent,

Table 2–2a		GROSS DOMESTIC PRODUCT BY METROPOLITAN AREA (Thousands of Pesos)	
1988			
METROPOLITAN AREA	GDP	%	
Mexico total	390,451,299	100.00	
Federal District	83,371,073	21.35	
México	44,511,815	11.40	
Jalisco	26,463,416	6.78	
Nuevo León	24,724,058	6.33	
Veracruz	22,183,413	5.68	
Guanajuato	12,884,944	3.30	
Chihuahua	12,684,878	3.25	
Puebla	12,121,622	3.10	
Coahuila	11,664,132	2.99	
Baja California	9,929,109	2.54	
Aguascalientes	2,865,161	0.73	
<b>TOTAL</b>	<b>263,403,621</b>	<b>67.45</b>	

Source: *Perfil Estadístico de la Población Mexicana*, INEGI, 1994

Table 2–2b		NET MUNICIPAL INCOME OF PRINCIPAL METROPOLITAN AREAS (Thousands of Pesos)	
1992			
METRO AREA	NET INCOME	%	
Federal District	1,053,021	10.38	
Monterrey	655,927	8.47	
Guadalajara	489,328	4.83	
Mexicali	327,884	3.23	
Juárez	293,063	2.89	
Tijuana	264,627	2.81	
Chihuahua	249,930	2.48	
Puebla	218,563	2.15	
Hermosillo	170,371	1.68	
León	148,502	1.45	
Querétaro	138,734	1.37	
Aguascalientes	132,368	1.30	
Nuevo Laredo	124,937	1.23	
Torreón	113,980	1.12	
Toluca	113,797	1.12	
Veracruz	99,786	0.98	
Saltillo	98,585	0.97	
Tampico	98,435	0.97	
Coatzacoalcos	48,518	0.46	
<b>TOTAL</b>	<b>10,144,143</b>	<b>47.50</b>	

Note: Net income is defined as the total revenue collected by a municipality from taxes, rights, participation in private sector activities and any other sources.

Source: *El Ingreso y el Gasto Público en México*, INEGI, 1994.

through this survey and the analysis of a number of significant prior studies, to gain a perspective on the equilibrium existing between the supply and demand of environmental education in Mexico in order to give the CEC realistic options with which to improve the quality and availability of these programs.

Table 2-3		INDUSTRIAL EMPLOYMENT AND VALUE OF PRODUCTION BY SECTOR			
<b>INDUSTRIAL EMPLOYMENT BY SECTOR 1993</b>					
No.	Sector	Jobs	%		
1	Metal bending, machinery and equipment	962,060	29.64		
2	Food, beverages and tobacco	704,317	21.70		
3	Textiles and leather	547,290	16.86		
4	Chemicals, plastics and rubber	380,140	11.71		
5	Pulp and paper industries	197,371	6.08		
6	Nonmetallic minerals	183,868	5.66		
7	Wood and furniture	168,023	5.18		
8	Basic metals	59,045	1.82		
9	Other manufacturing industries	43,928	1.35		
<b>TOTAL</b>		<b>3,246,042</b>	<b>100.00</b>		
<b>ADDITIVE VALUE OF PRODUCTION BY SECTOR (thousands of pesos) 1993</b>					
No.	Sector	Additive value of production	%	GDP	%
1	Metal bending, machinery and equipment	47,003,645	25.35	291.6	22.95
2	Food, beverages and tobacco	48,908,111	25.30	336.6	26.49
3	Chemicals, plastics and rubber	42,739,156	23.05	225.9	17.78
4	Textiles and leather	15,473,983	8.35	114.9	9.04
5	Nonmetallic minerals	11,964,871	6.45	90.1	7.09
6	Pulp and paper	10,241,931	5.52	67.3	5.30
7	Basic metals	6,136,339	3.31	74.7	5.88
8	Wood and furniture	3,488,125	1.88	37.7	2.97
9	Other manufacturing industries	1,465,009	0.79	32.0	2.50
<b>TOTAL</b>		<b>185,421,171</b>	<b>100.00</b>	<b>1,270.8</b>	<b>100.00</b>
<p>Note: The additive value of production by sector reflects the aggregate added value produced by each sector through the industrial process. This value has not been reduced by any asset depreciation.</p> <p>Source: <i>XIV Censo Industrial, Censos Económicos 1994</i>, INEGI</p>					

Table 2-4	GENERAL CONTENTS OF THE SURVEY: ENGLISH SUMMARY	
<p><b>Section 1</b></p> <ul style="list-style-type: none"> <li>Name and address of the business</li> <li>Name and position of the respondent</li> <li>Name of the executive responsible for environmental protection</li> <li>Name of the executive responsible for training</li> <li>Number of managers, workers, and total employees within the business</li> <li>Level of foreign investment</li> <li>Industrial sector(s) of the business</li> <li>Location of business operation(s)</li> </ul> <p>In section 1, the survey form included space for the survey administrators to encode numbers to ensure the easy classification of all surveys returned to us.</p>		<p><b>Technical Issues</b></p> <ul style="list-style-type: none"> <li>Air pollution</li> <li>Water pollution</li> <li>Soil contamination</li> <li>Environmental impact</li> <li>Clean technologies</li> </ul> <p><b>Waste Reduction and Pollution Prevention</b></p> <ul style="list-style-type: none"> <li>Waste reduction/reuse/recycling</li> <li>Saving and efficient use of energy</li> <li>Pollution prevention programs</li> </ul> <p><b>Resource Management</b></p> <ul style="list-style-type: none"> <li>Sustainable management of natural resources</li> <li>Biodiversity</li> </ul>
<p><b>Section 2</b></p> <p>The purpose of this section of the survey was to pinpoint the respondents' needs, priorities, and desires regarding environmental education and training in 19 distinct areas. Further, the survey tried to ascertain the quality and quantity of programs currently available. Respondents were asked four basic questions in each of 19 survey areas:</p> <ul style="list-style-type: none"> <li>Indicate the importance of each area to your business (1=greatest to 3=lowest)</li> <li>Does your business have sufficient information in each of the following areas (1=greatest to 3=lowest)</li> <li>Does your business have adequate programs for environmental training in each of the following areas (1=better to 3=worse)</li> <li>Do you have a desire to implement and have someone conduct additional environmental training programs in your business (yes/no)</li> </ul> <p>The aforementioned questions were posed in the survey in relation to 19 specific areas as follows:</p> <p><b>Legislation and Regulation</b></p> <ul style="list-style-type: none"> <li>Environmental standards and legislation</li> <li>Environmental audits</li> <li>Environmental management systems (ISO 14000)</li> </ul> <p><b>Operations</b></p> <ul style="list-style-type: none"> <li>Management of operating systems to prevent pollution</li> <li>Health, hygiene and security</li> <li>Risk management</li> <li>Hazardous waste management</li> <li>Solid waste management</li> <li>Inspections</li> </ul>		<p><b>Section 3. Other Questions</b></p> <p>For each of the following categories (1=all levels above supervisor, 2=supervisors and technicians, and 3=workers) indicate:</p> <ul style="list-style-type: none"> <li>Number of trained employees</li> <li>Number of employees to be trained</li> <li>Average training hours per employee (1994-95)</li> <li>Average training hours per employee (1996-97)</li> <li>Total outlay 1994-95</li> <li>Proposed total outlay 1996-97</li> </ul> <p>Do you subcontract outside consultants to conduct environmental training (yes/no, who—name, phone)</p> <p>What price per person do you consider acceptable for a training session of 8 hours?</p> <p>[Note: four cost options were given in Mexican pesos, as follows: 1=1,501-3,000, 2=1,000-1,500, 3=501-1,000, 4=501 or less. Respondents were requested to identify the cost per person for each of three categories (management, supervisors and technicians, and workers).]</p> <p>What training options do you consider most appropriate to meet your company's environmental training objectives?</p> <p>[Note: Respondents were asked to choose from: external short courses, in-plant courses, diplomado courses, and self-study manuals]</p> <p>What environmental training needs do you currently find difficult to meet?</p> <p>Space for additional comments.</p>

### 3.0 A DEFINITION OF THE DEMAND FOR ENVIRONMENTAL TRAINING

This section presents the results of the survey described in section 2. These are divided into the following topics:

- A comparative analysis between the characteristics of the planned survey sample and the responses received;
- An identification of the training methods preferred by the survey respondents and the frequency with which various companies contract environmental training consultants;
- An analysis of industrial sector priority areas;
- An assessment of the respondents' level of satisfaction with current environmental training programs;
- An estimate of market size in Mexico's environmental training sector and an approximation of the amount companies will spend to satisfy these needs;
- A list of additional individual comments made by respondents; and
- General conclusions about the demand for environmental education and training, especially in the short term. Section 4 will discuss these conclusions at greater length.

#### 3.1 COMPARISON OF THE DESIRED SAMPLE WITH THE RECEIVED RESPONSES

The goal was to receive a minimum of 450 completed survey responses with a distribution similar to that of the planned sample presented in section 2.1 (i.e., by industrial sector, geographical zone and size). In fact, the actual survey response exceeded the goal by 17 percent, with a total of 528 responses. Although the distribution of the received sample was within plus or minus 3 percent of the planned sample for both industrial sector and geographical location, the responses by business size varied to a greater extent. Medium-size companies made up 25 percent of the actual sample, as opposed to a planned 15 percent, while large companies responded with 34 percent of the sample, compared to the planned levels of 45 percent.

Another relevant statistic is the capital mix in the businesses among the survey respondents: 70 percent of all companies were fully Mexican-owned while 30 percent had some degree of foreign ownership. Majority foreign ownership was greater in the larger companies (15.57 percent) than in the smaller companies (2.80 percent).

More than 87 percent of the small companies that responded had no foreign ownership at all, whereas only 47 percent of the large companies had none.

Because the number of responses received was sufficient to conduct the analysis, the smaller-than-anticipated response from large companies should not affect the validity of the survey, and the overall number and distribution of the responses should be adequate to permit valid conclusions to be drawn. Caution must be exercised, however, when examining the results from any survey. Excessive weight should not be given to small differences, and certain results may have various interpretations. The conclusions drawn from this survey have been carefully considered within the context of previous investigations as well as the authors' own experience.

#### 3.2 PREFERRED TRAINING OPTIONS AND THE USE OF CONSULTANTS

Training option preference in the Mexican industrial sector was one of the points the authors wished to explore. **Table 3–1** indicates the preference of respondents for each type of program. For statistical purposes all companies were classified into five categories: large, medium-size, small, maquiladoras, and totally Mexican-owned businesses. The last two categories were included in order to assess cultural trends in the maquiladoras, especially given their strong relationship with the export process and the potential differences between nationally owned companies and multinationals.

Whereas the survey data show a clear preference for in-plant courses, diplomado courses are the least-favored academic option, especially by the small companies. Short, externally offered courses and self-study programs are preferred almost equally. Maquiladoras and large companies show similar preferences in all categories except with respect to diplomado courses, which is not surprising, given that, due to their respective geographical locations, many maquiladoras do not have the same access to educational courses as most of the larger companies. In fact, aside from the few differences outlined above, all five categories of businesses had essentially the same preferences, albeit to greater or lesser degrees.



It is important to note that while in-plant courses seem best suited to worker training and awareness, diplomados and short external courses are probably the essential tools for educating executives and key technical experts, as many of the topics geared toward this group are difficult to offer in-plant.

On average, each respondent identified two preferred options for training workers, executives and technical staff. Respondents from the larger companies selected more training options, a 2.33 average, while those in medium-size companies selected, on average, 1.91 options and those in small companies, 1.71. Significantly, maquiladoras selected an average of 2.25 options, very similar to numbers for the larger companies. This is perhaps a measure of the greater familiarity with environmental training in both sectors.

One point that needs to be mentioned is the extent to which consultants are used to help various businesses with environmental training plans and programs. The survey data shows that only 32 percent of large companies, 20 percent of medium-size companies and 11 percent of small companies use external consultants. All of these numbers are regarded as small. The greater use of consultants by the larger companies is deemed a consequence of both the greater familiarity of larger companies with consultants and also the greater financial resources available to larger companies. Given the great interest shown in all options of environmental training, a careful analysis of the demand characteristics should yield a significant increase in business for training consultants.

### 3.3 ENVIRONMENTAL TRAINING PRIORITIES IN THE MEXICAN INDUSTRIAL SECTOR

In order to ascertain the environmental education and training priorities in Mexico’s industrial sector, the survey asked respondents to examine a list of 19 different environmental fields and then indicate which areas their business would identify as having a high priority for training (see **Figures 3–1** through **3–16**). They were also asked in which areas they most desired programs. The overall results are as follows:

1. Although the priorities for large, medium-size and small companies differed, the trends were similar for companies of all sizes. Of note is the fact that geographical or regional location did not appear to be significant. Trends were most affected by the industrial sector of the respondents. For example, the chemical, plastics and energy sectors rated the priority of every environmental area at over 90 percent. This is significantly different than the other sectors.

This last finding is perhaps due to the greater environmental awareness of respondents in the chemical, plastics and energy sectors, as well as the well-recognized economic benefit of environmentally beneficial measures such as recycling and pollution prevention. One other observation of importance is that large companies tended to give higher priority to the various areas than did medium-size and small companies. This is perhaps due to the greater financial resources and information base of the larger companies.

Table 3-1	PREFERRED TRAINING METHODS FOR VARIOUS INDUSTRIAL SECTORS				
	Industry (% of sampled companies)				
	Large	Medium-size	Small	Maquiladora	National
External (brief) courses	57%	52%	48%	59%	52%
In-plant courses	78%	70%	67%	75%	72%
“Diplomado” courses	45%	28%	18%	35%	25%
Self-study programs	54%	41%	46%	51%	48%
Average number of programs mentioned by a respondent	2.33	1.91	1.71	2.25	1.96

2. It is obvious upon analysis of the survey results that there is a great deal of interest in environmental education and training. In general terms, the areas of greatest priority for the respondents were:
  - Environmental standards and legislation;
  - Management to prevent pollution;
  - Water pollution and treatment;
  - Hazardous and solid waste management;
  - Energy efficiency;
  - Health, hygiene and security;
  - Air pollution; and
  - Waste reduction, reuse and recycling.
3. The environmental areas of least priority were:
  - Biodiversity;
  - Sustainable resource management;
  - Environmental impact;
  - Environmental management systems (ISO 14,000); and
  - Risk management.
4. The respondents in the categories of “food, beverages, and tobacco” and “other manufacturing companies” gave low priority to the following areas:
  - Biodiversity;
  - Health, hygiene and security;
  - Environmental impact; and
  - Risk management.

The low priority given to health, hygiene and security by these sectors is of real concern. The maquiladoras, on the other hand, assigned a very high priority to health, hygiene and security—a reflection of the importance placed on such topics by the authorities and business leaders within companies and maquiladoras.

5. The desire for training programs did not totally agree with the programs of highest priority, rather, they varied as a function of company size. In all cases, however, the strongest preferences were for courses in pollution prevention management, energy efficiency and regulatory and legislative policies.

Respondents from larger companies indicated their desire for courses on waste reduction, reuse and recycling, pollution control systems and environmental management systems (ISO 14,000) while respondents from small companies favored health, hygiene and

security and management of operating systems for pollution prevention.

It is also clear from the survey that the respondents’ desires cover a broad range and that it is not realistic to base conclusions on small differences. In order to convince industrial groups of the benefits of environmental education and training programs they must first be persuaded that these programs are cost-beneficial in terms of both economic and human resources.

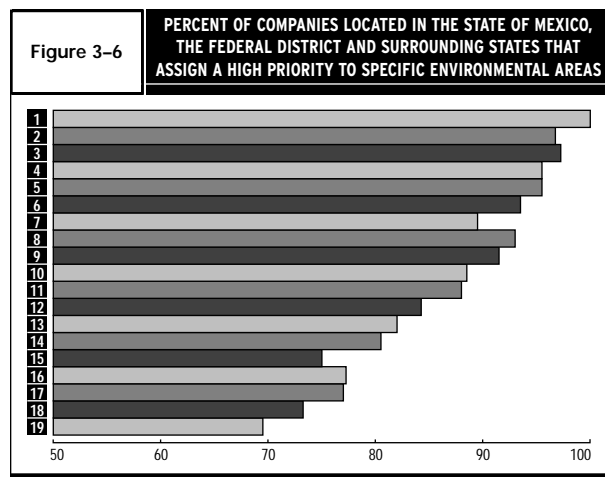
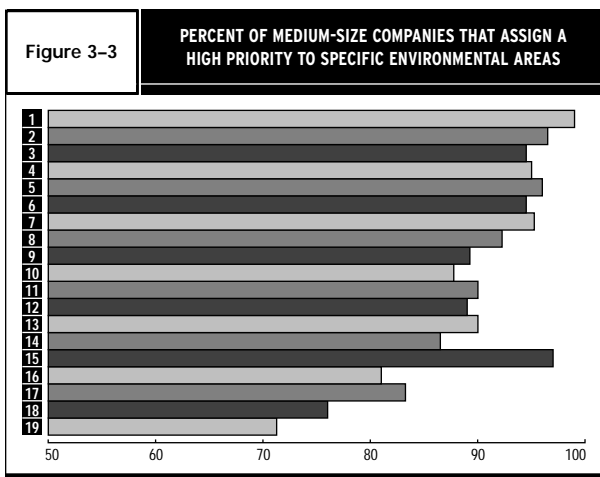
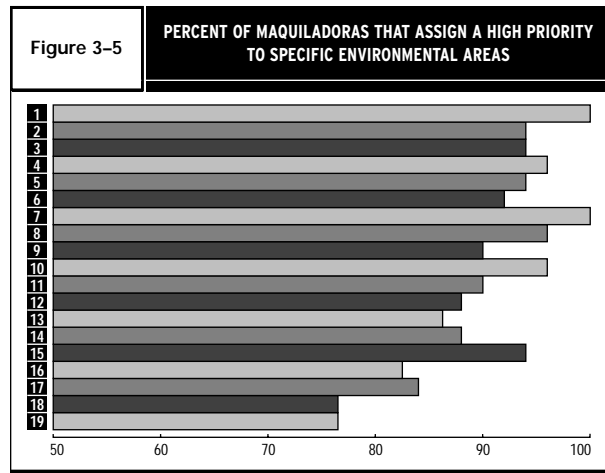
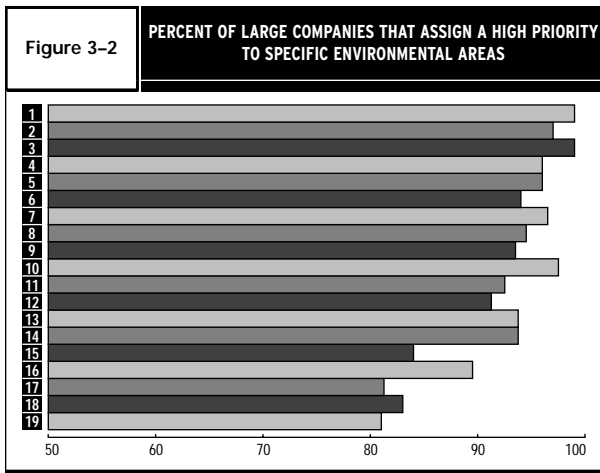
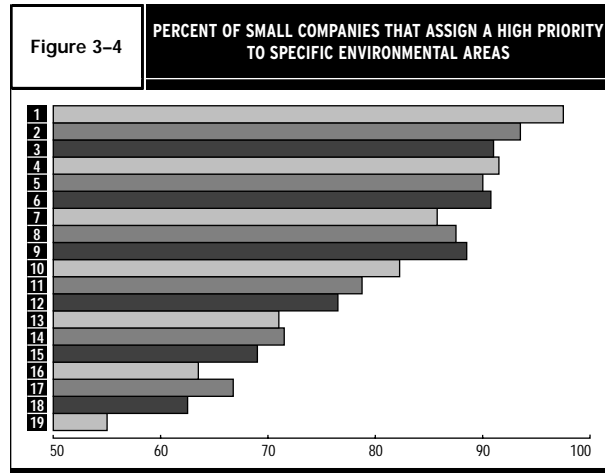
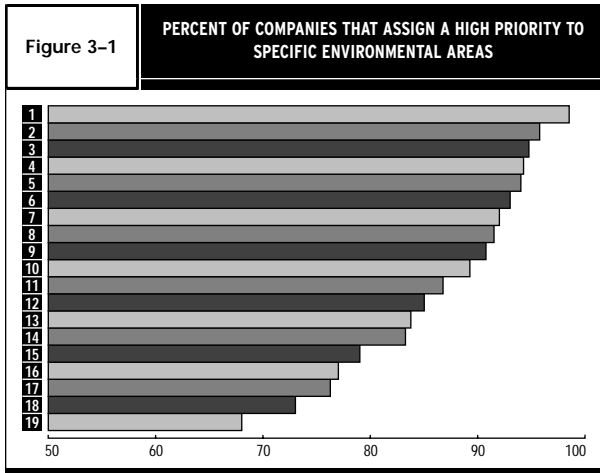
The environmental training areas most desired were either those with the greatest cost impact to the operation of various businesses or those that affect relationships with authorities, including laws and regulations. The main reason for the interest of large companies is probably the movement of multinationals toward the ISO process.

### 3.4 RESPONDENTS’ ASSESSMENT OF THE ADEQUACY OF THEIR ENVIRONMENTAL TRAINING PROGRAMS

The survey was designed, in part, to assess the degree to which respondents were satisfied with the environmental training programs accessible to their businesses (see **Figures 3–17** through **3–20**).

The only environmental area where more than 80 percent of respondents identified their existing programs as adequate was “health, hygiene and security.” This area, it should be noted, has been extensively promoted in Mexico for a number of years. In 12 other areas of environmental training, less than 60 percent of the respondents found program availability to be adequate. These results show the same tendency among companies of all sizes; however, a greater proportion of respondents from larger companies than smaller companies considered their programs to be at least adequate. This result may be due to the lower participation in environmental training programs by personnel from smaller companies, or the fact that more existing courses are focused on larger companies, or again, it may simply be a function of the greater investment that larger companies make in this field. This point needs further consideration.

These results reflect the potential of this market as course offerings improve and their acceptance increases in consequence.

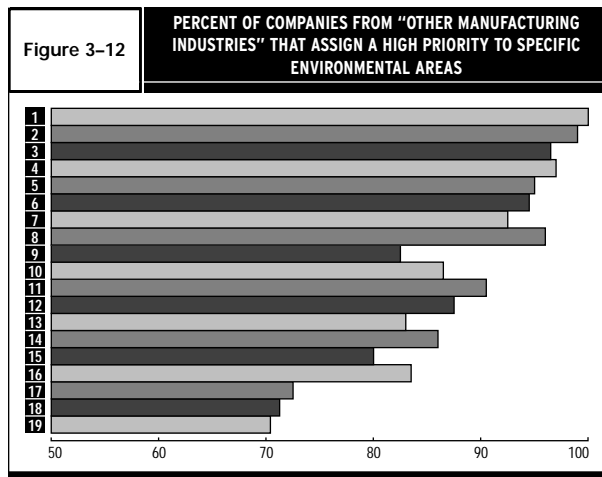
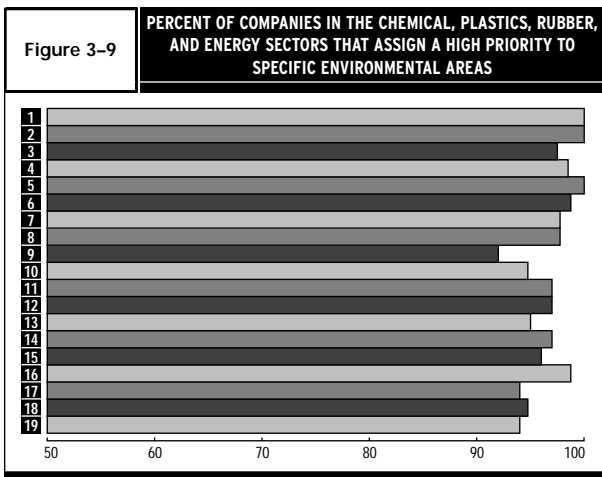
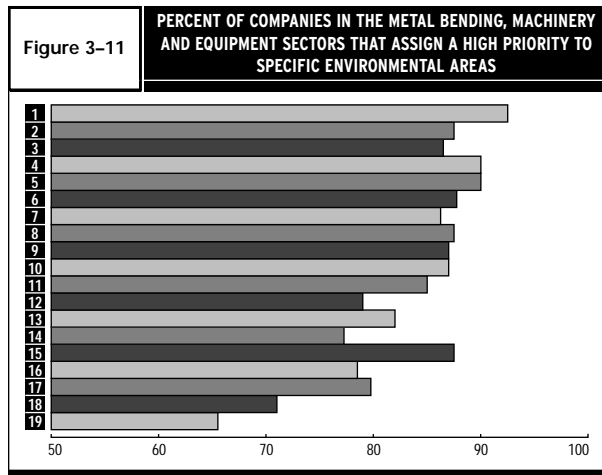
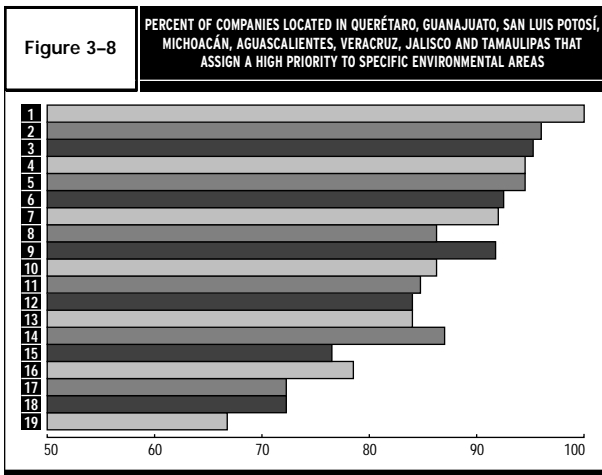
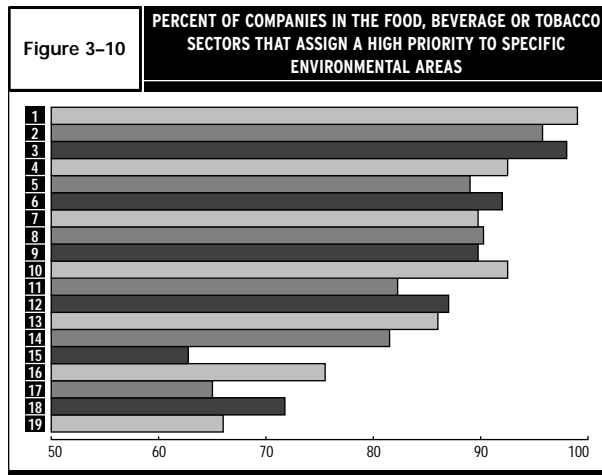
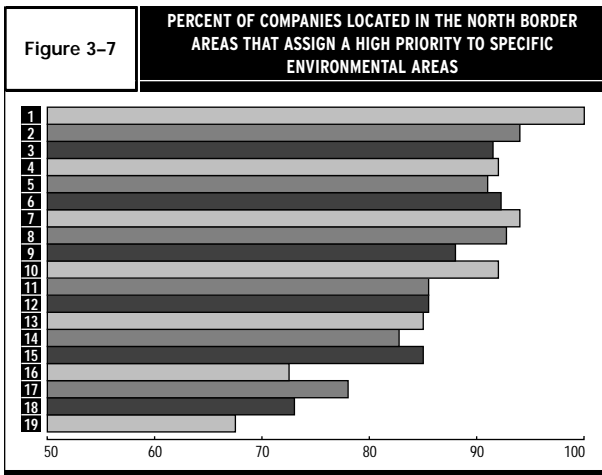


**Environmental Areas**

- 1 Environmental standards and legislation
- 2 Pollution prevention programs
- 3 Water pollution
- 4 Management to prevent pollution
- 5 Hazardous waste management
- 6 Solid waste management

- 7 Health, hygiene and security
- 8 Energy efficiency
- 9 Air pollution
- 10 Waste reduction/reuse and recycling
- 11 Soil contamination
- 12 Clean technologies
- 13 Inspections

- 14 Environmental audits
- 15 Risk management
- 16 Environmental management systems (ISO 14,000)
- 17 Environmental impact
- 18 Sustainable resource management
- 19 Biodiversity

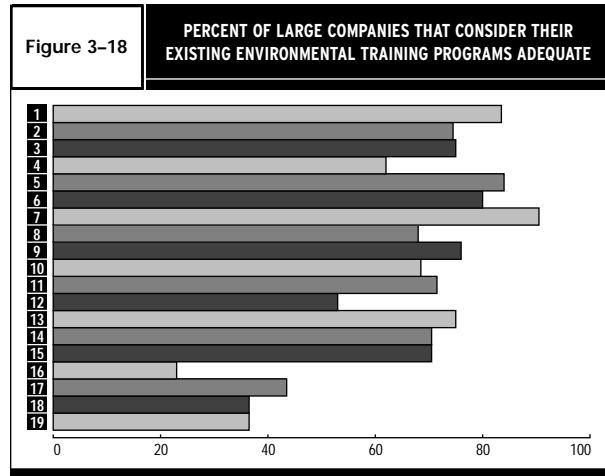
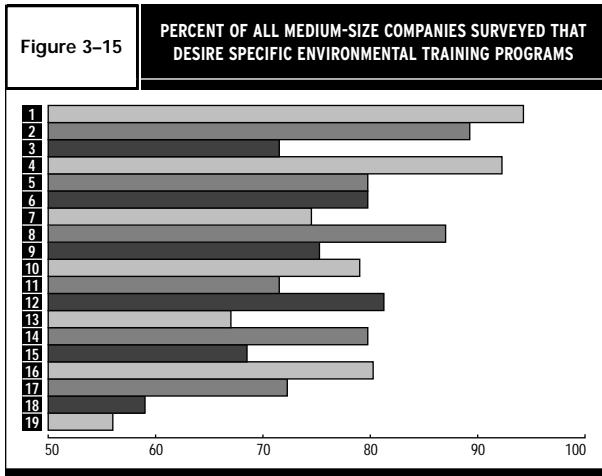
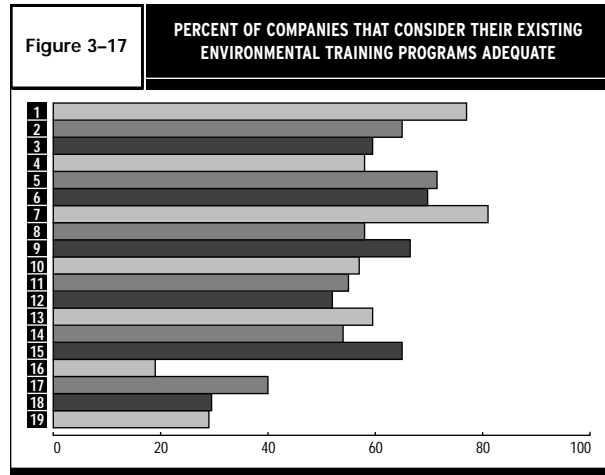
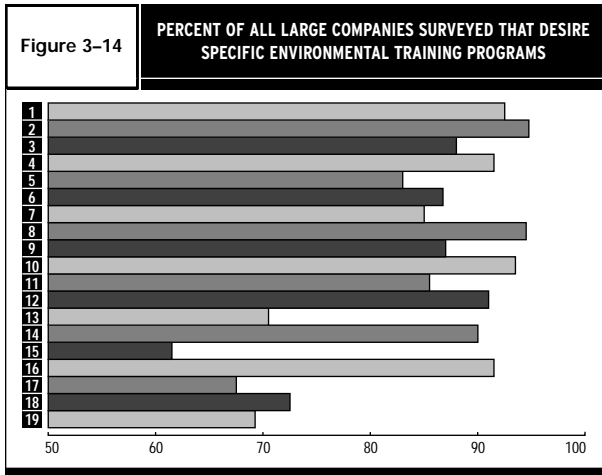
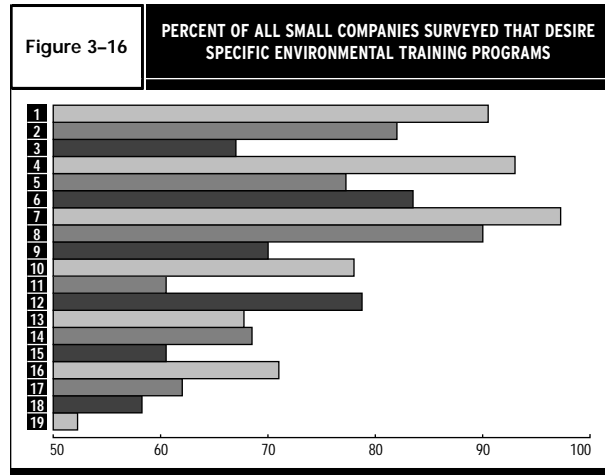
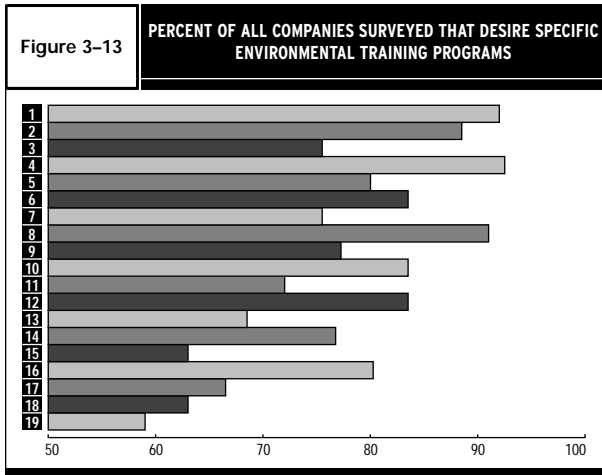


**Environmental Areas**

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- 15 Risk management
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- 19 Biodiversity

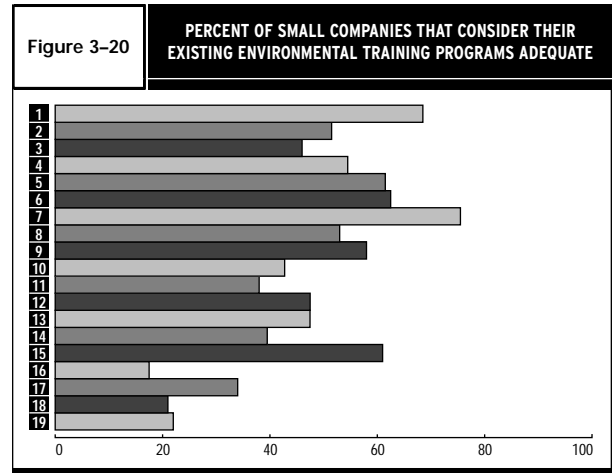
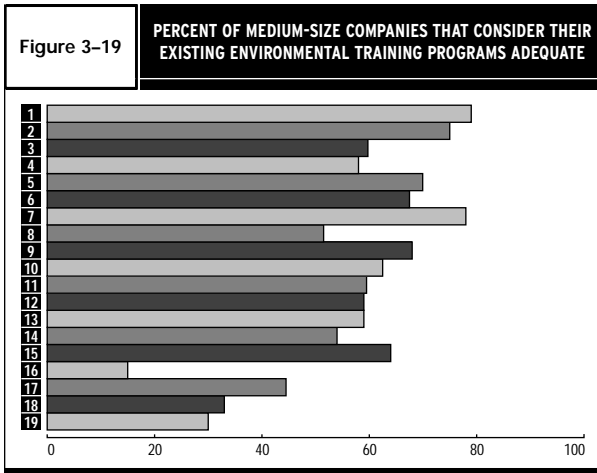


**Environmental Areas**

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- 17 Environmental impact
- 18 Sustainable resource management
- 19 Biodiversity

**Table 3-2** DIFFERENCE BETWEEN "HIGH PRIORITY" AND "ADEQUATE" RESPONSES

	PERCENT THAT CONSIDER PROGRAMS:		
	High Priority	Adequate	Difference
Environmental management systems	77.08	18.75	58.33
Sustainable resource management	73.11	29.54	43.57
Biodiversity	68.18	28.97	39.21
Management to prevent pollution	94.51	57.95	36.56
Environmental impact analysis	76.14	39.96	36.18
Water pollution	95.08	59.46	35.62
Energy efficiency	91.48	57.38	34.10
Waste reduction, reuse and recycling	89.39	56.62	32.77
Clean technologies	85.04	52.27	32.77
Soil contamination	86.74	54.92	31.82
Pollution prevention programs	96.02	65.15	30.87
Environmental audits	83.33	53.39	29.74
Air pollution	90.72	66.28	24.44
Inspections	83.90	59.65	24.25
Solid waste management	93.18	69.69	23.49
Hazardous waste management	94.13	71.40	22.73
Environmental standards and legislation	98.86	76.32	22.54
Risk management	78.98	64.96	14.02
Health, hygiene and security	92.23	81.06	11.17

**Table 3–2** presents a calculation of the difference between the percentage of respondents that assigned a high priority to each area of environmental training versus the percentage of those who consider their existing environmental training programs to be adequate. A plausible interpretation of this data is that the larger the difference between the two figures, the greater the likelihood of a lack of knowledge about current course offerings in that environmental area; on the other hand the smaller the difference, the better a given environmental training area has been understood and accepted as important, thus showing that the training offered is better established.

### 3.5 MARKET SIZE OF ENVIRONMENTAL TRAINING SERVICES IN MEXICO'S INDUSTRIAL SECTOR

Any analysis of the demand for environmental training would seem to require at least an approximation of the size of this market. The survey requested information regarding the prices respondents were willing to pay to train their personnel. Budgetary information was also solicited as to the number of employees in various job categories for whose training each responding company was willing to pay in the 1996–97 period. Knowing the size of Mexico's industrial sector and given the responses to the above questions, the size of the market could be estimated in general terms, along with the average price ranges businesses would be willing to pay for such training. First, the total number of people to be trained in the entire industrial sector was extrapolated from the survey results and then the analysis was completed in two ways:

1. Using the price per person that respondents considered acceptable to pay, one estimate of the total environmental training market was obtained, and
2. The respondents' budget figures were used to calculate, first, an average price per person, and then a second estimate of the total environmental training market.

Given the manner in which the questions were framed in the survey, option 1 should yield a conservative estimate and provide a lower price in the executive category; however, the average of both methods seems to yield a reasonable estimate of market size. The market

for 1996–97 is estimated at between 72 and 141 million Mexican pesos per year, and a population of 400,000 executives, technical staff and workers to be trained within the Mexican industrial sector over the next two years.

The area of worker training showed the greatest difference between the two market estimates (55.5–157.6 million pesos). Most of this difference (76 percent) is attributed to the market for training in large companies. This difference indicates that the portion of their budget that large companies responding to this survey have allocated for worker training is insufficient for the number of workers they want trained. The market estimate for technical and executive staff varies between 89.4 and 123.5 million pesos or an average of 106.4 million pesos.

**Tables 3–3** and **3–4** compare the percentages of executives, technical staff and workers with the training budget allocated for these categories in each of three size-segments. While technical staff and executives in the larger companies constitute only 11.5 percent of the industrial staff, the market share of this segment, as represented by the environmental training budgets, is 38.5 percent.

One other interesting point is the percentage of personnel requiring training versus total personnel for each size category. The results are extremely consistent, as follows:

• Large companies	16.1 percent
• Medium-size companies	13.3 percent
• Small companies	15.6 percent

Essentially, respondents estimated that one in six or seven of their employees required environmental training.

In summary, the environmental training market can be divided into two groups: executives and technical staff, and workers.

For the first group, short courses, academic programs, in-plant courses and self-study programs were preferred, with an average expenditure of 723–3,167 pesos (US \$96–422). For the second group, preferred training included in-plant courses and self-study programs. The average expenditure for workers, as defined by the survey responses, was 152–239 pesos (US \$20–32). While each of the two groups represents an annual market exceeding 50 million pesos, the estimate for worker train-

ing is the most uncertain. As the quality and quantity of training programs increases, the economic value of the market should also grow. Support from regulatory authorities will also increase awareness in the subject which, in turn, will enhance the size of the training market.

**3.6 ADDITIONAL COMMENTS BY RESPONDENTS**

The last question in the survey provided the respondents with an opportunity to comment or make suggestions concerning those areas where they identified a need or a problem. Of the 178 comments received, two-thirds were in the following areas:

- Solid and hazardous waste management;
- Waste reduction and recycling;
- Legislation, regulation and standards;
- Wastewater treatment;
- Air pollution control;
- Energy efficiency; and
- Environmental management systems (ISO 14,000).

Generally, the comments expressed the desire for greater access to programs either close to, or at, their plant locations.

In addition, a number of interesting comments were made noting a need for the following items:

- Self-study material, including videotapes and written material prepared with small companies in mind;
- A simple, clear and current directory of relevant governmental publications;
- An extensive environmental awareness program for all levels of the industrial sector;
- Simple course or class material to increase environmental awareness of new employees, geared toward small companies;
- Samples of environmental awareness campaigns for workers, including posters, booklets and decals;
- A program to bring ecological awareness into the home, including information on the use of toxic materials in the home; and
- Programs for the electronic dissemination of relevant environmental information.

NUMBER OF EMPLOYEES COMPANIES PLAN TO TRAIN OVER NEXT 2 YEARS		AVERAGE PRICE THAT RESPONDANTS ARE PREPARED TO PAY		MARKET SIZE FOR NEXT 2 YEARS (millions of pesos)	
		What they desire to pay (A)	Actual budget input (B)	Range comparing (A) and (B) with number of employees	
Large industry	Executives	9,000	1,752	3,167	15.8–28.5
	Technicians	17,000	1,049	934	15.9–17.8
	Workers	200,000	543	152	30.4–108.6
	Total	226,000	—	—	62.1–154.9
Medium-size industry	Executives	9,000	1,562	2,805	14.1–25.2
	Technicians	9,000	928	834	7.5–8.3
	Workers	48,000	469	197	9.5–22.5
	Total	66,000	—	—	31.1–56.0
Small industry	Executives	13,000	1,554	2,013	20.2–26.2
	Technicians	22,000	797	723	15.9–17.5
	Workers	65,000	408	239	15.6–26.5
	Total	100,000	—	—	51.7–70.2
<b>Total</b>		<b>392,000</b>			<b>144.9–281.1</b> <b>213.0 (average)</b>



**3.7 GENERAL CHARACTERISTICS OF THE MEXICAN ENVIRONMENTAL TRAINING SYSTEM**

At this point it would be desirable to use the survey results to summarize the Mexican environmental training situation, especially in the short term. Then, in the following section, this short-term view will be used to explore longer-term trends and identify means by which to improve the environmental education system such that it supports existing demand in a more consistent fashion.

1. The survey results reveal the high priority given by respondents to environmental training, especially in areas strictly overseen by the authorities, such as standards and regulations; regulatory and administrative procedures; waste reduction, reuse and recycling; and pollution prevention. As such, the results of the survey agree with the findings of de Alba and Galindo, and the CEC 1995 roundtable, both of which were cited in section 1.

The survey results showed no significant geographical variations in demand characteristics, although variations based on company size and especially, industrial sector, were more significant. In particular, the chemical, plastics, and energy sectors demonstrated a greater awareness and higher interest in environmental matters than the other industrial sectors surveyed.

2. The respondents expressed dissatisfaction with both the quantity and quality of courses accessible to them today, as well as a continued interest in improving their employees' environmental awareness and skills. Environmental training

organizations therefore have an opportunity to expand through a re-evaluation of their curricula, class locations, and calendars.

3. Environmental training consultants are underused by companies, especially smaller businesses, and although this could be due to many factors, it represents a great opportunity for consultants who can show that they offer "value added."
4. The preferred option for environmental training is in-plant training, while academic and diplomado courses are considered less useful, especially by respondents from smaller companies. It should be noted that self-directed programs also represent an excellent opportunity for worker training.
5. The environmental training market in Mexico is of sufficient size to justify the development of private, nonprofit and public institutions, including participation from foreign organizations, especially the NAFTA signatories. It is estimated that a market with an annual value of 100 million pesos is divided into two roughly equal segments: worker training and the training of executive and technical staff. This market will likely see substantial short-term growth, especially as a function of increased awareness. Such growth could be accelerated through the implementation of institutional and financial incentives.

	JOB CATEGORY BREAKDOWN VERSUS RESOURCE ALLOCATION PERCENTAGES					
	INDUSTRY					
	Large		Medium-size		Small	
	Percent of employees	Resource allocation	Percent of employees	Resource allocation	Percent of employees	Resource allocation
Executives	4.0	24.0	13.6	37.5	13.0	37.5
Technicians	7.5	14.5	13.6	21.1	22.0	28.2
Workers	88.5	61.5	72.8	41.4	65.0	34.3

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

### 4.1 ANALYSIS OF THE SHORT-TERM DEMAND FOR ENVIRONMENTAL TRAINING: PRIORITY AREAS.

The preceding section presented the results of the survey, giving a short-term perspective of the demand for environmental education and training services in Mexico. The present section will expand this perspective, using the personal experience of the authors in addition to the results of previous studies. This broader outlook will aid in the development of long-term programs and provide a clear definition of opportunities for the promotion and financing of environmental education and training services in Mexico. For the purposes of this project, comments will be addressed principally to the general environmental education of technical and professional staff who intend to pursue careers in environmental areas.

Mexico's economic climate is a major barrier to both the supply and demand of environmental education and training today because the resources to pay for employees attending classes are scarce. (This problem will be further discussed in section 4.3.) Nevertheless, the demand for environmental education in the industrial sector has grown dramatically in recent years. Today, over 250 higher education programs are offered annually in Mexico, in addition to more than 200 diploma-do courses and over 600 short courses, most of which were begun in the past decade. Industrial participation in these programs serves to reinforce prior comments noting the interest of the industrial sector in environmental education and training, especially for executives and technical staff.

Prior studies and survey results all indicate that increased awareness of regulations and enforcement actions has the effect of increasing demand in specific sectors. The survey results for the chemical companies, as shown in section 3, demonstrate the enhanced awareness of this sector which has taken the brunt of the regulatory push to date. This type of action will also be necessary in other industrial sectors in order to increase awareness and improve environmental conscience.

One point that clearly emerges from the survey is the lack of a regional influence in the demand picture; differences

in relation to size and sector were noted but large, medium-size, and small companies all showed the same three areas of highest priority:

- Standards and legislation,
- Pollution prevention programs, and
- Wastewater treatment.

Another important point is the great variability in the awareness levels of the different industrial sectors. Demand appears to vary drastically among respondents as a function of their awareness, skills, regulatory knowledge and other factors. Many respondents are at a stage where they desire basic information rather than skill-set development.

When considering the question of demand, one finds two types of respondents:

1. Companies with very limited knowledge of the subject, including many small companies or those that have received very little enforcement attention. These generally desire:
  - Simple, written information and videos of a basic nature; self-study guides; pamphlets; and decals;
  - General, low-cost awareness courses, and
  - Directories of government publications.
2. On the other hand, those respondents with greater awareness of the subject seem to desire formal environmental training programs in specific areas in order to improve the skills of personnel in the environmental area. Many respondents in maquiladoras and in chemical, plastics, and state-owned sectors fall into this second group, which desires a diversity of courses at a reasonable cost.

Two points worth noting are that the size of the market is sufficiently large to attract numerous training institutions and that demand appears to be the highest where companies perceive a direct economic benefit. "Ecoefficiency" then, must be at the core of any incentive program to foster and promote environmental programs in both short and long terms. It is clear, however, that companies are willing to pay very little to train each worker, thus leading to the conclusion that fewer workers will be trained in the short term than indicated by the respondents. It does seem, though, that worker

training will increase, especially in an improved economic climate, as better environmental training programs are put into place and executives and technical staff are trained.

The short-term demand for environmental education and training is characterized by three basic points:

- Although there is interest in environmental training, it is for low-cost programs and primarily in areas pushed by regulators or where environmental action has favorable economic consequences.
- Certain sectors, for instance the chemical, plastics, and state-owned companies, have a greater degree of environmental awareness than other sectors and therefore desire more detailed, skill-oriented environmental training programs.
- While all sectors need awareness training, some are ready for skill-based training. “Train the trainer” programs are needed to promote more rapid progress.

One of the problems with the development of both short- and long-term environmental training and education strategies is the fact that most of the higher education programs are concentrated in the Federal District while only 13 percent are offered in the southern and south-eastern parts of the country. An analysis of programs by geographical distribution shows that two-thirds of the programs are offered in only six states plus the Federal District. These six states (Baja California, Coahuila, the State of Mexico, Jalisco, Nuevo León and Veracruz) and the Federal District have institutions of higher education that represent, in each state, a diversity of over ten different environmental programs.

One-third of the baccalaureate programs, 45 percent of the masters’ programs and 64 percent of the doctoral programs are offered by institutions located in the Federal District and surrounding states. On the other hand, the southern region of the country offers only 8 percent of the baccalaureate and 2 percent of graduate education programs. Also concentrated in urban areas are diplomado courses, 40 percent of which are offered by institutions in the Federal District, where over 60 percent of short courses are also offered.

The apparent lack of environmental education and training infrastructure outside the Federal District and a few

select areas of the country creates problems for companies without easy access to a sufficient diversity of programs. The expansion of environmental training programs beyond the few locations where they are offered today is a necessary step in the development of Mexico’s environmental conscience. This needed program expansion presents opportunities for regional cooperation between the three neighbors in North America.

## 4.2 LONG-TERM TRENDS

In section 1, the environmental education framework was defined as developed at the T’bilisi conference. Within this framework and based on the survey results, an approach for long-range programs can be extrapolated from the short-term goals outlined by survey respondents.

As was noted by the participants at T’bilisi, it is important that environmental programs be tied to the general social, political, economic, cultural and ecological context of each society. At the same time, environmental objectives need to be tied to national development objectives. It is essential that government and private leaders, who serve as agents of change, clearly perceive the importance of environmental matters (such as environmental education and training) to the economic, social, and cultural development of a nation. Equally, an environmental education and training system must take into account that countries may develop regional projects at different rates. In addition, the effect of development on the environment must be factored into the creation of new programs for environmental education and training.

Although in the long term environmental education and training programs need to focus on disseminating knowledge (skills) and developing an attitude (awareness) of environmental conservation, environmental improvement and efficient resource utilization, this knowledge must also include consideration of the physical, biological and socioeconomic aspects of the environment in order to motivate a change in behavior and attitude. For instance, industrial professionals must understand the degree to which their professional practices affect the environment so that they explore ways to reduce waste generation and minimize the risk of adverse environmental impacts.

Training programs must stimulate professionals to examine techniques that can be used to negate or minimize the effect of environmentally harmful industrial practices.

The process of economic globalization constitutes the most important driving force influencing the development of a long-range environmental education and training framework. In developing such a framework, it is important that production practices be modified to take into consideration the process of globalization and the environmental management standards demanded by production in a global market. The manufacture of products in Mexico must incorporate the environmental protection measures expected from both the national and international buying public; however, the fact that countries such as Mexico lack qualified human resources to implement global standards in both the public and private sectors must also be taken into consideration when such measures are developed.

Environmental training programs within each country in North America should meet certain common, minimum standards in order to produce environmental professionals of comparable skills. The Canadian environmental education and training system, for example, includes an organized certification process for environmental professionals. Such certification assures the industrial sector that they can recruit personnel from an identified human resource base that has the necessary skills to tackle a whole range of public and private sector occupational requirements.

#### 4.2.1 Environmental Experts and Certification

While studies such as this serve to identify Mexico's needs and priorities, the next step should be to assess the knowledge and skills necessary to carry out the responsibilities of an environmental professional. The Canadian experience in this area, coupled with the survey results presented in this report, provides a basis for an environmental skill-set inventory of Mexico's industrial sector. Such an inventory could then be used to define the occupational standards of various environmental professions compatible with other North American practices, and for which environmental labor standards may then be defined. As a

first step, the following classification of environmental professionals into 21 categories is suggested:

1. Professionals and technical specialists in:
  - Chemistry;
  - Physics;
  - Biology;
  - Engineering;
  - Geology;
  - Social sciences, education, and communications;
  - Agriculture;
  - Business administration;
  - Health, hygiene and security; and
  - Architecture and urban planning.
2. Sub-specialists and technicians in:
  - Water supply and wastewater treatment;
  - Noise abatement;
  - Water pollution control;
  - Air pollution control;
  - Natural resources management / "ecotourism"; and
  - Hazardous waste/ solid waste management.
3. Specialists at the worker level in:
  - Water and wastewater treatment;
  - Natural resources and conservation;
  - Hazardous waste/ solid waste management;
  - Fishing; and
  - Recreation and "ecotourism."

#### 4.2.2 Professional Environmental Certification

The certification of environmental professionals (i.e., the recognition granted to persons who have clearly demonstrated their knowledge, education, training, ability and experience as well as a high moral ethic) constitutes a parallel process to the development of environmental occupational standards. In reality, environmental certification is quite complex, given the multidisciplinary nature of the field and the lack of exact mechanisms clearly defining the profiles of specific occupations.

The "Council of Standardization and Certification of Occupational Competence" could be strengthened to form a national organism responsible for the developing and implementing the standards and procedures that would permit evaluation of the competency of

environmental professionals. Such a council could either act directly or delegate specific functions connected with the certification process to other institutions. In any case, the certification organization should be independent of the training process and have no relationship with potential candidates for evaluation. It could include distinguished figures from the academic, public and private sectors, and should be representative of the various geographic areas and professional disciplines so as to provide a wealth of significant, diverse points of view. The certification process must be transparent and objective in order to merit society's trust.

The legal basis for the certification process is derived from Article V of the Mexican Constitution, as well as from the Law of Professions where the role of "expert" is defined. In this law, the possibility of delegating the certification role to professional associations (*colegios*) is contemplated. These *colegios* could, in turn, implement the actual evaluation process for certification. Professionals could then be certified by their respective business chambers, once a standardized process is developed.

The authors believe that the process of professional environmental certification will promote the development of a Mexican work force with competency and skills as advanced as those of its North American neighbors. Mexico needs such a work force to stay competitive in the global marketplace. Certification will also provide tangible benefits to the industrial sector and to the nation's citizenry.

Users of environmental services will benefit from the certification process by being assured that those providing such services have the proper skills and knowledge to do so. Certification in the labor market permits a more accurate description and classification of specific occupations, simplifying the employee selection process. In the academic sector, certification permits the planning and development of uniform programs with curricula harmonized to the needs of the industrial sector. For environmental professionals, certification serves to identify their specialization while formally recognizing their knowledge and skills. For society at large, certification provides the confidence that environmental activities are being managed by competent professionals.

In summary, then, it can be seen that environmental certification would have significant benefits for Mexico. Specifically, it will:

- Develop "environmental competency" indicators, which will orient environmental training programs and reduce costs connected with the deployment of human resources for environmental tasks.
- Tie the skill level of available environmental human resources to the requirements of various businesses.
- Make common occupational environmental standards available that allow the recognition of "achieved competency" and "skill level," regardless of the means of achievement.
- Create a reference definition of specific industrial sector needs that could, in turn, lead to an improved supply of training services.
- Increase the skill level and productivity of various businesses by improving the quality of their human resources. This would also reduce accidents and other work-related risks, as well as lessening industrial pollution.
- Develop human resources responsive to advances in environmental technologies and techniques for pollution prevention.
- Establish an information system based on worker skill level—which would provide indications about qualifications of the labor market. In this way the certification process would stimulate the process of continuing education.

It is also important to mention that the Mexican General Law of Ecological Equilibrium and Environmental Protection (*Ley General del Equilibrio Ecológico y la Protección al Ambiente*) and its supporting regulatory framework provide a process for creating a national reference database that would list persons who demonstrate their environmental education, technical capabilities and experience. This could then serve as a reference source for users of specialized environmental services, such as environmental audits or risk assessments.

As a result of economic globalization, important factors emerge that give added justification to creating a national certification system. Commitments stemming from the North American Free Trade Agreement or other international or regional agreements to which Mexico is a signatory party, and those that result from the imple-

mentation of voluntary international standards such as ISO 14,000 must all be considered.

In Article 10, Chapter XII of the North American Free Trade Agreement, the general criteria for certification and licensing are clearly spelled out. In accordance with the letter and spirit of this treaty, the basis for licensing and certification must:

- Be based on objective and transparent criteria,
- Be no more complex than necessary to ensure service quality, and
- Not constitute a restriction to the regional trade between the signatory parties.

Annex 1210.5 requires the signatory governments to stimulate the process by which appropriate organizations in each country can develop criteria and standards that are mutually acceptable and can lead to proper licensing and certification of professionals.

It is important to note at this time that there is a tremendous difference between the supply and demand for environmental training in Mexico as compared to Canada and the United States. This difference exists in the type of infrastructure and systems, in the human resources available to the process and also in the human resources requiring training. This difference puts Mexico at a competitive disadvantage in a market where environmental considerations are a component, further emphasizing the need for a well-structured and efficient environmental certification process. On the other hand, the experience of Canada and the United States in establishing environmental certification processes could well be beneficial to Mexico and should be considered in the course of designing a system there.

Another point that deserves consideration is the process currently underway in Mexico to gear the country's industrial infrastructure to the international drive toward the voluntary ISO 14,000 environmental management standards. As the survey results noted, respondents displayed an enormous lack of knowledge about this standard but at the same time a great interest regarding it. Given the fact that not being part of the process could present a barrier to the export of Mexican products into the international markets, the organizations that represent Mexican companies are watching the

evolution of ISO 14,000 closely. The Mexican Institute for Standardization and Certification (Instituto Mexicano de Normalización y Certificación A.C.—IMNC), founded under the leadership of CONCAMIN, is currently holding regional meetings to assess how best to deal with the ISO 14,000 process.

It should be noted that, in the long term, the most important point in establishing a system of environmental education and training services in Mexico is the design and implementation of a process of environmental certification in an efficient manner. In this matter, one must look to the national legal system for processes that are compatible with the national laws regulating education and training, thereby ensuring that the process of environmental certification is accepted not only by the authorities but also by society.

#### **4.3 OPPORTUNITIES TO ACCELERATE THE DEVELOPMENT OF ENVIRONMENTAL EDUCATION AND TRAINING SERVICES IN MEXICO: OPTIONS FOR FINANCING**

Environmental education and training are basic components of any national environmental program and, as such, their content must respond to the needs of the production employment sector—the employer of the majority of environmental professionals. The survey conducted for this study helps to define the priorities of this production sector as well as the amounts that businesses from this sector are prepared to pay for training services (which, as noted by the survey, is very little, especially for the training of workers).

Accelerating the development of an environmental education and training system in Mexico must necessarily involve a variety of institutions including government, professionals in the field, industrial chambers, financial institutions, scientists, and other members of the academic community. Each of these has specific interests and roles to play in the process:

- Mexican environmental professionals have, in many cases, studied outside the country and bring a broad background that can serve as a foundation for the development of secondary or university-level education, or other training.
- Industrial associations have a very important role to play in the promotion of environmental education

and training, particularly for workers and technical specialists.

- The principal obstacle in the development of these programs, especially for small companies, is the Mexican economic situation. Multilateral credit mechanisms through programs of institutional strengthening at institutions such as the Inter-American Development Bank or the World Bank would help to overcome this obstacle. Consideration should be given to pilot programs in this area, including programs through the assistance of Environment Canada and the US EPA.
- Although government could secure both national and international sources of financing, due to the scarcity and complexity of multilateral financing, these sources should be developed in a creative and resourceful manner.

Because it is essential to prepare broadly based environmental professionals and trainers in order to accelerate the process of environmental education and training in Mexico, the application of multilateral financing to “train the trainer” programs is of major importance. It is also essential to invite both national and foreign organizations to participate in the Mexican environmental education and training market.

While the industrial sector has some resources to support environmental training, and does use them, especially in those areas calculated to improve productivity and efficiency, the real challenge is to convince companies of the benefit of being “environmentally friendly,” not only by reducing costs but also by improving community relations. One way to involve companies more intimately could be to document successful experiences in order to showcase the benefits of investing in environmental education and training.

It is probably not realistic to expect that large subsidies or multilateral credits will be available in the short term. Instead, the modest program recommended herein perhaps represents the best alternative.

The most difficult challenge, especially in the short term, is attracting smaller companies to participate in environmental education and training programs. With this in mind, the following suggestions are offered:

- Increase the number of awareness-building programs, including brochures and pamphlets. These

include free or low-cost programs which apply directly to the needs of the smaller companies.

- Continue environmental audit and inspection programs aimed at smaller companies in order to reinforce awareness.
- In association with the industrial associations, develop environmental education programs of a general nature at low cost.

It is also probable that regional cooperation can help in the development of curricula sufficiently broad to satisfy the environmental education and training needs of the Mexican industrial sector.

#### 4.4 FOUNDATIONS FOR THE DEVELOPMENT OF REGIONAL COOPERATION PROGRAMS

In discussions with the survey respondents and members of the public sector, it was repeatedly suggested that the CEC needs to serve as both facilitator and catalyst in the development of environmental education and training programs, as well as in the coordination of trilateral efforts to cooperate in these areas.

The push for regional cooperation must include the development of an infrastructure to train environmental educators at both general and specialized levels. This process is still embryonic, although some Mexican institutions of higher education have already established cooperative programs at the baccalaureate, master’s or doctoral level with cooperating institutions in Canada or the United States.

Environmental educators need training in technical topics, but must also have a clear understanding of socioeconomic and social issues. As most professionals in the field have a natural, rather than social, sciences background, this point is doubly important.

The establishment of new university-level courses and training classes in environmental education at all levels, and in the priority areas identified by the respondents, is essential. An improvement in the interchange of information between environmental educators from the three countries in North America is also needed in order to prepare educational curricula for these new courses. Although these exchanges have been reinforced in the past few years through meetings, bulletins and other

means under the leadership of organizations in the three nations of North America, a specialized publication at a senior level or the organization of environmental educators into regional networks could also be helpful.

Considering the priority areas noted by respondents, the process of regional cooperation appears most important in the following areas:

- Pollution prevention and their operating systems,
- Water and wastewater treatment and techniques for water pollution prevention,
- Solid and hazardous waste management,
- Recycling and waste reduction, and
- Management and control of air pollution.

A well-structured collection of short courses covering these priority areas could be created with the support of institutions of higher learning and the government.

Based on the survey results and the market analysis, the areas which represent the best avenues for regional cooperation would seem to include:

- The training of educators and teachers;
- The development of training materials;
- The training of auditors and inspectors;
- The harmonization of North American certification organizations and the development of systems to ensure the initiation of labor standards; and
- The exchange of technical information between experts of the United States, Canada and Mexico.

Any system of environmental education and training must entice institutions to participate actively in the Mexican market. The survey results clearly show the allure of this market; nonetheless they demonstrate the necessity for institutional and economic subsidies to make courses more attractive, especially to smaller companies. It is also important to promote the offerings of existing or planned diplomado courses, short courses and academic programs in different regions of the country, through the active effort of institutions in all three countries.

There are a number of successful model programs today that deserve mention. For example, the trinational environmental master's program at the Colegio de la Frontera Norte in the City of Tijuana. Another interesting model

from a structural standpoint is the Partnership for Environmental Technology Education (PETE) based in Pleasanton, California. This organization includes the participation of professionals from all three North American countries and includes the following institutions:

- Assiniboine Community College, Manitoba, Canada;
- Red Deer College, Alberta, Canada;
- Front Range Community College, Colorado, United States;
- Lansing Community College, Colorado, United States;
- Instituto Tecnológico y de Estudios Superiores de Monterrey, Nuevo León, Mexico; and
- Universidad Autónoma Metropolitana, Unidad Azcapotzalco, Mexico.

In order to facilitate access to information about clean technologies in the industrial sector, it is recommended that an electronic database be created for the efficient dissemination of such information. Material for the database would be voluntarily furnished on a trinational scale by the providers of these technological services but the database would not serve to recommend, approve, or certify specific technologies. The database could be allied with the activities of existing institutions such as the Mexican Center for Clean Manufacturing (CMPL), the goal of which is to establish an environmental strategy directed at promoting clean manufacturing processes and the production of clean products. CMPL promotes the reduction of environmental risk, waste reduction, and ecoefficiency. This center is also linked to twenty others around the globe through programs of the United Nations.

A greater emphasis would also be desirable in the promotion of:

- Short duration environmental technology courses,
- The interchange of educators and researchers, and
- Conferences and workshops promoting the exchange of mutually important experiences and technological advances.

Although long-term multilateral financing represents the best opportunity to finance the development of academic programs and short courses in those areas of the country currently lacking them, at this time the



recommendation is for a more modest approach utilizing existing institutions, including:

- Assistance in developing sister university programs,
- Cooperation in establishing of exchanges of instructors and researchers,
- Assistance in the area of curriculum development,
- Regional cooperation in developing short courses, and
- Assistance in training professors and instructors for geographical areas lacking environmental education programs.

Finally, an important area where regional cooperation can make a difference is in the establishment of reciprocity agreements between the three countries in order to develop certification programs and environmental occupational standards. Thus it is recommended that a continuous trilateral working group be established to assist the CEC in creating such opportunities for regional cooperation, using existing instruments, systems and institutions.

#### 4.5 STRATEGIC RECOMMENDATIONS

Previous sections of this report, particularly the survey results, show that the Mexican industrial sector is primarily interested in short-term programs, especially those essential to short-term business goals. In the long run, however, it is important to orient environmental training and education towards the development of human resources. Indeed the industrial sector needs access to a good quality supply of well-trained environmental professionals in all areas, including executives, technical professionals and workers.

Given the country's economic crisis, a two-pronged approach is recommended, consisting of a short-term strategy, ready for quick implementation, and a long-term strategy designed with the country's needs in mind. The short-term strategy should consider the following points:

- Strengthen existing programs and institutions while continuing to support the creation of new environmental education and training programs, especially in geographic areas of the country where such programs do not exist or are underdeveloped.
- Prioritize the training of multidisciplinary generalists who can be rapidly integrated into the Mexican labor force.
- Develop inexpensive support materials, and expand basic environmental education programs prepared with the assistance of industrial chambers, especially those which target smaller companies.
- Continue to use environmental audit and inspection programs to ensure continued emphasis on environmental protection in the industrial sector.
- Continue to emphasize the training of environmental educators and instructors.
- Invite both national and foreign institutions to participate in environmental training and education.
- Train instructors, auditors and inspectors and develop or adapt instructional materials through regional cooperation and information exchange in both the short term and the long term.
- Continue the use of multinational cooperation programs between the academic institutions of various countries, as well as conferences and other multinational events, in order to promote regional cooperation.
- Design and implement electronic technology transfer programs, especially in the areas of clean technologies and pollution prevention.
- Initiate a reciprocity agreement between the three signatories to NAFTA in order to guide the development and implementation of programs for environmental certification and occupational standards.

In the long term, a well-structured process is needed, aimed at developing the human resources that will enable executives, technical specialists and workers to gain sufficient knowledge and experience in the environmental area to properly carry out their occupations. This strategy includes the following components:

- Complete a clear inventory of the necessary skills in the various occupational areas;
- Develop national occupational standards in order to define the basic skill-sets necessary in each occupation and at various levels of responsibility in Mexico's industrial sector;
- Develop an environmental certification program with the support of the industrial, public and academic sectors;
- Emphasize voluntary environmental management programs such as ISO 14,000; and
- Focus on establishing an environmental culture such that, in the long term, environmental education in all sectors of the country is institutionalized, especially the areas of environmental protection and sustainable development.

The CEC can serve as a catalyst to spur both short- and long-term programs, especially through regional cooperative initiatives. This will, especially over the long term, help harmonize certification systems in all three countries and accelerate the process of environmental certification in Mexico.

## 5.0 APPENDIX—SUPPLY AND DEMAND FOR ENVIRONMENTAL EDUCATION AND TRAINING IN NORTH AMERICA

### 5.1 INTRODUCTION

The following is a summary of the study, *Demand and Supply Services and Cooperation Opportunities for Environmental Education and Training in North America*, prepared by Dr. Edmundo de Alba and José Manuel Galindo. This study, commissioned by the CEC and completed in 1995, covers both the supply and demand for environmental education and training in Mexico and opportunities for cooperation in this area. It also studies the problems of accreditation, certification and their mutual recognition among the signatories of NAFTA and makes proposals for future activities in these areas. Persons interested in obtaining the document in its entirety should contact Dr. Hernando Guerrero, Program Manager for Capacity Building, CEC.

### 5.2 THE SUPPLY OF ENVIRONMENTAL EDUCATION IN AND FOR MEXICO

This document is concerned with two types of environmental education and training: the education of professionals and technicians for environmental occupations via the existing higher education system (engineers, biologists, physicians and lawyers, for example) and the training of professionals and technicians who are already working, or plan to work, in activities related to the environment. It does not concern itself with the training of educators or with the environmental education of the general public. The information on the supply of environmental education and training is divided into three categories: formal environmental education (i.e., academic degrees), certificate programs, and short courses.

#### 5.2.1 Formal environmental education

In 1995 the Mexican higher education system offered 262 different academic degree options — up from 216 in 1993 and 258 in 1994. These programs can be broken down into four categories, as follows:

Professional degree	100
Specialization	26
Master's degree	112
Doctorate	<u>24</u>
<b>Total</b>	<b>262</b>

When examined by discipline, these statistics show that both the professional and doctoral programs are dominated by the natural and agronomic sciences, while engineering ranks third in terms of the total number of options offered. Health sciences programs are in very low supply (seven in total) and constitute an extremely important area (including research into environmental diseases, their prevention and treatment) that should be given special attention.

The geographical distribution of academic degree programs is such that the Mexico City region offers one-quarter of all courses, as does the northern border states region, with the other half distributed around the country. While some regions have developed specific disciplines, occasionally to the detriment of other programs (for example, the northern border states offer 26 programs in agronomy yet only one in health sciences) the general opinion of those concerned is that the higher education system is reacting appropriately to create the needed supply of education.

#### 5.2.2 Diplomado Courses

A diplomado course is of relatively long duration, usually several months in length, and is devoted to a specialized subject and designed to satisfy the continuing educational needs of professionals. Statistics from 1995 show that 89 diplomado courses were offered in 10 different areas of specialization. The geographical data demonstrates a heavy concentration of these courses in the Mexico City region (42 percent), with the northern border states accounting for 21 percent, and the remaining 37 percent distributed throughout the rest of the country. Most prevalent are the diplomado courses on environmental policy and administration (32 of 89) and risk/impact assessments (18 of 89). This can be explained by the fact that, at present, employees of large and medium-size companies and civil servants constitute the primary interested group.

Because the correlation between energy savings and environmental protection has yet to be fully recognized

in Mexico, diplomado courses in energy conservation and recycling represent a small portion of the total. This is also the case with courses relating to environmental health. The small supply of available diplomado courses in more specific, technological areas, like air and water pollution prevention and control as well as hazardous waste management, is expected to increase once the general preparation stage is satisfied.

### 5.2.3 Short Courses

Short courses, on the other hand, are primarily introductory in nature or concerned with specific problems or techniques. The statistics on them in this study also include workshops and seminars. The study shows that this category of environmental education is especially conducive to regional cooperation.

During the period between May 1994 and April 1995, 349 short courses were given in Mexico by Mexican institutions. At the same time, 160 courses for Mexican audiences or on Mexican topics were offered by the United States while 92 were offered by Canada.

As with diplomado courses, the statistics show that policy and risk impact and assessment courses dominate the Mexican short-course offerings. It should be noted, however, that those giving short courses have reacted more quickly to the increasing demand for training in such areas as air and water pollution, hazardous waste, biodiversity and general pollution control. This tendency is expected to increase.

While the US and Canadian supply of short courses for Mexico is dominated by air and water pollution, hazardous waste is also an important topic in the US market. On the other hand, biodiversity has been a very small component of the Mexican short-course market in the United States and Canada. It is likely that large numbers of these courses do not figure in the statistical data as they result from private arrangements between authorities and nongovernmental organizations of the three countries.

While courses in all three countries were offered by private, academic and governmental organizations, some clear trends emerge from the statistics demonstrating the different approaches to cooperation taken by the three countries. In Mexico the large majority of courses are

offered by academic institutions. The United States relies on the private sector much more than the university system to offering courses for the Mexican market. Sometimes, fees are quite elevated. On the other hand, the Canadian strategy is to use governmental contacts to introduce Canadian knowledge and experience to the Mexican market. Although most of these courses are offered by the government, they are often developed by the academic system.

### 5.2.4 Other Supply Considerations

There are few ways to evaluate the quality of the various environmental education and training options available in Mexico. Although there are two systems of evaluation for academic degrees which will be discussed in section 5.5.1, there are no formal systems for the evaluation of diplomado courses or short courses. Currently participants make choices based primarily on reputation. Some considerations on quality are presented in section 5.3 and the education of experts (*peritos*) is discussed in section 5.5.1.

Although the effect of the recent economic crisis in Mexico has yet to be analyzed fully, it is the general opinion of those who offer short courses that while there has been some contraction in demand, this does not stem from structural economic factors. Still, the potential demand for short courses is high, primarily because of their lower cost; and when fellowships or tuition discounts are offered, the audience is significantly larger yet.

One way to simulate growth in the environmental training market might be to ensure that a portion of any investment (either public or private) made in the environmental area is devoted directly to the creation of specific, easily accessible training. This strategy has already been proven effective in projects associated with the World Bank and other lending institutions, as well as being an important part of environmental cooperation programs between Mexico and its partners.

## 5.3 DEMAND FOR ENVIRONMENTAL EDUCATION AND TRAINING

The demand for environmental education and training has shown a dramatic increase in the last few years, in both the public and private sectors. Although a certain amount is self-generated, the driving force behind this growth has been the recent proliferation of regulations, environmental

standards and enforcement activities in the area of the environment. The creation or strengthening of governmental institutions in charge of environmental administration has also created a demand for professionals and technicians specializing in environmental activities.

### 5.3.1 Public and Private Demand

Mexican studies exploring the demand for environmental education and training have been very scarce. Two known studies were used for the present report. In 1993 a survey of the public sector was conducted by the INE (National Institute of Ecology) which is being updated by Cecadesu (Training Center for Sustainable Development). In addition, a recent study of demand on the part of micro, small and medium-size Mexican companies was carried out jointly by Concamin (National Confederation of Industrial Chambers), Canacindra (National Chamber of Transformation Companies), Cespedes (Center of Private Sector Studies for Sustainable Development) and EETINA (Environmental Education and Training Institute of North America), with the technical support of ITESM (Technological Institute of Higher Learning of Monterrey).

The public sector study results show a high demand for areas such as policy, pollution control and general environmental issues. This is evidenced by the recent personnel hirings in environmental administration at all three levels of government. On the other hand, while private sector demand is also high in policy and general environmental areas, sub-areas include environmental regulation and administrative procedures related to environment.

One noticeable figure is the relatively high demand for courses related to hazardous waste in both public and private sectors. The present supply, in contrast, does not reflect this demand, thereby highlighting an opportunity for cooperation between Mexico and its North American partners. Demand in areas related to energy and environmental health is relatively low, however, and special attention should be given them in order to increase national demand.

The private sector study also noted the significance of environmental education and training for upper management and at the supervisory and technical level. The lack of planning and regulation in environmental training has led institutions of variable quality to offer

these courses; stronger coordination is needed to create a more solid basis in the field.

### 5.3.2 Training for NGOs

Certain nongovernmental organizations such as the World Wildlife Fund (WWF) have shown an interest in studying the supply and demand for environmental training in Mexico. A study by the United Nations Development Program, dealing with the strengthening of social organizations in Mexico through training and access to information, underscored four needs:

- To strengthen the strategic organizational, operative, administrative and financial capacities of social organizations;
- To strengthen the relationship between the government and society to improve mutual knowledge;
- To facilitate the access to social organizations and augment their use of information; and
- To use technical and methodological training for the formulation of environmental policies.

### 5.3.3 Training for Regulations

As previously noted, the primary force behind the demand for environmental education and training is the development of regulatory activities and, in particular, specific environmental standards. The distribution of these standards should, therefore, be an indicator of the potential demand for environmental education and training in Mexico. The figures show that the vast majority of these standards are concentrated in the areas of wastewater and air pollution, with hazardous waste, air monitoring and natural resources, for example, being significantly less important. In both the public and private sector demand studies mentioned in section 3.1, a special need was noted for short courses or seminars related to economic instruments for the environment as well as environmental standards.

### 5.3.4 Opportunities in the Environmental Training Market

A study completed in 1995 by US AID (the United States Agency for International Development) projects the relative size of the environmental market for Mexico. This, in turn, can be used as another indirect indicator of the potential demand for environmental education and

training. The study shows the relative size of the market in different environmental areas and projects their growth for the next year (1996). The growth rates of individual sectors could be indicators of an eventual demand for training. The figures demonstrate that the highest growth is predicted for the area of renewable energy (116 percent), with solid and hazardous waste (24 percent), water pollution and control (24 percent) and energy efficiency (20 percent) also showing strong growth rates.

### 5.3.5 Other Demand Considerations

In a 1995 survey of 90 Mexican companies carried out by Colmex (*Colegio de México*) on various aspects of the environment, nearly two-thirds of the companies consulted stated that they had specific environmental policies. A similar percentage declared adequate access to technological information. Slightly over half had environmental training programs, while 58 percent cited contracts with environmental consulting firms.

On the other hand, in this survey, the results of which were used for the preparation of the present document, companies said that they were willing to devote time for their employees to engage in environmental training. The reasons for this are a perceived future economic benefit and to prepare for an increase in environmentally related activities.

Fulfilling of the demand for environmental education and training is closely related to the financial aspect of environmental pollution prevention and control. The present state of the Mexican economy, due to the recent economic crisis, has negatively affected real as opposed to potential demand for environmental education and training, although, as the US AID study points out, this impact should not be larger than the average impact on the whole economy. Although the market will still be driven primarily by increased enforcement, it is critical that resources for environmental activities, including environmental education and training, be accessible and affordably priced.

## 5.4 OPPORTUNITIES FOR COOPERATION

This section describes the policies and priorities for environmental cooperation between the North American partners. An outline of possible sector-oriented opportunities for environmental cooperation is presented, as

well as avenues for strengthening current areas of cooperation in the region.

### 5.4.1 Environmental Cooperation Policies

Within the context of the North American Agreement on Environmental Cooperation, signed in 1993, each country has, during the last few years, set up various mechanisms to promote cooperation on environmental education and training at both local and international levels. The nature of these mechanisms is directly related to the policies for environmental development and cooperation in each country.

#### Canadian Policies

Canadian environmental development policy is, at present, designed to increase cooperative links with other countries and further the presence of the Canadian environmental industry worldwide. This is being done, primarily, by improving the availability of information and funding opportunities from international agencies in addition to global, multi- and bilateral agreements. Efforts are also being made to strengthen industrial participation in Canada's development assistance programs. Perceived priorities for cooperation with developing countries have led to the recent International Environmental Management Initiative (IEMI), which gives special attention to developing countries in the following areas:

- Monitoring and assessing the nature and pathways of pollutants and waste streams;
- Prevention of pollution by minimizing or eliminating solid, liquid and gaseous wastes through process engineering;
- Offering a single medium approach to "production control," with an end-of-pipe solution; and
- Environmental cleanup and restoration.

In addition to the Forum for International Trade Training (FITT), which looks for opportunities to acquire international trade skills in the area of education and training, Canada has set up a pilot program to strengthen Mexican environmental abilities. In general, Canadian cooperation with Mexico in environmental matters emphasizes:

- The strengthening of institutions devoted to environmental policy and regulations;
- The quality of air in urban areas,

- Drinking water treatment and residual waters, and
- Infrastructure development.

### **Mexican Policies**

The priorities of the Mexican National Development Plan (PND) 1995–2000 include increasing the competitiveness of Mexican companies and furthering the training of professionals and technicians; creating a closer link between technological education and the requirements of the productive sectors; investing in environmental infrastructure and financing sustainable development; and engaging in projects that will help clean up the more contaminated cities, encourage better management of hazardous wastes and protect biodiversity.

Under a provision of the PND 1995–2000, a corresponding Program for Environment is currently being developed. In the meantime, the last General Report on the Environment in Mexico (1993-94, Sedesol), noted the need for additional legislation on environmental education and for a strategy for collaboration in the design and implementation of joint projects.

Although Mexico has not yet established a clear set of policies for cooperation in the area of environmental education and training, actions in this area have been carried out on several fronts. At the government level, in addition to the implementation of various agreements and memoranda of understanding, the Ministry of Ecology has established the Training Center for Sustainable Development (Cecadesu). In the social sector the recently formed Environmental Education and Training Institute of North America (EETINA) was born out of a Mexican initiative to improve environmental conditions in North America and around the world through environmental education and training. Made up of a very significant group of institutions and associations, it has set up a fellowship program to cooperate with Mexico in the education of skilled “master trainers.”

### **United States Policies**

The United States has an enormous amount of experience in many areas of environmental cooperation. Through the Environmental Protection Agency (EPA), it is involved with the advance of environmental technolo-

gies, the development of pollution control and prevention strategies, the dissemination of information relating to environmental matters, as well as technical training and cooperation in technological areas.

In 1991, the EPA encouraged the formation of the United States Environmental Training Institute (USETI) to serve as a training forum for developing partnerships between US environmental organizations (both public and private) and key decision-makers from developing countries. A nonprofit organization, USETI has been a partner with Mexico in various training activities and is expanding its Mexican program.

The US government’s priorities are designed to cover the more obvious training needs in Mexico, such as air and water pollution control and hazardous waste. However, many diverse cooperative efforts in the area of environmental education and training have also been initiated by the private, academic, and social sectors, without any government intervention. One organization that has developed goals and objectives for international cooperation is the North American Association for Environmental Education.

### **5.4.2 Review of Opportunities**

This section outlines the principal opportunities for cooperation. It stresses that regional cooperation on environmental education and training should be the result of agreements between the three countries, led by the CEC.

#### **Criteria for the Creation of Priorities**

A 1994 study by Colmex documents the relative acuity of pollution in 15 of the most environmentally important branches of industry. This study uses the Linear Acute Human Health and Terrestrial Ecotoxicity (LAHHTE) index to measure the production of contaminants produced by a company per unit of value of produced product. The study shows that the fertilizer and chemical industries are the most intensely polluting, followed by shoe manufacture and leather tanning, then paper and cardboard production.

The above study could be one way of ordering priorities for cooperation but there are many others, as mentioned in previous sections. For instance, public and private demand would dictate that policy matters should be at the

top of the list, whereas a study of market opportunities would indicate that water treatment might be a better choice. Although choosing the criteria for a list of priorities for cooperation could be a difficult task, some general trends can be inferred from the data [a complete tabulation of the various lists used to create the following options can be found in the full version of the report]:

- Training options on environmental policy and risk/impact assessment are likely to continue to be in high demand.
- Hazardous waste management is a high opportunity area for environmental education and training.
- Environmental health and specific environmental education options (including “train the trainer” programs) require special attention and promotion.
- Mobile sources of pollution should command additional attention in the cooperative training effort.
- The relationship between environmental practice and energy/renewable resources must be stressed further in training programs, policy, regulations and standards.
- A move should be made towards technological change in high polluting branches, beginning with courses that overview opportunities for environmental technology.

#### 5.4.3 Other Considerations and Opportunities

Two basic directions for environmental education and training have emerged from the previous analysis. On one hand, there is a need to target the upper management of the public and private sectors in areas such as environmental protection, technological changes that increase productivity while minimizing environmental effects, and policy and regulation. On the other hand, a clear set of branch-specific, technologically oriented training programs for the technical and professional levels of both public and private sector companies is also needed. It is critical to involve regional private sector providers of technology, services and environmental goods in the design of such courses.

This preliminary look at the supply and demand of environmental educational and training courses and the opportunities for future cooperation in that area suggests a set of measures for the future:

- Increase the number of environmentally related degrees offered by the higher education system.
- With the partnership of specialists from other North American countries, strengthen continuing education programs via diplomado courses, especially in the areas of hazardous waste and environmental health.
- Encourage the decentralization of education and training activities.
- To stimulate the free market for environmental goods and services, involve the private sector of all three countries in the development of branch-specific short courses and technologies.
- Continue to view enforcement as the main driving force for positive environmental activities, including education and training.
- Make more direct and specific use of financial mechanisms to increase the supply and demand for environmental education and training.
- Continue, in the short term, the investigation into the public sector demand for environmental education and training.
- In order to define a clear vision for a long-term program of environmental education and training, as well as opportunities for cooperation, a detailed study of the private demand must be carried out. The participation of private, public, academic and social sectors is essential to the strength of the final product.
- A trilateral working group, specializing in the stimulation of environmental education, could add significantly to the creation of additional opportunities for cooperation by making use of existing instruments of cooperation such as MoU and institutions like EETINA.

#### 5.5 ACCREDITATION, CERTIFICATION AND MUTUAL RECOGNITION

In general terms, accreditation is used in the evaluation of education and training programs and their associated institutions, certification is used to assess the qualifications and abilities of persons, while recognition is the result of the adoption of common standards for the mutual acceptance of accreditation or certification processes.

Although defining the term “environmental professional” is a complex undertaking, a systematic classification of the (often overlapping) skills involved would be useful to establish the criteria for the process of certification or accreditation. The following section describes the present



efforts to accredit and certify environmental occupations in the three North American countries.

### 5.5.1 Efforts to Accredite and Certify in Canada, Mexico, and the United States

#### Canada

At the time of this study, the Canadian government, in partnership with the private sector, was examining options for a National Certification Program (NCP). The program would demand: credibility through recognized standards and protocol; visibility through international recognition; efficiency through affordability, flexibility, and the ability to be financially self-sustaining; and reciprocity through harmonization with organizations like the EPA and the Organization for Economic Cooperation and Development (OECD). In addition, the Canadian Council for Human Resources in the Environmental Industries (CCHREI) has initiated a national sector study to assess environmental occupations and personnel proficiency, which would lead to the establishment of occupational standards and a skill recognition process.

#### Mexico

Mexico has very few activities specifically devoted to accreditation or certification of occupations or programs for education and training in environmental matters. A general certification process, however, does exist for professionals. This process, part of the constitution, requires that certain professions acquire a certification called “Cédula Profesional” (Professional Register) and that the process of qualification and certification of experts (*peritos*) be carried out by professional associations (*colegios*). A draft project for a new Law on Professions, presently being examined by professional associations and authorities, incorporates regulations on certification under the international treaties to which Mexico is a party.

The National Professional Association for Chemical Engineers and Chemists (CONIQQ) is leading the way in the certification of *peritos* in industrial safety and environmental protection, with a variety of sub-specialties. Other such organizations, like the Mexican Institute of Chemical Engineers (IMIQ), are working towards inter-institutional coordination in order to improve the quality of environmental academic programs.

Other forms of accreditation include an INE register of consultants in the area of environmental impact studies, which ascertains the experience and technical capacity of registrants.

The National Center for the Evaluation of Higher Education (Ceneval) aims to evaluate the higher education system and its academic programs through the analysis of academic results, while the National Council of Science and Technology (Conacyt) oversees the evaluation of graduate degrees using criteria related to research quality. Within this context, the Inter-institutional Committees for the Evaluation of Higher Education (CIEES) have defined criteria for inter-institutional evaluation. This process has four aspects: evaluating the role and activities of higher education in specific areas, recognizing programs that satisfy established standards, considering which programs merit additional economic support from government, and evaluating technical assistance for the initiation of new projects.

Mexico’s technical education system, in conjunction with the World Bank, is implementing a program to modernize its training system. The project has four components: developing a national system of competency standards that incorporates skill testing and certification, modernizing training programs based on the new standards, stimulating the demand for competency-based training and certification, and establishing a data registry for the new training and certification system.

#### The United States

Most US states have regulations stating that certain environmental occupations are subject to certification or minimum training, for example water purification and wastewater plant operators or transporters of hazardous goods. In addition, several national associations have set up certification programs for environmental matters, or are in the process of doing so.

The National Environmental Training Association (NETA) has created a Certified Environmental Trainer program for training specialists which is recognized both by industry and government and is actively involved in developing competency standards in environmental occupations. The North American Association for Environmental Education (NAAEE) has also been involved over the years in setting standards for environmental education materials as well as

evaluating both student and educator performance. The National Association of Environmental Professionals (NAEP) administers a peer-reviewed Certified Environmental Professional (CEP) program which evaluates and distinguishes environmental professionals who have proven themselves through education, experience and examination. The NAEP is also considering the establishment of a program to certify entry-level environmental professionals and recognize academic centers for environmental excellence.

### 5.5.2 Advances in the Mutual Recognition of Professional Services

Within the general context of globalization, several organizations are engaged in studying and implementing the recognition of professional degrees and services. UNESCO has promoted several such programs through regional agreements and the OECD has created a list of recommendations from its 1985 report called Policy of Competency and Professions. Part of the mandate of the World Trade Organization (WTO) is to facilitate the acquisition of information related to the registration, recognition and obtaining of titles of professional competency. In addition, the international standard, ISO 14000, while voluntary, deals with many areas of environmental management, including the requirement for each member organization to identify needs and provide appropriate training for all personnel whose work may create a significant impact on the environment.

#### The North American Free Trade Agreement

Chapter XXII, Article 10 of NAFTA includes criteria for licensing and certification, standards and mutual recognition. These criteria should:

- Be based on objective and transparent criteria, such as competency and the ability to provide a service;
- Not be more burdensome than necessary to ensure the quality of a service; and
- Not constitute a disguised restriction on the cross-border provision of a service.

NAFTA also requires that governments encourage their respective professional organizations to elaborate criteria voluntarily for the mutual recognition of professional services and certification. As previously

noted, engineering organizations have been leading the way in this area in all three countries and a document, entitled *Mutual Recognition of Registered/Licensed Engineers by Jurisdictions of Canada, the United States of America and the United Mexican States to facilitate mobility in accordance with the North American Free Trade Agreement*, is currently being circulated in each country for ratification.

### 5.5.3 Options for Mutual Recognition

Any possible scheme for mutual recognition should be reciprocal, transparent, efficient and self-financing (although some federal support from each country could create a more favorable atmosphere for the establishment of such a program). Before any real opportunities for such mutual recognition arise, however, all three countries must finish the process of creating and implementing their own national programs, be they voluntary or obligatory in nature. It is clear that more studies should be done to assess both the need for, and the benefits stemming from, the creation of environmental professional standards and certification procedures.

One possible strategy for the advancement of mutual recognition programs in environmental matters is to incorporate them directly into ongoing negotiations for the free trade of professional services. Another possibility could be to study the approach taken by the engineering profession in this matter and create a pilot project based on this study.

During the survey of different institutions conducted during the preparation of the present document, a consensus emerged favoring the initiation of a collaborative work to analyze possible programs for improving national certification and mutual recognition in environmental matters.

## 5.6 A PROPOSAL FOR FUTURE ACTIVITIES

This section proposes two sets of activities to the CEC, based on the above study: the creation of a basis for a cooperative program, and the initiation of a process of certification and mutual recognition for environmental professionals.

### 5.6.1 The Basis for a Cooperative Program

#### Workshop of Experts

In order to consider the basis for a cooperative program of environmental education and training in North America, the authors propose the creation of a workshop of experts which would focus on certain areas, such as the formal education and training of environmental professionals, and the basis for a study on demand and cooperative programs. Specifically, the workshop would:

- Create a provisional set of priorities for cooperative environmental education and training, taking into consideration: relatively underdeveloped areas (e.g., environmental health); areas with large potential demand (e.g., policy training); prototypes for specially designed short courses for enterprises and government, with topics such as “Environmental Investment Opportunities” and “Environmental Policy and its Evolution”; and options for the promotion of clean technologies through training programs.
- Explore cooperative mechanisms to strengthen environmental diplomado courses and short courses and orient them more specifically for the industrial and service sectors.
- Review the use of existing instruments for environmental education and training cooperation.
- Conduct a more complete study on the demand for environmental education and training services.
- Explore the creation of national and trilateral committees on environmental education and training cooperation in North America.

The possible participants of such a workshop include representatives of government; industrial and service organizations; professional organizations of environmental educators and trainers; academic organizations; and national, regional and international financial institutions with environmental portfolios.

#### Further Study

One clear result of the present document is the need for a comprehensive study on the demand for environmental education and training in Mexico. Such a study could form the basis for a long-term program of cooperation in this area and would need to:

- Analyze the need for the education and training of administrators, environmental professionals and technicians in both the industrial and service sectors as well as at all three levels of government.
- Profile the courses needed to fulfill the technologically oriented needs of priority areas and promote the demand for training in sectors and geographical areas that are currently underdeveloped.
- Include a regionalization scheme in order to decentralize training activities.
- Encourage the use of financial mechanisms for environmental investments (including alternative sources of financing for regional programs) in the design and implementation of the program.
- Explore means by which to overcome existing barriers and strengthen regional cooperation.
- Incorporate the concept of a data bank on the supply of environmental training in Mexico in order to improve information on short courses offered by the private and public sectors, ecological conservation training activities and NGO training activities.

The above study could also incorporate the “train the trainer” programs; however, a decision will have to be made on the eventual scope of the study: should it deal with the entire human resources market of Mexico or be restricted to the definition of current needs, future requirements and opportunities for cooperation in the area of environmental education and training in Mexico? To oversee such a study, a steering committee should be set up that includes the participation of representatives from the private sector, government, academia and professional organizations of all three countries under the direction of the CEC.

### 5.6.2 Activities for Mutual Recognition:

#### A Trilateral Symposium on Environmental Accreditation, Certification and Mutual Recognition.

A trilateral symposium could be the first step towards mutual recognition in this area. As this subject is still in its infancy in Mexico, a workshop, held there before the symposium, would help to clarify Mexican views on this issue. The goals of the symposium would be to strengthen plans for national accreditation and promote mutual recognition. The symposium should:

- Assess the needs and benefits of certification and mutual recognition, including study of the possible characteristics of a plan for mutual recognition (transparency, efficiency, autonomy, participation, financing and reciprocity) and how such a plan would reach to professionals and technicians.
- Review the advances in classification methodologies for environmental certification.
- Examine the NAFTA negotiations for the mutual recognition of professional service providers.
- Explore regulatory and institutional development needs.
- Investigate the possible structure of corresponding national committees as well as options for a continuous process that would lead to a mutual recognition scheme.

Possible participants in the symposium would include: authorities from educational, environmental, technical and professional organizations; representatives from existing certification schemes, the academic sector and organizations involved with NAFTA negotiations of mutual recognition; and private sector representatives.

### **5.6.3 Final Comments**

The above proposals to the CEC constitute an initial program of tangible, short-term activities that could lead toward its long-term goals in the field of education and training.

The governments of the region have attached a high priority to cooperation in environmental education and training. A solid and ambitious program involving all three countries is a valuable instrument for improving the free market of environmental goods and services within the region.

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