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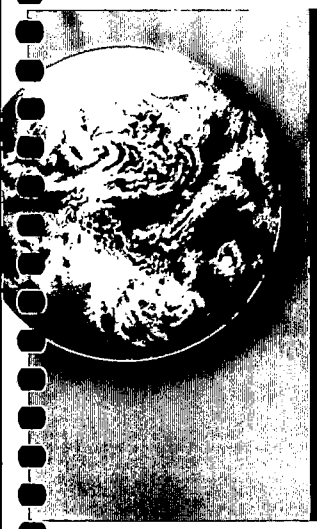

Assessment of Canadian Business Opportunities under the Basel Convention

Canada

Assessment of Canadian Business Opportunities Under the Basel Convention

Final Report

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Executive Summary

This report, an assessment of Canadian Business Opportunities under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, presents the results of a consultative study to (1) identify existing and potential business opportunities for Canadian environmental firms; and (2) develop a strategy for facilitating Canadian access to these opportunities.

Environment Canada, through the Canadian Environmental Industry Strategy, aims to promote business opportunities for the Canadian environment industry arising from Canada's International Conventions and Agreements. This will help Canada advance its objectives under important Conventions such as the Basel Convention and lead to economic benefits for Canadian environment industry companies. The implications of the Basel Convention are diverse, and it has heralded many international initiatives leading to responsible hazardous waste management and sustainable development programs.

Canada has been active in promoting international efforts under the Basel Convention. The Convention was signed by 116 nations in October 1987 and entered into force on May 5, 1992. Canada became an official Party to the Convention on November 26, 1992, with the introduction of the Export and Import of Hazardous Waste Regulations under the *Canadian Environmental Protection Act* (CEPA). Signatories to the Convention agree to follow the articles of the Convention, regulating the movement, control and disposal of hazardous wastes transported between nations.

Canadian companies have developed capabilities and strengths in the hazardous waste management field and are well positioned to participate in many of the activities – including transport, use, minimization, recycling and disposal – resulting from this commitment.

Research of statistical data on hazardous waste business activities, and consultations with government and industry representatives provided the building blocks for the following analyses presented in the report:

- assessment of Canadian capabilities in the environmental sector;
- assessment of the scope of economic opportunities for Canadian environmental industries relevant to the Basel Convention in view of Canadian capabilities; and
- assessment of areas of opportunity in the environmental sector where Canadians have a competitive advantage.

Chapter 1 outlines the history, current status and implications of the Basel Convention, summarizes hazardous waste management activities globally and discusses Canadian programs to assist the environmental industry in accessing foreign markets.

Chapter 2 presents an overview of hazardous waste management activities in Canada (import, export, treatment, disposal, recovery) and the key Canadian capabilities in the hazardous waste field. Summarized are the results of consultations with waste management and environmental industry representatives, environmental industry

associations, and federal and provincial government agencies regarding Canadian strengths and opportunities under the Convention. Barriers to business and potential opportunities in the international hazardous waste management field are also outlined.

Chapter 3 assesses opportunities for Canadian businesses in the international hazardous waste management field, identifying the geographical regions that offer particular opportunity and the technical sectors that would be of most promise to Canada.

Chapter 4 provides strategy options for the government's consideration in promoting opportunities for Canadian businesses in the hazardous waste management sector internationally. Results are based on consultations with private sector and government representatives.

Chapter 5 proposes a strategy to assist the Canadian environmental industry in developing and capturing opportunities in the international hazardous waste market. The strategy elements described are needs analysis; capacity building; facilitation, coordination and financing; evaluation; and marketing Canada's international image.

Chapter 6 outlines specific strategies for the geographical areas offering the most opportunity for Canadian businesses. The areas identified are India/Pakistan/Sri Lanka; and Latin America and the Caribbean.

By fully implementing its international commitments, Canada will maintain and enhance its credibility in the environmental field and thus help promote business opportunities for Canadian companies pursuing hazardous waste markets internationally.

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1.0 Background and Setting

1.1 Background and Objectives of this Study

The United Nations Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal focuses on the responsible and effective recycling and disposal of hazardous waste, control of transboundary movements of hazardous wastes, technology transfer and harmonization of standards. The Basel Convention has diverse implications and has led to many international initiatives related to responsible hazardous waste management and sustainable development.

Canada was involved in the development and implementation of the Basel Convention, and was one of the original signatories in 1989. As such, Canada is well positioned to participate in many of the initiatives resulting from the Convention. This report gives the results of a consultative study to identify the potential business opportunities for Canadian environmental firms; and to develop a strategy for facilitating access to these opportunities.

From research into existing statistical data on hazardous waste business activities, and from consultations with government and industry representatives, assessments were conducted of:

- Canadian capabilities in the environmental sector, particularly as it relates to the hazardous waste industry;
- the scope of existing and expected economic opportunities for Canadian environmental industries relevant to the Basel Convention, in view of Canadian capabilities; including assessment of which parts of the world these opportunities might be expected to occur; and
- opportunities where Canadians have a competitive advantage in the environmental sector.

This report presents a strategy outlining how the federal government could promote the identified opportunities.

1.2 Organization of Report

Chapter 1 of this report outlines the history, status and implications of the Basel Convention and summarizes hazardous waste management activities globally. It also provides a summary of Canadian programs to assist the environmental industry in accessing foreign markets.

Chapter 2 summarizes hazardous waste management activities in Canada (import, export, treatment, disposal, recovery) and outlines the prime Canadian capabilities in the hazardous waste field. It provides the results of consultations with waste management and environmental industry representatives, environmental industries associations, and federal and provincial government agencies, regarding Canadian strengths, barriers to business, and potential opportunities in the international hazardous waste management field.

Chapter 3 gives an assessment of opportunities for Canadian businesses in the international hazardous waste management field, focusing on geographical regions of most opportunity, and the sectors that would be of most promise to Canada.

Chapter 4 provides an overall strategy for the Canadian government, in cooperation with industry and the provinces, to promote opportunities for Canadian businesses in the hazardous waste management sector internationally.

Chapter 5 goes into detail about each element of the overall strategy, and Chapter 6 gives specific strategies for the two top-ranked regions.

1.3 Basel Convention: History, Current Status and Implications

1.3.1 History

In 1947, global generation of hazardous wastes amounted to about five million tonnes. This had risen to approximately 400 million tonnes by 1988, with approximately six million tonnes generated in Canada. A major issue related to these growing quantities of hazardous wastes was the effective management of the material. In developed countries, with environmental concerns at the forefront, hazardous waste management requirements were becoming increasingly stringent, resulting in an associated increase in management costs. Some developing countries, searching for revenue-generating activities, imported hazardous wastes for low-cost recycling and disposal, often in substandard facilities that provided no protection for the receiving environment.

It was apparent that improper disposal of hazardous wastes was becoming a serious problem. In 1987, the United Nations Environment Program (UNEP) initiated a solution to the world's hazardous waste disposal problems by adopting the Cairo Guidelines and Principles for the Environmentally Sound Management of Hazardous Waste. These guidelines required an exporter of hazardous waste to notify receiving and transit nations of the export, to receive their consent prior to export and to ensure that the disposal site met certain safety and environmental requirements. In order to formalize and broaden the scope of their international hazardous waste regulation, UNEP created a convention to formalize regulation procedures into international law. This resulted in the Basel Convention.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal was adopted on March 22, 1989, by the 116 states participating in the Conference of Plenipotentiaries on the Global Convention on the Control of Transboundary Movements of Hazardous Wastes, convened by the UNEP Executive Director and held in Basel, Switzerland. The Basel Convention entered into force on May 5, 1992. Canada became an official Party to the Convention on November 26, 1992, with the introduction of the Export and Import of Hazardous Waste Regulations under the *Canadian Environmental Protection Act*. Subsequent meetings of the Conference of the Parties were held in December 1992 (Piriapolis, Uruguay), March 1994 (Geneva, Switzerland) and September 1995 (Geneva, Switzerland) to create the mechanisms for implementation. As of March 1997, 109 countries and the European Economic Community are party to the Basel Convention. Signatories to the Convention agree to follow the articles of the Convention regulating the movement, control and disposal of hazardous wastes transported between nations.

The Basel Convention produced 29 articles and six annexes (since amended to include seven annexes) that regulate hazardous wastes shipped across national borders. The main objectives of the 1992 Convention are to:

- ensure that the generation of hazardous waste is reduced to a minimum;

- treat and dispose of hazardous waste in the country of origin, to the extent possible;
- establish enhanced controls (legislation and documentation) on exports and to ensure prior informed consent;
- prohibit shipments of hazardous wastes to countries lacking the legal, administrative and technical capacity to manage and dispose of them in an environmentally sound and efficient manner;
- prohibit hazardous waste disposal in the area south of 60° south latitude;
- cooperate on the exchange of information, technology transfer, and the harmonization of standards, codes and guidelines; and
- prohibit export or import of hazardous waste with non-signatory nations, unless it is done under the provisions of separate bilateral or multilateral agreements.

Hazardous wastes are defined in the Convention annexes by their generating waste stream or waste constituents, and meet prescribed hazardous characteristics. A waste is also considered hazardous if it is so defined by the domestic legislation of the country of export, import or transit.

Countries that have not to date progressed to ratification from their original signatory status include many African countries, some Middle East countries, Venezuela, the Democratic People's Republic of Korea, Haiti, Afghanistan, Mongolia, Nepal, Samoa, Thailand, Yugoslavia and the United States.

Numerous guidance documents have been prepared to assist countries in meeting the Convention requirements. These include: Model National Legislation on the Management of Hazardous Wastes and Other Wastes, as well as on the Control of Transboundary Movements of Hazardous Wastes and Other Wastes and their disposal; a Manual for Implementation of the Basel Convention; numerous Technical Guidelines on various waste streams (organic solvents, waste oils, PCB/PCT/PBBs, and household wastes) and on waste disposal/treatment options (specially engineered landfills, incineration on land, and used oil re-refining/other reuses) and a Confirmed Illegal Traffic Report Form.

The meetings of the Conference of the Parties (COP) to the Basel Convention are held to facilitate the implementation of Convention initiatives. The most recent meeting, held in Geneva in September 1995, summarized the status of numerous implementation activities. Global interest in the Convention is rising, and the critical issues of interest are regulatory conformance, capacity building (facility development), and control and monitoring of illegal traffic. The third COP identified the following priority implementation activities:

1. Definition of hazardous waste characteristics;
2. Protocol development on liability and compensation; and
3. Development of outstanding technical guidelines.

This COP also amended the Convention by adopting a proposed modification requiring an immediate prohibition on exports of hazardous waste destined for final disposal from developed countries to developing countries, and a phase-out by December 31, 1997, of all transboundary movements of hazardous wastes that are destined for recycling from developed countries to developing countries.

1.3.2 *Decisions by the Parties*

The items summarized below were taken from Decisions Adopted by the Third COP, and list priority areas for consideration by the Parties to the Convention.

1. Illegal Traffic in Hazardous Wastes:
   - develop and implement stringent legislation to control illegal traffic;
   - report cases of illegal traffic; and
   - cooperate with Interpol.

   The Secretary of the Basel Convention is to:
   - assist Parties in developing legislation;
   - assist Parties in developing infrastructure to monitor and penalize illegal traffic;
   - cooperate to achieve better control and monitoring of cases of illegal traffic; and
   - organize training courses for customs officers, port authorities, judiciary personnel and police forces.

2. Research:
   - continue work on evaluation of cleaner production processes to minimize hazardous wastes: exchange information with the International Labour Organization on cleaner production issues; and
   - develop disposal alternatives, in conjunction with the Food and Agriculture Organization and UN Industrial Development Organization, for waste pesticides.

3. Technical Guidelines:

   Develop technical guidelines on:
   - physical-chemical treatment;
   - biological treatment;
   - recycling/reclamation of metals and metal compounds;
   - wastes resulting from surface treatment of metals and plastics; and
   - clinical wastes from medical care in hospitals, medical centres and clinics.

4. Hazard Characterization:
   - continue work on criteria for hazardous characteristics to clarify Annex I wastes;
   - initiate work on characterizing wastes liberating toxic gases in contact with air or water, toxic wastes (delayed or chronic), and ecotoxic wastes;
   - continue characterization of wastes capable, after disposal, of yielding another material (i.e., leachate) that possesses any of the Annex III characteristics;
   - continue work on limit values for use in the *de minimis* approach; and
   - coordinate with UN-ECE/ EUROSTAT in developing standard terminology for waste and recycling activities.

5. Recovery of Hazardous Wastes:
   - develop methods of improving the recovery of hazardous wastes in non-OECD countries through assessment of the recovery

facilities, identifying methods to improve their operations.

6. Establish an Information Management System:
   - Uruguay, Argentina, El Salvador, and Trinidad and Tobago were selected for the Latin American and Caribbean region;
   - review India as a regional centre;
   - China and Indonesia are centres representing the Asian region;
   - solicit countries to provide financial resources and/or technically qualified individuals to collaborate in the establishment of centres for which sites have been agreed upon (possibly collaborate with the International Chamber of Commerce); and
   - solicit countries to provide financial resources and/or technically qualified individuals to collaborate in the undertaking of studies for Africa and western Asia.
7. Training:
   - assist developing countries and countries with economies in transition with effective implementation of the Convention, including activities in Agenda 21 of direct relevance to the Convention; and
   - provide resource persons, expert in hazardous waste related issues, to advise developing countries and countries with economies in transition on the requirements for strengthening their institutional capacities for implementation of the Convention and/or to provide in-service training for experts from these countries.

1.3.3 OECD Decisions

The Organization for Economic Co-operation and Development has long been concerned with the transboundary shipment of hazardous wastes and has contributed to the relevant European Community directives and the Basel Convention. In March 1992, OECD countries committed to create and fully implement an international method of controlling transfrontier movements of wastes destined for recovery operations within the OECD area, generating Council Decision C(92)39/FINAL. This was adopted under Article 11 of the Basel Convention, and classifies recoverable wastes into green, amber or red lists, according to risk criteria, each with specific management requirements.

A valuable implementation document utilized by the OECD was developed by the United Nations Conference on Environment and Development (UNCED): Agenda 21, Chapter 20, "Environmentally Sound Management of Hazardous Wastes Including Prevention of Illegal International Traffic in Hazardous Wastes". This document, which is a final version of Agenda 21, Chapter 20 (part of the document adopted at the Earth Summit in Rio de Janeiro in June 1992), guides the OECD's environmental efforts. Numerous action items are identified to address effective control of the generation, storage, treatment, recycling and reuse, transportation, recovery and disposal of hazardous wastes. Target areas include:

1. preventing or minimizing the generation of hazardous wastes; eliminating or reducing to a minimum transboundary hazardous waste movements; and ensuring use of environmentally sound hazardous waste management options to the maximum extent possible within the country of origin;

2. ratification of the Basel Convention;
3. ratification and full implementation of the Bamako Convention; and
4. elimination of the export of hazardous wastes to countries that prohibit imports of such wastes.

Action items are identified in the areas of:

1. promoting the prevention and minimization of hazardous wastes;
2. promoting and strengthening institutional capacities in hazardous waste management;
3. promoting and strengthening international cooperation in the management of transboundary hazardous waste movements; and
4. preventing illegal international hazardous waste traffic.

As such, the activities of the OECD complement other implementation initiatives under the Basel Convention. With the 1991 creation of the OECD Joint Session of Trade and Environment Experts, the OECD addresses the broader goals of sustainable development by promoting the compatibility and mutual reinforcement of trade and environmental policies in practice. The overall goals of the Basel Convention are related to other international policy initiatives on sustainable development as well. Such initiatives, focused by the Rio Earth Summit, include the directives of a number of UN organizations, including the UN Development Program, the Commission on Sustainable Development, the UN Division for Sustainable Development, the Scientific Committee on Problems of the Environment, and the Sustainable Development Network.

International issues related to developing countries are multifaceted. Solutions to the challenges of transboundary shipment of hazardous wastes will need to consider economic and social implications, as well as environmental goals, if they are to be effective and non-restrictive to developing countries.

1.4 Hazardous Waste Experience and Practice in Developed and Other Countries

Available information on recent hazardous waste management trends is limited to European, North American and Pacific developed countries. Countries generating the most hazardous waste on an annual basis include Belgium, France, Italy, Portugal, the United Kingdom, Canada, Germany, the Netherlands, Spain and the United States.

Among the largest exporters of hazardous waste are Canada, Germany and the Netherlands. Although they generate less hazardous waste, Austria, New Zealand and Sweden export large portions of the hazardous wastes generated. And although it exports a small percentage of the total hazardous waste it generates, the United States exports a significant amount.

Among the trends noted in the above information, the following was evident:

- fewer countries disposed of imported wastes in 1993 than in 1992;
- of the largest exporters of hazardous waste, Germany sends most to disposal;
- Canada is shifting from disposal toward recovery;
- the trend appears to be for countries to import more than they export, with imported wastes destined more toward recovery than disposal;
- disposal is primarily by incineration or landfill;

- recovery methods focus on metals recovery, physical-chemical treatments or energy recovery; and
- the United States is the largest exporter of hazardous wastes to non-OECD countries.

Additional hazardous waste management analysis was available through a MarketLine International 1995 review of Global Hazardous Wastes, based on 1994 data. The information in this report regarding evaluation of market opportunities focuses primarily on current hazardous waste management practices in the United States, Japan, the United Kingdom, France, Germany, Italy and Spain. Table 1 summarizes the MarketLine report's data.

- there is a broad trend toward less landfilling;
- there is less use of large off-site facilities (except in Japan);
- there is more on-site recovery, reuse, energy recovery, site remediation activity and waste minimization;
- for any country, a few large integrated service companies dominate the hazardous waste market (in the countries where there are such companies); the rest of the market is usually fragmented, consisting of specialized small companies;
- government lobbying is an important factor for successful companies; and

TABLE 1 1994 HAZARDOUS WASTE SUMMARY (FROM MARKETLINE, 1995)

Country	Market Value (million US$)	Production (million tonnes)	Market Value per Tonne (US $/t)
United States	16,500	218.60	75.50
Japan	4,540	5.75	789.40
United Kingdom	740	2.10[a]	355.30
France	2,100	6.70	313.30
Germany	4,240	8.90[b]	476.60
Italy	1,080	3.00	360.00
Spain	42	3.39	12.70
Total	**29,240**	**248.40[c]**	**2,382.80**

Note: [a] excludes hazardous wastes treated on-site or imports
[b] excludes hazardous waste treatment residue or recycled hazardous waste
[c] excludes the generators Belgium (27.5, 1994) and Canada (7.8, 1991)

The general trends observed in the MarketLine report were:

- over time, there is an overall decrease in hazardous waste production;
- hazardous waste management costs are increasing, possibly due to efforts aimed at waste minimization and concentration of contaminants;
- hazardous waste is generated from the chemical, iron and steel, oil, engineering, mining, paper, and power industries, or from site remediation activities.

Observations for specific countries include:

- **United States:** substantial increase in wastes from site remediation;

estimates of hazardous waste quantities are strongly influenced by what is defined as a hazardous waste under U.S. regulations; most (76.5 tonnes in 1994) disposal is by aqueous treatment; many landfills are closing; recovery was 2.2% and thermal treatment was 3% in 1994; hazardous waste quantities expected to stabilize by 2000, due to impact of waste minimization initiatives.

- **Japan:** largest treatment is in oil incinerators; illegal dumping was common in the past; landfilling decreasing due to lack of space and increasing regulatory requirements; site remediation still developing; high-tech solutions preferred; sludge accounted for 42% of industrial waste in 1994; hazardous waste management is the responsibility of the generator, so many companies have on-site facilities; environmental standards increasing; waste minimization initiatives still developing.
- **United Kingdom:** 48% of total disposed volume is landfilled, 32% is treated, 10% recycled and 9.5% incinerated (one-third at cement kilns); one-third of imported hazardous waste was fuels, oils and greases; almost half of imports were from Germany; 6% of imports were PCB waste; waste minimization and site remediation services are growing; operating below capacity in 1994; EC directives could increase hazardous wastes by 33% due to redefinition.
- **France:** approximately 50% of produced amount landfilled in either industry-owned or public landfills; after landfilling comes resource recovery (about 33% of produced amount); growth in site remediation of orphaned sites (government funded); no information provided on the fate of imported wastes.
- **Germany:** trend to waste minimization and waste recycling; about 60% of on-site hazardous waste (42% of total generated) is landfilled, the rest is incinerated; or if sent for off-site treatment, 80% is treated (thermal or physical-chemical) and remainder is landfilled.
- **Italy:** landfill 54% of total generated hazardous waste, treat 29% and thermally destroy 8%; closing illegal landfills and modernizing facilities.
- **Spain:** over a third of generated hazardous waste disposed of in on-site landfills; government establishing incineration capacity; of the two-thirds of total waste that is disposed of off-site, only 10% properly disposed of and the remainder is landfilled or exported: estimate a need for a further million-tonne disposal capacity to manage, and remainder to be reduced by waste minimization; site remediation is developing; government to remediate 300 priority sites in next 10 years; developed a Hazardous Waste Plan (February 1995) targeting a 40% reduction in hazardous wastes by 2000 (tax breaks for waste minimization efforts, and subsidies); the fate of imported waste not addressed, but expected to be similar to that of internally generated wastes.

It is likely that most developing countries have no implemented legislation regarding hazardous waste management control and no infrastructure in place to enforce control measures or monitor hazardous waste management (generation, transportation, treatment, disposal) activities, and any active industries will either manage their own hazardous wastes in effective ways (either on-site or exported to appropriate facilities) or there will be no differentiation between non-hazardous and hazardous treatment methods. There may be some publicly available appropriate treatment/

disposal facilities, but their maintenance may be questionable and consequently they may not be operational or they may not operate properly.

1.5 Canadian Programs to Assist the Environmental Industry

1.5.1 Canadian Environmental Industry Strategy

The federal government's Environmental Industry Strategy was announced in September 1994, and contains 22 initiatives aimed at promoting the Canadian environmental industry, particularly small to medium-sized enterprises (SMEs). The Strategy, which was the result of extensive dialogue with industry representatives and associations, provincial governments and numerous other stakeholders, emphasizes the need for a strong cooperative effort in both industry and government to build a major Canadian global presence in the environmental goods and services sector. Among the initiatives are support programs for environmental technology development demonstration, simplified access to relevant government services, certification of products and services, green procurement by the federal government, participation in development assistance programs, the support of strategic alliances for export markets, improved access to opportunities through international agreements and institutions, and the international transfer of environmental expertise.

The key federal agencies that are involved in the development of the Canadian Environmental Industry Strategy are:

- Environment Canada;
- Industry Canada;
- Department of Foreign Affairs and International Trade;
- Canadian International Development Agency; and
- Public Works and Government Services Canada.

Environment Canada's primary goal is to protect and enhance the Canadian environment, and also to participate in international agreements, initiatives and arrangements that affect the environment on a global scale, and hence indirectly affect the Canadian environment.

Within the Department, the Basel Convention/Agreements Section of the Transboundary Movement Division of the Hazardous Waste Branch leads Environment Canada in implementing and negotiating Canada's interests under the Basel Convention, including stakeholder interests. This Division also administers the implementation of the Export and Import of Hazardous Waste Regulations. The Technology and Industry Branch, through programs such as the International Environmental Management Initiative (IEMI; see Section 1.5.2), promotes and facilitates the development of the Canadian environmental industry, under the broad program of the Canadian Environmental Industry Strategy.

Industry Canada supports technology development, industrial growth and international export opportunities. The Department plays a central role in the development and implementation of the Canadian Environmental Industry Strategy, which results in various memoranda of understanding with other countries.

Examples of projects that have been completed or are under way under the Canadian Environmental Industry Strategy or related programs include:

- waste management initiative in Namibia;
- environmental assessment and remediation project in Latvia;

- seminar on contaminated site rehabilitation, Mexico (February 1996);
- seminar on Canadian approaches to hazardous waste management, Poland (November 1995); and
- support to Regional Training Centre in Uruguay.

Future initiatives include the possible development of subregional training centres, for example in Latin America and the Caribbean; and a seminar in Chile on management and technologies for waste and recycling.

1.5.2 *Funding Sources and Programs*

The Canadian International Development Agency (CIDA) funds bilateral projects in many developing countries. For example, there are about 20 such projects in India, for a total of about $125 million. This includes the India-Canada Environment Facility (ICEF), as well as a fund of $72 million for the support of environmental projects by Indian institutions, and a $500,000 Small Projects Fund, which supports innovative environmental initiatives by Indian organizations in partnership with Canadian organizations. The CIDA Industrial Cooperation Program (CIDA-INC) fosters commercial partnerships between Canadian firms and firms in developing countries. For example, CIDA-INC has approved $32 million in funds to India since 1993, and, as of mid-1995, there were 51 active projects in India. CIDA-INC promotes India-Canada joint venture development programs through the Canadian Manufacturers Association (CMA) and the Canada-India Business Council (CIBC).

The Canada Export Development Corporation (EDC) supports international projects that offer benefits to Canada, including infrastructure developments.

The International Environmental Management Initiative (IEMI) was established by the federal government in 1995 to promote the transfer of Canadian government and private sector environmental expertise relating to regulations, policies and technical programs to developing countries or countries with economies in transition. A total of $1.8 million, over three years, has been allocated to projects under the IEMI. The initiative is led by the following agencies:

- Environment Canada;
- Industry Canada;
- Department of Foreign Affairs and International Trade;
- CIDA; and
- Canadian Environmental Industry Association.

IEMI program direction is provided by an Implementation Committee consisting of a representative from each of the above organizations.

The IEMI gives priority to projects that further progress on key global environmental issues such as ozone depletion, toxic substances, climate change and biodiversity. Priority is also accorded to areas relating to water and wastewater management, environmental impact assessment, land quality control and natural resource management. The federal government's commitment to pollution prevention and cleaner production also guides priorities for the allocation of resources under the IEMI.

Through the IEMI, other countries can become familiar with Canadian environmental technologies, products, and services, as well as the Canadian approach to environmental science and engineering, pollution prevention and environmental policy. This transfer of Canadian

environmental expertise can promote stronger environmental management regimes in developing countries, which will ultimately promote the delivery of Canadian products and services.

Project funding under the IEMI is allocated for the following activities:

- project and program identification studies;
- technical support to enhance environmental management capacity in developing countries; and
- environmental technology transfer and cooperation.

Progress in the area of international agreements and activities has been achieved under a Canada-Poland bilateral agreement (waste management, wastewater, etc.); a Canada-Mexico agreement (laboratory accreditation, water quality, contaminated sites, etc.); a Canada-Chile agreement (environmental impact assessment, norms and standards); and through trade fairs (e.g., Bahamas in 1994 and Indonesia in 1995, as well as Globe 96).

1.6 Conclusions

A review of relevant literature from government and industry sources was performed to assess the involvement of other countries in the global hazardous waste management sector and to identify existing government programs to assist the Canadian environmental industry. The following conclusions were drawn from this review.

1. The countries generating the most hazardous waste on an annual basis are Belgium, France, Italy, Portugal, the United Kingdom, Canada, Germany, the Netherlands, Spain and the United States. Among the largest exporters are Canada, Germany, the Netherlands, Austria, New Zealand, Sweden and the United States; and the United States is the largest exporter of hazardous waste to non-OECD countries. There is a trend toward an overall decrease in hazardous waste production over time, and a trend toward increasing disposal costs.

2. Canada is shifting from disposal toward recovery, with disposal primarily by incineration and landfill, and recovery focusing on metals recovery, physical-chemical treatments or energy recovery.

3. A number of programs exist to help Canadian industry access both domestic and international markets for hazardous waste management and other environment-related fields. The key federal agencies involved in the Canadian Environmental Industry Strategy are Environment Canada, Industry Canada, the Department of Foreign Affairs and International Trade, Public Works and Government Services Canada, and the Canadian International Development Agency. A number of initiatives relevant to the hazardous waste management field have been undertaken or are planned.

2.0 Analysis of Canadian Strengths, Opportunities and Barriers

2.1 Introduction and Approach

To determine the strengths of Canadian environmental businesses and the opportunities and barriers facing them, consultations were conducted with Canadian business people, federal government agencies, provincial government departments, and environmental industries associations.

Published resources and industry and government contacts were used to draft a list of appropriate contacts. Contacts were then solicited for information regarding the Basel Convention and its implementation, their areas of contribution, and real and perceived opportunities and barriers.

This chapter summarizes the information obtained.

2.2 Current Involment by Canadian Industries in Hazardous Waste Sector

2.2.1 *Canadian Hazardous Waste Imports and Exports*

Table 2 summarizes information on 1995 Canadian imports and exports of hazardous waste, as provided by Environment Canada.

The largest quantities of exports for disposal consist of waste acids, waste bases and inorganic cyanides. The major exported waste streams destined for recovery include organic solvents (with and without halogens), corrosives, lead with waste acid (likely battery-related), and "flammable gases on contact with water" wastes. All of the exports are destined to the United States.

Imported hazardous wastes originate primarily in the United States, but small amounts destined for recovery are generated by France, Denmark, Italy, Spain, Sweden, the United Kingdom and Finland. Imported wastes destined for disposal are primarily hexavalent chromium contaminated with zinc and cadmium or zinc and arsenic, lead/cadmium leachate, other leachates, flammable lead-contaminated organic solvents or halogenated organic solvents. The largest shipments of wastes for recovery include organic solvents (both with and without halogens), lead or lead/copper contaminated leachates, surface treatment wastes with waste acid, and corrosives with lead (or lead and waste acids).

TABLE 2 1995 CANADIAN EXPORTS AND IMPORTS OF HAZARDOUS WASTE

Shipment Type	Annual Amount (tonnes)	Amount to Disposal (tonnes)	Amount to Recovery (tonnes)
Export	225,989	98,535	127,454
Import	383,134	111,812	271,322

In summary, approximately half of the exported waste for disposal is inorganic cyanides; slightly over a third of exported waste for recovery is lead with waste acid; most of the imported wastes for disposal are metal-contaminated aqueous streams or metal- or halogen-contaminated organic solvents; over a third of the wastes imported for recovery are corrosive surface treatment wastes; and over a quarter of imported wastes are lead contaminated with acid. It is apparent that waste types being exported for recovery are also being imported for recovery.

Of the hazardous wastes imported into Canada, the major streams include metal-contaminated wastes (primarily leachates), surface treatment waste, halogenated and non-halogenated organic solvents, hexavalent chromium waste, waste acids and bases, photographic waste, cyanide waste, paint-related wastes, mercury-contaminated wastes and biomedical wastes. Of these waste streams, only the organic solvent, surface treatment waste, metal contaminated leachate and photographic wastes are recovered.

The major recovery methods are recycling/reclamation of metals and metal compounds, and the treatment of surface treatment waste. Other recovery methods utilized are fuel blending, recycling/reclamation of other inorganics, re-refining of used oil, solvent reclamation and recycling/reclamation of non-solvent organics.

Of the Canadian hazardous waste that is exported for recovery, the major recovery methods include solvent reclamation, metals recovery, waste base regeneration and fuel blending/alternative energy source.

A number of the waste streams that are exported from Canada for disposal are amenable to recovery, including organic solvents, metal-contaminated solutions, waste corrosives and photographic wastes. Possibly some of the inorganic cyanide wastes could be treated in Canada as well.

Information on notification for import of hazardous wastes into Canada and notification for export of hazardous wastes out of Canada is provided in data from *Resilog*, published by the Transboundary Movement Division of Environment Canada. Based on that information, in the first half of 1996, the United States, Australia, Luxembourg, Finland, Germany, the Netherlands, Bahrain, Egypt, Kuwait, Oman, Saudi Arabia, the United Arab Emirates, the United Kingdom and Mexico proposed to ship wastes into Canada, with 99.7% originating in the United States. It is to be noted, however, that the data are drawn from notification numbers, not the actual movement of hazardous wastes, and are therefore limited in application and scope.

2.2.2 *Canadian Capabilities*

Additional information on Canadian waste management capabilities is available in Industry Canada's *Canadian Environmental Solutions* (version 2.1) company listings, and in the 1996/1997 *Canadian Environmental Directory* published by the Canadian Almanac and Directory Publishing Co. Limited. Numerous companies are listed in the following areas:

- waste collection services/equipment, liquid/hazardous;
- waste collection services/equipment, solid;
- waste disposal systems and equipment, liquid/hazardous;
- waste disposal systems and equipment, solid;
- waste exchangers;
- waste management;
- waste management consulting, liquid/hazardous;

- waste management consulting, solid;
- waste management, liquid/ hazardous;
- waste management, solid;
- waste management systems, liquid/ hazardous;
- waste management systems, solid;
- waste minimization technologies;
- waste quality assessment;
- waste treatment equipment, liquid/ hazardous;
- waste treatment equipment, solid;
- waste treatment and disposal facilities; and
- water and wastewater management.

Review of these companies and those identified as being potential importers or exporters of hazardous wastes by *Resilog* generated the list of industry contacts who were solicited for information respecting Basel Convention opportunities.

The various major Canadian capabilities in the hazardous waste management field are linked to the recovery, treatment and disposal processes in which the industry is currently engaged. These capabilities can be summarized generally as follows:

- waste collection and transportation services;
- waste treatment/disposal services and systems;
- waste collection/treatment/disposal equipment;
- waste exchangers;
- chemical analysis and related laboratory services;
- waste management consulting:
  - needs assessment;
  - regulatory development;
  - waste inventories;
  - waste minimization, opportunities assessment;
  - integrated waste management planning;
  - analytical services, quality assurance/quality control (QA/QC);
- technology assessment:
  - treatment technologies;
  - disposal and secure landfilling technologies;
  - incineration technologies;
  - recycling and recovery technologies;
  - remediation technologies; and
  - transportation.

Of these capabilities, it would appear that those listed under waste management consulting and technology assessment are the ones that could be offered most successfully in international markets. Because of costs, Canadian companies would find it difficult to compete as waste managers, in an operating sense, in many foreign countries. Canadian skills in needs assessment, facility design, technology assessment, etc., are more easily exported.

The more generic lines of business such as needs assessment, regulatory development, waste inventories and integrated waste management planning would be important services to offer to less-developed countries, whereas services to developed countries would more likely include the more specialized technology assessments.

2.3 Industry Perspectives on Canadian Strengths and Opportunities

A number of Canadian hazardous waste management companies were contacted and interviewed respecting perceived Canadian environmental industry

strengths, as well as barriers and competitive factors, and possible business opportunities resulting from implementation of the Basel Convention.

The participating organizations were:

- The Battery Broker Environmental Services Inc.;
- Bovar Waste Management;
- Cyanide Destruct Systems Inc.;
- Hazardous Materials Management (publication);
- Hazco Environmental Services;
- Laidlaw Environmental Services Ltd.;
- Mining Association of Canada;
- Mohawk Oil Company;
- Newalta Environmental Services Corporation;
- Noranda Smelting;
- Philip Environmental Inc.;
- Republic Environmental Services Ltd.;
- Safety-Kleen Canada Inc.;
- Stablex Canada Inc; and
- WMI Waste Management of Canada Inc.

The following sections summarize notable comments.

2.3.1 *Canadian Strengths*

Most comments indicated that many waste-processing technologies are actually imported, rather than developed by Canadians (an exception is the Mohawk used oil re-refining process). Consequently, it is not technology development, but the effective and sometimes unique application of that technology, that is a Canadian strength.

The large distances that complicate transportation issues also provide high levels of the associated regulatory skills. Another identified Canadian strength is expertise in the development and implementation of regulatory infrastructure. It was noted, however, that there are still problems within Canada in standardizing regulatory requirements (e.g., interprovincial variations in hazardous waste definitions and criteria levels). A final strength, based on Canadian culture, is our tendency toward negotiation as opposed to litigation, and our strong negotiation abilities.

A few specific strengths mentioned in the interviews are identified below:

- Canadian receivers take ownership of the wastes received, unlike in the United States, where the liability usually remains with the generator;
- the only successful paint recycling facilities in North America are in Canada;
- hazardous waste transportation in Canada is seen to have better equipment and higher standards than in the United States;
- Canadian businesses generally work well with government agencies;
- the Canadian environment business has many highly skilled people (engineers, chemists, biologists, risk assessment specialists, toxicologists, software/data specialists, instrumentation specialists, etc.);
- a well-developed cyanide waste treatment technology is in Canada;
- most used oil re-refiners use the Mohawk process, a clean recycling process of used oil (a non-renewable resource) back to a high-quality product (compared with burning used oil for energy recovery);

- business assisted the B.C. government with development and implementation of the Waste Oil Regulation;
- many companies effectively collect from numerous small generators, economically addressing complex collection challenges;
- there are strong Canadian capabilities (some currently exported) in chemical treatment and stabilization;
- Canadian metallurgical companies have well-developed metal recycling expertise;
- the Canadian pulp and paper industry is a leader in developing clean production processes and technologies; and
- Canadian business, by world standards, normally takes a proactive approach to environmental control.

2.3.2 *Opportunities Possible from Basel Convention Implementation*

The majority of perceived opportunities related to Basel Convention implementation are assistance with regulation development, implementation and enforcement, training, and development of waste management programs, collections systems, waste tracking and waste characterization, although several respondents could see no direct opportunities for Canadian industry. The following emerged as specific opportunity areas:

- development of collection programs;
- specific waste treatment and processing technologies amenable to export;
- regulatory development;
- training in various areas; and
- facility design.

2.3.3 *Barriers*

The key factors perceived as barriers to competition in the international hazardous waste management business are related primarily to the level of awareness of technical and regulatory issues in the host country, the commitment to enforcement and regulation in the host country, attitudes of Canadian businesses on some business matters, knowledge of potential clients and their specific needs, the difficulties SMEs face in getting started in a foreign country in view of start-up costs, unfamiliarity with local infrastructure and so forth, and the inaccessibility of capital pools (chiefly to SMEs), which in some cases are tied to nationality. Also noted by some was the need for Canada to show leadership in effective hazardous waste management, cleaner production and pollution prevention at home.

Among the specific points noted were that Canadians need to learn to work better in consortia overseas. Trade missions organized by government, to be effective, need careful preparatory work, communication efforts, focus, planning, and follow-up action. Finally, government and industry in many developing countries need to be advised as to reasonable expectations: often they ask for the best available technology, but do not have the expertise or ability to operate it.

2.3.4 *Government Involvement*

Some respondents suggested that government should focus its efforts on the development and enforcement of environmental regulations on hazardous waste. Others saw a need for government involvement in establishing relationships with countries. Needs assessment was seen as another key role on which government can focus, in cooperation with private sector companies. In this sense,

trade mission efforts need to be refined by properly evaluating likely opportunities — becoming more aware of Canadian strengths in the waste business and local needs. Once the needs assessment and contact development programs have been conducted thoroughly, private sector companies can take the lead in pursuing business lines. A number of comments were also made to the effect that government subsidies or incentives would not prove beneficial, and that government should not be involved in the operation of specific waste management businesses, especially when the wastes managed move outside the government's jurisdiction. It was also suggested that government could facilitate the movement of wastes by harmonizing interprovincial and international approvals processes for shipments.

2.4 Federal Government Perspectives on Canadian Strengths and Opportunities

The following observations were obtained in response to a questionnaire sent to senior officials of various federal government agencies.

2.4.1 *Canadian Capabilities*

The respondents viewed the following as significant capabilities that Canada has in the hazardous waste management sector relevant to the Basel Convention:

- waste treatment and disposal of imported wastes;
- advanced methods of treatment and disposal;
- recycling and recovery of waste materials;
- design and/or operation of treatment/disposal systems in other countries;
- technology transfer and training in cleaner production/pollution prevention;
- capacity building (e.g., development of regulatory systems);
- waste management systems design (collection, transportation, disposal);
- remediation, bioremediation of contaminated sites;
- needs assessment, risk assessment, impacts assessment, etc.;
- transportation safety; and
- environmental service industries including environmental auditing, impact assessment and needs assessment.

The types of wastes viewed as relevant to current Canadian capacity in hazardous waste management include:

- oily wastes and oilfield wastes;
- aqueous wastes containing heavy metals;
- contaminated organic solvents;
- leachates;
- surface treatment wastes (acids, corrosives);
- PCBs (e.g., Swan Hills);
- mine tailings;
- fly ash, bottom ash;
- automobile shredder residue; and
- foundry sand.

Some respondents commented that developing countries may be aware they have problems, but often are not aware of the exact nature and scope of these problems. Accordingly, government support programs should focus on short-term upstream services (i.e., beginning with an assessment of needs) and on

developing regulatory infrastructure and protocols in the host country.

2.4.2 *Competition and Barriers*

In terms of the main competitors to Canadian environmental businesses, respondents identified the other G7 countries (e.g., the United States, Japan and Germany) as the principal sources of competition. This competition is for not only the management of hazardous wastes, but also the manufacturing of critical equipment such as incinerator kilns, and the array of environmental services such as environmental assessments, risk assessments, training and so forth.

Criteria for competition included such factors as:

- cost of treatment (labour, materials, energy, etc.);
- transportation;
- restrictions, national policies, etc.; and
- regulatory burden.

Barriers to conducting work in the hazardous waste area include the above factors, as well as the potential liability associated with handling, transporting, treating, recycling and disposing of hazardous waste, and reference was made to the Laidlaw, Chemwaste and Superfund lawsuits. Another barrier noted was the "mindset" of Canadian companies, which typically do not look to overseas markets. Ultimately, industry's perception of opportunities and risks was seen as the key factor.

2.5 Provincial Government Perspectives on Canadian Strengths and Opportunities

The governments of the Canadian provinces also play a role in supporting the environmental industry in domestic and foreign markets. The information below draws on the examples of New Brunswick and Alberta.

2.5.1 *New Brunswick*

The Province of New Brunswick offers the following support for environmental businesses in the province:

- financial assistance (partial) to cover the expenses of businesses attending trade shows;
- the organization of trade shows;
- interest-free loans;
- a clearinghouse of information pertaining to local capabilities and a conduit for international contacts for local firms; and
- training and counselling of businesses to assist them in preparing their marketing strategies.

In order to qualify for support, a firm must have a product that fills a need in the marketplace and must possess a proven track record. Experience has shown that companies that form joint ventures with local firms in the host country have a better chance of success in breaking into international markets.

2.5.2 *Alberta*

The Province of Alberta provides a similar clearinghouse of information for Alberta firms. Businesses are provided the following services, mainly through the Department of Economic Development:

- information on upcoming trade shows;
- encouragement of visits by international speakers;
- an information centre recording the capabilities of businesses in the province; and
- financial assistance (limited).

The Province of Alberta supplies information on trade shows that are about to occur and encourages visits by speakers from the international community. These visits highlight business opportunities for Alberta companies and enable participants to keep abreast of the capabilities of businesses in the province. Financial support to Alberta firms was available, but has been curtailed due to government cutbacks.

2.5.3 *Barriers*

Interviewees made the following points concerning barriers to the entry of Canadian firms to the international environmental marketplace:

1. Small to medium-sized enterprises (SMEs) generally have difficulty marketing themselves effectively, and thus gaining access to the international marketplace.
2. SMEs are generally more successful in gaining access to the international marketplace if they form a joint venture or consortium with another Canadian company or companies, thus providing sufficient mass or depth. Similarly, Canadian SMEs that partner with a local firm in the host country are generally more successful over the long term.
3. Trade shows are not a very effective mechanism for business development in the international environmental products and services market. Outgoing trade missions and workshops are more effective, but must be organized carefully and well in advance. They will be more successful if they are focused on a particular area of interest and if they are followed up effectively.
4. Success is enhanced if the particular technology being offered is effectively demonstrated for the potential customer under local conditions; however, in many cases it requires financial assistance from government to do this.

2.6 Perspectives of Environmental Industries Associations on Canadian Strengths and Opportunities

Several environmental industries associations were contacted to assess the capabilities of Canadian businesses as they relate to the implementation of the Basel Convention. The following associations were approached:

- Canadian Environmental Industries Association (CEIA);
- Environmental Services Association of Alberta (ESAA);
- Saskatchewan Environmental Managers Association (SEMA); and
- CEIA – Ontario.

The association contacts were interviewed to determine their perspectives relating to Canadian capabilities and the barriers and competitive factors that face businesses in the international arena.

The general conclusion derived from discussions with these association managers and directors is that Canada has demonstrated that it has world-class expertise in the field of hazardous waste management. Many of these managers and directors have had opportunities to travel to other countries, or to talk with

people around the world, and they report that Canada is seen as a leader in the industry, with a track record to prove its status.

Foremost in many people's minds worldwide is the Alberta Special Waste Treatment Centre at Swan Hills, Alberta. Some of those from more advanced countries, who have surveyed the world and toured numerous facilities, have found the Treatment Centre to be a leading establishment in hazardous/special waste treatment.

Capability areas in which Canada excels were identified as:

- waste treatment and disposal;
- advanced methods of hazardous waste treatment/disposal;
- design/operation of systems/ facilities;
- training;
- capacity building through initiatives such as the International Environmental Management Initiative (IEMI);
- environmental services (environmental impact assessment, risk assessment, inventory); and
- transfer of knowledge.

Meanwhile, the following areas are developing and growing:

- recycling and recovery;
- technology transfer; and
- transportation.

Recycling and recovery technologies are largely driven by market prices (supply and demand) and are usually viewed as expensive relative to the quantities generated, especially by smaller developing countries. Technology transfer has not occurred on a large scale, as Canadian companies are seen to be protecting their investments.

The interviews identified the following countries as major competitors to Canadian businesses in the field of hazardous/special waste management:

- the United States;
- Germany;
- Japan;
- the Netherlands; and
- Great Britain.

These countries are seen as excelling in the area of special/hazardous waste management mainly because each of them experienced the environmental crisis prior to Canada. Each of these countries, due to high population, high level of industrialization and strict environmental standards, developed the required technologies. They have taken these technologies and their expertise into the international marketplace.

The success of some of these countries' business ventures has been due to their approach. When an opportunity was identified, technical personnel were sent on a reconnaissance mission. The technicians, specialists and engineers approached the situation from a technical rather than a political viewpoint.

2.6.1 Barriers

The following barriers were identified as reasons why Canadian businesses are not more actively involved in international business opportunities relating to the implementation of the Basel Convention.

1. Only a few firms are of sufficient size (mass) to be able to sustain the investment required.

2. A lack of financial and human resources was identified.

3. A criticism of some government-sponsored programs was that they involved public sector personnel performing an advisory and assistance role to host countries on hazardous/special waste management policies, practices and technologies. This is viewed by some as an impediment to involvement by the Canadian private sector. A more useful role for government is to identify the needs and allow the consulting services sector and business development sector to undertake the assignment and provide sustainable solutions through education, training, the transfer of knowledge and technology and/or design/build/operate treatment/disposal systems.

4. The Basel Convention is perceived by some as a potential barrier to Canadian business development regarding the importation of wastes to Canada for treatment/disposal. However, the terms of the Convention as they currently stand do not prohibit the importation of the major waste types for treatment/recovery/disposal from the countries with which Canada normally does business. There may be a need for domestic information programs to correct this perception.

5. A major challenge lies in convincing small and medium-sized companies that they can actually compete and succeed in the international marketplace. This points to a need for facilitation and information programs to assist and promote the entry of SMEs into foreign markets.

2.7 Summary of Conclusions

2.7.1 *Opportunities and Strengths*

The review of relevant government and industry data, and consultations with waste management and environmental industries representatives, environmental industries associations, and federal and provincial government agencies yielded the following conclusions regarding Canadian activities, capabilities and strengths in the international hazardous waste management field.

1. The major streams of hazardous waste exported by Canada for disposal are waste acids and bases, and inorganic cyanides; and for recovery, organic solvents, corrosives, lead with waste acid, and wastes constituting flammable gases on contact with water; these are exported to the United States. Imported hazardous waste, mainly from the United States, includes metal-contaminated wastes (primarily leachates), organic solvents, waste acids and bases, surface treatment wastes, photographic waste, cyanide waste, paint-related wastes, mercury-contaminated wastes and biomedical wastes. Of these, the organic solvent, surface treatment waste, metal-contaminated leachate and photographic wastes are recovered.

2. The major recovery methods prevalent in Canada include:

   - recycling/reclamation of metals and metal compounds;
   - treatment of metal surface treatment waste;
   - recycling/reclamation of other inorganics;

- solvent reclamation;
- recycling/reclamation of non-solvent organics;
- re-refining of used oil; and
- fuel blending.

Disposal is chiefly by secure landfill or incineration.

3. There are various major Canadian capabilities in the hazardous waste management field, linked to the recovery, treatment and disposal processes in which Canada is currently engaged (as outlined above). In terms of activities, these capabilities can be summarized generally as follows:

   - waste collection and transportation services;
   - waste treatment/disposal services and systems;
   - waste collection/treatment/disposal equipment;
   - waste exchangers;
   - laboratory and analytical services;
   - waste management consulting:
     - needs assessment;
     - regulatory development;
     - waste inventories;
     - waste minimization, opportunities assessment;
     - integrated waste management planning;
   - technology assessment:
     - treatment technologies;
     - disposal and secure landfilling technologies;
     - incineration technologies;
     - recycling and recovery technologies;
     - remediation technologies;
     - transportation; and
     - analytical QA/QC.

4. Of these capabilities, it would appear that those listed under waste management consulting and technology assessment are the ones that could be offered most successfully by Canadian businesses in international markets.

5. The more generic lines of business such as needs assessment, regulatory development, waste inventories and integrated waste management planning would be important services to offer to less-developed countries, whereas services to developed countries would typically include the more specialized technology assessments.

2.7.2 *Barriers and Needs*

Consultations with government and industry representatives and associations, and review of other relevant information, revealed the following about barriers and needs in the hazardous waste management sector for Canadian businesses.

1. Because experience in hazardous waste management will engender the greatest competitive ability domestically and internationally, Canada's chief competitors in the international hazardous waste market will include those countries that are already among the most active in the hazardous waste management field. These will include primarily the United States, Germany, Japan, the United Kingdom and the Netherlands, as well as Sweden, Belgium, France and Italy.

2. Small to medium-sized enterprises (SMEs) generally have difficulty marketing themselves effectively, and thus gaining access to the international marketplace. Also, relatively few firms are of sufficient size to be able to sustain the investment required or to develop the necessary contacts. Many foreign markets are inaccessible to SMEs, due to lack of funds to get started, lack of knowledge of local infrastructure, and lack of client base. A major challenge lies in convincing SMEs that they can actually compete and succeed in the international marketplace.

3. SMEs are generally more successful in gaining access to the international marketplace if they form a joint venture or consortium with another Canadian company or companies, thus providing sufficient mass or depth. Similarly, Canadian SMEs that partner with a local firm in the host country are generally more successful over the long term. However, Canadian companies need to be more willing and adept at forming such consortia.

4. Outgoing trade missions and workshops may be effective in identifying and facilitating opportunities, particularly for SMEs, and have more potential than trade shows. However, they must be organized carefully and well in advance. They will be more successful if focused on a particular area of interest.

5. Success is enhanced if the particular technology being offered is effectively demonstrated for the potential customer under local conditions; however, in many cases financial assistance is required from the Canadian government to do this.

6. Weak regulatory and enforcement infrastructure in many foreign countries pose a barrier to a healthy environmental goods and services industry, both for Canadian and local firms. Over the long term, programs to enhance these capabilities would lead indirectly to opportunities for Canadian (and local) firms to participate in the environmental and hazardous waste management markets.

7. Among industry and governments internationally, there is little awareness of Canadian capabilities and of firms capable of providing services and products.

8. A criticism of some government-sponsored programs was that they involved public sector personnel performing an advisory and assistance role to host countries on hazardous/special waste management policies, practices and technologies, which some view as potentially impeding opportunities for the Canadian private sector. However, others said that some countries are more willing to do business with a foreign company if the company's government actively endorses their involvement.

9. The more useful role for government is to identify needs and allow the consulting services sector to undertake the assignment and provide sustainable solutions through education, training, technology transfer and design/build/operation of treatment/disposal systems. Capacity building in the areas of policy development, enforcement training and related institutional matters, however, could perhaps be best dealt with by direct government assistance and advice.

10. The Basel Convention, and its possible expansion in terms of the types of wastes covered, is seen as a potential barrier to Canadian business development regarding the importation of wastes to Canada for treatment/disposal. However, unless the current requirements under Basel Convention are altered, the commitment to meeting the terms of the Convention does not preclude the importation of the major waste types for treatment/recovery/disposal from the countries with which Canada normally does business. Domestic information programs may be needed to correct this perception.

11. Although some developing countries are aware they have problems, they often are not aware of the exact nature and scope of these problems. Accordingly, government support programs in these countries should focus on short-term upstream services (i.e., beginning with an assessment of needs) and on developing regulatory infrastructure and protocols in the host country.

2.8 Summary of Needs

The research and the interviews that were conducted indicate that the chief requirements of Canadian businesses in penetrating foreign hazardous waste management markets may be summarized as:

- assessment and analysis of technological, institutional and regulatory needs in developing countries or those with transitional economies;
- stronger regulatory and enforcement institutional capacity in developing countries, combined with public and government support of the initiatives;
- enhanced opportunities for Canadian firms (especially SMEs) to enter promising foreign markets, through contacts with local governments, key industries and institutions, and potential partners, and through increased knowledge of the local environment and opportunities;
- more available information on assistance programs offered by Canadian public and private sector sources, and on current and planned initiatives;
- information available to other countries on Canada's capabilities in the environmental goods and services sector, and on environmental achievements in Canada; and
- maintenance and enhancement of Canada's international image in pollution prevention, cleaner production, risk management, and effective environmental management systems.

3.0 Analysis of Opportunities

3.1 Approach

This chapter discusses opportunities for the federal government to take a leadership role, in cooperation with industry, other levels of government and other countries, in promoting Canadian international business participation in hazardous waste management. The opportunities are discussed in terms of:

- geographical areas of opportunity; and
- technical (sectoral) areas of opportunity.

It is intended that the strategy and action plan (Chapters 4, 5 and 6) will flow from this discussion.

3.2 Geographical Opportunities Assessment

3.2.1 *Global Regions Offering Growth Potential*

It is important to identify which areas of the globe will be the most promising for government and business investment. Consultations with industry representatives suggest that the choice of geographical areas should be based on political and economic stability. Relatively stable countries that exhibit a level of development amenable to technology transfer and infrastructure development should be targeted.

Some of the countries of potential interest, on general grounds, are:

Latin America and Caribbean Region

Chile
Argentina
Brazil
Cuba
Uruguay
Trinidad and Tobago
St. Lucia, St. Kitts and Nevis
Mexico
Antigua and Barbuda
Bahamas
Barbados
Costa Rica
Guatemala
Honduras
Ecuador
Panama
Peru
Paraguay

Asia/Australia Region

Australia
New Zealand
Sri Lanka
India
Pakistan
China
Indonesia
Malaysia
South Korea
Papua New Guinea
Philippines
Singapore
Thailand
Taiwan
Vietnam

Other Regions

Czech Republic/Slovakia
Greece
Hungary
Poland
Turkey
South Africa

A review of ongoing UN Development Program projects (at the end of 1993) showed the following trends to the programs being funded:

- the African region received the largest portion of the budgeted projects;
- the Asia-Pacific region was second, and Latin-America/Caribbean was third, followed by Arab states and Europe; and
- growth in gross resources occurred only for the Latin America/ Caribbean region, with significant decreases noted for the Asia-Pacific, Arab states and Europe.

An additional consideration is that a number of OECD countries are not currently fully capable of meeting the Basel Convention requirements. As previously noted, many of the OECD countries provided no data for the annual report on hazardous waste imports and exports. This suggests a need to bolster the capacity of the regulatory infrastructure, particularly in tracking and documenting systems.

It will be necessary to assess the relative merits of each country or region, and thus to prioritize according to which ones offer the greatest business opportunities for Canadian firms in the hazardous waste management sector.

3.2.2 *Indicators for Prioritization*

Priority regions of the world — where business opportunities for Canadian firms in the hazardous waste management sector can be expected to be significant over the medium and long term — can be identified using the criteria (indicators) below:

- political stability;
- comparable industrial profile (i.e., similar industries, similar wastes);
- presence of industries generating hazardous wastes (e.g., military installations, chemicals);
- ease of communication (e.g., common language);
- common political tradition (e.g., Commonwealth and Francophonie countries);
- receptiveness of the public to environmental investment, public pressure for government to take assertive stance in controlling pollution;
- level of income, economic stability, and ability to pay;
- degree of environmental regulation and enforcement;
- receptiveness and level of commitment of the government to pollution prevention;
- receptiveness of industry to doing business with Canadians;
- predicted industrial expansion and economic growth;
- comparable transportation challenges; and
- existing or imminent trade or other agreements with Canada.

A brief explanation of these indicators follows.

Political Stability

Areas where there is political unrest (e.g., wars, riots, bombings, civil unrest) will not be focusing their attention on hazardous waste management. In addition, the financial and personal safety risks are high.

Comparable Industrial Profile

Countries with industries similar to those in Canada will generate similar wastes; consequently, Canadian expertise in hazardous waste management can best satisfy their needs.

Degree of Industrialization

Countries with high degrees of industrialization or becoming industrialized will generate more wastes and therefore have a greater need for waste management expertise.

Ease of Communication

An essential component in overseas projects is the ability to communicate effectively. This facilitates proper identification of the country's specific needs as well as the most effective use of project resources.

Common Political Traditions (e.g., Commonwealth and Francophonie Countries)

Common traditions enable a more rapid understanding of the country's political culture, which is essential for the design and implementation of regulations and infrastructure that will function properly in that culture and meet its needs.

Public Receptiveness

The success of a program such as a national waste management program is fully dependent on the degree of commitment and willingness of the public to participate.

Economic Stability

The economic stability of a country is reflected in the economic wellness of the public. Countries where the per capita income is below a critical level (approximately US$5,000 per year) may place little priority on environmental issues, and consequently would not be as receptive to incorporating the changes necessary to address them.

Degree of Environmental Regulation and Enforcement

This is an indication of the level of maturity of a country's environmental and hazardous waste program, and consequently points to the type and amount of assistance required. To a large extent, the effectiveness and breadth of environmental legislation is a key driving factor in the environmental goods and services industry, whether in Canada or abroad.

Government Commitment to Pollution Prevention

The effectiveness of any environmental protection or hazardous waste management program is critically dependent on the extent of enforcement of related regulations, as mentioned above.

Comparable Transportation Challenges

One of Canada's strengths in the hazardous waste field is in safe transportation over extended distances, as well as development of effective collection programs from small-quantity generators. Accordingly, this is an area where Canadians could effectively contribute.

Existence of Bilateral Agreements

The existence of agreements covering hazardous waste management and transportation facilitates project development and implementation. General trade agreements (e.g., NAFTA) indirectly encourage and facilitate development of the hazardous waste management industry, as well as potentially provide a source of funding where there is a commitment to harmonization of environmental standards. Canadian commitments under the Basel Convention (e.g., development of a regional Training and Technology Transfer Centre in the Latin America/

TABLE 3 EXISTING OR IMMINENT BILATERAL AGREEMENTS WITH CANADA

Region	Effective Date
Europe:	
Canada-Netherlands MOU	1988
Canada-Germany MOU	1990
Canada-France MOU	1991
Canada-Poland MOU	1993
Canada-Russia Agreement	1993
Latin America/Caribbean:	
Canada-Mexico Agreement	1990
Canada-Chile MOU	1995
Canada-Uruguay MOU	1996
Canada-Argentina MOU	1996
Canada-Brazil MOU	1996
Canada-Trinidad & Tobago MOU	1996
Asia & Pacific:	
Canada-Hong Kong MOU	1992
Canada-PR of China MOU	1993
Canada-Korea MOU	1995
Canada-Taipei MOU	1996
Canada-Thailand MOU	1997

Source: Information supplied by Environment Canada (1997)

Caribbean region) are also incorporated into this indicator.

Table 3 gives a listing of the current agreements and memoranda of understanding between Canada and other countries. It is to be noted that the listings are for "environmental" projects, and that only a portion of these can be expected to deal with hazardous waste issues as such.

Canadian Presence and Preferences

A final, but important, point concerns the preference and previous experience of Canadian companies in various international settings. The successful entry of a Canadian company into a foreign market depends on many factors, but among the most important are the personal interests and background of its principals, the presence of suitable partners, and perseverance. Obviously, this factor is specific to any given company, so generalizations are hard to make. For one company, Mexico may be a great opportunity because the firm has personnel who are fluent in Spanish and, perhaps, an existing alliance with one or more partner firms in Mexico. The situation will be quite different for a company where many of the principal staff are familiar with China and fluent in Chinese, and where there are partner companies in China. For this reason, it is difficult to generate a list of priority target countries. However, some guidance can be given by examining the list of countries for which CIDA-INC projects in the environmental sector are in place. Existing or imminent CIDA Bilateral and Industrial Cooperation agreements with Canada are listed in Table 4, along with the number of CIDA projects under the Industrial Cooperation Program.

TABLE 4 EXISTING OR IMMINENT CIDA BILATERAL AND INDUSTRIAL COOPERATION AGREEMENTS WITH CANADA

Country/Region	Bilateral Agreements	CIDA-INC Projects
Mexico	Regional environmental project	41
China	Energy Efficiency in Buildings project ($8.5M); China-Canada Cooperation in Cleaner Production ($10.5M)	34
India	Confederation of Indian Industry (Environmental Management)($7M); Small Project Environmental Fund ($0.5M); Waste Recycling Project ($2.1M)	19
Indonesia	Environmental Protection Collaborative ($20M)	19
Chile	Regional environmental project	16
Malaysia	Training and Visits Project ($2M)	15
Colombia	Regional environmental project	14
Venezuela	Regional environmental project	12
Brazil	Regional environmental project	11
Vietnam	Vietnam-Canada Environmental Project ($10M)	11
Morocco		10
Turkey		10
Cameroon		9
Egypt	Egypt Environmental Initiatives ($20M)	9
Zimbabwe		9
Argentina	Regional environmental project	8
Senegal		7
Thailand	Golden Jubilee Training and Visits Project ($2.9M); Canada-Thailateral Environment Project ($0.5M)	7
Tunisia	Ligne de crédit parallèle société pour l'expansion des exportations ($5M)	7
Barbados	Regional environmental project	6
Sri Lanka	Regional environmental project	6
Ecuador	Regional environmental project	5
Jamaica	Regional environmental project	5
Benin	Gestion des déchets solides pour Cotonou et Porto Novo ($5M)	0
Bolivia	Réforme de l'industrie minérale et du secteur de l'environnement ($2.5M)	0
Nepal	Small Project Environmental Fund ($0.5M)	0
Latin America	Arpel Environmental Project ($5M); OLADE Energy and Environment Project ($4.9M); Lead Phase-out Project ($0.5M)	
Central America	Alliance for Sustainable Development ($1.5M)	
ASEAN	Economy and Environment Program for SE Asia ($1.8M)	

3.2.3 *Ranking of Countries/Regions*

Table 5 shows the scoring under each indicator for each country or region. Each score is a subjective rating on a scale of 1 to 10, with 10 being "most favourable". A weighting factor (1-5) indicates the relative importance of each indicator criterion. The raw score for each indicator/country is multiplied by the appropriate weighting factor to yield the figure in the cells of the table. The scores are then summed for each country/region to indicate an overall rating. Although it must be emphasized that the above ranking exercise is highly subjective and is based on incomplete information for some criteria, some clear differences emerge.

Taking into account the factors listed in the previous section, as well as the influence of existing bilateral agreements and CIDA-funded projects already in place, the following clusters of countries/regions appear as priorities:

- *Asia-Pacific:* characterized by high industrial expansion rates and a growing awareness of existing and possible environmental threats; bilateral and other agreements/ projects in place or imminent; regulatory infrastructure varies markedly among countries.

TABLE 5 THE RANKING OF DIFFERENT COUNTRIES OR REGIONS (ACCORDING TO INDICATORS)

		Country/Region										
INDICATOR	Weight	Brazil	Argentina	Chile	Central America	Caribbean (commonwealth)	East Europe (Hungary, Poland, Czech, Slovakia)	India/Pakistan	China	Vietnam, Taiwan, Korea, Thailand	Malaysia, Indonesia, New Guinea	South Africa
Political Stability	5	8	8	7	5	9	6	7	5	8	8	7
Comparable Industries	3	8	8	8	5	6	8	7	7	8	8	7
Degree of Industrialization	2	6	6	6	4	5	8	7	6	7	7	7
Ease of Communication	5	5	5	5	5	9	7	8	5	6	5	7
Common Political Tradition	2	5	5	5	4	9	4	7	4	5	5	6
Public Receptiveness	3	5	5	5	5	7	7	8	5	6	6	5
Economic Stability	4	6	7	7	5	6	6	7	6	7	7	7
Regulation/Enforcement	2	5	5	5	5	6	6	7	3	5	5	6
Government Commitment	5	6	6	6	6	8	6	8	5	6	5	6
Transportation Similarity	1	9	9	9	5	7	6	7	7	5	5	6
Bilateral Agreements	5	8	8	8	7	7	4	7	6	6	6	2
Total Weighted Score		**239**	**243**	**238**	**196**	**275**	**226**	**272**	**198**	**239**	**229**	**218**

Notes: 1. Score reflects subjective rating based on available information.
2. Total is sum of raw scores (scale of 10) multiplied by weighting factor.

- *Latin America and Caribbean:* high industrial expansion rates in a number of countries, and growing awareness of environmental threats; regulatory infrastructure varies markedly among countries; trade agreements in place or likely in future; historical links with current and former Commonwealth and Francophonie countries in the Caribbean.
- *China,* with its rapidly expanding industrial economy, is highly ranked as well, but the future of this region as a market appears to be heavily dependent upon political factors, which are not easily quantified.

To provide a more specific prioritization becomes subjective and dependent on significant assumptions. However, a listing of the 10 top-ranked countries for each of the Asia and Latin America/ Caribbean regions is given below. It is important to re-emphasize that this listing does not take into account the individual preferences and capabilities of any given company, and is not intended as a formula for entering foreign markets.

Asia-Pacific

China
India
Indonesia
Taiwan
Vietnam
Thailand
Malaysia
Pakistan
Sri Lanka
Korea

Latin America and Caribbean

Mexico
Chile
Argentina
Colombia
Venezuela
Bolivia
Uruguay
Trinidad and Tobago
Barbados/Bahamas/Jamaica
Brazil

To illustrate how the criteria apply to some example countries, India would be favoured by the following factors: relative political stability; comparable industrial profile to Canada in heavily industrialized areas (i.e., refineries, chemicals, manufacturing, metals, mining, etc.); presence of industries generating hazardous materials; ease of communication and common political tradition (i.e., English language, high literacy rate, Commonwealth tradition); receptiveness of the public to environmental investment (new middle class expanding; level of income growing; concern about environmental issues increasing); degree of environmental regulation and enforcement (many industries have been closed down for pollution offences); high receptiveness and level of commitment of the government to pollution prevention due to recent Supreme Court actions; predicted significant industrial expansion and economic growth in industrial centres; and comparable transportation challenges (large country, with road, rail, sea modes). Pakistan is probably on the same path as India, as is Sri Lanka, but they are not as far advanced in terms of regulations development, enforcement infrastructure and so forth.

The Commonwealth (and Francophonie) countries in the Caribbean would also represent significant opportunity (e.g., Bahamas, Barbados, Jamaica, Trinidad and Tobago), even though they are not large industrial states. Ease of communication and common political tradition (i.e., English language, high literacy rate, Commonwealth tradition), receptiveness of the public to environmental investment

(level of income growing; concern about environmental issues increasing), and comparable transportation challenges (small island states face waste shipping challenges similar, in some ways, to those faced by a large country like Canada) would all contribute to such opportunity. Many of the countries in Latin America are experiencing rapid industrial growth, and expansion has produced a need for effective waste management. Overall, the industrializing countries of South America and the Caribbean are favoured due to the above factors and the existence or imminence of bilateral trade agreements (e.g., Chile under NAFTA). The Basel Convention commitment for a Regional Training Centre in this region is another important factor.

3.3 Sectoral Opportunities Assessment

A report studying the feasibility of establishing hazardous waste training and technology transfer centres in Latin America and the Caribbean (Jacques Whitford, 1994) identified the following principal needs for these centres:

- training and information in clean production technologies;
- assistance in the establishment of legislative frameworks and enforcement mechanisms;
- training of customs officials, enforcement officers and administrators in the implementation of the Basel Convention;
- development and implementation of hazardous waste classification schemes;
- assistance in monitoring of illegal hazardous waste trafficking;
- establishment of an electronic network of hazardous waste data and resources;
- development of hazardous waste inventories and waste brokerage systems; and
- training in laboratory protocols.

These needs are the same as many of these identified in Agenda 21, Chapter 20 (see Appendix 1).

Specific Canadian sectors providing resources compatible with the above needs were identified in the same report (Jacques Whitford, 1994):

- waste minimization and clean production technology;
- recycling of industrial waste;
- hazardous waste disposal or destruction;
- industrial waste brokerage;
- hazardous waste transportation;
- landfill design, construction and management;
- emergency response and clean-up;
- environmental and human health risk assessment;
- design and construction of institutional infrastructure;
- training of enforcers and administrators;
- custom infrastructure respecting hazardous wastes;
- handling, labelling and documenting procedures;
- enforcement infrastructure development;
- illegal trafficking monitoring procedures;
- laboratory procedures; and
- software development.

Taking the above information into account, as well as the present review of hazardous waste industry data (e.g., *Canadian Environmental Directory; Canadian Environmental Solutions*) and questionnaires/interviews with industry representatives, it is evident that the areas where Canada has a potential leadership role relevant to the Basel Convention include the following:

- needs assessment (for hazardous waste management, waste audits, inventorying, database management, regulatory framework, institutional and technology);
- waste minimization opportunity assessments;
- integrated waste management planning including hazardous wastes;
- risk assessments (health and environmental);
- hazardous waste transportation (collection, waste tracking, safe transport, program design);
- development of regulations, guidelines, regulatory framework;
- development of institutional infrastructure (e.g., enforcement procedures, staffing, waste tracking, laboratory requirements);
- facility design and operation: incineration, secure landfill, physical-chemical treatment;
- long-term safe storage design;
- recycling technologies, particularly for used oil, solvents, paints, metals;
- recovery technologies (e.g., for metals from sludges, ores, tailings);
- management systems and treatment technologies for oily wastes and oilfield wastes;
- remediation technologies (including bioremediation) for sites contaminated with hazardous wastes (assessment, remedial investigation, process feasibility studies, design, implementation);
- development and planning of waste exchange systems;
- evaluations and program design: waste minimization, pollution prevention, source reduction;
- clean production technologies (e.g., pulp and paper, zero discharge);
- development of emergency response systems and networks;
- laboratory and analytical procedures, QA/QC;
- database systems development, modelling and other software;
- on-site or mobile contaminant treatment/destruction process technology; and
- capacity building and training in all of the above areas, and in more general areas such as environmental impact assessment, risk assessment, cleaner production.

Canadian firms could promote their expertise in any or all of the above areas, with some expectation of success.

4.0 Strategy Options for Promoting Canadian Business Opportunities

This chapter proposes strategy options for the government's consideration in promoting the Canadian environmental industry in respect to the Basel Convention. The proposed options are based on the results of research and consultations with private sector and government representatives, as described in the preceding sections.

The following are the possible types of involvement or initiative that the federal government, in consultation or collaboration with other sectors, could contemplate to enhance the entry of Canadian companies into the international market for hazardous waste management:

1. needs assessment and prioritization;
2. capacity building;
3. facilitation (trade shows, workshops, etc.);
4. database development (surveys, inventories, etc.);
5. direct promotion of Canadian companies; and
6. financial support for joint ventures and other projects.

These possible strategy elements are outlined briefly below.

4.1 Needs Assessment and Prioritization

In each country or region of interest, a study may be needed to assess and evaluate:

- priority environmental (pollution, hazardous waste) issues;
- existing institutional structures;
- legislative framework and adequacy of regulatory instruments;
- key gaps in technology, and need for demonstration/pilot projects;
- potential for partnerships with government agencies, state companies and private sector;
- government's level of interest in Canadian participation; and
- receptiveness of private sector to Canadian participation in this market sector.

From this assessment, the following will be identified:

- potential market niches for Canadian companies in the host country, in areas where Canadians have significant capacity (e.g., treatment of metal-containing sludges; incineration of PCBs; management of biomedical wastes);
- key needs in the host country with respect to institutional improvements and staff training;
- key needs in the host country related to additional or improved regulations, standards, guidelines;
- need for demonstration/pilot projects, for proving technologies under local conditions; and
- overall feasibility and potential value of targeting the promotional strategy at the host country (i.e., potential market volume, accessibility, partnerships, receptiveness).

For the purposes of illustration, an assessment of needs that match Canadian capabilities has been performed for India and Chile (see Appendix 2).

4.2 Capacity Building

Capacity building may be targeted toward the public sector (government officials, scientists, technicians, analysts) or the private sector (industry, labs, etc.) or both. Enhancing the capacity of local authorities and agencies and their personnel will improve business opportunities for environmental companies (local or Canadian). For example, strengthening a regulation on hazardous waste disposal tends to create an opportunity for the private sector to provide services in the design and operation of secure landfill, physical/chemical treatment, or incineration facilities.

Capacity building may take any of the following forms:

- training (management);
- training (technical);
- technology transfer;
- development of regulations, guidelines or standards; or
- institutional improvements.

Institutional improvements could include, for example, the establishment of a training centre, an enhanced database management system, or a feasibility study for a hazardous waste treatment facility.

A number of countries are currently in the process of expanding their capacities to manage hazardous wastes, and would represent particular opportunities for Canadian contributions in capacity building. Three examples of countries that are involved in establishment or expansion of internal capacity are India, Vietnam, and Trinidad and Tobago. Because various countries are at different stages in the capacity development process, different forms of involvement in capacity building will be required. In India, for example, regulations are relatively well advanced; industry-specific standards, processes and management systems are now needed. In countries that are at an earlier stage of development, the promulgation of laws and regulations may be required.

4.3 Facilitation (Trade Shows, Workshops, etc.)

The federal government has, in the past, sponsored trade shows, trade delegations and workshops in other countries. These involve Canadian environmental firms and local government, industry and other participants. The purpose of these events is to expose Canadian companies to potential new clients (government or private sector) and potential new partners, and to introduce them to the realities of doing business in the host country.

The present survey has generated some feedback on the relative merits of various forms of facilitation. The prevailing view seemed to be that trade shows and conferences were often less productive than anticipated, and that what was needed was topical focus in an area of locally high priority, and well-planned follow-up to the event. Regarding the latter point, it was widely felt that a trade show, conference or workshop should not be done as an end in itself, but rather as part of a critical path aiming at specific outputs and including an evaluation phase.

4.4 Database Development (Surveys, Inventories, etc.)

Past efforts at promoting environmental (and other) industries in other countries have included the development of databases on industrial, commercial and

government sectors in that market, which are intended to serve as a guide to Canadian companies interested in doing business there. Databases have also been developed by the federal government and environmental industries associations on Canadian companies that supply environmental goods and services, identifying those interested in doing business in other countries.

While a database can be useful as a starting point for a Canadian company hoping to do business in another country, a prevailing view was that there are sufficient databases on Canadian companies to meet the need, and that the development of further databases on markets in other countries would not necessarily be cost-effective in terms of promoting business opportunities.

4.5 Direct Promotion of Canadian Companies

In theory, the government could directly promote individual Canadian companies in foreign markets, but there are several problems with this. The process of selecting companies to promote would leave the government open to criticism as to the criteria used, and possibly to charges of favouritism. In addition, it is questionable whether the government's involvement in promoting individual firms would be consistent with the free enterprise principle: if a company is fit to do business in Canada or elsewhere, it should be capable of marketing its own products or services.

There is a need, however, to get more information about Canadian products and services in the environmental and waste management field to potential clients in foreign countries. Canada's potential for increased environmental business in other countries is helped significantly by its favourable environmental image around the world. This image could be enhanced by publishing information on Canadian environmental accomplishments and success stories. This type of publication has been done in the past (e.g., through CIDA): information about Canadian environmental issues and achievements (e.g., in combating pollution) was compiled in a brochure, for distribution through Canadian embassies and High Commissions.

4.6 Financial Assistance Programs

Financial assistance programs for projects involving Canadian companies represent an important and direct means of promoting Canadian environmental industries. This mechanism is already well established through programs such as CIDA's Industrial Cooperation Program, which funds feasibility studies, and through the Export Development Corporation. Canada's participation in international financial institutions such as the Asian Development Bank and Inter-American Development Bank is an important way in which Canada's financial support promotes the activities of Canadian (although not exclusively Canadian) companies in the environmental and other sectors.

5.0 Outline of Strategy

5.1 Strategy Elements

Based on the needs and options outlined in the previous chapters, the proposed strategy to assist the Canadian environmental industry in developing and capturing hazardous waste market opportunities internationally involves the following elements:

- needs assessment;
- capacity building;
- facilitation;
- marketing Canada's international image; and
- coordination, financing and evaluation.

The objective of each strategy element is defined as follows:

Needs Assessment

- to assess the environmental issues, degree and types of industrial pollution, state of control measures, regulatory and institutional infrastructure, and receptiveness of local government and business to Canadian involvement; and from this to evaluate (i) the products and services that are needed by the target country, and (ii) the elements that need to be in place for Canadian businesses to successfully enter the local market for environmental goods and services.

Capacity Building

- to enhance the capacity of regulatory, enforcement and related institutions and structures, in high-priority target countries, through targeted and focused training programs and the establishment of regional centres for technology transfer and demonstration.

Facilitation

- to facilitate the entry of Canadian SMEs into foreign hazardous waste management markets, in critical areas, through a strategically developed dialogue process between Canadian firms and host-country governments and industries; and to conduct appropriate follow-up to encourage joint ventures and pilot/demonstration projects.

Marketing Canada's International Image

- to implement proactive, state-of-the-art environmental management systems in public and private sector operations in Canada, emphasizing pollution prevention, cleaner production, risk management, and effective environmental management systems; and to implement international commitments, in order to maintain and enhance Canada's international credibility in the environmental field.

- to provide published information on Canadian environmental issues, challenges, and accomplishments ("success stories") for distribution to potential clients, partners, etc., in other countries.

Coordination, Financing and Evaluation

- to maintain, update and make available an accessible inventory of funding and other assistance

programs offered by the Canadian public and private sector; to secure financing for Canadian hazardous waste management initiatives in other countries; and to evaluate the success of capacity building, facilitation and other government programs in order to optimize the mix of strategy elements.

5.2 Optimal Mix of Strategy Elements

The different situations encountered in different countries call for a varying mix of the following basic strategy elements:

- needs assessment;
- capacity building; and
- facilitation.

For example, in a developing country with only a rudimentary regulatory framework and a low level of expertise in its institutions, a needs analysis would logically be the focus of early efforts, followed by capacity building in the form of regulatory development and generic training (e.g., environmental impact assessment, principles of enforcement, etc.). Some African, Latin American and newly emerging Asian nations would fall into this category.

In contrast, in a country such as India — where there is a relatively well-developed professional guild and comprehensive environmental regulations — specifically targeted sectoral training (technology transfer) would be more effective, as would facilitation to help Canadian companies access specific markets. The basic strategy elements may be viewed as a continuum, progressing from needs assessment, to capacity building, to facilitation. These elements may be used in formulating specific strategies tailored to priority countries, as outlined in the next chapter.

5.3 Description of Strategy Elements

5.3.1 *Needs Assessment*

The first step in developing a country-specific strategy is to assess the environmental, pollution and waste management issues in that country, including:

- degree and types of environmental degradation, loss of natural resources;
- degree and types of industrial pollution;
- control measures in use in local industry;
- regulatory framework in existence;
- institutional infrastructure and level of expertise;
- receptiveness of local government and business to Canadian involvement; and
- other relevant factors.

From this analysis, it will be possible to evaluate (i) the specific products and services that are needed by the target country; and (ii) the elements that need to be in place for Canadian businesses to successfully enter the local market for environmental goods and services. Specifically, the form of capacity building that should be made available, and the types of products and services that should be promoted through facilitation, will stem from this analysis.

5.3.2 *Capacity Building*

It is proposed that the Canadian government undertake a targeted program to enhance the regulatory and institutional strength of priority countries.

Parties to the Basel Convention agreed on the need for regional centres for training and technology transfer, according to the specific needs of different regions and subregions. The regional centres are to focus on implementation of the Convention, on sound management of hazardous waste, and on waste minimization. Canada, Finland, and Australia agreed to undertake feasibility studies to consider establishment of regional centres in the Latin America and Caribbean, Eastern Europe, and Asia-Pacific regions, respectively. Canada completed its feasibility study in 1994-95.

The feasibility study recommended centres in four locations: a regional coordination centre in Uruguay, and three sub-regional centres in Argentina, El Salvador and Trinidad and Tobago. The study recommended that the centres should aim to achieve financial self-sustainability by charging for their services, while raising funds from international financial institutions such as the Inter-American Development Bank and World Bank.

Later meetings determined that the subregional centres in Latin America and Caribbean Region would focus on technology transfer, while the regional coordination centre in that Region would develop legislative framework, train government and industry personnel, and develop and maintain an information clearinghouse.

It is recommended that a major part of the federal government's strategy comprise an ongoing commitment to the establishment and maintenance of the regional and subregional centres in Latin America and Caribbean. Specific proposals for the establishment of the centres should be finalized as soon as possible.

The development of programs should include the following as the highest priorities:

- regulatory and technical experience;
- source control and waste minimization systems;
- testing and proving of cleaner production technologies through pilot projects; and
- demonstration projects to promote management systems (e.g., source reduction).

In terms of technology and information transfer, the aims of the programs would be to advise and train in the following areas:

- development of regulatory instruments (in cooperation with the host government);
- pollution prevention and cleaner production technologies;
- safe disposal and incineration, physical-chemical treatment;
- remediation;
- emergency response;
- risk assessment, contingency planning;
- auditing;
- laboratory protocols, instrumentation, QA/QC;
- enforcement mechanisms, inspections, investigations;
- sampling and monitoring techniques;
- development of technical standards, guidelines, codes of practice;
- hazardous waste classification systems;

- hazardous waste inventorying systems and database management;
- networking and information management systems;
- waste exchange systems; and
- transportation systems, labelling, manifests.

The establishment and maintenance of the centres should be a coordinated effort, with government, private sector and university involvement. An important goal will be to identify funding sources.

In the further development and implementation of this program, Canada should consider promoting, funding and participating in the following specific areas, such as its human and fiscal resources will allow.

Hazardous Waste Management Program for Trinidad and Tobago

- comprehensive program for the sound management of hazardous and oily wastes from oil and gas, manufacturing and maritime industries;
- Inter-American Bank has approved a $45 million loan to fund the program;
- The proposed program will:
  - implement an investment program for collection, processing and safe disposal of hazardous waste;
  - promote pollution prevention measures for pollution from industrial, exploration and transportation sources;
  - establish a monitoring and information system for program evaluation;
  - establish institutional and management structures to run the program.

Montevideo Sanitation Program, Uruguay

- established in Montevideo in November 1996, jointly with Uruguayan and Canadian funds;
- involves the establishment of an industrial source control program to complement a sewage collection and treatment expansion and upgrading program;
- a feasibility study is needed to assess the program;
- Inter-American Development Bank funds needs to be accessed.

Industrial Source Control Programs in Mexico, Argentina and Chile

- several possible industrial source control programs to reduce organic loading and toxic chemicals and to recover waste substances have been identified in the Region (e.g., Toluca industrial park, Mexico; others in Argentina and Chile);
- these would serve as demonstration projects for pollution prevention opportunities, as well as for the benefits of source reduction and materials recovery;
- would promote cleaner production technologies and regulatory compliance within industry.

Support of Other Regional Training and Technology Transfer Centres

In addition to establishing and maintaining regional centres in Latin America and Caribbean Region, Canada should support the establishment and maintenance of similar centres in Asia-Pacific Region.

As a longer-term strategy, additional regional training and technology transfer centres should be supported as future opportunities arise. As well as centres in Asia-Pacific and Latin America/Caribbean regions, these would include centres in Central/Eastern Europe (Czech Republic) and Africa (Nigeria or Egypt).

5.3.3 *Facilitation*

The following outlines a program to mount a sequence of strategically developed workshops aimed at facilitating the entry of small to medium-sized Canadian enterprises into the hazardous waste management markets of developing countries or countries with economies in transition. The workshop process is outlined below, and a brief description of each stage in the process is given in Appendix 3.

The proposed strategy consists of the following elements:

Phase 1: Assessment of Needs

- perform needs assessment to determine topical focus of workshop process.

Phase 2: In-Country Dialogue (preliminary)

- first-stage dialogue/workshop in host country;
- seminar program.

Phase 3: In-Country Dialogue (follow-up)

- second-stage dialogue/workshop in host country;
- sector-specific seminars and training.

Phase 4: Evaluation and Follow-up

- perform process evaluation;
- ongoing technical seminars program;
- evaluate possible assistance for joint ventures;
- determine exit point.

It is important to determine the point at which the dialogue and capacity-building processes have achieved their purpose, and at which the participating Canadian companies should be able to market their own products and services without further significant government involvement other than ongoing capacity-building or monitoring activities. At that point, a decision can be taken to activate the strategy in the next priority region or country.

Canada's follow-up activities and involvement will be carefully conceived, so that:

- the activities of both government and private sector players complement other international efforts;
- government's involvement is aimed primarily at those areas for which it normally has responsibility (e.g., inspection, enforcement, legislative frameworks);
- the Canadian private sector is given full opportunity to participate in areas where it has expertise (e.g., cleaner production, disposal and treatment methods, remediation, risk assessment); and
- opportunity is taken to merge the concept with other, existing institutions or with other closely related concepts (e.g., hazardous waste management and pollution prevention).

5.3.4 *Marketing Canada's Environmental Image*

Keeping Our House in Good Order

One of the advantages that Canadian businesses have in other countries is Canada's reputation as a good "environmental citizen". To successfully pursue and develop business opportunities in the environmental management field internationally, Canada will need to preserve and enhance this reputation in the future. The recently published (1997) report of the Commissioner of the Environment and Sustainable Development to the Canadian Parliament reiterated statistics indicating that Canadians, per capita, are large consumers of energy and natural resources, and large generators of waste. The report also highlighted that Canada is unlikely to meet some significant international commitments, such as its target for limiting greenhouse gas emissions.

If Canada is to maintain its valuable leadership role, it is important to set an example by meeting sustainable development objectives and commitments. The federal government is in a position of leadership, as well as enforcement, in this respect. Some examples include the implementation of hazardous waste regulations under *Canadian Environmental Protection Act* (CEPA) Part IV at federally operated facilities; strengthening of CEPA and enforcement of the strengthened act and regulations; promotion of pollution prevention and waste minimization measures in Canadian industry; and steps to meet Canada's international commitments on limiting greenhouse gas emissions.

Implementation of the above items would indirectly assist Canada's efforts in promoting Canadian business in other countries, as well as creating opportunities for Canadian environmental businesses at home.

Publishing Canadian Success Stories Abroad

Canada's international environmental image could be enhanced by publishing information on Canadian environmental accomplishments and success stories, in the context of Canadian environmental issues and challenges. This type of publication has been done in the past (e.g., through CIDA), when information about Canadian environmental issues and achievements (e.g., in combating pollution) was compiled in a brochure, for distribution through Canadian embassies and High Commissions. It is recommended that this effort be expanded and sustained.

5.3.5 *Coordination, Financing and Evaluation*

Coordination

A database of activities and funding and other assistance programs that are organized or offered by either the public or private sector in higher-priority countries should be developed, updated and made available to Canadian public sector agencies or private sector companies upon request. This should be a cooperative effort involving government departments, environmental industries associations and business councils, and private sector companies. An initiative of this type is currently being developed for India.

Financing

The success of any needs assessment, capacity-building, facilitation or marketing initiative is dependent on adequate funding and on effective follow-up. Because funding for international projects in the environmental, waste management and infrastructural sectors comes from a wide variety of sources, it is critical for strategy managers to identify and secure adequate funding to fuel such initiatives over the long term.

Accordingly, it is recommended that a tactical plan be developed and implemented, in the near future, to evaluate the prospects for funding strategic objectives from various Canadian and international sources, including but not necessarily limited to:

- World Bank;
- Global Environmental Facility;
- Inter-American Development Bank;
- Asian Development Bank;
- OECD;
- CIDA (e.g., Industrial Cooperation Program); and
- UN-based funding programs (UNEP, UNIDO, WHO, FAO, etc.).

In addition, it is recommended that the federal government, in cooperation with environmental industries associations, re-resource and continue the International Environmental Management Initiative (IEMI) under the Canadian Environmental Industry Strategy. The resourcing program should extend for a further three years, at a higher level ($2.5 million over three years), to allow for increased awareness and interest in this initiative.

It is recommended that the IEMI be aligned to facilitate greater participation by private sector technical, regulatory/legal and management experts, in collaboration with government personnel. Proposals could still be routed through federal government offices, as is currently the case.

It is also recommended that the focus of the IEMI be broadened to further pursue opportunities for promising ideas generated by regional workshops, such as pilot projects, demonstration projects and joint ventures. This would be of great assistance to SMEs that are attempting to access promising foreign markets. IEMI could be used as "bridge" funding to gain access to more substantial funding from one or more of the major international financial institutions or from private sector sources.

Evaluation

The following indicators can be used to evaluate the success of programs.

1. *Regional Training and Technology Transfer Centres*
   - number of companies in the region/subregion that have implemented waste minimization schemes;
   - amount of hazardous waste minimized in specific sectors;
   - amount of hazardous waste recycled in specific sectors;
   - hazardous waste legislation enacted;
   - number of enforcement actions (e.g., seizures, prosecutions);
   - number of personnel trained;
   - number of joint ventures involving Canadian companies; and
   - number of industries or municipalities adopting Canadian technologies as a result of demonstration or pilot projects.
2. *Facilitation through Focus Workshops*
   - number of contracts secured by Canadian companies;
   - number of joint ventures involving Canadian companies; and

- number of industries or municipalities adopting Canadian technologies as a result of demonstration or pilot projects.

5.4 Respective Roles of Public and Private Sectors

Government and the private sector can and should play complementary, coordinated and mutually supportive roles in the execution of strategy elements, particularly:

- needs assessment;
- capacity building;
- implementation; and
- facilitation.

As a general principle, government should not be in the position of competing with the private sector in offering services relevant to hazardous waste management and environmental protection. Public-private competition need not be the case, as there are many areas in which government is in a position to advise, on the basis of its domestic experience, responsibilities and mandate, while specialized technical expertise is often found in the private (or quasi-private) sector. Some of the specific areas in which each sector can appropriately be involved are listed below.

Public Sector

Needs Assessment

- initial needs assessment, issue-related;
- regulatory and institutional analyses.

Capacity Building

- regulatory framework;
- regulatory enforcement principles and techniques;
- hazardous waste classification systems;
- environmental procurement programs;
- environmental impact assessment and risk assessment principles;
- emergency response and contingency networks;
- hazardous waste collection/transfer systems, waste exchanges;
- public education and activation programs;
- laboratory certification, QA/QC;
- accreditation programs (e.g., auditors, inspectors);
- technology verification.

Implementation/Facilitation

- initiate and sponsor workshops;
- organize and conduct workshops.

Private Sector

Needs Assessment

- sector-specific, technology-intensive;
- regulatory and institutional analyses;
- hazardous waste inventories;
- industrial profiles.

Capacity Building

- development of specific regulations, codes, guidelines;
- technology transfer and training:
  - hazardous waste treatment/ disposal technologies;
  - incineration technology;

- remediation technology;
- waste minimization, pollution prevention technologies;
- recovery of materials from hazardous waste;
- hazardous waste recycling technologies;
- monitoring systems and networks, instrumentation;
- risk assessment;
- hazardous waste classification.

Implementation/Facilitation

- environmental impact assessment studies;
- risk assessment studies;
- development of sector-specific environmental management plans;
- integrated hazardous waste management planning studies;
- design/operation of hazardous waste treatment/disposal systems;
- design/operation of incineration systems;
- remediation technology;
- development/application of waste minimization, pollution prevention methods (sector-specific);
- recovery of materials from hazardous waste;
- development/application of hazardous waste recycling technologies;
- design of monitoring systems and networks, instrumentation;
- organize/conduct facilitation workshops, under contract.

6.0 Strategies for Focus Countries/Regions

6.1 Approach

Based on the strategy outline and strategy elements proposed in Chapter 5, this chapter presents strategies specific for the two proposed focus areas:

- Asia-Pacific; and
- Latin America and Caribbean (Commonwealth).

6.2 Asia-Pacific

6.2.1 Rationale

The promising countries in this region are numerous. Because it received a particularly high ranking in Table 5, the India/Pakistan (including Sri Lanka) subregion will be used as an example for the development of a regional strategy. It must be recognized, however, that the varying political, industrial, economic and social factors throughout Asia-Pacific call for different country-specific strategies.

The factors that make India a promising focus for developing Canadian business opportunities in the hazardous waste sector have been noted earlier in this report. They include a rapidly expanding economy; the existence of a wide range of industries producing hazardous wastes; an abundance of well-educated and literate people; a well-developed legislative framework; a commitment to enforcement by current central and state governments; and local industry's general receptiveness to working with Canadians. Also in its favour are that agreements are in place or pending (e.g., CIDA and the Confederation of Indian Industries (CII)); and that funding programs are available, in some cases specifically to deal with hazardous waste (e.g., through the World Bank). Pakistan is probably on the same path as India, as is Sri Lanka, but they are not as far advanced in terms of regulations development, enforcement infrastructure, and so forth. For convenience, however, the three countries have been regarded as a cluster.

6.2.2 Needs Assessment

Environmental, pollution and hazardous waste issues in India are already fairly well understood in some states (Asian Development Bank, 1994), while other states will require area-wide assessments, waste inventories and waste minimization opportunity assessments. Feasibility studies and conceptual designs for a common hazardous waste facility on a demonstration level could be promoted with the central or state governments, and proposals for source reduction and pollution prevention demonstration projects within specific industrial complexes would likely be well received. Pakistan and Sri Lanka would require more fundamental needs assessment (i.e., industry characterization, infrastructure evaluation and regulatory review).

Appendix 4 contains a review of the environmental pollution and hazardous waste issues in India, and a summary of specific technical needs.

6.2.3 Capacity Building

A generic form of capacity building and training has already been performed by various agencies in India, but specific sectoral training targeted at highly polluting industries ("red category")

would be very useful. Examples of topics for training and technology transfer include:

- waste minimization in the textiles dyeing industry;
- pollution control, source reduction and material recovery in the leather tanning industry;
- treatment/disposal of electroplating sludges;
- recovery of metals from sludges; and
- treatment/utilization of oily wastes and management of oilfield wastes.

Sectoral training programs should be coordinated with industry associations such as the CII and with ongoing programs supported through CIDA and other sources.

A mix of sectoral programs and generic training would be useful in Pakistan and Sri Lanka, subject to the needs assessment.

6.2.4 *Facilitation*

Because there is a general receptiveness in India, Pakistan and Sri Lanka to working with Canadian enterprises, the timing is ideal for Canadian companies (particularly SMEs) to gain exposure to potential clients, local partners and local regulatory agencies. It is recommended that the organization of a phase 1 workshop on hazardous wastes management be initiated, as outlined in a previous chapter. Depending on the response from Canadian and local participants, this should be followed by a phase 2 workshop in 9 to 12 months. Evaluation and follow-up would ensue as appropriate. A key objective of the process is to promote pilot or demonstration projects to prove promising technologies under local conditions. Possible locations include Delhi, Bombay (Mumbai), Ahmadebad, Bangalore and Madras (Chennai), which have large industrial aggregations. Depending on the success of the initial workshop/dialogue, other phase 1 or phase 2 workshops could be contemplated for other industrial centres.

Such efforts should be undertaken in consultation with the CII and other industry associations, as well as with the state and central government (Pollution Control Boards, Ministry of Environment and Forests) and centres of expertise such as the Indian Institute of Technology (IIT).

6.2.5 *Coordination and Information*

The government, in consultation with CIDA and relevant business associations (e.g., Canada-India Business Council) should develop/update and publish a guide to initiatives and programs relevant to the hazardous waste management (and other) businesses in India, and distribute it on request to Canadian private sector and other groups. It is noted that such an initiative is already in the planning stages.

As part of the capacity-building program outlined above, seminars should be offered on the Canadian approach to, and advances in, pollution prevention, remediation technology, hazardous waste recycling and recovery of materials, and other sectors where Canada has made significant advances.

6.2.6 *Marketing Canada's Environmental Image*

In order to maintain Canada's international environmental image, information on Canadian environmental accomplishments and success stories should be updated and published, in the context of Canadian environmental issues and challenges. The type of publication that has been done in the past through CIDA, where stories on environmental issues and achievements were compiled into a brochure for distribution through

Canadian embassies and High Commissions, could be considered.

6.3 Latin America and Caribbean Region

6.3.1 Background/Rationale

The region comprises a number of countries whose economies are expanding and liberalizing, and, with the prospect of various trade agreements (e.g., Chile), would appear to offer business opportunities for Canadian companies in the hazardous waste sector. Among the countries in this region are Brazil, Mexico, Argentina, Chile, Peru, Paraguay, Uruguay, Ecuador, Trinidad and Tobago, St. Lucia, St. Kitts and Nevis, Antigua and Barbuda, Bahamas, Barbados and Jamaica. Depending upon political factors, Cuba may also present opportunities over the long term.

Within the region, there is a range of industries producing hazardous wastes. Many of these countries do not yet have a well-developed legislative framework. However, among the states of the Commonwealth, there is a common language and political tradition, and an overall receptiveness by industry to work with Canadians. Funding programs have become available (e.g., through the Inter-American Development Bank), some of which specifically have to do with hazardous waste needs assessment, and infrastructure planning and development.

6.3.2 Needs Assessment

Most countries of the region will require area-wide assessments of various degrees, waste inventories and waste minimization opportunity assessments. Where this has been accomplished, feasibility studies and conceptual designs for hazardous waste facilities can be pursued. Trinidad and Tobago, Barbados and Bahamas, for example, have had some level of inventory and conceptual facility design, but need to go further in developing and substantiating these plans. There would appear to be a great utility in developing a concept for a source reduction and pollution prevention demonstration project within a large industrial complex, to serve as a model for the entire region.

6.3.3 Capacity Building

In most states of the region, a generic form of capacity building would be appropriate, with some having already been performed. This would involve the training of government and industry personnel. It would also include programs to enhance regulatory development, waste tracking systems and other institutional developments.

In some cases, a sectoral form of training and technology transfer would be useful (i.e., waste minimization, pollution control, source reduction and material recovery in specific waste-producing industries). The ideal venue for this is the Regional Training and Technology Transfer Centre established in November 1996, and subregional centres as described earlier in this report. It is recommended that Canada continue to support the development of this concept, and to strongly consider supporting, and participating in, the specific hazardous waste management planning and demonstration projects itemized in section 5.3.2. The Centre could also serve as a focus for regional needs assessments in the hazardous waste sector.

6.3.4 Facilitation

Because of the complexity of the region, Canadian businesses, particularly SMEs, need to have exposure to potential clients, local partners and local regulatory agencies. It is therefore recommended that the organization of a phase 1 workshop on hazardous waste management be

considered, followed if necessary by a phase 2 workshop in 9 to 12 months, with appropriate evaluation and follow-up as outlined earlier in this report. Candidate centres for such a dialogue include, but are not limited to, Trinidad and Tobago, Uruguay and Chile.

6.3.5 Coordination and Information

The Canadian strategy should include, as part of the training program outlined above, seminars on the Canadian approach to, and advances in, pollution prevention, remediation technology, hazardous waste recycling and recovery of materials, and other sectors where Canada has made significant advances.

A guide to Canadian business and industry initiatives and programs relevant to the hazardous waste management (and other) businesses in the Latin America and Caribbean region should be developed, and updated and distributed on request to private sector and other groups.

6.3.6 Marketing Canada's Environmental Image

As noted in section 6.2.6., information on Canadian environmental accomplishments and success stories should be published for distribution in target countries of the region.

References

Asian Development Bank/Tamil Nadu Pollution Control Board, 1994, *Tamil Nadu Project Environmental Monitoring and Pollution Control*, final report, prepared by Stanley International, volumes 1-4.

Bureau of International Recycling, 1996, Somber Mood at BIR Conference, from BIR homepage: http://www.tecweb.com/wlibrary/bir.htm.

Canadian International Development Agency, 1997, Letter from B. Boudreau to B. Thompson (1997-04-30), re: Hazardous Waste Business.

Department of Foreign Affairs and International Trade, 1996, Focus India — India's Environmental Sector: Business Opportunities for Canadians. (The Delphi Group).

Environment Canada, 1996, Exports and Imports of Hazardous Wastes to Canada in 1995.

Environment Canada, Transboundary Movement Division, 1996, *Resilog* (semi-annual hazardous waste movement summary for first half of 1996, for 1995, and for last half of 1994).

Government of Canada and the Government of the United States of America, 1986, Agreement between the Government of Canada and the Government of the United States of America concerning the Transboundary Movement of Hazardous Waste.

IndEco Strategic Consulting Inc., 1995, *An Assessment of Canadian Trade in Hazardous Waste Destined for Recycling*, prepared for Environment Canada.

Jacques Whitford Environment Limited, 1994, Canadian Perspective on a Hazardous Waste Regional Training and Technology Transfer Center(s) in Latin America and the Caribbean, Supplementary Addendum to: *Feasibility Study – Establishment of a Regional Training and Technology Transfer Center for the Implementation of the Basel Convention*, prepared for Environment Canada, Hazardous Waste Management Branch.

MarketLine International, 1995, *Global Hazardous Waste*, prepared for the Department of Foreign Affairs and International Trade.

Organization for Economic Co-operation and Development (OECD), 1992, Decision of the Council (92)39/FINAL, Decision of the Council Concerning the Control of Transfrontier Movements of Wastes for Recovery Operations.

OECD, 1995, *Report on Trade and Environment to the OECD Council at Ministerial Level*, from OECD homepage: http://www.lib.msu.edu/publ_ser/docs/igos./igoswww.htm.

Sheehan, James M., 1994, *The Greening of Trade Policy: Sustainable Development and Global Trade*, from Competitive Enterprise Institute (CEI) homepage: http://www.cei.org.

United Nations, 1989, Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

United Nations, 1995, Manual for the Implementation of the Basel Convention, SBC No. 95/005, from Basel Convention homepage: http://www.unep.no/unep/secretar/basel/home.htm.

United Nations, 1995, Model National Legislation on the Management of Hazardous Wastes and Other Wastes, as well as on the Control of Transboundary Movements of Hazardous Wastes and Other Wastes and their Disposal, SBC No. 95/004, from Basel Convention homepage: http://www.unep.no/unep/secretar/basel/home.htm.

United Nations, 1994, Report and Decisions adopted at the First and Second Meetings of the Conference of the Parties, SBC No. 94/008, from Basel Convention homepage: http://www.unep.no/secretar/basel/home.htm.

United Nations, 1995, Report and Decisions of the Third Meeting of the Conference of the Parties to the Basel Convention, Geneva, 18-22 September, 1995, SBC No. 95/003, from Basel Conventional homepage: http://www.unep.no/unep/secretar/basel/home.htm.

UNCED, 1992, Agenda 21, Chapter 20, Environmentally Sound Management of Hazardous Wastes Including Prevention of Illegal Traffic in Hazardous Wastes, adopted by the Plenary in Rio de Janeiro, June 14, 1992, United Nations Conference on Environment and Development, from International Intergovernmental Organizations homepage: http://www.lib.msu.edu/publ_ser/docs/igos/igoswww.htm.

Water Technology International Corporation, 1997, Report from the Workshop for Establishment of the Regional Coordinating Centre and Sub-Regional Centres for Training and Technology Transfer for the Implementation of the Basel Convention within the Latin American and Caribbean Region.

Appendix 1: Summary of Initiatives Proposed in Agenda 21, Chapter 20

1. ***Promoting the Prevention and Minimization of Hazardous Waste***

   - establish standards that avoid discrimination against recycled material (G);
   - provide economic or regulatory incentives to stimulate development and implementation of cleaner production processes or recycling technologies and encourage waste minimization investments (G);
   - intensify research and development of cost-effective alternatives for processes or substances currently generating hazardous wastes of significant concern: emphasis given to alternatives that are economically accessible to developing countries (G);
   - support the establishment of domestic facilities to handle domestically generated hazardous wastes (G);
   - promote technology transfer of clean technologies and low-waste production to developing countries (G);
   - develop guidelines for cleaner production with sectoral trade industry associations (G);
   - encourage industry to treat, recycle, reuse or dispose of waste as close to the source as possible (G);
   - encourage technology assessments (G);
   - establish training and information centres (G);
   - implement environmental management systems to assist in identifying where improvements resulting in waste reductions are needed (I);
   - develop guidelines for estimating the cost and benefits of various cleaner production, waste minimization and hazardous waste management processes (G);
   - establish regulations placing the responsibility of proper hazardous waste management on the generating industry (G);
   - assess the value of existing information systems (G);
   - establish easily accessible nation-wide and regional information networks (G);
   - extend and strengthen international organization systems for collection of cleaner production information (through UNEP Cleaner Production Program and ICPIC) (G);
   - promote use and distribution of Cleaner Production information (G);

G = government direction I = industry direction

- survey countries that have adopted economic regulatory schemes and incentive mechanisms for hazardous waste management and clean technologies (OECD);
- facilitate open hazardous waste management information exchange with industry and the communities they operate in (G);
- facilitate international cooperation in Convention implementation initiatives and monitoring effects of hazardous waste management;
- increase financial support for cleaner technology research and development programs (G);
- phase out processes generating significant quantities of highly toxic hazardous wastes (I);
- encourage reduction, reuse, recycling and recovery of hazardous wastes (I);
- encourage industrial training programs, incorporating hazardous waste prevention and minimization techniques and launching demonstration projects in cleaner production (G);
- integrate cleaner production principles and examples in training programs (I);
- develop awareness campaigns related to cleaner production (I);
- develop inventories of hazardous waste production to identify technology needs and implement sound hazardous waste management (G);
- adopt a "polluter pays" approach to remediation of hazardous waste problems, and establish national hazardous waste reduction programs with clear targets and monitoring methods (G);
- work with industry on sector-by-sector cleaner production and waste minimization campaigns (G);
- develop national procedures for environmental impact assessment, incorporating a "cradle-to-grave" approach for hazardous waste management (G);
- develop procedures for monitoring the application of the cradle-to-grave approach (G);
- bilateral and multilateral development assistance agencies should substantially increase funding for cleaner technology transfer for developing countries.

2. ***Promoting and Strengthening Institutional Capabilities in Hazardous Waste Management***

- establish and maintain inventories of hazardous wastes, treatment/disposal sites, contaminated sites and site clean-up requirements (G);
- develop easy-to-implement guidelines for characterization and classification of hazardous wastes (G, I);
- evaluate health risks in areas near uncontrolled hazardous waste sites and initiate remediation (G);

G = government direction I = industry direction

- prepare technical guidelines on the prevention, minimization, safe handling and disposal of hazardous wastes (G);
- implement training and research in the evaluation, prevention and control of hazardous waste health risks (G);
- encourage the establishment of combined treatment/disposal facilities for hazardous wastes in small and medium-sized industries (G);
- identify and clean up hazardous waste contaminated sites, utilizing a "polluter pays" principle (G);
- evaluate military establishments' conformance with hazardous waste management requirements and international standards (G);
- distribute technical and scientific information related to health aspects of hazardous wastes (G);
- develop registries and notification systems of exposed populations at risk of improperly managed hazardous wastes (G);
- develop listings of generators, treatment, recycling and disposal facilities for hazardous wastes (G);
- support institutional/ interdisciplinary groups directed at strengthening risk assessment, risk management and risk reduction related to hazardous wastes (G);
- support human resource development in developing countries, such as consolidating networks (G);
- encourage self-sufficiency in hazardous waste disposal in the country of origin to the extent environmentally sound and feasible (G);
- increase support for hazardous waste research management in developing countries (G);
- evaluate the long-term health effects in developing countries (G);
- conduct research aimed at the needs of small and medium-sized industries (G);
- expand technology research to address environmentally sound hazardous waste handling, storage, transport, treatment, disposal, recycling, waste assessment, and remediation of hazardous wastes (G, I);
- identify relevant and improved technologies for handling, storage, treatment and disposal of hazardous wastes (I);
- undertake a public training program to increase awareness of hazardous waste concerns (G);
- increase public participation in hazardous waste management programs (G);
- train industry and government personnel in the specific issues related to hazardous waste monitoring, management, treatment and minimization (G, I);

G = government direction I = industry direction

- develop and distribute educational material on hazardous wastes and their effects, for use in schools and by the general public (G);

- establish programs for surveying adverse effects on the population and environment due to exposure to hazardous wastes (G);

- promote centres of excellence for training in hazardous waste management, building on appropriate national institutions and encouraging international cooperation (G);

- transnational corporations and other large-scale enterprises are encouraged to adopt standards of operation no less strict than those of the home base country (I);

- assist countries in identifying risks and prioritizing problem wastes (I);

- support national institutions that monitor and enforce control of hazardous wastes;

- develop industry-based institutions for dealing with hazardous wastes and service industries for handling hazardous wastes (G);

- adopt technical guidelines and support implementation of conventions (G);

- develop international network among hazardous waste professionals (G);

- assess the feasibility of establishing and operating national, regional and subregional hazardous waste treatment centres (G);

- strengthen academic/research institutions to support their training and education capabilities (G);

- conduct environmental audits of existing industries to improve current regimes for the management of hazardous wastes (G).

3. ***Promoting and Strengthening International Cooperation in the Management of Transboundary Movements of Hazardous Wastes***

- incorporate the Basel Convention notification procedure into national legislation (G);

- develop, where appropriate, regional agreements concerning hazardous waste movement (G);

- strengthen national capabilities to monitor and control transboundary movements of hazardous waste (G);

- develop criteria and guidelines respecting resource recovery, recycling/reclamation, direct or alternative uses and for determining acceptable recovery practices, including expected performance criteria (G, I);

- establish monitoring and surveillance systems for transboundary movements (G);

G = government direction I = industry direction

- develop guidelines to evaluate the environmental soundness of treatment processes (G, I);
- develop identification guidelines for hazardous waste (G, I);
- develop and utilize appropriate and standardized waste characterization test methods (G, I);
- ratify the Basel and Bamako Conventions and facilitate their implementation (G);
- address the issues of liability and compensation for damages resulting from transboundary movement and disposal of hazardous wastes (G);
- implement procedures for ban/prohibition of hazardous wastes to countries that do not have the capacity to deal effectively with the wastes or that have banned import of the wastes (G);
- address the procedures necessary for the management of emergency situations related to transportation or disposal of hazardous wastes (G).

4. ***Preventing Illegal International Traffic in Hazardous Wastes***

- adopt and implement legislation to prevent the illegal import and export of hazardous wastes (G);
- develop appropriate national enforcement programs to monitor compliance, and enforce the legislation governing transboundary hazardous waste movement (G);
- develop an information network and alert system involving local communities (G);
- cooperate in the international exchange of related information respecting transboundary hazardous waste movements (G);
- strengthen institutional and regulatory capacities in order to prevent illegal import/export of hazardous wastes (G).

G = government direction I = industry direction

Appendix 2: Hazardous Waste Management and Technology Needs in Two Priority Countries

India

Although India has a well-developed regulatory system, there are a number of specific problems for which technology transfer and adaptation are needed. Canadians, because of their experience, would be in a good position to engage in these initiatives.

Based on current industrial pollution control and waste management practices in India, some of the high-priority technology development needs facing specific industries are identified below.

- Removal of dissolved solids (primarily inorganic salts), sulphides, BOD and chromium from wastewaters in the tanning industry;
- Removal of dissolved solids (primarily dyes, inorganic salts, bleach, alkalinity) from wastewaters in the textiles industry; means of segregating strongly coloured waste streams from other effluent streams and reuse for rinsing, etc.;
- Removal of dissolved solids (primarily inorganic salts and organic acids) and BOD from wastewaters in the sago (tapioca) industry; feasibility of using wastewaters for irrigation;
- Removal of BOD from wastewaters in the distillery industry;
- Treatment and disposal of spent nickel catalyst and chrome-bearing sludges, fertlizer plant;
- Dewatering of various sludges and reverse osmosis residuals (e.g., tannery, textiles, dyeing);
- Biomedical waste treatment, incineration, disposal;
- Removal of BOD, COD, colour and toxic organics from wastewaters in pulp and paper industry;
- Treatment of effluents containing metals, acids, cyanides from small metal-finishing operations; treatment or disposal of resulting sludges; feasibility of on-site pre-treatment;
- Treatment/disposal of oily sludges in the petroleum refining and petrochemical industries, or use in energy recovery through incineration;
- Treatment/disposal of mercury-bearing sludges in the chlor-alkali industry; application of cleaner (membrane) technology;
- Treatment/disposal of acid sludges in the petrochemical and small-scale chemicals industries, through physical-chemical treatment or secure landfilling;
- Treatment/disposal of fluoride-containing gypsum sludges in the fertilizer/chemicals industry;
- Disposal/treatment of waste sludges from the leather tanning industry, or possible use as agricultural fertilizer after anaerobic treatment;
- Disposal/treatment/use of wastewater sludges from the textiles industry, or possible use as agricultural fertilizer after treatment;
- Reuse (e.g., bricks, cement) or acceptable disposal of fly ash from thermal power plants; possible use in stabilizing other wastes;

- Remediation of heavily contaminated sites (e.g., heavy metals, oily products) using in-situ physical-chemical, bioremediation or other methods;
- Cost-effective treatment of domestic sewage effluent for reuse as process water (e.g., refineries, distilleries) or for recharging aquifers; pre-filtration requirements for reverse osmosis treatment.

Chile

There are a number of areas in which Canadians have capabilities that could be applied in a country such as Chile, where there is a need for further development of both regulatory and institutional infrastructure, as well as technology transfer and training.

These capabilities can be summarized generally as follows:

- Waste collection and transportation planning;
- Waste treatment/disposal services and systems planning;
- Waste collection/treatment/disposal equipment and design;
- Waste exchange development;
- Laboratory and analytical service;
- Waste management consulting:
  - needs assessment;
  - regulatory development;
  - waste inventories;
  - waste minimization, opportunities assessment;
  - integrated waste management planning;
  - training.
- Technology assessment:
  - treatment technologies;
  - disposal and secure landfilling technologies;
  - incineration technologies;
  - recycling and recovery technologies;
  - remediation technologies and remediation planning for hazardous waste contamination;
  - transportation of hazardous wastes;
  - analytical QA/QC.

Appendix 3: Proposed Strategy for Facilitation

The following outlines the process for mounting a sequence of strategically developed workshops aimed at facilitating the entry of small to medium-sized Canadian enterprises (SMEs) into the hazardous waste management markets of developing countries or countries with economies in transition.

Phase 1: Needs Assessment

In each country or region of interest, a study will be conducted to determine:

- priority environmental (pollution, hazardous waste) issues;
- existing institutional structures;
- legislative framework and adequacy of regulatory instruments;
- key gaps in technology, and need for demonstration/pilot projects;
- potential for partnerships with government agencies, state companies and private sector;
- government's level of interest in Canadian participation; and
- receptiveness of private sector to Canadian participation in market sector.

From this assessment, the following will be identified:

- potential market niches for Canadian companies in the host country, in areas where Canadians have significant capacity (e.g., treatment of metal containing sludges; incineration of PCBs; management of biomedical wastes);
- key needs in the host country related to institutional improvements and staff training;
- key needs in the host country related to additional or improved regulations, standards, guidelines;
- need for demonstration/pilot projects, for proving technologies under local conditions; and
- overall feasibility and potential value of targeting promotional strategy at host country (i.e., potential market volume, accessibility, partnerships, receptiveness).

On the basis of this assessment, the precise form and scope of the ensuing strategy elements in the focus country will be determined. In some cases, the basic information for this will already be available, and the task will accordingly be easier. The time frame for the task should be about three to six months.

Phase 2: First-Stage Dialogue

The objectives of the first-stage dialogue (workshop) process are (i) to facilitate the introduction of interested Canadian SMEs into local markets for environmental goods and services; (ii) to familiarize Canadian participants with local regulations, institutional structures and industrial practices; and (iii) through a simultaneous series of seminars, to contribute to the knowledge of local government and industry personnel on Canadian technologies, approaches, legislative mechanisms and management systems.

Attendance from the local side will include government and industry representatives at a relatively high level, in order that the commitments and intentions put forward at the workshop carry sufficient weight to ensure follow-up by both sides. Canadian companies participating in the process will

be encouraged to collaborate amongst themselves to perform joint ventures in the focus country. The workshop is a means of informing participants from Canada and the focus country about each other's respective needs and capabilities, and of obtaining commitment and opening the door for specific work proposals.

The topical focus of the dialogue need not be limited to hazardous wastes, but could also include other topics of potential interest (as identified in the needs assessment) such as wastewater management, air pollution, energy conservation and so forth.

The first-stage dialogue process will include a series of technical seminars for local government and industry personnel, dealing with generic topics in hazardous waste management, Canadian institutional and regulatory mechanisms, and Canadian approaches to hazardous waste management.

The dialogue and seminars process will be of about one week's duration.

Phase 3: Second-Stage Dialogue

The objectives of the proposed follow-up dialogue (workshop and seminars) are:

- to enhance and facilitate the opportunities for Canadian SMEs to follow up possible joint ventures identified during the first-stage dialogue;
- to lead discussions for possible joint ventures to a higher, project-specific level of detail; and
- to provide training in a more comprehensive format, focused on priority sectors as identified in the first-stage dialogue.

Whereas the first-stage dialogue involves senior officials of local government and industries who were able to make a commitment to action, the second-stage dialogue will take this endorsement to project-specific discussions involving technical personnel from key local industries.

The process will take place over a two-week period, with the first week being structured as a workshop. The workshop will include one to two days of plenary sessions to discuss specific technical issues in further detail, followed by one to two days of focus group discussions and site visits to come down to a project-specific level of discussion. The focus groups will deal with individual sectoral problems identified as high priorities in the first-stage dialogue.

The process will provide an opportunity for Canadian participants to meet with local industries and partners, and arrive at a level of agreement for specific work assignments.

A training program provided in the second-stage dialogue will consist of two components, a seminar component and an on-site component. The seminars will be given over a period of three days at an appropriate institution. The on-site component will consist of visits by Canadian experts to a few facilities in key sectoral areas or waste management facilities. The seminars and site visits will focus on opportunities for enhanced hazardous waste treatment and disposal, source reduction, recovery, and cost implications, with a chance for discussion by the assembled participants.

As an optional feature, a two-week visit by several delegates of local industry could be considered. The purpose of the visit would be to foster an awareness of Canadian practices in hazardous waste management, waste minimization, source reduction and waste recovery, as well as institutional and regulatory structures such as government laboratories, waste exchanges, waste management and incineration facilities. The trip could also feature visits to some of

the Canadian participants' facilities, to further promote joint venture opportunities.

Phase 4: Process Evaluation and Follow-up

An evaluation will be made during Phase 4 as to (i) the number and scale of substantive leads for opportunities for Canadian companies as a result of the process to that point; and (ii) the response and suggestions coming from the training and capacity-building initiatives. On the basis of this evaluation, the future form of the government's involvement will be planned. This might involve such initiatives as:

- facilitating financial assistance for Canadian companies in further pursuing joint ventures, pilot projects and other work stemming from the process;
- institutional support (e.g., the establishment of a regional training centre); or
- developing or extending capacity-building programs in the host country.

Capacity building will be established on a sustained basis, if required and if feasible. This may be in one or more of the following forms:

- additional training (management, technology transfer);
- development of regulations, guidelines, or standards; or
- institutional improvements.

Training programs may be developed after assessing the following as possible key needs in the host country:

- hazardous waste classification and classification systems;
- database management, inventory systems;
- networking and information database systems;
- waste exchanges;
- transportation systems (e.g., labelling, manifests);
- pollution prevention and cleaner production technologies;
- waste minimization and recovery (general);
- waste minimization and recovery (sector-specific);
- instrumentation, monitoring, sampling, calibration technologies;
- laboratory protocols, QA/QC;
- toxic identification evaluation (TIE) and toxics reduction evaluation (TRE) procedures;
- enforcement mechanisms (for inspectors and investigators);
- technical standards, guidelines, codes of practice; and
- legislative and regulatory instruments.

The need for development of *strengthened regulations, guidelines or other standards* will be identified in the initial needs assessment, and must be done in consultation with the host government. Capacity building may also be in the form of *institutional improvements*, including, for example, the establishment of a training centre, an enhanced database management system, a hazardous wastes inventory survey, or a feasibility study for a common hazardous waste treatment facility in the host country. The need for these, as well as the support of the host country government and industry, would be generated in the first-stage dialogue process.

Appendix 4: Environmental Issues and Cleaner Technology Needs in India

Background and Setting

As one of the world's most rapidly industrializing countries, India is faced with significant environmental and energy challenges. At the same time, the economic liberalization of recent years has considerably reduced the risks of doing business there, and has made the country an attractive location for investors on a global scale. In many cases, the pace of industrialization has far surpassed the development of institutional infrastructure and technical methods to address the accompanying environmental problems. Accordingly, market growth for environmental technologies and services in India is estimated to be in the range of 20-25% per year. In addition to the rapid economic expansion, the advantages of India as a place for doing business include the use of English as the common language; an expanding middle class, which serves as a vast consumer market; a substantial entrepreneurial sector; and a huge supply of skilled workers. As well, there are many internationally recognized universities and technical institutions, with a great number of technically proficient graduates.

The list of environmental management and technology priorities in India is a long one. In very general terms, the priorities are to develop and implement improved waste management systems and methods, cleaner production technologies, and more energy-efficient processes. Major projects being undertaken by governments include sewage treatment plants, waste disposal sites, common effluent treatment plants (CETPs) for small-scale industries, river clean-up projects, and clean energy generation.

As an outcome of tightening environmental regulations at both central and state levels, there is an increased need for consultancy services, such as pollution prevention and control, design and construction of effluent treatment plants (ETPs), hazardous and biomedical waste treatment and disposal facilities, emission control technologies, energy efficient technologies, and waste minimization. An additional need is for institutional capacity building and training in specific sectoral areas.

Because of Canada's sound reputation in the environmental field, its technical expertise, and federal government support, Canadian businesses, both large scale and small to medium-sized enterprises (SMEs), are in a good position to provide these technologies and services. At the same time, however, a targeted position must be adopted. Care must be taken to focus on services that are in limited supply in India, which are usually those that involve new technologies based on the innovative use of science. Further, these methods need to be adequately tested under local conditions to ensure that they are sustainable and appropriate for the climatic, technological and socio-economic conditions.

Industrial Environment

Most states in India feature major industrial "complexes" containing chemical, petroleum refining, fertilizer, thermal power generation, manufacturing and other facilities. In addition, there are numerous industrial "clusters" that contain many small industries of a given type (e.g., leather tanning, textiles, metal finishing), and that together produce large amounts of untreated liquid and solid wastes. A

multiplicity of liquid, gaseous and solid pollutants and wastes are produced at the industrial complexes and clusters, as well as by other human activities such as vehicle emissions. Some of these wastes are discharged directly to watercourses, or stored untreated in waste piles, where waste materials can eventually enter surface or groundwater.

Environmental Pollution Issues

The key hazardous waste and pollution issues are summarized below.

- Pollution caused by industrial activities is a growing concern and a major threat to the environment in agricultural areas. An example of the displacement of agriculture by expanding industry is the case of textiles (dyeing and bleaching) mills near Tirupur in the State of Tamil Nadu, where groundwater has been heavily polluted by textiles effluents. As the industry has expanded, the agricultural lands have shrunk due to lack of useable irrigation water.
- Industrial plants in complexes generate significant quantities of hazardous wastes in the form of sludge from wastewater treatment, chemical by-products, filter cakes, off-specification chemicals and other sources. Large quantities have accumulated on industrial sites, and in many cases they are not stored in such a way as to prevent entry into surface or groundwater following precipitation. Such wastes are commonly landfilled or "stored" on-site for future disposal or treatment. These include, but are not limited to:
  - oily sludges resulting from crude oil-refining and petrochemical operations;
  - mercury-bearing sludges from chlor-alkali operations;
  - acid sludge accumulated at petrochemical plants;
  - cyanide-containing wastes;
  - acid, cyanide, and metal-bearing wastes originating from small-scale electroplating operations;
  - fluoride-containing sludges; and
  - chromium-containing sludges.
- Small-scale industries also generate quantities of hazardous wastes, some of them highly toxic. The electroplating and metal-finishing industry produces solid/sludge wastes containing heavy metals, cyanides and acids, at many sites. In some cases, the wastes are stored in pits or elsewhere on-site, while in others the liquid wastes are flushed down the municipal drainage system.
- Liquid wastes or high-viscosity sludge wastes are being discharged from large-scale industrial facilities, either to the sea or to canals/ watercourses leading to the sea. Some of the more significant of these include: ammonia-bearing wastes (e.g., fertilizer plant); oily liquid effluents (e.g., refinery); high BOD (biochemical oxygen demand) wastewaters (e.g., sugar distilleries, viscose); and liquid waste high in total dissolved solids (e.g., petrochemicals).
- Liquid effluents from leather tanning operations pose a significant threat to local surface water quality in a number of industrial clusters. Common effluent treatment is needed in these areas. Removal of chromium, dissolved solids (salts), sulphides and organic matter, and proper management of post-treatment sludges, are major technical hurdles.

- Effluents from textiles (dyeing and bleaching plants) are a major threat to surface water, groundwater and soil quality. The satisfactory management of sludges from wastewater treatment also poses a significant challenge.
- A major site-specific source of pollution is the deposit of major quantities of fly ash slurry directly to the sea, from three major thermal power stations. This issue is a highly visible one, and has attracted considerable attention from fishermen and others. Aquatic organisms, including fish and the biota on which they depend for food, are adversely affected by suspended particulate matter with respect to respiration, feeding and reproduction.
- Sugar distilleries and pulp and paper factories produce significant amounts of sludge and liquid waste high in organic (oxygen-depleting) material, which is a threat to water quality in aquatic systems.
- Environmentally hazardous residues (e.g., potassium chlorate) are generated by match-producing industries (e.g., around Kovilpatti).

Institutional and Regulatory Structures

Most states of India have established a state Pollution Control Board, whose responsibility it is to administer and enforce central and state-level pollution control legislation in that state. There is also a Central (India) Pollution Control Board, which has a broader responsibility in terms of ensuring consistency of standards, collection and analysis of pollution data and so forth. While the Boards are empowered to enforce legislation, a major part of their role is to monitor environmental quality and industrial emissions, participate in research on pollution control and prevention, identify sites for storage, treatment and disposal of hazardous wastes, set standards for effluent discharges and emissions, and, in general, develop comprehensive programs for pollution control.

Some states (e.g., Tamil Nadu) have fairly comprehensive environmental legislation, including air pollution, water pollution and hazardous waste legislation. The Pollution Control Boards are empowered to set effluent standards for industrial effluents. Hazardous Waste Management and Handling Rules require operators to be authorized, stipulate packaging and labelling standards and require states to identify hazardous waste disposal sites and maintain an inventory of such sites. The rules define 18 categories of hazardous wastes.

Technical Needs

Based on current industrial pollution control and waste management practices in India, some of the high-priority technology development needs facing specific industries are identified below.

- Removal of dissolved solids (primarily inorganic salts), sulphides, BOD and chromium from wastewaters in the tanning industry;
- Removal of dissolved solids (primarily dyes, inorganic salts, bleach, alkalinity) from wastewaters in the textiles industry; means of segregating strongly coloured waste streams from other effluent streams and reuse for rinsing, etc.;
- Removal of dissolved solids (primarily inorganic salts and organic acids) and BOD from wastewaters in the sago (tapioca) industry; feasibility of use of wastewaters for irrigation;

- Removal of BOD from wastewaters in the distillery industry;
- Treatment and disposal of spent nickel catalyst and chrome-bearing sludges, fertlizer plant;
- Dewatering of various sludges and reverse osmosis residuals (e.g., tannery, textiles, dyeing);
- Biomedical waste treatment, incineration, disposal;
- Removal of BOD, COD, colour, and toxic organics from wastewaters in the pulp and paper industry;
- Treatment of effluents containing metals, acids, cyanides from small metal-finishing operations; treatment or disposal of resulting sludges; feasibility of on-site pre-treatment;
- Treatment/disposal of oily sludges in the petroleum refining and petrochemical industries, or use in energy recovery through incineration;
- Treatment/disposal of mercury-bearing sludges in the chlor-alkali industry; application of cleaner (membrane) technology;
- Treatment/disposal of acid sludges in the petrochemical and small-scale chemicals industries, through physical-chemical treatment or secure landfilling;
- Treatment/disposal of fluoride-containing gypsum sludges in the fertilizer/chemicals industry;
- Disposal/treatment of waste sludges from the leather tanning industry, or possible use as agricultural fertilizer after anaerobic treatment;
- Disposal/treatment/use of wastewater sludges from the textiles industry, or possible use as agricultural fertilizer after treatment;
- Reuse (e.g., bricks, cement) or acceptable disposal of fly ash from thermal power plants; possible use in stabilizing other wastes;
- Remediation of heavily contaminated sites (e.g., heavy metals, oily products) using in-situ physical-chemical, bioremediation or other methods; and
- Cost-effective treatment of domestic sewage effluent for reuse as process water (e.g., refineries, distilleries) or for recharging aquifers; pre-filtration requirements for reverse osmosis treatment.