Technology, Competitiveness And Canada's Environmental Industry

An Outlook into the Future Development of the Canadian Industry

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Canadian Cataloguing in Publication Data

Main entry under title:

Technology, competitiveness and Canada's environmental industry: an outlook into the future development of the Canadian industry

Issued also in French under title: La technologie, la compétitivité et l'industrie canadienne de l'environnement : une perspective du développement futur de l'industrie canadienne.
Includes bibliographical references.
ISBN 0-660-16879-0
Cat. no. En49-30/1-4E

1. Environmental protection — Economic aspects — Canada.
2. Industries — Environmental aspects — Canada.
3. Environmental policy — Canada.
4. Green technology — Canada.
5. Environmental engineering — Canada.
I. Canada. Environmental Protection Service.

HD9718.C3T42 1997 363.7'00971 C97-980063-3

HD
9718
.C3
T42
1997

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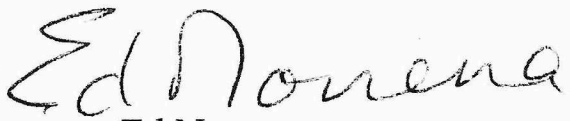
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Foreword

Although the environmental industry is relatively new, it is a rapidly evolving and growing sector of the Canadian economy. This report, initially prepared in the spring of 1995, provides a snapshot of the environmental industry at that time and examines future opportunities and areas of growth. Much has changed within the environmental industry since this report was first written. However, it remains a valuable resource document for industry, academia and environmental groups alike, or, for that matter, anyone who would like to learn more about this dynamic sector of the economy.



Ed Norrena

Director General
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Chapter 1 – Introduction

The environmental industry sector (EIS) is elusive. It is as ancient as humankind's first attempts to deal with its wastes. It is so new that we have not yet agreed on a definition for it. It is the backyard compost of our grandparents and the sophisticated devices that measure minute quantities of polluting substances in our soils, waters and atmosphere.

The environmental sector is becoming a necessity if our society is to continue enjoying the fruits of industrialization. That, too, is why it is increasingly popular. It is also a tool of government, and its fate frequently rests with the decisions made by our political leaders. That, however, makes it unpopular, because it is tied to rules that set limits to what we can do. Its breadth of activities is large, fluid and constantly changing. As quickly as new problems arise, so do new solutions.

This report necessarily reflects the complexity of this subject. It is impossible to separate the EIS from the environment itself. Like the environment, it extends beyond national boundaries and plays a direct role in the lives of people around the world. It is impossible to ignore the economic, social and scientific policies of government that affect it. It is impossible to avoid the critical debate over Canada's resources and how they should be managed.

Despite the volume and complexity of the information available about the environment and the EIS, several themes emerge:

1. The state of the world's environment constitutes a permanent cause for global concern.
2. The markets for environmental goods and services will continue to grow rapidly.
3. Industry and government must work together to confront the challenge of environmental degradation.
4. In response to public pressure, business and government are changing the ways in which they deal with environmental issues.
5. Good environmental practices are becoming good business practices and often contribute to competitiveness.
6. Government action is critical to the environment and to the environmental sector.
7. Success depends on mechanisms and policies that allow business to prosper and profit by engaging in environmentally appropriate activities.
8. Technological development can address the needs of both environmental protection and competitiveness.

This report takes up these themes, examining each in turn. In doing so, it supports a modern approach to the EIS, one in which a concern for the environment is aligned with the imperatives of business.

CONFRONTING THE ENVIRONMENTAL CHALLENGE

In April 1995, Canada surprised the world by challenging international law to end Spanish overfishing of turbot in the Grand Banks. Arguing that the very survival of the fishery depended on the immediate end to this practice, the then Canadian Minister of Fisheries Brian Tobin declared that Canada would act now rather than allowing negotiations to drag on *"... to the last turbot."*

The "turbot war" is not the first conflict over resources on the planet, nor will it be the last. But it was a surprise to Canadians to find themselves even considering military action to protect remaining fish stocks. It was also a grim reminder of the heavy price the fishing industry and consumers – in Canada and around the world – must pay for the overexploitation of a finite global

resource. The annual harvest has now fallen in all but two of the world's 15 major fishing regions.[1]

The confrontation served as a wake-up call to Canadians, a reminder that while other issues come and go, the state of the environment is now a permanent part of the political, economic and social agenda. But Canada is not alone. The same recognition of the environmental challenge can be found in most of the developed industrialized world. It is even making its way into the awareness of less developed nations. As governments pursue growth, as poorer countries strive to join the ranks of the developed and industrialized and as people seek to improve the material conditions of their existence, pressure on the world's resources increases.

It is now widely acknowledged that our planet's resources are finite and that there are limits to its capacity to absorb and neutralize humanity's wastes. Indeed, World Bank economists Herman Daly and Robert Goodland have written that environmental sustainability is now *"universal and non-negotiable."*[2]

Concern for the environment has been on the international political agenda for at least three decades. During that time, enormous progress has been made in our understanding and our capacity to address environmental problems. Internationally, the world has gone from talking about the environment at the 1972 United Nations (UN) Conference on the Human Environment to taking specific actions on ozone depletion, ocean dumping and the disposal of hazardous waste. Critical to this process was the work of the World Commission on Environment and Development, created in 1983 by the UN and chaired by Gro Harlem Brundtland of Norway. The Commission's report, *Our Common Future*, drew world attention to the environmental consequences of unbridled development and called for a *"new era of economic growth – growth that is forceful and at the same time socially and environmentally sustainable."*[3]

The UN Conference on Environment and Development (UNCED) in Brazil in 1992 further nudged the nations of the world toward action by encouraging them to sign Conventions on Biological Diversity and Climate Change. At the same time, industrialized countries formalized a financial commitment to help developing countries meet global environmental standards by creating the Global Environment Facility (GEF), which is managed under the auspices of the World Bank.

Canada has been a world leader in its support for these Conventions. At home, Canadian governments – federal, provincial and municipal – have initiated legislation to protect the environment and have declared their commitment to sustainable development. In this they have enjoyed the strong approval of the general public, which has consistently supported action to protect the environment.

As the search intensifies for solutions to environmental problems, a whole new industrial sector, devoted exclusively to environmental protection and pollution control, has become a significant part of both the Canadian and world economies. While water treatment and waste disposal are an established and familiar part of the industrial landscape, much of this EIS is just emerging, and its interests and activities have now reached into areas as broad and diverse as ecosystem management, satellite observation systems and the collection and recycling of used products.

The list of environmental crises (see Chapter 2) can be long and distressing, but it also serves as a spur to renewal and change. Society may adopt a passive attitude, reacting to disasters only after they occur, or it may move to introduce mechanisms that reduce the likelihood of disasters or avoid them altogether. Whichever posture we adopt, there will be a need for an industry that can respond to the challenge. As the demand for a cleaner, safer world grows, so too will the demand that industry find better, more creative solutions to the tension between production and pollution.

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1 L.R. Brown *et al., State of the World 1995* (New York: WorldWatch Institute, W.W. Norton, 1995), p. 21.

2 R. Goodland and H. Daly, *Environmental Sustainability: Universal and Non-Negotiable*, paper prepared for the meeting of the Ecological Society of America, Knoxville, Tennessee, August 7-11, 1994. Daly has left the World Bank and is now at the University of Maryland.

3 World Commission on Environment and Development, *Our Common Future* (New York: Oxford University Press, 1987), p. xii.

A GLOBAL OPPORTUNITY

Concern over the environment is now pervasive; as nations and consumers demand goods that are cleaner as well as cheaper and more efficient, continued competitiveness in the global environmental market is essential to a country's economic success. The global market is also being stimulated by the introduction of more stringent environmental regulations, greater cross-border and cross-sectoral cooperation and the increasing linkage of environmental concerns to development and global security issues. In addition, emerging global trends point to a shift away from pollution control to pollution prevention. Innovative processes and products will be required to deal with the demand for solutions to this new focal point of consumer concern.

Ultimately, some observers have suggested that the world is going through an "Eco-Industrial Revolution" involving nothing less than a global industrial restructuring that is reshaping the very basis of competitive advantage.[4] Increasingly, a company's competitiveness, even its very survival, will depend on its environmental performance.

The environmental imperatives shaping the global market are such that the very way the world does business is being transformed. As the international demand for "green" products and processes grows, so does the rate of technological innovation and application required to meet it. In the words of two American observers:

> *What is at stake is not a splinter market, but virtually all goods manufactured for almost all purposes. Producers of goods from yogurt to cars must increasingly respond to the new environmental imperatives. In a global economy, no nation can successfully isolate itself from the policies and demands of others. A nation that attempts to do so will soon find itself with a dwindling share of the international trade in manufactured goods and, as a consequence, with a shrinking standard of living.*[5]

It is obvious that the demand for environmental expertise and technology is increasing. Even so, it is sometimes difficult to predict or quantify this demand. Estimates vary, sometimes considerably, regarding the size and projected growth of the world market for environmental products and services. By some measures, though, the world environmental market could double, over the course of the present decade, reaching approximately US $600 billion in the year 2000.

At present, this global market is dominated by the environmental industries of the Organisation for Economic Co-operation and Development (OECD) countries, among which suppliers from the United States, Germany and Japan account for the largest share. U.S. environmental goods and services account for close to half the world's production, although only about 10 percent of this is destined for export and the balance is directed to domestic needs. Germany and Japan are still far behind the United States in their production of environmental goods and services, but both are investing heavily in their environmental industries as a way of establishing a competitive advantage in the global marketplace.

The global market for environmental goods and services presents Canadian companies with a huge opportunity. Even though international competitive pressures can be severe for Canadian companies, the global market is immense, and the most effective of our firms can easily find niches for themselves in which they enjoy an unbeatable competitive advantage. What is more, the firms in Canada's EIS have no choice; they must adapt to the competitive pressures of a globalized economy. The fact is that even the domestic Canadian market is open to competition from foreign sources, and, whether Canada's firms meet those competitors at home or abroad, they will still need the skills and expertise that will allow them to prevail. One of the greatest challenges facing Canada's EIS remains the need to concentrate on technologies that position it to take advantage of current and emerging market opportunities and to develop the domestic and international partnerships that will permit Canadian companies to compete more effectively against larger rivals.

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4 M.J. Kiernan, "The Eco-Industrial Revolution: Reveille or Requiem for International Business?" *Business and the Contemporary World* (Autumn 1992), pp. 133-143.

5 A. Miller and C. Moore, *Green Gold – Japan, Germany, the United States and the Race for Environmental Technology* (Boston: Beacon Press, 1994), p. 15.

CANADA'S ENVIRONMENTAL INDUSTRY SECTOR

Within the context of this growing international environmental market, Canadian companies have developed some highly competitive technologies and expertise in areas such as water and wastewater treatment, the disposal of liquid and solid waste, hazardous waste management, resource protection and conservation, air quality management, and environmental impact assessment (EIA) and energy conservation. Canada is also recognized as a world leader in remote sensing and geographic information systems (GIS), which are used in the monitoring and analysis of the world's natural resources and environment on land, in the oceans and in the atmosphere.

Canadian environmental companies are capable of meeting the global challenge. They enjoy an excellent international reputation and are able to provide a competitive range of products and services. This is despite the fact that their relatively small number and size will often force them to develop specialized niche markets. It is also in spite of the fact that the EIS is one of Canada's youngest industrial sectors. It is hardly more than a decade old, and many of the companies that are part of the sector have come into existence only in the past five years. Although still young, it is extremely dynamic and continues to grow rapidly.

In 1994, Department of Industry estimates placed the size of the sector in Canada at 4,500 firms employing 150,000 workers with annual sales of $11 billion. One third of these companies are in manufacturing and accounted for sales of $6 billion, while the other two thirds involved in providing environmental services had sales of $5 billion. The majority of companies active in the sector are small and medium-sized enterprises (SMEs).

The annual growth rate of the EIS has been estimated at 6 percent a year or about three times the rate of the Canadian economy as a whole. The Canadian market for environmental products and services is expected to grow at about 10 percent annually over the next five years.[6] Another estimate is provided by the American publication *Environmental Business Journal,* which predicts that the Canadian market will grow at an average rate of 11 percent annually during the period 1992-1997, with the market reaching $21.3 billion in 1997.

The industry is located mainly in the urban areas of Ontario and Quebec, although both British Columbia and Alberta possess increasingly significant industries of their own and other provinces seek to develop their own local or regional sectors as well. Despite this regional concentration, a strong Canadian EIS is vital to the entire country.

Above all, it is characterized by rapid development and technological innovation. According to some estimates, about half of the environmental products that will be in use 15 years from today do not even exist yet. The EIS promises the creation of more knowledge-based and high-technology jobs, a key element in the development of the Canadian economy and its continued competitiveness.[7]

The EIS has been likened to the health industry in that it results in technologically innovative and economically appealing spin-offs and also addresses a strategic, perennial concern.[8] The Canadian EIS provides expertise, technologies and services to meet the environmental needs of its clientele, which includes governments, utilities, industries (chemicals, petroleum, etc.), manufacturers (automobiles, electronics, etc.), as well as distribution and processing industries (food, etc.), construction and other commercial enterprises and private consumers in general. Although the Canadian EIS's clientele is virtually universal, traditional industrial sectors still constitute the larger part of its customer base.

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6 Environment Canada and Industry Canada, *Consultation Paper: Environmental Industry Strategy for Canada* (Ottawa, January 1994), p. 4.

7 J. Higgins, "Global Environmental Industry," *Ecodecision* 11 (January 1994), pp. 20-22.

8 *Ibid.*, p. 20.

The challenge in the years to come will be for the EIS to expand sufficiently to meet anticipated demand while facing ever-increasing pressure to shift its focus away from traditional "end-of-pipe" activities (i.e., waste disposal, pollution control) toward processes that prevent pollution and minimize waste from the outset.

FOSTERING A STRONG ENVIRONMENTAL SECTOR

The global market offers huge opportunities for the expertise and technical innovation of Canada's EIS companies. At the same time, our firms have demonstrated an ability to develop and produce a wide range of internationally successful environmental products and services. Even so, the domestic industry and market supporting Canada's international EIS efforts remain small by world standards. The industry will need careful nurturing if it is to develop international competitive strength.

The Canadian EIS displays a number of weaknesses, perhaps the most serious of which is in research and development (R&D) performance. Although the EIS performs relatively more R&D than other Canadian private-sector firms, its R&D remains low compared to that of private firms in most other industrialized countries. In addition, a shortage of capital for research, development and commercialization is a chronic problem for most companies. Because the firms are small, many lack the technical capability to upgrade continuously or create technologies that would allow them to take advantage of growing domestic and international markets.

The significance of the environmental opportunity has not been lost on the leaders of many other industrial countries. Using a combination of strict environmental regulations and creative strategies to support the development of an indigenous EIS, countries such as Japan and Germany are aiding their industries to capture world markets. The high cost of energy in Japan and the tradition of industry-government cooperation led to the early development of energy-efficient manufacturing techniques and to a recognition of the long-term business opportunities of pollution control and prevention technologies. Germany has developed some of the toughest environmental regulations in the world, ones that challenge the ingenuity of German industrial designers and in the process help them develop world leadership in environmental markets.

The United States, too, is a world leader in some areas, though this is primarily because it represents the world's largest market rather than because of a consistent regulatory policy or any initiatives to support industry. Indeed, some analysts suggest that inconsistent policies have impeded the development of U.S. industry and its ability to compete both domestically and in international markets.[9]

Like the United States, Canada adopted a number of programs in the early 1990s to promote the development of environmental technologies. In 1994, it also introduced the Canadian Environmental Industry Strategy, which enlists the participation of federal and provincial governments and the private sector in a collaborative effort to create a strong and competitive industry. This package of government initiatives provides both infrastructure support and incentives to increase sales in domestic and international markets.

As important as regulatory and other incentives have been to the adoption of environmental practices in industry, they are now being complemented by an evolutionary change in industry beliefs and actions.

Pollution prevention has become not only an integral part of government planning, but also an important element of corporate management. At some point in the 1980s, many firms changed from fighting or "resistantly adapting" to environmental pressures to incorporating environmental considerations into their policies. Corporations acknowledged their own responsibility for some environmental problems and developed environmentally oriented strategies *"based on the expectation that excelling in protecting the environment*

[9] Miller and Moore, *Green Gold.*

is necessary, creates new opportunities and eventually could lead to competitive advantages."[10] Such strategies are characterized by:

- increasing the firm's capability to develop product/market combinations;
- waste and emission reduction at the source as a practice of continuous improvement; and
- transparent and good relations with the public, consumers and regulators.

As a result of this transformation, the industries generating pollution and waste accept responsibility for their actions and take responsibility to manage and reduce pollutants ahead of government regulations. This process, while still in its infancy in most countries, is taking hold in corporations around the world. Good environmental citizenship is one reason, but, more importantly, good environmental practices are now recognized as good business practices. The benefits are increasingly seen to outweigh the costs, particularly when the shift involves the adoption of cleaner, more efficient processes. These frequently save money, help to sell products and address the competitiveness imperative to cut costs and reduce wastes.

In addition, a whole range of new recycling businesses are proving to be profitable while saving costs to the public. After a difficult start and considerable subsidization, recycling has become a rapidly growing industry, which is reducing the need for virgin resources, cutting the amount of waste going to landfills and providing employment at a higher rate than manufacturing and resource extraction. And while the manufacturing of secondary materials is still young, over the longer term, metals recovery and paper recycling are expected to supply far more jobs than mines and logging operations. For example, if a million tonnes of solid waste is put in a landfill, it creates 600 jobs; if incinerated, it creates 80 jobs; if recycled, it creates 1,600 jobs.[11] Reprocessing holds out the promise not only of providing more jobs, but also of being indefinitely sustainable, because it is not reliant on limited supplies of minerals or trees.

As industry has evolved, so has government. The period of command and control regulations is fading as both industry and government recognize that the most effective way to achieve environmental goals is to allow industry the freedom to find efficient and cost-effective solutions. This does not, however, mean an abdication of government's responsibility to set standards within the community and to protect the health and safety of its citizens. It is critical that governments set the standards and effectively enforce them. It is the appropriate role of business to find the best way to meet them. Given adequate time and a supportive environment, business has proven on many occasions that it is up to the task. Indeed, experience suggests that while the Earth's resources and absorptive capacity are limited, the ingenuity of humans to find solutions to environmental problems is not.

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[10] J. Schot and K. Fischer, "The Greening of the Industrial Firm," in K. Fischer and J. Schot, eds., *Environmental Strategies for Industry, International Perspectives on Research Needs and Policy Implications* (Washington, D.C.: Island Press, 1993), p. 12.

[11] Brown *et al., State of the World 1995,* pp. 89-90.

Chapter 2 – Drivers of Demand for Environmental Products and Services

A CHANGING WORLD

The development of the Canadian environmental industry sector (EIS) is impelled by a number of forces that affect both its international and domestic activities. Most of these drivers of demand ultimately derive from current environmental conditions, which inspire a deep public concern over environmental problems. This concern, in turn, leads to public pressure on government to initiate regulatory action and on industry to adopt more environmentally acceptable practices.

The EIS exists, therefore, because of a new awareness of the importance of the environment. Environmental concerns are forcing companies to change the way they do business and to rethink the nature of business itself. This re-evaluation of traditional business practices is made all the more compelling by the central role industry plays in the shaping of the planet's destiny; after demographic growth, modern industrial and agricultural activities are among the leading contributors to environmental degradation.

The world's finite resources cannot accommodate infinite growth. To restore the natural balance needed to support life on this planet, economic activity must be indefinitely sustainable. There is no precise definition of sustainable development, but it is generally held to mean that we should not act economically or socially in ways that endanger future generations or compromise their ability to satisfy their own needs.

Sustainable development redefines progress and efficiency by forcing us to do more with less. It challenges our society to move from quantitative growth to qualitative development. In making this transition, there are many promising business opportunities to be exploited. These include:

- cost savings from the efficient use of energy and materials;
- reduced dependence on unstable sources of supply;
- greater stability in the price, availability and use of natural resources;
- stimulation of research and development (R&D), technological innovation and product development;
- growth of markets for resource-efficient technologies, products and services; and
- a competitive advantage gained from more efficient use of raw materials.

Population growth and increasing industrial resource consumption are making environmental change more widespread and rapid. The result is to impair the Earth's restorative capacity. The effects on our environment are clear: the contamination of rivers, aquifers and lakes; the pollution of the world's oceans and the exhaustion of fish stocks; the disappearance of forests and the diverse species that dwell within them; the loss of agricultural land to desertification, erosion and soil contamination; the further depletion of the planet's ozone layer; and the possibility of significant climate change due to global warming (the greenhouse effect).

Nor is the impact of demographic and economic forces likely to lessen. According to Bruce Smart of the World Resources Institute, by the year 2050, the current level of world economic activity will have quintupled.[1] Only a dramatic reduction in the environmental impact per unit of Gross Domestic Product (GDP) could reduce or hold the environmental burden constant. Smart estimates that a reduction in excess of 80 percent of today's levels would be needed to achieve such a result.

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[1] B. Smart, ed., *Beyond Compliance: A New Industry View of the Environment* (Washington, D.C.: World Resources Institute, April 1992), p. 5.

The private sector is of key importance to the success of any attempt to reduce the planet's environmental burden. It is, in Smart's words, *"a powerful instrument for sustainable development – and thus an institutional resource of major environmental significance."*[2]

Awareness of the severity of the environmental problems confronting the world has grown over the past three or four decades. The international scientific community, governments and, more importantly, average citizens are now conscious of the planet's environmental plight and convinced of the need for action. It seems clear that the environment will be one of the fundamental issues of the 21st century, in much the same way that the Cold War dominated world affairs for the half century following 1945.

The imperatives of a new international environmental consciousness arise from a heightened concern over the state of the planet's environment. The growing demand for industrial change is, again in the words of Bruce Smart, *"rational, timely, and legitimate, and its satisfaction essential to humankind's future."*[3]

In a study of recent developments relating to environmental technology and markets, Curtis Moore and Alan Miller maintain that *"the world is rapidly moving into a new technological era, a second Industrial Revolution every bit as important and long-lasting as that of two centuries ago."*[4] The past few years have seen an explosion of environmental technologies – more efficient industrial processes, cleaner energy sources, more environment-friendly products and specially designed software. Such new technologies offer companies the opportunity of becoming more competitive by becoming environmentally sound. Thus, the market for these technologies continues to grow as environmental products and services come to be viewed not as luxuries but as necessities.

The demand for environmental products and services is now global. Public concern over environmental issues is high, and most governments are being pressed to act. The EIS will evolve by responding to growing consumer demand on the one hand and the emergence of comprehensive environmental regulations on the other. Success will go to competitive companies that can balance and keep pace with these two imperatives.

Forces Driving the Environmental Industry Sector (EIS)

Environmental Conditions

Public Concern

Political Pressure

Government Action and Legislation

Increased Spending by Industry and Governments (Investments, R&D)

Increased Demand for Goods and Services

Greater Profits from Investments in Environmental Companies

THE DRIVERS OF DEMAND

1. Environmental Conditions

The EIS would not exist at all if there were no serious environmental problems requiring solutions. This may seem obvious, but it is often overlooked in the studies of the EIS that focus exclusively on the regulatory or market factors affecting the industry. Regulatory measures may be the easiest driver to identify, but they are only the most obvious manifestation of deeper and more complex forces affecting the development and orientation of the EIS.

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2 *Ibid.*, pp. 5-6.

3 *Ibid.*, p. 5.

4 A. Miller and C. Moore, *Green Gold – Japan, Germany, the United States and the Race for Environmental Technology* (Boston: Beacon Press, 1994), p. 5.

Table 2-1 Population Size and Availability of Renewable Resources Circa 1990, with Projections for 2010

INDICATORS	c. 1990 (in millions)	2010 (in millions)	TOTAL CHANGE (in percent)	PER CAPITA CHANGE (in percent)
Population	5,290	7,030	+ 33	—
Fish catch (tonnes) *	85	102	+ 20	- 10
Irrigated land **	237	277	+ 17	- 12
Cropland **	1,444	1,516	+ 5	- 21
Rangeland / pasture **	3,402	3,540	+ 4	- 22
Forests **	3,413	3,165	- 7	- 30

* Excludes aquaculture ** In hectares

Source: L.R. Brown *et al., State of the World 1995* (New York: WorldWatch Institute, W.W. Norton, 1995), p. 11.

There are many who still question the relative costs incurred by environmental remediation or regulation and speak of "eco-realism" as a corrective to more extreme, or inconvenient, pro-environmental opinions. On current trends, however, the environmental situation of the planet will continue to deteriorate.[5] In the face of a constantly expanding world population, unsustainable rates of resource consumption and unabated environmental degradation, concern now over the economic costs of dealing with the global environmental situation will inevitably yield to a future concern over the far greater and growing costs of inaction. As shown in Table 2-1, a large amount of our planet's natural capital will experience significant environmental decline in the near future.

The demands created by current levels of consumption are already straining the planet's ability to meet them, yet they are caused by only a small fraction of the world's population. This problem is compounded by the fact that the larger and continuously growing populations of the developing countries are also attempting to enhance their own living standards, often copying the wasteful practices of societies that have already achieved industrialization. As a result, the wasteful pattern of consumption seen in advanced industrial societies will inevitably spread to other parts of the planet, exerting far greater pressure on an environment that is already overburdened.

5 "Stay Cool" and "Global Warming and Cooling Enthusiasm," *The Economist*, 335, 7908 (April 1, 1995), pp. 11-12 and pp. 33-34; G. Easterbrook, "Here Comes the Sun," *The New Yorker* (April 10, 1995), pp. 38-43.

Carbon Dioxide Output Expected to Soar

A surge in energy demand in coming years will result in growing emissions of carbon dioxide, according to the International Energy Agency (IEA) and the OECD. In the annual *World Energy Outlook* published on April 24, 1995, it is estimated that global energy demand will increase at an average annual rate of 1.7 to 2.1 percent over the next 15 years. It is predicted that in 2010, fossil fuels will still account for 90 percent of the world's supplies. *"As a result, world carbon dioxide emissions will increase by 30-42 percent"* in that period.

By 2010, OECD countries will consume 45 percent of the world's energy, and the Organization of Petroleum Exporting Countries' (OPEC) share of the world's oil market will increase from 40 to 50 percent.

"With both the supply and demand of oil shifting proportionately away from the OECD, the actions of producers and consumers outside the OECD will come to have greater and greater impact on energy availability...and potentially, on how our economies perform," according to Robert Priddle, IEA Executive Director.[6]

"Planet Earth is having a once-in-a-billion-years carbon blow-out sale, all fossil fuels priced to move, no reasonable offer refused. And when this eon's hydrocarbons are sold, they're gone, never to be seen again."[7]

Despite current trends, the Organisation for Economic Co-operation and Development (OECD) analysis summarized in Table 2-2 suggests that some of the most severe problems caused by unsustainable patterns of consumption can be solved. Moreover, the long-term effects of changes in consumption patterns will have ultimately beneficial results. In other words, short-term pain can lead to long-term gain.

Any change in consumption patterns, however, requires a major shift in thinking within the corporate and industrial community. Evidence suggests that such a shift is already under way in the general public and has started to influence some private-sector decision-makers whose participation is crucial if conservation is to become a global phenomenon.

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6 International Energy Agency, *World Energy Outlook – 1995 Edition* (Paris: Organisation for Economic Co-operation and Development, 1995); R. Corzine, "CO_2 Outlook Expected to Soar," *Financial Times* (April 25, 1995).

7 P. Hawken, *The Ecology of Commerce* (New York: HarperBusiness, 1993), p. 84.

Table 2-2 Analyzing Elements of Consumption and Consequences of Change

AREA OF CONCERN	ADVERSE IMPACT OF CURRENT TRENDS	ENVIRONMENTAL CONSEQUENCES OF TREND/ PATTERN CHANGES (reduced demand/consumption)	ECONOMIC CONSEQUENCES OF TREND/PATTERN CHANGES (reduced demand/consumption)
Energy	• increasing emissions (CO_2, SOx) • depletion of non-renewable resources	• decrease in greenhouse effect/acidification • conservation of resources	• ST* — income loss for traditional energy producers • LT* — societal transition toward use of other energy sources including renewable forms
Vehicles	• increasing local air pollution • depletion of resources (use of raw materials and space for infrastructure) • better local air quality	• reduced CO_2 emissions • improved urban amenities	• ST — shift in traditional car manufacturing and related sectors • LT — development of other modes of transport • LT — increase in public transportation
Packaging	• generation of waste • inefficient use of resources	• reduced generation of waste • fewer resources used	• ST — loss of income and employment for current packaging industry ST — new opportunities for alternative, recyclable packaging • LT — growth in consumer preference for more sustainable packaging
Water	• conflicts over access and quality • increasing drought and erosion • more ecosystem damage	• more good quality water available • reduced pressure on ecosystems	• LT — proper pricing: water becomes an economic commodity • LT — reduced potential for water rights conflicts
Cattle/beef/tropical timber	• increasing deforestation • increasing desertification • increasing erosion • increase in CO_2 sinks	• preservation of ecosystems • maintaining biodiversity	• ST — loss of income for timber and beef producers • LT — sustainable yield (alternative products) • LT — opportunities for economic diversification (e.g., tourism)
Fish	• depletion of stocks • loss of biodiversity	• preserving balance in ecosystems • maintaining biodiversity	• ST — loss of income to fisheries industry • LT — sustainable yield • LT — management of a common property resource
Other raw materials	• rising environmental impacts of extraction • growing depletion and exhaustion • low/uncertain commodity prices	• conservation of resources for future generations • reduced environmental damage from extraction and production	• ST — loss of income and employment in the extraction and primary production sectors • ST — stimulate R&D on substitutes • LT — transition toward more use of recycling processes • LT — greater price stability

* ST: Short Term * LT: Long Term

Source: Organisation for Economic Co-operation and Development (OECD), *Managing Change: The Challenge of Sustainable Development* — ENV/EPDC (94)3 (Paris: OECD, February 15, 1994), p. 11.

2. Public Pressure

The most important characteristic of the environmental industry both in Canada and abroad is its inextricable link to government. Either directly or indirectly, the regulations enacted by governments define the environmental industry, providing it with a large part of its *raison d'être*.

Governments around the world continue to pass a wide variety of laws from which they derive regulations, guidelines and programs designed to prevent pollution, to alleviate the impact of past environmental degradation and to promote conservation. Every sector of the environmental industry is affected by this type of action and must deal with government on an ongoing basis.

Government action creates the legislation or regulations that influence the industry's activities and composition. The main driving force behind government action, however, remains public pressure. Public opinion about the environment has evolved in a fairly consistent manner since the 1960s, despite brief periods of relative quiescence. There have already been two discernible waves of popular environmentalism, and some observers believe a third wave is about to wash over us.

a. The First Wave

The first wave of public concern broke in the early 1960s and was largely a reaction to the strong economic growth that followed World War II and sidelined environmental concerns. Reg Whynott, Regional Chairman for Hamilton-Wentworth, a bastion of Canada's heavy industry, recalls the dominant attitude of both citizens and decision-makers during this period:

> *Twenty years ago, few people thought of the environmental consequences of heavy industry or urban development. That was the price you paid for progress.*[8]

One particular event in Japan heralded a new era of popular environmentalism. Since the 1930s, the Japanese chemicals firm, Chisso, had been dumping methyl mercury from a fertilizer plant into Minamata Bay, a source of fish and shellfish for the local population. In the 1950s, villagers began to exhibit the symptoms of what became known as Minamata Disease: seizures, severe retardation, loss of coordination and partial or total deafness or blindness. The contamination affected 1,385 villagers, and another 649 died of mercury poisoning. The livelihoods of hundreds of fishermen and their families were destroyed.

The publication, in 1962, of *Silent Spring* by Rachel Carson was a landmark in the evolution of environmental concerns. It argued that chemical pesticides, notably DDT, could wipe out entire species and cause irreversible damage to the global environment. In her investigation of the effects of DDT, Carson constructed what was, in the words of historian David Dickson, *"a generalized critique of the narrow focus of contemporary science and technology, of their apparent blindness to broad social and environmental effects."*[9]

This early public concern over the environment elicited a generally reactive, even hostile, response from industry and government, both of which viewed environmental regulation as an impediment to economic expansion. Even so, public concerns deepened. They culminated in the early 1970s with the emergence of new environmental institutions (including Environment Canada). The year 1972 marked the crest of this first wave, with the first global conference on environmental issues, the United Nations Conference on the Human Environment, held in Stockholm. This event led directly to the creation of the United Nations Environment Programme (UNEP).

In the same year, the Club of Rome published a ground-breaking report entitled *Limits to Growth* in which it encapsulated its fears over the implications of unrestrained economic growth for the Earth's limited stocks of resources. The report concluded that

> *...if present trends in world population, industrialization, pollution, food production and resource depletion continue unchanged, the limits*

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[8] Quoted in M. Kendrick, "Hamilton-Wentworth Changes Course," *National Round Table Review* (Spring 1994), pp. 4-7.

[9] Quoted in C. Piller, *The Fail-Safe Society: Community Defiance and the End of American Technological Optimism* (New York: Basic Books/HarperCollins Publishers, 1990), p. 6.

to growth on this planet will be reached sometime within the next 100 years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.[10]

Also in 1972, the OECD adopted the "polluter pays principle." As its name suggests, the principle is the polluter should bear the costs of remedying the effects of the pollution it has caused. Alternatively, if the costs are high enough, the polluter will be encouraged to avoid polluting in the first place.

Although the first wave of popular environmentalism aroused considerable debate over environmental issues, the tangible results achieved were relatively modest. These early efforts succeeded in dealing only with the more obvious sources of water and air pollution by imposing ultimately superficial "end-of-pipe" solutions.

Despite its relative lack of success in addressing more complex and far-reaching environmental problems, the first wave was instrumental in identifying the environment as a global concern of vital importance. Environmentalism found fertile ground in the social and political unrest that defined the 1960s and early 1970s, and, though the ferment would subside somewhat in the following decade, the way was prepared for a second wave of popular environmental concern.

b. The Second Wave

A number of spectacular eco-disasters during the 1970s and 1980s propelled the growth of a popular environmental consciousness. The incidents demonstrated the scope of environmental risks posed by industrial activity and showed the vulnerability of human beings and the larger ecosystem (see box: Eco-Disasters of the 1970s and 1980s). Tragedies such as Chernobyl and Bhopal and disastrous chemical and oil spills have been dismissed as problems inherent to certain specialized industries. The general public, however, saw in them an inclination on the part of business and government to carry on with an increasingly untenable business-as-usual approach in spite of appalling loss of life and environmental damage.

Public opinion was also influenced by confirmation that the continued use of chlorofluorocarbons (CFCs) was causing a hole to open up in the stratospheric ozone layer over the Antarctic. This was coupled to fears about the effect this would have on skin cancer rates. Other fears were expressed about the effects of global warming on the world's climate. On a more mundane level, in 1988, the public was treated to the spectacle of a seemingly endless voyage by the waste-laden *Karin B*, searching for a port where it could discharge its cargo of garbage. Environmental problems, the public saw, could not be solved by foisting them on others.

Nor have the signs of environmental degradation diminished since the 1980s. Scientists have found a hole in the ozone layer over the Canadian Arctic. In February 1995, the British Antarctic Survey announced that parts of the Antarctic ice shelf had disintegrated and pointed to the warming of the regional climate over the last half century as the cause. *"What we are seeing now are changes only now just working through to glaciers and ice sheets,"* said a spokesperson. *"There is little doubt that the retreat of the ice shelves is, in the short term, irreversible."*[11]

The events that helped launch the second wave serve as a reminder that public concern over the environment does not spring out of nowhere. Canadians contemplating environmental disasters abroad should not conclude that they live in a "fireproof house." Although Canada has been extremely fortunate in escaping similar catastrophes, it has nevertheless endured its own environmental crises, including the burning tire yard of Saint-Basile-Le-Grand, the St. Clair River "blob," PCB spills, the mercury poisoning of the Wabigoon river system and the recent depletion of East Coast fish stocks, which led to the collapse of Canada's Atlantic fisheries.

The second wave of public environmental concern culminated in the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. The event responded to growing worldwide popular demand for action on environmental issues. It launched an international

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[10] D.H. Meadows *et al.*, *The Limits to Growth,* A Report for the Club of Rome's Project on the Predicament of Mankind (New York: Signet New American Library, 1972).

[11] "Local Warming Leads to Ice Shelf Disintegration," *Global Environmental Change Report* 7, 5 (March 10, 1995), p. 6.

Eco-Disasters of the 1970s and 1980s

In 1976, an explosion at the Icmesa chemical plant in the Italian town of Seveso, near Milan, released a giant cloud laced with dioxin — one of the deadliest substances ever created. The cloud settled over a nearby residential area, contaminating some 4,000 acres of land and causing the death of an estimated 70,000 animals. Nearly 30,000 individuals were seriously threatened, with hundreds developing blurred vision or disfiguring skin rashes; 700 people were evacuated on a long-term basis. In subsequent years, the number of birth defects soared.

In 1978, President Carter declared Love Canal, New York, a federal disaster area. Part of the town, whose name would become synonymous with the growing toxic waste problem, had been built atop a dump containing some 22,000 tonnes of waste chemicals. Despite industry assurances that the dump was secure, inhabitants complained for years of childhood cancers, immune dysfunctions and numerous other ailments. By 1980, the U.S. government had relocated some 2,500 residents and razed a school and 237 homes, while hundreds more stood empty.

In 1978, the wrecked supertanker *Amoco Cadiz* spilled more than 200,000 tonnes of crude oil off the Breton coast, killing some 30,000 seabirds as well as 230,000 tonnes of fish and shellfish. Nearly 200 km of Brittany's coastline was contaminated by this spill, the worst such event up to that point in history. It was eclipsed in 1989 by the grounding of the *Exxon Valdez*,which resulted in the spilling of 250,000 tonnes of oil off the coast of Alaska.

In 1979, the reactor core of the nuclear power plant at Three Mile Island underwent partial meltdown. The televised disaster unfolded in full view of millions of Americans and galvanized public opinion against nuclear power. The plant released a plume of radiation over hundreds of kilometres, and only remarkably good luck prevented a complete meltdown of the reactor core, an event that would have laid waste to most of the state of Pennsylvania.

In 1984, one of the world's worst environmental disasters occurred in the industrial city of Bhopal, in central India. A breached storage tank at the local Union Carbide chemical plant sent a cloud of deadly methyl-isocyanate gas into the atmosphere. The effects of the gas are similar to those of phosgene, a gas used during the First World War. The results of the leak were tragic. Nearly 2,000 people were killed, while an estimated 10,000 more perished in the weeks and months following the disaster. Roughly 200,000 of Bhopal's inhabitants suffered adverse health effects resulting from the disaster, with tens of thousands becoming permanently blind or crippled.

In 1986, a Soviet reactor located in the Ukrainian town of Chernobyl, about 100 km from Kiev, underwent a complete meltdown, turning hundreds of square kilometres into a radioactive wasteland. Thousands of residents were evacuated, and the fate of Kiev's water supply was in serious doubt for some weeks after the disaster. Radioactive clouds poured from the stricken reactor, polluting 20 countries up to 2,000 km away. This calamity virtually destroyed the credibility of the nuclear industry worldwide and prompted the Italians to abandon their own nuclear program and the Swedes to accelerate the phase-out of their nuclear industry.

In 1986, an electrical fault in the Sandoz chemical company's storage complex in the Swiss town of Muttenz, near Basel, caused a fire in a warehouse containing nearly 1,300 tonnes of chemicals. Firefighters contained the blaze by dousing it with water, which then carried about 30 tonnes of herbicides, insecticides and mercury compounds into the Rhine. The spill left a slick some 50 km long, which was swept downriver from Switzerland, wiping out most or all water life along a 300-km stretch of the Upper Rhine. The West German government was forced to close down all wells along the river and provide 25,000 people with water ferried by tanker, while Dutch authorities closed three sluices in order to divert the poisons away from The Hague, Leiden and Amsterdam.

Shortly after the Sandoz disaster, dubbed "Chernobasel" by the media, two German companies, BASF and Hoechst, Switzerland's largest chemical company, Ciba-Geigy, and the smaller Swiss firm, Siegfried, admitted that their facilities had also leaked toxic chemicals into the Rhine and emitted dangerous gases into the air.

effort to deal with some of these problems, notably those relating to climate change and loss of biodiversity, which were addressed in two international conventions. The main result of the Conference was *Agenda 21,* a "wish list" (in the words of some observers) that emerged from the global consensus on the need for reducing future risks for the planet and its inhabitants by providing an action plan to guide countries into the 21st century.[12]

One of the more positive aspects of the Rio conference, and an indication of how much public opinion had evolved over two decades, was the changing perception of industry and its role. As noted by Bill Long, the OECD's Director of Environment:

> *In 1972, at the UN Environmental Conference in Stockholm, industry was widely seen and condemned as the villain in environmental degradation. Twenty years later, in Rio, industry was presented as an important and necessary partner in the future quest for sustainable development. Government representatives from all regions seemed to recognize that industry – at least large segments of it – is beginning to demonstrate a remarkable ability to carry out its business in a manner which is both clean and profitable and that the international community needs industry's technologies and skill if the goals of economic growth and environmental quality are to be achieved concurrently.*[13]

The second wave of popular environmentalism had a profound impact on modern industrial society. It was successful in forcing significant changes in business practices and in reducing environmental risks. It also gave rise to Green parties, which became a powerful force in European politics, especially in Germany. Although the last recession blunted the second wave's drive, it did not eradicate the pro-environmental consciousness it encouraged, nor the changes it helped bring about in mainstream politics and policy making.

c. The Third Wave

A new, third wave of environmental change is already looming. According to Doug Miller, President of Synergistics Consulting, who regularly surveys both general and public audiences on issues relating to sustainable development, the third wave is now *"rising out of the shoulders of the second, driven out by both necessity and opportunity."* He goes on to define the third wave as the *"sustainability wave,"* which will *"overhaul the machinery of society that continues to point people and enterprise in the wrong direction, rewarding unsustainable pursuits.... It will change the economic relationships and signals to ensure the future will not rest only on good intentions."*[14] The significance of Miller's statement is clear: in the years to come, companies must learn to live with, indeed, become part of, a broad social movement that is essentially environmentalist in its outlook.

d. Public Opinion

Public opinion has had a decisive impact on the development of the environmental industry, both in Canada as well as internationally. Public concern for the environment has fluctuated in the short term, but, over the longer term, it has remained a constant feature of most opinion surveys since the end of the 1960s. In a recent environmental management survey, 40 percent of respondents considered public pressure to be one of the principal factors in the establishment of private-sector environmental management systems.[15]

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12 R. Kumar *et al., The Challenge of Sustainability* (Toronto: Centre for a Sustainable Future/Foundation for International Training, 1993), p. 4.

13 W. Long, "Environmental Policies of OECD Member Countries in the Post-UNCED Period," speech to the 1992 *Seoul Symposium: UNCED and the Prospect of an Environmental Regime in the 21st Century,* Seoul, Korea (September 2-5, 1992), p. 4.

14 D. Miller, "The Third Wave," *National Round Table Review* (Fall 1994), pp. 12-14.

15 KPMG, "The Canadian Environmental Management Survey, 1994," in *Putting the Green in Green Industry Strategies: The Role of Environmental Industries in Restructuring for Sustainability* – Draft (Toronto: Canadian Institute for Environmental Law and Policy [CIELAP], December 1994), p. 17.

Canadians, in particular, are well-informed regarding environmental issues. Recently, the University of Chicago's National Opinion Research Center conducted an international survey of knowledge about the environment and science. Canadians topped the list, ranking just ahead of the British, New Zealand, Norwegian and Dutch respondents. Spanish, Russian and Polish citizens came in last among the 20 countries studied.[16]

Environics Research conducts regular national surveys of 1,500 Canadians on issues relating to the environment. These surveys, published on a quarterly basis in the *Environmental Monitor*, have yielded some interesting evidence regarding Canadians' changing attitudes toward the environment:

- Even with over a million people unemployed, Canadians do not believe that jobs suffer from measures to protect the environment.
- An overwhelming majority of Canadians see environmental protection as a driver of, not an impediment to, economic recovery and growth.
- The view that environmental protection contains golden opportunities is reflected in the virtually unanimous view that "green" exports could play an important role in Canada's export trade over the next decade.
- A majority of Canadians do not accept the view that environmental standards make us less competitive internationally.
- Canadians are ready to confront false economies, where real costs of production are not reflected in the price for goods and services. Canadians realize that environmental costs must eventually be paid for, and a majority would prefer them to be paid up front, even in the midst of a recession.
- Canadians do not expect sustainability to come easily or without significant personal sacrifice. A majority expect it will mean major changes in lifestyle and consumption patterns. As long as the burden is equally distributed, they are willing to do their share.[17]

Although environmental issues have been overshadowed in the first half of the 1990s by short-term economic concerns, they have not disappeared from Canadian awareness. The environment has become a perennial concern for Canadians and resurfaces as a major issue on a regular basis. In the words of Doug Miller:

> *It is not the average Canadian that needs to be convinced of the significant rewards of aggressively pursuing sustainable economics. They already see sustainability as necessary, practical and key to our economic prosperity.*[18]

e. Other Manifestations of Public Concern

Popular concern over the environment has taken new forms in recent years. The Not In My Backyard (NIMBY) syndrome has spread throughout the world. In India, for example, citizen groups halted DuPont's plans to build a US $217 million synthetic nylon factory in the jungle highlands of Goa, the country's smallest state.[19] And in the United States, after years of controversy in the 1970s, Dow Chemicals acknowledged the toxicity of dioxins in its herbicide 2,4,5-T. The Dow official history tells the story of the aftermath of the controversy:

> *We began to understand that we needed to do a much better job of listening to our critics and of communicating what our studies were finding out about dioxin in ways they could relate to. Just professing good science was no longer enough.... Here and there in the company, people pressed for a re-evaluation of their company's attitude and approach. 'PERCEPTION IS REALITY' signs went up on bulletin boards. Our top executives began participating in roundtable conferences, sitting down with people from the public and private sectors, including environmental groups.*[20]

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16 "Canada Ranks First in Survey," *The Globe and Mail* (April 19, 1995), p. A7.

17 D. Miller, "Canadians Ahead Again," *National Round Table Review* (Fall 1993), p. 35.

18 *Ibid.*

19 G. Cohen and S. Sarangi, "DuPont: Spinning Its Wheels in India," *Multinational Monitor* 16, 3 (March 1995), pp. 23-27.

20 Smart, *Beyond Compliance*, p. 161.

In 1985, Dow chairman Robert W. Lundeen expressed in the most succinct terms possible the lesson learned by Dow: *"We found that if we were perceived as not running our business in the public interest, the public will get back at us with restrictive regulations and laws."*[21]

More recently, in February 1995, as the result of a citizen enforcement lawsuit, Shell Oil agreed to drastically reduce selenium pollution from its Martinez, California, refinery and to pay US $2.2 million to address pollution problems in San Francisco Bay.[22]

Perhaps more significantly, environmentalist leanings are being imported into companies by new employees, contributing to a noticeable shift in corporate attitudes. A 1994 survey conducted by the consulting firm KPMG revealed that 69 percent of respondents felt that their employees were a major factor motivating the establishment of environmental management systems.

In Canada, as elsewhere in the industrialized world, lifestyle changes are leading to new opportunities and technologies for reducing, reusing and recycling a wide variety of goods and services. Energy-efficient housing; public transit; the "blue box" program; the more efficient use of fuel; less-wasteful packaging; the conversion of waste plastics, oils and sewage to petrochemical feedstocks; returnable reusable bottles; and the recycling of metals, paper and wood products are all examples of the "everyday" growth opportunities that exist for the Canadian environmental sector.

As consumers turn more and more to so-called "green" products, a company's good name, and therefore its balance sheet, depends to an increasing degree on its reputation as an environmentally friendly corporate entity. This concern on the part of companies is reflected by voluntary or government eco-labelling initiatives. But, most importantly of all, public pressure results in political pressure, which in turn generates legislation, regulations and new industry practices.

3. Government Action

Unlike most markets where business responds directly and predominantly to consumer preferences, the development of environmental products, process technologies and services is greatly influenced by current and anticipated government policies, regulations and procurement. Government legislation and regulations are generally enforced through the imposition of standards or in the form of taxes on discharges. The trend over the last decade has been in favour of more stringent measures. These measures drive the industry and help to develop markets. They may also keep out products from countries with inadequate environmental standards.

In Canada, environmental regulations and frameworks exist at both the federal and provincial levels. They are one of the major drivers of the Canadian EIS. In 1993, the Canadian Chamber of Commerce conducted a survey of nearly a thousand small to medium-sized enterprises (SMEs) regarding environmental management practices. Respondents stated that they believed that environmental management is driven solely by regulation, while demand and peer pressure resulted in voluntary action. The participants did not oppose regulation as such, but indicated that they were concerned about the regulatory framework as it currently exists.[23]

These findings were echoed in the KPMG survey mentioned previously. According to KPMG, 95 percent of respondents viewed compliance with regulations as the principal motivating factor in the establishment of private-sector environmental management systems.[24] The KPMG survey was conducted in the summer of 1994. Its authors surveyed Canadian companies, hospitals, municipalities, universities and school boards to capture a snapshot of the state of management of environmental risks and issues. The principal motivators for action were rated as follows:

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21 *Ibid.*, pp. 158-161.

22 "Shelling Out for Pollution," *Multinational Monitor* 16, 3 (March 1995), p. 30.

23 J.-L. Barry, "Environmental Management," *National Round Table Review* (Fall 1993), p. 32.

24 KPMG, "The Canadian Environmental Management Survey, 1994," p. 17.

Motivator	Percentage of All Respondents
Compliance with regulations	95
Director/officer liability	69
Employees	62
Cost savings	49
Customer requirements	49
Shareholders' concerns	42
Public pressure	40
Marketing advantages	32
Underwriters' requirements	29
Lenders' requirements	26
International standards	25
Supplier requirements	22
Environmental interest groups	16
Voluntary government programs	16
Trade considerations	10

Source: KPMG, "The Canadian Environmental Management Survey, 1994," in *Putting the Green in Green Industry Strategies: The Role of Environmental Industries in Restructuring for Sustainability* – Draft (Toronto: Canadian Institute for Environmental Law and Policy [CCIELAP], (December 1994), p. 17.

Regulatory drivers can also include national "Green Plans," like Canada's, aimed at dealing with environmental threats to the planet as well as to specific countries. Such plans can also address various national resource accounting initiatives. For a more detailed discussion of the Canadian regulatory environment, see Chapter 5 of this report.

Recognizing the often global nature of the environmental problems facing it, Canada has signed a number of major international agreements that have served to complement domestic efforts at environmental protection and regulation. In addition to giving an added impetus to Canadian initiatives to promote sustainable development, they have contributed to the growth of the EIS (see Appendix I).

Government action, whether at the national or international level, is designed to encourage "organic" changes within the industry – that is to say, changes that manage pollution at the source. Ultimately, all industry sectors will be required to adopt an integrated approach to the environment, and companies will eventually be forced to develop or follow more acceptable standards and practices.

As an example, the asbestos industry has largely disappeared due to the public's environmental concerns. A giant such as Union Carbide has been reduced to a shadow of its former self. This is due almost exclusively to the public relations debacle it suffered following the Bhopal tragedy, when it was accused of flouting the basic environmental safeguards that it would have respected in the United States, its corporate homeland.

Citizens (and governments) are now more likely to hold companies liable for environmental damage and to take environmental matters much more seriously than in the past. Five years after the *Exxon Valdez* spilled 11 million gallons of oil into Alaskan waters, the Exxon company has been subjected to intense media scrutiny and public outrage over slipshod compliance with environmental regulations. As a result, it has spent, or has been ordered to pay, US $9 billion, of which nearly US $6 billion covers punitive or compensatory damages. The company still faces another US $500 million in claims by fishermen, native Alaskans, cannery owners, municipalities and business owners.[25]

Many companies complain that environmental regulations impede economic growth. This widely held belief was called into question by a blue ribbon panel of American economists writing in the June 1994 edition of the *Journal of Economic Literature.* They stated that: *"Overall there is relatively little evidence to support the hypothesis that environmental regulations have had a large adverse effect on competitiveness, however the elusive term is defined."*[26]

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25 "Exxon Spill Bill," *EnviroLine* 5, 19 (November 7, 1994), p. 4.

26 A. Jaffee *et al.*, "Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?, "*Journal of Economic Literature* 1, 42 (June 1994), p. 24.

Traditional opposition to regulation is also refuted in the studies conducted by Prof. Stephen Mayer of the Massachusetts Institute of Technology (MIT). After analyzing a wide range of U.S. federal and state data, Mayer discovered that the opposite was true. *"States with stronger environmental policies consistently out-performed the weaker environmental states on all the economic measures."*[27] Although he stopped short of claiming that stronger environmental regulation encouraged greater economic prosperity, in a later study he wrote:

> *I expected to find a small to modest negative association between environmentalism and economic prosperity [that] would have confirmed the prevailing wisdom at the time [but] it simply was not true. What was truly puzzling was that the analysis uncovered a consistent and systematic positive correlation between stronger state environmentalism and stronger economic performance across four or five indicators. States with stronger environmental standards tended to higher growth in their gross state products, total employment, construction employment, and labor productivity than states ranked lower environmentally.*[28]

Not all companies subscribe to the belief that regulation need hobble enterprises or interfere with profits. The Georgetown, Ontario, firm of Varian Canada, which manufactures microwave devices for satellite communications and radar applications, has developed a metal-plating process that substitutes an ultrasonic aqueous cleaning system for vapour degreasing, which used ozone-depleting substances (ODS). Varian eliminated ODS from its manufacturing processes three years ahead of the regulatory deadline of 1996. It avoided having to put warning labels on products exported to the United States as required under new U.S. legislation for products that use ozone-depleting chemicals in their manufacture or contain such chemicals. It therefore gained a significant competitive advantage in the marketplace.[29]

At least one company had the foresight to get ahead of the environmental curve and quickly carve out a market advantage for itself. In 1975, three years before the U.S. government banned the use of CFC propellants for aerosols and 12 years before the Montreal Protocol mandated the progressive phasing out of CFCs by 1996, S.C. Johnson Wax voluntarily and unilaterally abandoned the use of CFCs. Samuel C. Johnson, great-grandson of the company's founder, explains his decision:

> *We had done some homework on the matter, but when it became apparent that keeping fluorocarbons in some of our products would harm our reserve of consumer trust and loyalty, we made the commitment to removing the propellant within a week. Bang. We quickly made a very significant move for the company.*[30]

4. Demand from Industry

The changing environmental conditions, growing public pressures and government regulations combined to initiate and sustain demand for the products and services of the EIS. When these forces became more firmly embedded, the more far-sighted companies increasingly began to see that to remain competitive, they were going to have to be environmentally responsible. A variety of industries themselves began to demand more from the EIS.

This in turn led to distributors and manufacturers adapting their response to the market's new requirements, thereby continuing the process of redefinition that characterizes the industry.

New technologies are continuously required to improve productivity and to meet evolving regulatory standards at reduced compliance costs.

To evolve successfully in a new and increasingly competitive global market, companies must adopt a more progressive approach regarding the

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27 Mayer article in Miller and Moore, *Green Gold,* p. 75.

28 *Ibid.*

29 Environment Canada, *Pathways to a Greener Future – Environmental Industry in Canada* (Ottawa: Minister of Public Works and Government Services Canada, 1995), p. 10.

30 Smart, *Beyond Compliance,* p. 87.

environment. They must cease thinking of the environmental issues facing them, or their industry, in isolation. To remain flexible and responsive to market demands, companies will be forced to integrate environmental considerations into their corporate culture and abandon the conservative and conformist attitude that still characterizes much private-sector thinking on the environment.

> *It is clear that good environmental management is not simply a matter of a government affairs department keeping abreast of legislation. It requires a response from every part of a company's operations and from all its managers and employees.*
>
> *This cannot be achieved in the traditional reactive manner, in which management interventions usually focus on fixing symptoms rather than on underlying causes. There are simply too many forces and information signals from outside the company, and a reactive corporation is unlikely to remain competitive for long.*
>
> *The imperatives of sustainable development imply that a business organization that intends to survive and prosper in the decades ahead must, therefore, become a learning organization, built to adapt to rapid changes and to generate creative solutions more effectively than its competitors.*[31]

A larger number of companies are coming to realize that efficient use of resources to manufacture goods or to provide a service results in large net incomes, less waste, less pollution and a better environment. Inefficient production methods usually result in poor company performance and poor environmental quality. Gary Gallon, President of the Canadian Environmental Industry Association, notes that "*a contaminant discharged into the environment is a misplaced raw material that could have made money for the company, rather than just becoming a polluting liability. Pollution is just a product in the wrong place.*"[32]

Examples of this philosophy in action can be found everywhere. In Brockville, Ontario, 3M Canada opened a new plant that created 50 entirely new jobs. The Canadian site was chosen over locations in the United States and Mexico because of 3M Canada's reputation for on-time, quality products. It developed this reputation through a corporate strategy that takes into account the environmental consequences of production.

This strategy, called the Pollution Prevention Pays Program, has been in place at 3M since 1975 and has generated corporate-wide savings of hundreds of millions of dollars. Bob Whelan, Manager of Corporate Information, says: "*We are operating on the assumption that it is easier, cheaper, and more profitable to eliminate pollution at source.*" The program has focused on the elimination of pollution through product reformulation, process modification, redesign of equipment and recovery of waste materials. Consequently, 3M Canada has built up exports from 2 percent of sales to 20 percent, while taking the environment into consideration. Its experiences show that sustainability and prosperity can go hand-in-hand.

At its Perth, Ontario, plant, 3M's strategy has led to new products from what was once considered waste. Adhesive by-products, which would have once required waste disposal, are now being sold to a running-shoe manufacturer as a raw material. Plastic by-products are now being used as input to GI Joe figurines. Through actions like this, 3M is able to profit from its waste. A solvent used in the manufacture of a popular scouring pad has been replaced with water, thereby eliminating chemicals and costs from the manufacturing process. In addition to this, the Perth plant has reduced its landfill waste by 98 percent, simply by finding uses for the waste either in the plant or in other businesses. The plant is now serving as a model for other 3M plants around the world.[33]

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31 S. Schmidheiny, "Changing Course 1992," quoted in "Canadians Ahead Again, Environmental Management," *National Round Table Review* (Fall 1993), p. 35.

32 G. Gallon, "Environmental Industries Part of a New Canadian Economy," *National Round Table Review* (Fall 1993), p. 10.

33 "Success Story: 3M Canada Turns Waste into Jobs," *National Round Table Review* (Fall 1993), p. 23.

Another Ontario company, Polyphalt, has developed and commercialized a valuable new technology that creates a large and sustainable market for waste materials. The technology, invented at the University of Toronto, is used in the production of advanced "engineered" asphalt materials. Polyphalt technology uses proprietary combinations of polymers, plastics and rubbers to modify and improve the durability and cost effectiveness of asphalt materials.

The novel manner in which the Polyphalt process combines polymers in asphalt allows for performance synergies and improvements heretofore difficult to achieve. The performance advantages of Polyphalt's polymer-modified asphalt (PMA) are further strengthened by the economic and environmental benefits of incorporating recycled materials into the process. These include reduced pavement rutting at elevated temperatures, improved resistance to thermal cracking at cold temperatures and reduced susceptibility to moisture damage, fatigue and oxidative aging. In addition, PMA has an extended storage stability, is compatible with a wide range of base asphalts and requires no special handling. Economic benefits stem from reduced maintenance and longer pavement life and the potential for thinner overlays to reduce initial costs.[34]

In Germany, Knauf Gypsum, the country's largest construction materials company, is busy converting air pollutants into sheets of wallboard (sheet rock). This process begins by spraying the exhaust from coal-fired generating stations with a watery mist containing limestone, a requirement to meet stringent German regulations for removing sulphur dioxide from emissions. The resulting watery sludge cannot be dumped, again because of strict German environmental regulations. So industry had to find a means of re-using it. Knauf Gypsum rose to the occasion. It uses the sludge to produce gypsum briquettes, which are then pulverized and transformed into gypsum wallboard. These are sold throughout Germany and exported to the United Kingdom, which is how a by-product of German air pollution finds its way into the British construction trade.

According to Curtis Moore and Alan Miller, the Knauf Gypsum program is the successful outcome of two simultaneous streams of innovation,

> *... one aimed at developing pollution control systems better than scrubbers, the other at perfecting better ways to use scrubber waste. Both streams not only help make the German economy itself more efficient, but also encourage the development of products that can be sold on the world market, boosting employment and income at home.*[35]

A somewhat similar result has been obtained by a Vancouver-based Canadian company, Zerotech Technologies. It implemented a zero-discharge technology at a pulp mill (Bleach Chemical Thermal Mechanical Pulp) located at Port Cartier, Quebec. Multiple-effect evaporators were used to concentrate liquid effluents, which would then be mixed with wood chips from a nearby sawmill and used as fuel in a modified bark boiler. This was the first pulp mill in eastern Canada to completely "close the loop." The economics are made possible because of the availability and proximity of the sawmill. This system is environmentally sustainable, is technically attractive and generates jobs. Both the pulp mill and sawmill are newly constructed. In the future, this technology will be applied to the recovery of energy from pulp and paper sludge.[36]

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34 Industry Canada, *Environmental Solutions Fact Sheet: Polyphalt – A Novel Technology to Improve Asphalt Performance* (Ottawa: Industry Canada, Environmental Technology Commercialization Program, 1994).

35 Miller and Moore, *Green Gold*, pp. 19-20.

36 Environment Canada, *Pathways to a Greener Future*, p. 18.

TransAlta Utilities

TransAlta Utilities operates in Alberta, where it generates approximately 70 percent of the province's electricity. Approximately 90 percent of its power comes from coal-fired generating plants. The remainder is hydro power, the company's original source of electricity. The coal to fuel these plants originates in surface mines that are located near the plants. This proximity reinforced the assumption that technology could limit the impact of emissions from the generating plant to a local area. TransAlta saw itself operating wholly within a narrow geographical region.

However, public concern surrounding global warming changed this view. It was obvious that the thermal power plants had an effect far beyond their geographical locations. Moreover, the pace of environmental legislation quickened with the enactment of the *Canadian Environmental Protection Act* (CEPA) in 1988, which led provincial governments to revise their own legislation. It was also clear that customers, employees and regulators wanted TransAlta to be environmentally responsible. A major shift in corporate thinking was needed.

The company began the task of integrating sustainable development into the way it did business. It created an Environmental Advisory Panel that included representatives of the public it served. The policies articulated by the Environmental Advisory Panel were then tested with employees who developed statements that were even more stringent. All stakeholders wanted their company to be environmentally responsible, and there was no way to ignore this message. TransAlta began the process of translating desires into action. Work teams were formed, and policies were implemented.

What is more, the company also took on a new external leadership role. Its president, Ken McCready, accepted the Chairmanship of Alberta's Round Table on the Environment and the Economy. As a result, the company's own experiences played a key role in helping to create an environmentally sustainable vision for the entire province.

From, B. Smart, ed., *Beyond Compliance: A New Industry View of the Environment* (Washington, D.C.: World Resources Institute, April 1992), pp. 93-96.

5. The Search for Efficiency

In addition to more efficient technologies to deal with the results of environmental pollution, innovation can lead to pollution prevention, which in turn saves on costs. Xerox has linked one of its major preoccupations, quality, with pollution prevention. The World Resources Institute provides the following case study of the corporation's efforts:

> *In December of 1984, the world was shocked by the catastrophe in Bhopal, India.... David Kearns, then CEO of Xerox Corporation, concluded that Xerox must act quickly and thoroughly to ensure that such environmental mishaps would not be possible anywhere in Xerox.*
>
> *This focus on prevention was in line with the company's increasing focus on quality. In 1984, Kearns and senior Xerox management launched the Leadership Through Quality process, which led to Xerox Business Products and Systems winning the Malcolm Baldridge National Quality Award in 1989. This process, a major cultural change for Xerox, embraced quality principles, management action and behaviour, and the use of quality tools.*
>
> *As a cornerstone of quality, a prevention program was implemented to protect the environment, and it is ongoing at all operations. This included institutionalizing procedures for reviewing all processes and process changes from an environmental standpoint. Systematic environmental audits are conducted at least annually at all manufacturing facilities.*

> *... These standards greatly exceed the local requirements in many of the countries with Xerox operations.... Work of this nature is admittedly costly. But, failure to remedy environmental problems early can be orders of magnitude more costly. Ultimately, it can subject a business to potentially huge fines and generate public ill will that can seriously hurt the business.*[37]

The U.S. Office of Technology Assessment (OTA) and the U.S. National Research Council have conducted separate studies that reveal the critical role of initial design stages in improving quality, reducing the cost and lead time of product development and enhancing competitiveness.[38]

Another advantage is that product design offers a unique point of leverage from which to address environmental problems, since it is the stage at which decisions are made regarding the types of resources and manufacturing processes to be used. These decisions ultimately determine the characteristics of waste streams. By giving designers incentives to consider the environmental effects of their choices, companies can address environmental problems that arise throughout the product life cycle, from the extraction of raw materials to their final disposition.

The two design goals of enhancing competitiveness and quality of environmental protection can be consistent. According to the OTA:

> *Design strategies that reduce production costs and improve quality often have the benefit of generating less waste and pollution. Moreover, many companies are already using the environmental attributes of their products in their marketing strategies, and polls suggest that consumer demand for "green" products is likely to grow. Many observers believe that those companies that are able to design high-quality, environmentally sound products will enjoy a competitive advantage in the 1990's and beyond.*

The OTA's analysis suggests that simply providing information to designers and consumers about environmental impacts of products and waste streams is not enough. The environmental costs of production, consumption and disposal should be accounted for at each stage of the product life cycle. According to the OTA, the challenge to policy-makers is to choose a mix of regulatory and economic instruments that target the right problems and give designers the flexibility to find innovative, "environmentally elegant" solutions.

Competitive advantage is largely determined by a company's ability to adapt to market requirements by developing new technologies or applications. In an extremely dynamic industry where it is estimated that 50 percent of the technology that will be in use 15 years hence does not yet exist,[39] success belongs to the company or entrepreneur who is "the fastest with the most," the one who is, in other words, the most efficient.

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37 Smart, *Beyond Compliance*, pp. 105-110.

38 U.S. Congress, Office of Technology Assessment, *Green by Design* (Washington, D.C.: U.S. Government Printing Office, 1993), pp. 3-4 and pp. 53-54.

39 J. Higgins, "Global Environmental Industry," *Ecodecision* 11 (January 1994), pp. 20-22.

Product Versus Systems-Oriented Green Design

In the product-oriented approach, designers begin with a product concept and develop a design solution within the framework of the existing production/consumption system. Designers might ask questions such as:

- What are the waste streams from alternative manufacturing processes?
- What substitutes for toxic constituents are available?
- How is the product managed after its disposal?
- How does the design affect recyclability?
- What are the environmental impacts of the component materials?
- How is the product actually used by consumers?

A systems approach to design involves a unified consideration of production and consumption activities. Supply-side and demand-side requirements are treated in an integrated way. This is a more far-reaching design approach in which designers might ask:

- How would new supplier and customer relationships affect the management of product materials throughout their life cycle?
- How could the same consumer need be fulfilled in a "greener" way (i.e., thinking about a product in terms of the service it provides, rather than as a physical object)?
- How could other companies' waste streams be used as process inputs?

From, U.S. Congress, Office of Technology Assessment, *Green by Design* (Washington, D.C.: U.S. Government Printing Office, 1993), pp. 53-55.

Chapter 3 – Global Opportunities and Canada's Competitive Position

INTRODUCTION

Canada's domestic environmental industry is small by world standards, but Canadian companies are developing unique and globally competitive technologies. These demonstrated strengths can be used by Canadian firms to enter the rapidly expanding global market for environmental technologies. The global market represents an enormous business opportunity for innovative Canadian producers of environmental goods and services and for the Canadian economy. For example, Canadian firms have established an excellent reputation for water and wastewater treatment systems, for handling liquid and solid wastes and for providing products such as incinera-tors, shredders, compactors and recycling equipment.

That kind of success, however, still belongs to only a handful of Canada's environmental industry sector (EIS) firms. Less than a fifth of them export, while the rest remain reluctant to commit the effort and the resources needed to penetrate foreign markets. While 23 percent of the industry's manufactured products are exported, it is estimated that 37 percent of the Canadian market for environmental equipment is imported and that Canada has a net trade deficit in this area of about $1 billion a year.[1]

Canadians Can Compete!

Laidlaw Inc. is one of Canada's most impressive EIS success stories. Founded in 1959, Laidlaw has grown to become North America's second largest hazardous waste disposal company and third largest solid waste disposal company. The company's hazardous waste management group operates from 54 locations in North America alone. During the last three decades, Laidlaw has diversified and grown by acquisition and internal expansion and today principally provides transit services and waste management services to customers in the public and private sectors.

Laidlaw Environment Services was established in 1990 to offer a broad range of waste treatment capabilities, including wastewater treatment facilities, secure chemical landfills, incinerators, physical-chemical treatment facilities, fuel blending operations, waste transfer stations and waste bulking. The company also specializes in providing services for the small-quantity waste generator (e.g., disposal of the acid used in electroplating) and the packaging and disposal of residual chemicals from laboratory operations.

At its fiscal year end, August 31, 1990, revenue reached US $1,737,517,000, three quarters of which was generated in the United States. Sixty-three percent of revenue was attributable to waste management services, and 37 percent was derived from transit operations. The company's shares are listed on the Toronto, Montreal and New York stock exchanges. This successful firm is also currently operating in Norway and Belgium.

From, Ontario Ministry of the Environment and the Ontario International Corporation, *Ontario's Green Industries* (Toronto: Ontario Ministry of the Environment, March 1994), pp. 56-57.

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[1] Industry, Science and Technology Canada, *Industry and the Environment – The Environmental Industry Sector Initiative: A Progress Report and a Look at the Future* (Ottawa: Minister of Supply and Services Canada, 1993), pp. 8-9.

THE GLOBAL IMPERATIVE

Admittedly, the global environmental market is extremely challenging. It is dominated by major international competitors, especially the United States, Germany and Japan. Yet Canadian firms ultimately have no choice — they must move into that international arena. Only international markets will give Canadian firms the economies of scale and scope that will allow them to compete successfully. And lest there be any mistake, our firms have no choice but to learn how to compete. Already the economic "superpowers" are active in Canada's domestic markets.

Despite the growth of the domestic market and the activity of the Canadian EIS, much of the Canadian market remains dominated by large and long-established branch operations of foreign-owned companies and multinationals. Foreign-owned companies have access to proven technologies or products developed by their parent firms. This gives them an advantage over their Canadian-owned rivals, which must develop and market their products without the benefit of a larger supporting corporate infrastructure capable of absorbing the costs of design, production and marketing. Many Canadian firms import foreign products and materials in order to meet their own production requirements. In addition, the speed with which both the sector and the market have developed has left many gaps in terms of products and services. The manufacturing opportunities offered by these gaps have never been specifically identified.

Foreign competitors are increasingly active in domestic markets where Canadian firms have traditionally enjoyed some superiority. In the water and wastewater management field, for example, Canadian companies must now face strong competition from two French municipal services companies, Lyonnaise des Eaux Dumez S.A. and Générale des Eaux, which, in the words of the *Wall Street Journal*, are *"fighting for world-wide dominance of the arcane municipal services market."* [2]

Since many of the newer Canadian science and technology (S&T)-based companies concentrate on the delivery of highly specialized products to a small client base, they are ill-prepared to meet external competition. As noted in an overview of the Canadian EIS prepared by Environment Canada and Industry Canada, many are only just discovering the important role played by marketing, and few have a good understanding of their foreign competitors in Canada. The same report concludes that *"in an increasingly global market, no identification of the impact of foreign activity has been pursued. This important strategic component of strategic intelligence is missing."* [3]

The relatively low profile of Canadian companies in global markets is noticed by potential customers. For example, a survey of Chinese officials revealed a lack of familiarity with the range of environmental products and services offered by Canadian companies. They identified a number of weaknesses on the part of Canadian firms, including underfunded market development, the absence of adequate contact with Chinese technical personnel and decision-makers and insufficient participation in exhibitions and seminars that would have made them better known to potential buyers.[4] While conveying his deep admiration for Canada's environmental technology, an Egyptian official expressed similar feelings regarding the relative inability of Canadian firms to make their products and services known. *"Why does Canada hide its technology?"* he asked. *"Every day in Cairo we see the Americans, the Germans and the Japanese, but not the Canadians. But, your technology is better and we never see it."* [5]

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2 E.S. Browning, "French Companies Pour into U.S. Waterworks Market," *Wall Street Journal* (February 25, 1994), quoted in "The French Are Coming: Strong Water and Wastewater Competition," *CEIA Ontario Environmental Intelligence Faxletter* (March 1994), p. 4.

3 Environment Canada and Industry Canada, *Consultation Paper: Environmental Industry Strategy for Canada* (Ottawa, January 1994), p. 8.

4 External Affairs and International Trade Canada (EAITC), *Study on China's Market for Pollution Control Technology, Engineering Consulting Services and Related Equipment and Instruments* (Ottawa: EAITC and Canada-China Trade Council, 1992), p. 136.

5 Canadian Environment Industries Association (CEIA), "Conversations with an Egyptian Dignitary," *CEIA Ontario Environmental Intelligence Faxletter* (August 1994), p. 7.

These shortcomings must be addressed. Increasingly, the Canadian domestic market is becoming part of the larger international market, not merely as a result of globalization, but also because of Canada's adherence to the North American Free Trade Agreement (NAFTA). Although access to North America's 370 million consumers will provide Canadian companies with new opportunities for expansion and development, it also increases the permeability of the Canadian market. Canada's domestic EIS must position itself for future competitiveness.

THE GLOBAL MARKET

Estimates of the global market for environmental goods and services and its potential growth vary, sometimes considerably. The discrepancies stem from methodological problems, such as trying to quantify environmental expenditures internal to the firm. Some calculations may also include double-counting of expenditures. As a result, estimates of the market's size in 1992-1993 vary from roughly US $220 billion to US $290 billion.

Forecasts of the market's growth potential to the year 2000 range even wider, from US $300 billion[6] to US $600 billion.[7] Environment Canada and Industry Canada project the market to reach US $425 billion in 2000.[8]

According to a 1992 study by the Organisation for Economic Co-operation and Development (OECD), the OECD's member countries accounted for over 80 percent of the global market for environ-mental services and products in 1990. The United States was by far the largest national market, with a total demand of US $78 billion, followed by Japan at US $24 billion, the Federal Republic of Germany at US $17 billion, excluding the former East Germany, and France at US $10 billion (see Table 3-1).

The OECD countries generally spend between 1.2 and 1.5 percent of their Gross Domestic Product (GDP) on environmental products and services. The average growth rate for OECD environmental expenditures through the 1990s is estimated to be about 4.1 percent per year. The 1992 study anticipated higher than average growth in Canada and Japan, as well as in European countries such as Spain and Greece that need substantial environ-mental investment to meet European Community standards. The OECD reported that the lowest growth rates would be seen in Germany, the Netherlands, Switzerland, Austria and the Nordic countries, where relatively advanced environ-mental management capabilities already exist. Germany's demand for environmental goods and services has now increased, however, since unification with the heavily polluted territories of the former East Germany.

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6 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment – Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 118.

7 International Finance Corporation (IFC), *Investing in the Environment: Business Opportunities in the Developing World* (Washington, D.C.: The World Bank and the IFC, 1992), p. iii.

8 Environment Canada and Industry Canada, *Consultation Paper*, p. 8.

Table 3-1 OECD Estimates of Environmental Markets and Growth by Region

REGIONS / COUNTRIES	(US $billion) 1990	(US $billion) 2000	ANNUAL GROWTH (percent)
OECD North America	84.0	125.0	4.1
United States	78.0	113.0	3.8
Canada	7.0	12.0	5.5
OECD Europe	54.0	78.0	3.7
OECD Asia-Pacific	26.2	42.0	4.8
Japan	24.0	39.0	5.0
Australia	2.0	2.8	3.4
New Zealand	0.2	0.3	4.1
OECD Total	164.0	245.0	4.1
Non-OECD Total	36.0	55.0	4.3
Europe & FSU*	15.0	21.0	3.4
Other Non-OECD	21.0	34.0	4.9
World Total	200.0	300.0	4.1

Note: Some totals do not add up because of rounding. * FSU: Former Soviet Union

Source: U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment — Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 18.

The 1992 OECD study pointed to strong growth in the environmental markets of countries that were not OECD members, including several Pacific Rim states. The global market is changing rapidly as many developing countries intensify their focus on environmental issues for reasons of economic sustainability, security and greater access to the world trading system.

The OECD also analyzed the various components of the environmental market. Its findings suggest that among the OECD member countries, equipment accounts for about three quarters of the market and services for one quarter. The highest predicted growth rate is within the service sector and for equipment related to site remediation (see Table 3-2).

In contrast to the OECD's estimates, Environmental Business International (EBI) — publisher of the *Environmental Business Journal*, perhaps the most influential publication dealing with the global EIS — suggests a significantly larger environmental market with a much more optimistic assessment of its growth potential. The EBI projects an average annual growth rate of 7.6 percent between 1992 and 1997 (see Table 3-3).

Table 3-2 OECD Estimates of Environmental Markets by Sector

SECTOR	1992 (US $billion)	2000 (US $billion)	ANNUAL GROWTH (percent)
Equipment	152	220	3.8
Water/wastewater	60	83	3.3
Waste management	40	63	4.6
Air quality control	30	42	3.4
Other	22	80	5.2
Services	48	80	5.2
Total	200	300	4.1

Source: U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment – Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 118.

Table 3-3 EBI's Estimates of the Global Environmental Market

COUNTRY / REGION	1992 (US $billion)	1997 (US $billion)	ANNUAL GROWTH (percent)
United States	134	180	6.1
Canada	10	17	11.2
Mexico	1	2	14.9
Other Latin America	6	10	10.8
Western Europe	94	132	7.0
Europe / FSU*	14	27	14.4
Japan	21	31	8.1
Australia / New Zealand	3	5	10.8
Southeast Asia	6	13	16.7
Rest of world	6	9	8.4
Total	295	426	7.6

*FSU: Former Soviet Union

Source: U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment – Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 98.

KEY MARKET TRENDS

The current global market for environmental products and services is being shaped by a nearly universal shift in the priority and resources accorded to environmental quality. Stronger efforts are being made to develop an integrated approach to environmental management and regulation, in place of the traditional tendency to treat each issue (soil, air, water, etc.) separately.

There is also greater stringency in environmental standards and a stronger, if still highly variable, emphasis on enforcement. Pollution prevention, as opposed to pollution control, is now the goal of governments. This shift has been codified in legislation, if not always in action, in Canada as well as in Germany, Japan, the European Union (EU), the United States and elsewhere.

Shifting priorities have stimulated collaboration between government and industry in developing environmental policy and regulations. One

manifestation of this trend is the emergence of a number of voluntary codes of industry conduct, such as the *Business Charter for Sustainable Development* prepared by the International Chamber of Commerce or the "Responsible Care" program designed by the North American chemical industry. There is also a greater tendency for governments to adopt more flexible forms of industry control. This can involve the use of economic instruments such as environmental taxes and financial incentives, which specify standards of environmental performance but allow industry the flexibility to attain them.

In addition to cross-sectoral cooperation, a number of significant cross-border approaches to environmental standard-setting have also been developed. On a regional level, the EU remains perhaps the best example of successful international environmental regulation. It may be that a similar degree of regulatory convergence and standardization will eventually occur among the three NAFTA countries. Instruments such as the Montreal Protocol, the Convention on Biological Diversity and the Convention on Climate Change represent important worldwide initiatives that offer useful precedents for other international agreements.

These international agreements offer Canadian companies a number of opportunities, as suggested in Table 3-4. More importantly, these agreements are the signposts of the future, giving Canadian industry a clear indication of not only what products will be needed or eliminated, but the direction in which the international community is heading in terms of its efforts to deal with environmental problems.

One of the more important linkages affecting the evolution of the global market for environmental products and services is the growing connection between environmental considerations and trade policy. Perhaps the most visible of these linkages is the one established by NAFTA. In particular, NAFTA includes provisions to ensure that a difference in environmental standards does not give companies from one member country an advantage over firms from the other two NAFTA members.

Environmental issues are increasingly being linked to issues of global security. International financial institutions (IFIs) and other donor or aid organizations are adopting a stronger environmental stance requiring impact assessments and resource plans before extending funds. They are expressing stronger interest in protocols and agreements for the resolution of specific environmental problems. The commitment of the IFIs to environmental projects helps to drive environmental markets in less developed countries. The World Bank alone lent US $2 billion in 1993 for environmental projects. Other institutions and agencies involved include regional development banks, the United Nations Environment Programme (UNEP), the Montreal Protocol for the Protection of the Ozone Layer and the Global Environment Facility (GEF).

NATIONAL AND REGIONAL MARKETS

Canada's current share (3.5 percent) of the world market for environmental products and services is growing. However, there is much unrealized potential.

The primary market for Canadian exports of environmental goods and services is the United States, which accounts for 80 percent of Canada's $1 billion in exports.[9] About half of Canada's environmental exporters focus their marketing efforts on the United States. Roughly 20 percent are pursuing opportunities in the Pacific Rim, a similar proportion are looking at Western Europe and another 12 percent are active elsewhere in the world. Recent events, such as the ratification of NAFTA, the Prime Minister's high-profile visits to Asia and current free-trade negotiations with Chile, drew more attention to these countries as well as to the rest of Latin America and the Asia Pacific region.

1. United States

The size of the American economy, coupled with relatively strict environmental regulations, has made the United States the world's largest producer of and market for environmental goods and services. The size and relative openness of the

[9] Environment Canada and Industry Canada, *Consultation Paper*, p. 13.

Table 3-4 Opportunity Time Line: Substance Controls Established by International Agreements

AGREEMENT	SUBSTANCE	OBJECTIVE	TARGET DATE
Protocol SOx (LRTAP)	SOx	Reduction from 1980 level (4.6 megatonnes) to 3.2 megatonnes	1993
Protocol NOx (LRTAP)	NOx	Reduction to 1987 levels	1994
Montreal Protocol	Methyl chloroform	50% reduction	1994
Montreal Protocol	CFC	75% reduction	1994
Montreal Protocol	Halons	100% reduction	1994
Montreal Protocol	Carbon tetrachloride	100% elimination	1995
Montreal Protocol	Methyl chloroform	100% elimination	1995
Montreal Protocol	HBFC	100% elimination	1996
Montreal Protocol	CFC	100% elimination	1996
Montreal Protocol Basel Convention	Methyl chloroform Hazardous wastes	100% elimination Ban on export from OECD to non-OECD countries	1996 1997
Montreal Protocol	Methyl bromide	25% elimination	1998
Protocol NOx (LRTAP)	VOC	Freeze at 1988 levels (selected areas to 70% of 1988 levels); 30% reduction from 1989 levels	1999
Climate Change	CO_2 equivalent	Stabilize greenhouse gas emissions (CO_2, CH_4, N_2O) at 1990 levels of 526 megatonnes	2000
Canada-U.S. Air	NOx	Reduction from estimated year 2000 level of 970,000 tonnes (100,000 tonnes)	2000
Canada-U.S. Air	SOx	Cap of 3.2 megatonnes	2000
Climate Change	CO_2 equivalent	Reduction of greenhouse gas emissions (CO_2, CH_4, N_2O) from 1990 levels; 100% elimination	2005
Montreal Protocol	HCFC	100% elimination	2030

Abbreviations used:

CFC = chlorofluorocarbons

CH_4 = methane

CO_2 = carbon dioxide

HBFC = hydrobromofluorocarbons

HCFC = hydrochlorofluorocarbons

LRTAP = long-range transboundary air pollution

N_2O = nitrous oxide

NOx = nitrogen oxides

SOx = sulphur oxides

VOC = volatile organic compounds

U.S. market have attracted the attention of many foreign companies. Competition is intensifying in spite of the uncertainty created by recent moves toward deregulation at the national level.

Again, estimates of the market size vary, in part depending on whether calculations are based on revenues or expenditures. In contrast to the OECD's estimate of US $78 billion in 1990, the *Environmental Business Journal* suggested that total revenues for the American EIS were US $126 billion in 1990 and US $133.7 billion in 1992. Farkas Berkowitz and Co. produced an estimate of US $75 billion in 1992, while the United States Environmental Protection Agency (U.S. EPA) reported U.S. 1990 environmental expenditures to be US $115 billion.[10]

According to the Office of Technology Assessment (OTA), the U.S. market was valued at about US $81 billion in 1990 and growing at an average annual rate of 5.4 percent. This represents 39 percent of the total world market. The two largest areas of increased spending for the United States in 1990 were an 18 percent gain in business environmental plant and equipment and a 9.5 percent increase by government for sewer construction. However, the dynamics of the market are changing as U.S. priorities shift to integrated waste management, the management of hazardous waste (with some 10,000 toxic sites for cleanup) and air pollution controls.[11] A recent study, prepared for the U.S. Agency for International Development (AID) Office of Energy and Infrastructure, expects that the U.S. environmental industry will grow by an average of 6 percent annually through 1997.[12]

Growth in the U.S. environmental market will come from several directions. The *Clean Air Act* Amendments (CAAA) of 1990 tighten emissions control requirements for both stationary and mobile sources. The Amendments require major reductions in sulphur dioxide and nitrogen oxide emissions from power plants and other major sources; strengthen controls on volatile organic and toxic air pollutants; require cleaner vehicles and fuel; expand monitoring requirements for power plants; and regulate disposal of CFCs. As a result, it has been estimated that cumulative revenue increases (in 1990 US dollars) for producers of stationary and mobile source air pollution control equipment will reach between US $35 and US $49 billion by the year 2000, while engineering, design and construction firms could bring in another US $2 billion, to reach US $4 billion. Makers of instruments and monitoring systems could see revenues grow from US $1 to US $3 billion over the period. The CAAA is also expected to increase revenues for natural gas, low-sulphur coal and reformulated and oxygenated gasoline producers.[13]

For Canadian companies, U.S. market trends are similar to developments in Canada. They will often serve as leading indicators of demand trends in Canadian markets because of the relatively advanced state of environmental regulation and enforcement in many U.S. states with similar resource and industrial bases.[14]

Although NAFTA regulations prohibit national preferences at the federal level, there are some problem areas. For example, the federally mandated toxic site remediation program has "Buy America" preferences, set-asides, audits, inspections, guarantees and liability insurance requirements that favour U.S. suppliers.[15]

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10 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment*, p. 99.

11 *Ibid.*, p. 98.

12 Environmental Business Research, *Assessment of U.S. Environmental Technology Strengths and Applications – A Report for the Office of Energy and Infrastructure (USAID)* (San Diego: Environmental Business International, Inc., January 1994), p. 2.

13 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment*, p. 100.

14 Ernst and Young, *Competitiveness Analysis of Canada's Environmental Services Industries* (Toronto: Ernst and Young, February 1994), p. 77.

15 Environment Canada and Industry Canada, *Consultation Paper*, p. 13.

2. Germany

Germany is well-known for the stringency and strict enforcement of its environmental regulations. The 1990 unification of East and West Germany added large areas of severely contaminated land and polluted air and water, opening up a host of marketing opportunities. The OECD estimated the German market at US $17 billion in 1990. According to EBI, the German market was almost US $32 billion in 1992 and was expected to grow by approximately 6 percent annually to reach about US $42 billion in 1997.[16]

3. Japan

After the United States, Japan has the second largest national environmental market in the world. The OECD estimates that the Japanese market will grow to US $39 billion by 2000.[17]

Japan, like the United States, Germany and several other OECD countries, already imposes stringent environmental regulations. One observer remarked:

> *The pursuit of micro miniaturization, resource conservation, space conservation, high-density living, intense communication links, high levels of team spirit, high productivity, innovative skills, a craving for information and continuous scanning of world technological advances — all are ways of responding to problems such as high population density, low natural resource endowments, high import dependence on energy, shortage of skilled personnel, and isolation from other countries.*[18]

The Japanese environmental market is expected to be stimulated by a strengthening of already strict standards in some areas as well as efforts to match better foreign performance in other areas. For example, concerted efforts are expected in Japan's water and waste sectors. According to the OTA, at the end of fiscal year 1990, only 44 percent of Japanese residents were served by centralized sewage treatment, and only 62 percent had flush toilets. The Five-Year Program for Sewerage Construction and Basic Program for Public Investment anticipates that sewer services will be provided for 70 percent of Japan's residents by 2000.[19]

Such imperatives are tied to greater affluence, a stronger interest in quality of life and demands for a cleaner environment — in particular, clean air and water. As a result, the Japanese environmental market is expected to grow at an average annual rate of 6.7 percent.[20]

4. Western Europe

Western European countries accounted for about 27 percent of the world environmental market according to the OECD, with expenditures of approximately US $54 billion in 1990. The market was expanding at an average annual rate of 4.9 percent, led by Germany, which was growing at 8.5 percent, and France at 5 percent. By contrast, environmental markets in the United Kingdom and Italy were growing at 3.5 percent and 2.5 percent respectively. Forecast growth rates are highest in the newer EU members, such as Portugal (8.3 percent), Greece (7.3 percent) and Spain (7.3 percent).[21]

Europe is primarily concerned with water and wastewater treatment and air pollution controls, but waste management and land reclamation are becoming more important (Table 3-5). A number of European countries and EU members already possess advanced environmental management systems, including comprehensive legislation,

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16 Environmental Business Research, *Assessment of U.S. Environmental Technology Strengths and Applications*, pp. 10-11.

17 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment*, p. 105.

18 B. Bowonder and T. Miyaki, "Technology Development and Japanese Competitiveness," *Futures* 22 (January-February 1990), p. 41.

19 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment*, p. 105.

20 *Ibid.*

21 *Ibid.*, pp. 102-103.

Table 3-5 Western Europe's Environmental Markets by Environmental Sector

SECTOR	1990 (US $billion)	1991 (US $billion)	1995 (US $billion)	ANNUAL GROWTH (percent)
Air pollution control	9.6	10.3	12.8	4.3
Water/wastewater treatment	12.8	13.8	21.3	9.1
Contaminated land reclamation	1.0	1.1	2.3	16.1
Waste management	20.9	22.5	28.0	4.5
Total	44.3	47.7	64.4	8.5

Source: U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment – Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 103.

stringent environmental standards, effective compliance and capable administration. Germany, Denmark, the Netherlands, Finland, Norway, Sweden, Switzerland and Austria fall into this group. Belgium, France, Ireland, Italy, Luxembourg and the United Kingdom have somewhat less rigorous environmental policies.

The so-called "southern tier" of the EU, including Greece, Portugal and Spain, lacks sufficient experience, environmental infrastructure and the ability to enforce strong environmental policies. They need to boost their environmental management capabilities to meet EU standards, and their environmental markets may grow faster than other Western European markets. This could offer Canadian firms a number of interesting opportunities as they "play catch-up" with their northern neighbours.

5. Eastern Europe and the Former Soviet Union

The once centrally planned economies of Central and Eastern Europe and the former Soviet Union (FSU) have inherited grave economic and environmental problems resulting from decades of grossly inefficient management. These countries lack the financial resources to purchase the environmental goods and services they need. In addition, business relationships are still difficult, though local public officials and private firms are becoming more familiar with Western business practices.

The large stock of obsolete and inefficient capital provides an opportunity for the provision of cleaner production and energy-efficient technologies for both retrofit and new facilities. The former East European Bloc countries (Poland, Hungary, Bulgaria, Romania, the Czech Republic, Slovakia and the former Yugoslavia) offer an estimated US $19.4 billion potential market for industrial sector, energy-efficient equipment, such as meters, analyzers, thermometers, steam traps, fluorescent lights, combustion equipment, insulation and the like.[22] Monitoring and control technologies, including industrial process control and residential thermostats, offer large environmental and commercial opportunities in these countries.

6. Latin America

There are significant environmental markets in Latin America, a region that has recently become a focal point for Canadian foreign and trade policy. Environmental spending is growing throughout the region, assigning priority to the provision of public water, sewers, refuse disposal services and industrial environmental activities. Some countries have committed more financial, legal and administrative resources to environmental matters.

[22] *Ibid.*, p. 107.

For example, the Mexican environment agency's budget grew from US $4.3 million in 1988 to US $78 million in 1992, essentially doubling yearly in real terms.[23]

Argentina, Brazil, Chile, Colombia, Mexico and Venezuela constitute the bulk of Latin America's market for environmental products and services (Table 3-6). Mexico and Brazil are the region's largest environmental markets, and, together with Chile, they have the most comprehensive environmental regulations and enforcement capabilities in the region.

Major purchasers of air and water pollution control equipment include the chemical, petroleum refining, steel, pulp and paper, food, textile and other processing industries. Multinational firms from the United States and Europe investing in the region are also major purchasers of environmental equipment and services. As in Central and Eastern Europe and the FSU, opportunities in Latin America arise from the building of new facilities and the introduction of modern processes. For example, *Petróleos Mexicanos* (Pemex), the Mexican national oil company, has been adapting refineries to produce unleaded gasoline and low-sulphur fuels. In Brazil alone, the steel, pulp and paper and cement sectors are planning to make environmental investments of some US $300 million a year.[24] Continued economic liberalization and loosening restrictions on foreign investment in energy and other industries should assist in the diffusion of cleaner production technologies throughout the region.

a. Chile

Chile's vigorous economic growth has taken its toll on the country's environment. Now, Chile's environmental problems are attracting greater attention from the public, policy-makers and Chilean industry.

Table 3-6 Major Latin American Environmental Markets, 1992 (US $millions)

COUNTRY	AIR	WATER	SOLID/ HAZARDOUS WASTE	TOTAL
Argentina	53	100	15	168
Brazil	120	845	50	1,015
Chile	195	350	15	560
Colombia	20	15	10	45
Mexico	104	400	110	614
Venezuela	25	9	10	44
Total	517	1,719	210	2,446

Source: U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment – Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 110.

Chile's natural resource-based industries offer an attractive market potential to Canadian companies with proven environmental technologies in the mining, forestry and power generation sectors. For instance, the Chilean copper industry is considering investment in new and modernized smelters, copper dryers and sulphuric acid recovery units that will prevent air pollution.

Chile provides a range of opportunities for the Canadian EIS, especially if current negotiations for a Canada-Chile free trade agreement are successful. Canada enjoys an excellent reputation as a supplier of advanced technology, and this enhances the potential for the sale of environmental goods and services as well as technology transfers.

b. Mexico

In 1992, Mexico's total environmental market was estimated at US $614 million (Table 3-7). Imports accounted for US $150 million of this total. About US $85 million (56 percent of total imports) came from the United States. Other major players in the Mexican market included Germany, Japan and Switzerland.

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[23] *Ibid.*, p. 108.

[24] *Ibid.*, p. 110.

Table 3-7 Mexico's Environmental Market (US $millions)

SECTOR	1990	1991	1992 (est.)	1993-1995 (est.)
Air pollution	78	90	104	119 – 157
Water pollution	105	126	400	500 – 780
Solid/hazardous waste	83	95	110	127 – 167
Total	266	311	614	746 – 1,104

Source: U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment – Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 109.

Canada has been a relatively minor player in Mexico's environmental market. Major sales included gas purifiers, catalytic converters, liquid and flow meters and units for heat exchange and heat treatment.[25] The picture was improving in 1993-1994, prior to Mexico's financial crisis and subsequent recession. Although the short-term outlook foresees a dip in demand, the medium- to longer-term outlook remains promising.

Growing numbers of Canadian companies are arriving in Mexico to capture a share of the market. Mexico is of special interest to the Canadian EIS because of its recent economic growth, obvious pollution problems and the preferential access accorded to Canadian service suppliers under NAFTA. In the words of Bruce Jank of the Burlington, Ontario-based Wastewater Technology Centre: *"There is opportunity after opportunity after opportunity."*[26]

Antonio Cortez, director of Diaztech, a joint venture between Diachem Industries of Vancouver and Mexico's Grupo Cesco, believes that NAFTA will open more business opportunities for his company, which specializes in the treatment of wastewater produced by the pulp and paper industry.[27]

Mexico's legislation faithfully emulates the policies of the U.S. EPA, thus providing for stringent environmental regulations. However, the enforcement remains weak. Yet the market for environmental products and services will be strong, and local Mexican firms will not be able to keep up with demand.

There are also significant funds now available for environmental protection. In April 1992, Mexico, with World Bank aid, began a US $126 million program to strengthen environmental management capacity at the federal, state and local levels. In September 1993, Mexico and the World Bank signed an agreement to provide US $1.8 billion in loans to clean up water pollution, industrial pollution, garbage and toxic waste disposal for the years 1994-1996. Mexico will also provide matching funds of US $1.2 billion, bringing the total amount set aside for environmental cleanup activities to US $3 billion.[28]

7. Asia

Potentially enormous markets for environmental goods and services are opening up in Asia. Above all, the two most populous countries in the world, India and China, are attempting, with mixed results, to combine economic development and environmental protection. Both countries are struggling to maintain basic environmental standards while attempting to deal with severe demographic pressures and the increasingly serious threats posed by modern industry. They are seeking to provide water, sanitary services and refuse disposal for their populations and for rapidly expanding and highly polluting industrial sectors such as chemicals, metals and electric power. In addition, India and China rely on large deposits of cheap coal that create significant pollution problems, particularly when both fuel combustion and energy use are inefficient.

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25 Industry Canada, *Environmental Business Opportunities in Mexico* (Ottawa: Industry Canada, 1993), p. 15.

26 L. Kootnikoff, "Canadian Firms Raring to Clean Up Mexico," *Financial Post* (November 17, 1993), p. 9.

27 *Ibid.*

28 *Ibid.*

Despite the size of their respective economies and the huge environmental problems each faces, the Indian and Chinese environmental markets are fairly modest in size relative to other industrial nations. If current trends are maintained, however, those environmental markets are on the verge of rapid growth.

There are also promising opportunities in Taiwan, Hong Kong, South Korea, Thailand, Malaysia and Singapore. Even Vietnam is beginning to emerge from two decades of economic isolation and is searching for the means of dealing with the serious environmental problems it must face.

Many of these Asian opportunities can be financed privately or through international financial institutions and regional development banks such as the Asian Development Bank. Because local environmental industries remain underdeveloped, demand for external suppliers is bound to get stronger, and this offers an opportunity, though a highly competitive one, for Canadian environmental companies willing to spend the time developing a position in these markets.

a. India

In the words of one observer, India's pollution and environmental degradation have reached *"alarming dimensions"* due to poverty, deforestation and haphazard urban and industrial development.[29] The Indian Science Congress has estimated that 50 percent of the country's 304 million hectares are subject to ecological degradation and that 14 major rivers are severely polluted, including the Ganges, which provides nearly 85 percent of the country's drinking water. The effects of environmental degradation on the human population are such that in 1981, again according to the Indian Science Congress, over 80 percent of all hospital patients in India were the victims of some form of environmental pollution.[30] The total Indian market for pollution control equipment in 1990 was estimated at US $400 million, of which imports accounted for approximately 20 percent. About 45 percent of the demand for pollution control equipment in India comes from the electric power and chemical sectors. Indian environmental equipment markets are projected to grow by 25 to 30 percent annually in the next few years.[31] According to the Globe Foundation of Canada, the Indian market for environmental products and services could increase to approximately US $1 billion annually by the end of the decade.[32]

Most of the environmental equipment used in India is manufactured locally by Indian firms, a number of which are affiliated with U.S., Swedish and German suppliers through licensing or partnership arrangements. British, Japanese and Swiss suppliers are also active in the Indian market. Canadian companies, however, have yet to make any significant inroads into this expanding market, though the Canadian environmental industry has the capacity to provide India with a wide range of competitive services and technologies notably in the area of clean production technologies and water and waste management.

b. China

China suffers from a variety of environmental problems, most caused by half a century of rapid and intensive industrialization. Many of China's rivers are seriously polluted, the land is subject to erosion or desertification and atmospheric pollution is a serious problem in most urban areas.

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29 H. Govind, "Recent Developments in Environmental Protection in India: Pollution Control," *Ambio*, 18 (1989), pp. 429-433.

30 Indian Science Congress, "Report of the 68th Session, 1981," quoted in H. Govind, "Recent Developments," pp. 429-433.

31 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment*, p. 113.

32 J. Wiebe, Comments delivered during the panel discussion on "How to be Effective in International Markets," held during the First National Conference of the Canadian Environment Industries Association (CEIA), *Towards a Sustainable/Competitive Environment Industry*, Ottawa (March 28-29, 1995).

The severity of China's environmental situation is compounded by the fact that Chinese authorities have only recently publicly recognized the scope of the crisis affecting the country. Government recognition of China's environmental problems as well as a combination of international pressure and financial support (notably from the World Bank) have caused a significant increase in the demand for environmental products and services in the 1990s.

China's Eighth Five-Year Plan for 1991-1995 allocated about US $15 billion for environmental protection, roughly double the amount in the 1986-1990 Plan. The government goal is for state spending on the environment to reach 0.85 percent of GDP in 1995, an amount that, according to Canada's Department of Foreign Affairs and International Trade (DFAIT), is still insufficient to deal adequately with China's environmental problems.[33] The major focus of the Eighth Five-Year Plan is to counter the effects of years of under-investment in pollution abatement facilities, especially in the area of water pollution. Another priority is air pollution, especially the reduction of emissions from coal-burning facilities through fuel substitution and the improvement of heating system efficiency, as well as "end-of-pipe" emission controls. Japan has already targeted part of its Green Aid for leasing or adaptation of technologies used in flue gas desulphurization at Chinese power plants. American clean coal technologies might also meet some of China's needs.[34]

China invests large amounts to maintain water quality. This is an area of crucial importance to its growing population, but it is also one where the country's needs in terms of equipment and instrumentation have been barely addressed. The Chinese market for equipment and instruments relating to the control, alleviation or prevention of water pollution was estimated to be US $433 million in 1991, with imports accounting for about US $50 million. Among the chief foreign suppliers of this market were Japan (40 percent), Austria (25 percent) and the United States (8 percent).

China has few landfills or incinerators that can meet industrial country standards for environmental protection. As a result, there is an acute need for solid and hazardous waste handling and disposal technology, which is the third environmental priority of the current Five-Year Plan.[35]

Canadian firms have made some inroads into China and now account for 2.4 percent of the country's market for air pollution equipment and 7.9 percent of the country's water pollution abatement market.[36] One Canadian firm that has done well in China is Controls Ltd., based in Surrey, British Columbia. It has sold its water and wastewater treatment technology to the Wuhan City Water Corporation in Hubei Province.[37]

As in India, an indigenous environmental industry is developing in China, and, according to Chinese authorities, there are more than 4,000 Chinese environmental companies with an estimated output of approximately US $1 billion annually. However, while the domestic industry can meet about 80 percent of demand, it is unable to supply the more sophisticated equipment many end users prefer. As a result, Chinese environmental industry officials are actively seeking foreign investment. Canadian environmental companies possess significant strengths in the areas that meet China's needs, especially solid and hazardous waste management, water and wastewater management, materials recovery and recycling and atmospheric pollution prevention. Although the short-term prospects for Canada's environmental industries may be limited by factors relating to China's internal reform and development, the medium- and long-term prospects are much brighter.

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33 External Affairs and International Trade Canada, *Study on China's Market*, p. xvii.

34 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment*, p. 113.

35 *Ibid.*

36 External Affairs and International Trade Canada, *Study on China's Market*, p. xxi.

37 Province of British Columbia, Environmental Technologies, British Columbia, Canada (Victoria, 1994), p. 6.

c. South Korea

The South Korean Ministry of the Environment undertook a US $10.5 billion, five-year program of public and private environmental investment from 1991 to 1995. The plan included large allocations for sulphur dioxide controls, waste landfills, incinerators, wastewater treatment and a cleaner fuel infrastructure that includes liquefied natural gas facilities. A total of 34 sanitary landfills may be built over the next two decades.

In 1991, South Korean businesses spent about US $732 million on pollution control facilities. Of this, US $375 million was for the water sector, US $314 million for air quality and US $37 million for noise abatement. US $181 million of environmental products and services were imported by South Korea in 1991, with the U.S. share accounting for 14 percent. With stricter air and water pollution standards coming into effect in 1995-1996, environmental investments could grow from US $1.25 billion in 1992 to US $4.5 billion by the year 2000, according to sources from South Korea's Energy and Resources Ministry. Requirements for catalytic converters in new automobiles will create large markets.

d. Taiwan

Taiwan's Six-Year National Development Plan for 1992-1997 lists 68 projects worth US $10.7 billion that are under the partial or complete control of the Taiwan Environmental Protection Administration or local environmental agencies.

Taiwan's environmental market was US $907 million in 1991, 68 percent of which was imports. The United States exported US $210 million worth of goods and services.

e. Other East Asian Markets

Other Asian countries, especially Association of Southeast Asian Nations (ASEAN) member countries, have experienced rapid economic growth and industrialization, which have created significant opportunities for the provision of both traditional environmental products and cleaner industrial and energy technologies. One estimate suggests that the 1993 aggregate ASEAN environmental market totalled about US $1.8 billion.[38]

Hong Kong has emphasized landfills and sewage treatment. Browning-Ferris Industries (U.S.), for example, was awarded a joint venture contract valued at US $400 million over 25 years to build and operate a landfill in Hong Kong. A US $15 billion sewerage infrastructure program is in progress, with extensive British business involvement. Hazardous wastes are also a growing concern in this rapidly industrializing region. Hong Kong, Singapore and Indonesia have integrated hazardous waste facilities in operation or under development by Waste Management International, a subsidiary of WMX Technologies from the United States, and Malaysia has recently awarded a contract for such a facility to I. Kruger of Denmark.[39]

Water and wastewater treatment, including industrial effluent treatment, are priorities throughout the ASEAN countries. River water is often highly polluted; sewerage service and safe tap water are often unavailable. Oil and chemical spills are another issue in this region because of a high concentration of petroleum production and refining facilities. The World Bank and the Asian Development Bank have financed more than US $2.5 billion of urban water and wastewater projects in Indonesia, although in 1992 the country had spent only about US $23 million on water pollution control equipment. Malaysia's 1991-1995 development plan allocated over US $1.5 billion for water resources, of which about a quarter was for sewerage and urban drainage.

Air emissions are also of growing concern. Clean coal and other cleaner energy technologies are important features in Thailand's environment and development plans. The Thai government recently awarded contracts for large flue-gas desulphurization equipment to Japanese suppliers and for gas turbine power plants to U.S. companies. Both are examples of the significant energy and air quality business opportunities in the area. Vehicle emissions are becoming more problematic, and it is not unreasonable to believe that other nations in the region will follow Singapore, South Korea and Taiwan in adopting cleaner standards for motor fuels and vehicles.

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[38] U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment*, p. 113.

[39] *Ibid.*, p. 114.

8. Near East

Environmental protection is becoming important in the Near East as human populations, industrial activity and agricultural production increase in scale and concentration. In most countries of the region, environmental regulations are still at an early stage of development.

Water quality is the major environmental concern in the region. In Egypt, 90 percent of effluents are untreated. In Morocco, 20 percent of the 1988-1992 National Investment Budget was dedicated to sanitation. Efficient water use and wastewater recycling are also important components of Israeli environmental practices: 66 percent of treated sewage is reused for irrigation. Drip irrigation apparatus is employed to minimize the spread of waterborne pathogens.[40]

Waste management is a public health issue particularly in urban areas. The OTA reports that greater Cairo has landfill and composting capacity to handle only 22 percent of the wastes generated. In smaller Egyptian cities, most wastes are not even collected. Turkey reportedly has no modern landfill or waste incineration capacity. With growing industrial production, the lack of hazardous waste treatment and disposal capability is also an issue. Finally, air pollution is a major concern in urban areas as industry, motorized transport and electric power generation increase.[41]

INTERNATIONAL FINANCING FOR ENVIRONMENTAL PROJECTS

Financing or other forms of assistance for Canadian companies seeking to export their environmental products or services is available from a variety of sources, including multilateral development banks (MDBs), UN agencies, the World Bank and governments.

One of the most important international institutions in regard to the needs of the EIS is the GEF, which is the financial mechanism that provides grant and concessional funding to developing countries for projects and programs that protect the global environment. The GEF receives support from 73 participating governments and provides annual funding of US $300 to US $400 million.

The World Bank is one of the GEF's three implementing agencies, along with the United Nations Development Programme (UNDP) and UNEP. These three agencies have the complementary skills and experience needed to carry out the GEF's mandate: the World Bank is strong in economic policies and investment project work; UNDP has extensive experience in managing technical and pre-investment assistance; and UNEP has led the effort to conclude international agreements on the environment, which complements its role in disseminating information on technological developments. World Bank staff manage GEF projects.

The GEF covers the "incremental cost" of a project undertaken with global environmental objectives. Grants support investments, technical assistance and research related to climate change, ozone depletion, pollution in international waters and biodiversity. This United Nations/World Bank program was made permanent in 1994 following its $1.3 billion, 1991-1993 pilot program.

The GEF funds projects, or components of projects in developing countries that might have important global benefits but do not generate a high enough rate of return based on a strictly national perspective.

> *While the industrial countries still cause the bulk of today's global pollution, growth and industrialization in developing countries place increasing demands on the earth's resources and, in the absence of suitable measures, will contribute an increasing share of global pollution. The GEF provides a mechanism through which industrialized and developing countries can work together as partners to address global environmental issues.*[42]

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40 *Ibid.*, pp. 114-115.

41 *Ibid.*

42 J. Kur, "Canadian Business Briefing: Opportunities in Projects Financed by the World Bank and the Inter-American Development Bank," presentation to the 1994 *Environment and Energy Conference of Ontario*, Toronto (November 16, 1994).

According to DFAIT, each GEF project is expected to cost from US $5 million to US $50 million. Most GEF projects will be processed as part of larger World Bank loans, but free-standing GEF projects of less than US $10 million will be considered. Projects in any developing country with a Gross National Product (GNP) per capita of US $4,000 or less are potentially eligible for GEF funding.

The GEF focuses on the following environmental problems:

- global warming, particularly the effects on the world's climate from greenhouse gas emissions resulting from the use of fossil fuels and the destruction of carbon-sequestering forests;
- destruction of biological diversity through the degradation of natural habitats and the overuse of natural resources;
- pollution of international waters and the accumulation of wastes in oceans, seas and international river systems; and
- depletion of stratospheric ozone from emissions of CFCs, halons and other gases.

The GEF is only one of a large number of international institutions that provide financing for environmental projects (see box: Selected Financing Sources for Environmental Projects). MDBs also present important business opportunities through their lending, insurance and equity operations.

Between 1984 and 1990, Canada contributed US $1.245 billion to the World Bank. Over the same period, the World Bank procured Canadian goods and services worth US $1.420 billion — a return on investment over the six years of 14 percent. In 1992, Canada's procurement rate with the Inter-American Development Bank (IDB) was even better, with an 8.33 percent annual return on investment. Overall, in 1992, for every dollar contributed by the Canadian International Development Agency (CIDA) to the MDBs, the banks spent 83 cents in Canada. New strategies are being developed to achieve an even greater share of procurement for Canada.[43]

Selected Financing Sources for Environmental Projects

International Finance Corporation (IFC)
International Bank for Reconstruction and Development (IBRD)
Inter-American Development Bank (IDB)
Inter-American Investment Corporation (IIC)
United Nations Development Programme (UNDP)
European Bank for Reconstruction and Development (EBRD)
European Investment Bank (EIB)
Asian Development Bank (ADB)
African Development Bank (AFDB)
Nordic Investment Bank (NIB)
Nordic Environment Finance Corporation (NEFCO)
Industrialization Fund for Developing Countries (IFU) — Denmark
Finnish Fund for Industrial Development Cooperation (FINNFUND) — Finland
Banque Française du Commerce Extérieur (BFCE) — France
German Finance Company for Investments in Developing Countries (DEG) — Germany
Finanziaria Meridionalo S.p.A. — Italy
Overseas Economic Cooperation Fund (OECF) — Japan
Netherlands Development Finance Company (FMO) — The Netherlands
Swedish Fund for Industrial Cooperation with Developing Countries (SWEDFUND) — Sweden
Commonwealth Development Corporation (CDC) — United Kingdom
Overseas Private Investment Corporation (OPIC) — United States
Agency for International Development (AID) — United States

From, J. Kur, "Canadian Business Briefing: Opportunities in Projects Financed by the World Bank and the Inter-American Development Bank," presentation to the 1994 *Environment and Energy Conference of Ontario*, Toronto (November 16, 1994).

[43] Canadian International Development Agency (CIDA), *CIDA and the Multilateral Development Banks* (Hull: CIDA , 1994); Environment Canada and Industry Canada, *Consultation Paper*, p. 5.

The IDB has established a series of environmental priorities, including:

- the provision of essential public services, together with the prevention and reduction of air and water pollution, especially in urban areas;
- the improvement and rehabilitation of productive ecosystems through the reduction of soil losses and improving the quality and efficient use of water;
- the promotion of sustainable use of natural forests and coastal and fishery resources to ensure conservation;
- the management and conservation of the region's natural heritage, with special emphasis on the biodiversity of tropical rain forests; and
- the conservation of the natural and cultural heritage of indigenous peoples.

Canadian firms seeking financing or other types of export assistance can also contact a number of Canadian government agencies for support, including:

- the Canada Business Service Centres (CBSCs);
- the Canadian Commercial Corporation (CCC);
- CIDA;
- DFAIT;
- the Export Development Corporation (EDC); and
- the Federal Business Development Bank (FBDB).

In addition, companies can get in touch with various provincial government trade departments as well as with industry associations such as the Canadian Exporters' Association (CEA).

The Inter-American Development Bank (IDB)

- largest regional MDB
- promotes investment of public and private capital in Latin America and the Caribbean to accelerate economic and social development
- composed of 46 member countries, of which 26 are borrowers
- majority of voting power rests with borrowing members, and the President is always from Latin America
- employs approximately 1,700 people
- maintains an office in each borrowing member country
- co-finances 10 to 15 projects per year with the World Bank

From, J. Kur, "Canadian Business Briefing: Opportunities in Projects Financed by the World Bank and the Inter-American Development Bank," presentation to the 1994 *Environment and Energy Conference of Ontario*, Toronto (November 16, 1994).

CANADA'S POSITION IN GLOBAL MARKETS

The pursuit of global markets is a matter of resources and scale. Because Canada's largest environmental firms are small by world standards, they must find allies and partners to support their efforts if they are to succeed internationally.

A number of business networks and alliances have already come into existence in response to the needs of individual firms in order to penetrate global markets more effectively. One major advantage inherent in these networks lies in the fact that companies can offer a more complete product line by including complementary firms in their area of specialization. A second major advantage is reflected in the synergies that emerge from alliances between services/engineering firms and technology-providing manufacturers.

Together, such partnerships can use their complementary strengths to pursue larger projects. Facilitative support has already been requested from governments for activities such as setting up

sales offices abroad to provide a presence in the target markets for accelerated entry.[44] One of the greatest challenges facing the Canadian EIS remains the need to concentrate on technologies that will position it to take advantage of current and emerging market opportunities and to develop the domestic and international partnerships that will permit Canadian companies to compete more effectively against larger rivals.

Canada's International Institute for Sustainable Development (IISD) identifies four generations of environmental technology. The first generation involves **remediation technologies,** which deal with environmental damage largely after the fact.

The second generation concentrates on **pollution abatement,** or so-called "end-of-pipe" solutions, which capture or treat pollutants before release but do not necessarily eliminate waste streams. The third generation is **pollution prevention technologies,** which, by industrial process design or product design or composition, reduce or prevent pollution and which are more cost-effective than pollution abatement technology. The fourth and most advanced generation focuses on **sustainable technologies** that provide alternative products or services, providing multiple benefits of an environmental/economic/social nature.[45]

In the short term, the most attractive markets for Canadian goods and services are found in countries playing catch-up with their more economically or environmentally advanced neighbours. For the most part, these markets require first- and second-generation technologies – that is to say, products and services designed to remediate or abate pollution. Eventually, though, these markets will require more sophisticated means of dealing with their environmental problems. Many developing countries may simply proceed to third- and fourth-generation technologies, bypassing pollution remediation and abatement technologies entirely.

Another way of looking at technological competitiveness is through the concept of critical technologies. There are strong linkages between the development of critical technologies and environmental concerns.

Critical Technologies and Applications Related to Environmental Technologies or Concerns

Energy capture	Photovoltaics Geothermal sources of energy Solar geothermal electricity
Energy storage and application	Batteries Superconductors Hydrogen storage Heat storage Fuel cells
Special energy end uses	Transportation Heating, cooling and lighting of buildings
Agricultural biotechnology	Bioremediation Biosensing Gene-transfer techniques
Improved agricultural techniques	Alternative agriculture Precision agriculture
Manufacturing monitoring, modelling and control	Plant siting Sensors Chemometrics Supramolecular assembly
Catalysis	Catalysts to improve product yield and reduce or prevent pollution
Separations	New and more effective distillation, drying, degreasing and evaporation techniques
Precision fabrication	
Materials design and processing	New ceramics, polymers and composites

From, G.R. Heaton *et al., Backs to the Future: U.S. Government Policy Toward Environmentally Critical Technology* (Washington, D.C.: World Resources Institute, June 1992), pp. 9-16.

44 Environment Canada and Industry Canada, *Consultation Paper*, p. 5.

45 International Institute for Sustainable Development (IISD), *EarthEnterprise Tool Kit – Markets, Technology, Financing, New Business Practices* (Winnipeg: IISD, October 1994).

Table 3-8 Acknowledged and Emerging Strengths of the Environmental Industry

ACKNOWLEDGED STRENGTHS	EMERGING STRENGTHS
Waste management	Laidlaw; Philip Environmental
Hazardous wastes treatment	Groupe Sani Mobile; Agglo recovery
Wastewater treatment technology	The Wastewater Technology Centre/RockCliffe Research Management; ADI Systems
Photo-oxidation (UV) technology	Solarchem; Trojan Technologies
Hydrogeology	Golder Associates; The Waterloo Groundwater Research Institute
Reverse osmosis/ultrafiltration	Zenon Environmental; Eco-Tec
Air pollution control	Turbotek Technologies; Rowan; Williams; Davies & Irwin
Recycling	Shannon Energy; ORTECH International
Consulting and engineering	Gore & Storrie; Proctor and Redfern
Analytical testing	Environmental Protection Laboratory; Mann Testing Laboratories
CFC recovery	Halozone; CFC Tek
Site remediation	Beak Environmental; HBT Agra
TQEM, environmental audits	KPMG Environmental; AT Kearney
Environmental health and safety	Pollutech; Altech Environmental
Advanced biological treatment	Boojum Research; The Natural Environmental Company
Energy alternatives/efficiency	Electrolyser Corporation; Battery Technologies Inc.

Source: J. Higgins, "Global Environmental Industry," *Ecodecision* 11 (January 1994), p. 21.

> *If environmental technology is segregated and regarded narrowly as remediation and pollution treatment equipment, environmental concerns will inevitably be neglected in the promotion of critical technologies, and the potential of many emerging technologies for environmental improvement will be overlooked.*[46]

Many Canadian companies have developed leading-edge environmental technologies, especially in water and wastewater treatment systems, handling liquid and solid wastes and providing incinerators, shredders, compactors and refuse recycling equipment. Capabilities cover the construction of large pollution prevention and control systems as well as the manufacture of components such as pumps, filters, valves and chemicals.

In his overview of the Canadian environmental industry, James Higgins provides a breakdown of the areas where the Canadian EIS possesses acknowledged advantages and where it is developing new strengths (see Table 3-8).

Canada's many demonstrated strengths can be used to develop an unassailable position in the global market for environmental goods and services. One example of Canadian global leadership in environmental protection is offered

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[46] G.R. Heaton *et al., Backs to the Future: U.S. Government Policy Toward Environmentally Critical Technology* (Washington, D.C.: World Resources Institute, June 1992), p. 1.

by Blue Bottle Technology. It responds to the challenge posed by CFCs, the human-made compounds that deplete the ozone layer in the stratosphere, causing an environmental problem of growing international attention.

Blue Bottle is an advanced absorption technology with worldwide patent protection. It was developed to reduce CFC, hydrochlorofluorocarbon (HCFC) and hydrofluorocarbon (HFC) emissions through recapture. It was also designed to provide the highest possible reclamation yield of high-purity product suitable for direct re-use without chemical breakdown.

Blue Bottle Technology uses portable, non-pressurized steel cylinders, packed with Halozite, a patented absorbent that selectively captures halogenated hydrocarbons such as CFCs, HCFCs and HFCs. The cylinders are effective in recovering refrigerants from automotive air conditioners and residential, commercial and large-scale refrigeration and air-conditioning units. The filled Blue Bottle Cylinders are reprocessed at a reclamation facility where the pure reclaimed refrigerant and the "purged" Blue Bottle Cylinders are available for re-use.

Another Canadian company on the global leading edge is Zimmark Inc. of Burlington, Ontario, which developed the continent's first on-site oil recovery system. Lubricating oil is an excellent candidate for recycling, as its lubricating properties do not disappear with time. Some 900 million litres are produced in Canada each year, about half of which is consumed in first-time use. Most of the other half could be used again, but only 22 percent of this oil is actually recycled. The remaining 380 million litres are burned, sprayed on gravel roads, ploughed into landfills or illegally flushed down sewers.

The high cost of collecting and refining the oil has meant that a technology for removing contaminants has seen only limited use. Now, with support from the Canada Centre for Mineral and Energy Technology (CANMET), Zimmark has discovered an on-site way to produce a higher-quality oil and reduce the processing time. Zimmark has made a dozen sales to railway companies in Canada and the United States, as well as to Hong Kong, China and Malaysia.[47]

Canadian companies have also entered into partnerships to develop new environmental products. The FuelMaker Corporation of Vancouver, British Columbia, was formed in 1989 to manufacture and market the FuelMaker appliance, a personal-use refuelling system for natural gas vehicles. FuelMaker is the successful result of the partnership of three major companies: Sulzer Brothers Ltd. of Switzerland, Questar Development of the United States and Canadian BC Gas Inc. Natural gas currently offers one of the most promising and effective methods of reducing vehicular emissions. Using advanced plastic and ceramic technology, the FuelMaker appliance is designed for oil-free lubrication. The appliance can accommodate the high ambient temperatures of Australia or the diverse climate of Canada and still operate reliably. FuelMaker Corporation's clients include British Gas, Gaz de France and many natural gas distribution utility companies in the United States.[48]

Despite the many successes of Canadian companies in developing environmental technologies and products for the global market, the international market is evolving rapidly. Canada's EIS will have to respond to remain competitive, and this does not just mean vis-à-vis the United States. Japan and Germany are likely to displace the United States as the world's leading suppliers of environmental products and services:

> *.... the U.S. has neither a national technology commercialization program like Japan's nor the stringent environmental regulations such as those enacted in Germany that would stimulate new technologies by creating markets for them.*[49]

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47 Energy, Mines and Resources Canada (EMR), Canada Centre for Mineral and Energy Technology, "Zimmark Develops the Continent's First On-Site Oil Recovery System," *CANMET: Supporting Environmental Technologies for New Markets (Factsheet)* (Ottawa: EMR, 1993).

48 Province of British Columbia, *Environmental Technologies, British Columbia, Canada* (Victoria, 1994), p. 60.

49 Miller and Moore, *Green Gold*, p. 194.

Air pollution limits on power plants and factories in Japan, Germany and many other industrialized nations are two to four times as stringent as in the United States The slower U.S. response to environmental problems is posing a threat to that country's long-term viability as a leading industrial power.[50] Ultimately, it will have no choice but to adapt to new environmental and technological imperatives.

The contrast between German and Japanese experience of government-corporate cooperation in developing strict environmental codes and American practices, which are now moving toward lower standards, deserves careful reflection. Canada must remain flexible in its approach to ensure that its response does not jeopardize the development of its own EIS. The challenges posed by technological and environmental change must be met with creativity and innovation: traditional approaches no longer suffice. Many Canadian companies display the vision and technical skills required to meet these challenges. There are still relatively few of them, and they need encouragement and support in their efforts to claim a share of the global environmental market. Such companies form the foundations for Canada's future international competitiveness.

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50 *Ibid.*

Chapter 4 — The Canadian Environmental Industry Sector

CANADA'S NEWEST SECTOR — HOW DOES IT STACK UP?

1. Introduction

The environmental industry sector (EIS) in Canada is large and growing rapidly. Current estimates by Industry Canada suggest that the sector contains 4,500 firms employing 150,000 workers with annual sales of $11 billion. One third of these firms are manufacturers and account for annual sales of $6 billion, while two thirds are service providers with total annual sales of $5 billion (Table 4-1). Much of the industry is located in the urban areas of Ontario and Quebec, with significant additional clusters in British Columbia and Alberta.

It is estimated that the industry has been growing at a rate of 6 percent a year or about three times the rate of the Canadian economy. It is largely an "enabling" sector, which provides expertise, technologies and services to meet the environmental needs of the traditional industrial sectors. With expectations that the Canadian market will grow at about 10 percent annually over the next five years, the challenge will be for the sector to expand to meet anticipated demand.[1]

In terms of employment, the environmental industry is the third largest in Canada. In 1992, only the chemical industry and pulp and paper mills were reported to have more employees, while upstream oil and gas, textiles and forestry ranked lower than environment in level of employment.[2] A large proportion of jobs are knowledge and science-based, with output per worker valued at $130,000, some 25 percent higher than the average for the manufacturing sector as a whole.[3]

Table 4-1 The Canadian Environmental Sector in the 1990s

	DOYLETECH 1992	ERNST & YOUNG 1992	INDUSTRY CANADA 1994
Total sales ($ billions)	$6.1	$6-8	$11
Total number of firms	3,000	3,000	4,500
Percentage of firms in manufacturing	33.3	25	33.3
Manufacturing sales ($ billions)	$4.35	$1.5-2.0	$6.0
Percentage of firms in services	66.6	75	66.6
Service sales ($ billions)	$1.8	$4.5-6.0	$5.0

Sources: D.J. Doyle, *Building a Stronger Environmental Technology Exploitation Capability in Canada,* prepared for Environment Canada and Industry, Science and Technology Canada (Kanata, Ontario: Doyletech Corporation, July 1992), p. 94; Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), p. 79; and Industry Canada and Environment Canada, *Environmental Industry Strategy for Canada, an Interdepartmental Consultation Paper* (Ottawa: Industry Canada and Environment Canada, January 1994), p. 5.

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1 Industry Canada and Environment Canada, *Environmental Industry Strategy for Canada, an Interdepartmental Consultation Paper* (Ottawa: Industry Canada and Environment Canada, January 1994), p. 4.

2 Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), p. 79.

3 Department of Foreign Affairs and International Trade (DFAIT) and Industry Canada, *Environmental Equipment and Services: International Trade Business Plan 1995/96* (Ottawa: Minister of Supply and Services Canada, 1995), p. 3.

The EIS is largely composed of small and medium-sized businesses (SMEs). The size of these firms varies, with some representing individual consultants and others employing more than 1,000 people. Average firm size differs by region. It is five employees in Atlantic Canada and 34 in Ontario. Most of the companies are very small (fewer than 50 employees) and generate revenues of less than $5 million per year. There are only a few large players in the sector, and even the largest, such as Philip Environmental, do not provide the full range of services offered by major international competitors.

It is a young dynamic industry, hardly more than a decade old, with a high proportion of firms that were created within the last five years. Entry into the service part of the sector is relatively easy, especially for consultants and software companies that require little start-up capital. Because much of the industry is technology-based, and these technologies are created to meet highly diverse and changing markets, the sector is in a constant state of renewal and consolidation.

Research and development (R&D) activity is critical to the development of new technologies, and some firms perform a large amount of it. While private-sector R&D performance in the environmental industry is higher than the average for all companies in Canada, it is low compared to other industrialized countries. Shortage of capital for research, development and commercialization is a chronic problem for most of these Canadian companies.

Because many of the firms are small, they lack the ability to upgrade or create new technologies that would allow them to take advantage of growing domestic and international markets. The most successful companies in the sector are those that have captured international niche markets. Even so, many are still not large enough to satisfy Canada's domestic environmental requirements.

2. Who Belongs in the Environmental Industry Sector?

There is a lack of detailed data on the EIS. Those that exist do little more than provide an indication of the scope of environmental business carried out in Canada. The problem arises from the nature of the industry itself. It is new, growing, driven by changing technologies, expanding into new areas and evolving as environmental considerations are gradually integrated into all aspects of the production process.

The "environmental sector" has so far eluded efforts to settle on a firm definition. It is generally agreed that it includes two distinct parts — manufacturing and services — though even these distinctions are far from clear. Technically, it is difficult to determine when engineering or auditing activities are environmental or in what circumstances equipment, such as copper piping, becomes an environmental product (i.e., a condenser). Should the industry include, for example, weather monitoring buoys or spraying equipment that reduces the amount of pesticide used on agricultural crops? Both these items are listed in provincial environmental business directories, even though their "environmental" focus may be questioned.

Further complicating the issue is the trend toward pollution prevention. This frequently involves changes in manufacturing processes that reduce or eliminate pollutants or conserve energy. Such changes, which are often made for economic reasons, form an integral part of plant modernization and, while important environmentally, may not be included in the environmental sector.

Many jurisdictions are also anxious to promote their environmental industries and broaden the term to include all products sold to an environmentally sensitive facility or to a municipal facility such as a wastewater treatment plant.[4] Ontario, for example, refers to its "broader green industry market" and estimates its value to have been between $6.8 and $10.4 billion in 1992, yet that figure is close to the total current estimate of $11 billion for the industry in all of Canada.[5]

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4 D.J. Doyle, *Building a Stronger Environmental Technology Exploitation Capability in Canada*, prepared for Environment Canada and Industry, Science and Technology Canada (Kanata: Doyletech Corporation, July 1992), p. 94.

5 Green Industry Ministerial Advisory Committee (GIMAC), *Green Industry Sector Strategy for Ontario* (Toronto: Ministry of Environment and Energy, April 1994), p. 6.

Efforts are under way to develop a standard definition of the EIS. At the international level, the Organisation for Economic Co-operation and Development (OECD) is currently working on a definition and expects to complete its deliberations in 1996. In Canada, Statistics Canada is working with Industry Canada to complete a breakdown of the sector into its components. It is expected that by mid-1997 data on the domestic market and the industry will be available.

In the early 1990s, the Department of Industry, Science and Technology developed a detailed industry definition that divides the sector into two parts, manufacturing and services. Each of these sectors contained the following subsectors:

MANUFACTURING	SERVICES
Water pollution control	Waste handling and environmental facility operation
Air pollution control	Consultant services
Solid waste management	Environmental pollution assessment and control
Measuring and monitoring and control instruments	Laboratory services and related field services
Scientific, research and laboratory equipment	Environmental research
Chemicals for pollution control	Natural resource conservation and protection
Noise control	

The preceding definition has served as the basis for a number of studies of the industry conducted in the 1990s. Of particular importance at the national level are the study of *Human Resources in the Environment Industry* prepared for Employment and Immigration Canada by Ernst and Young in 1993 and two studies prepared for Industry Canada by Doyletech Corporation, *Building a Stronger Environmental Technology Exploitation Capability in Canada* (1992) and *An Analysis of Canada's Supply Capability in Terms of Environmental Products* (1994).

These studies provide the only national data on the sector, but the numbers vary considerably. For example, the 1994 Doyletech study used a restricted definition and a new methodology for defining the manufacturing segment of the sector. The data included in the following sections of this chapter rely heavily on these studies, but because of the variations and "softness" of some of the data, percentages are used wherever appropriate.

3. Some Basic Data

a. Size of the Sector

Water and wastewater treatment equipment dominate the manufacturing sector, accounting for close to 60 percent of total revenues (Table 4-2).[6] In the services segment, waste handling and environmental facility operations were estimated at 50 to 75 percent of revenues.[7]

Table 4-2 Manufacturing Sales by Market Segment

	WATER AND WASTE-WATER	WASTE MANAGEMENT	AIR POLLUTION CONTROLS	OTHER
Percentage of revenues	58	21	17	4
Percentage of exports	51	18	22	8

Source: Doyletech Corporation, *An Analysis of Canada's Supply Capability in Terms of Environmental Products* (Kanata, Ontario: Doyletech Corporation, May 1994), p. 28.

b. Geographic Distribution

While estimates of the magnitude of environmental industry activity by region or province vary considerably, all sources suggest that Ontario accounts for close to half of the industry (Table 4-3). In its 1993 study, *Human Resources in the Environment Industry*, Ernst and Young suggested the following levels of activity for the entire sector by province: Ontario — 40 percent; Quebec — 20 percent; the Prairies — 20 percent; British Columbia — 15 percent; and the Atlantic provinces — 5 percent. A study of manufacturing firms in the sector gives even greater prominence to Ontario and Quebec.

6 Doyletech Corporation, *An Analysis of Canada's Supply Capability in Terms of Environmental Products* (Kanata, Ontario: Doyletech Corporation, May 1994), p. 28.

7 Ernst and Young, *Human Resources*, p. 16.

Three Definitions of the Environmental Sector

Over the past decade, the definition of the sector has come to encompass the concept of sustainable development, the management and conservation of resources and the re-engineering of industrial processes to improve their efficiency and to reduce the production of pollutants. In the Strategy Consultation Paper, "environmental industry" refers to the technologies and the processes, products and services that:

- monitor and assess pollutants and waste streams;
- prevent pollution by minimizing or eliminating wastes through process re-engineering;
- control pollution, often through a single-medium or end-of-pipe solution; and
- clean up and restore degraded environments.

From, Industry Canada and Environment Canada, *Environmental Industry Strategy for Canada, an Interdepartmental Consultation Paper* (Ottawa: Industry Canada and Environment Canada, January 1994), p. 4.

The Green Industry Sector is composed of companies whose primary source of revenue is derived from delivering environmental solutions to others. Green industry refers to technologies, goods and services that promote:

- environmental protection;
- water and energy conservation/efficiency, waste reduction/reuse/recycling (3Rs), remediation; and
- pollution prevention.

Green industries provide solutions, through innovative technologies and re-engineered industry processes, to global and local environmental threats such as climate change and diminishing clean water supplies.

From, Green Industry Ministerial Advisory Committee (GIMAC), *Green Industry Sector Strategy for Ontario* (Toronto: Ministry of Environment and Energy, April 1994), p. 6.

The environmental industry "*encompasses businesses whose products and services contribute to the sustainable use and management of our land, air and water resources.*"

From, Sentar Consultants, *Western Provinces Environmental Industries Business Development Study, Main Report* (Calgary: Sentar Consultants, January 1993), p. 1.

Table 4-3 Regional Share of Manufacturing Firms, Revenue and Exports

	ATLANTIC	QUEBEC	ONTARIO	WESTERN REGION
Percentage of companies	5	24	45	26
Percentage of revenues	2	22	58	18
Percentage of exports	2	17	60	21

Source: Doyletech Corporation, *An Analysis of Canada's Supply Capability in Terms of Environmental Products* (Kanata, Ontario: Doyletech Corporation, May 1994), p. 26.

c. Employment

The EIS is an important employer, providing jobs for about 150,000 workers in Canada. Close to 80 percent of these workers are employed in services. Waste handling and waste facility operations accounted for the largest part of this component, followed by consulting and laboratory services, as indicated in Table 4-4.

Table 4-4 Share of Employment by Industry Segment

INDUSTRY SEGMENT	PERCENT
Waste handling	59
Manufacturing	19
Consultant services	18
Laboratory services	2
Other	2

Source: Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), p. 81.

While equipment operators and maintenance workers predominate in waste handling, scientific and technical staff are large and critical components of most other segments of the sector, reflecting the technological focus of the industry (Table 4-5). In 1993, it was estimated that the demand for technically skilled employees would amount to 2,000 to 3,000 by 1996.[8] As the demand for environmental services continues to grow, it is likely that the need for skilled workers will continue at this level for some time. Furthermore, it is estimated that between 15,000 and 20,000 technically skilled professionals performed environmental functions in non-environmental companies or for governments in 1992. The demand in this area is also expected to increase, reflecting the growing trend toward pollution prevention in many manufacturing processes.[9]

d. Exports and Imports

Exports comprised 23 percent of revenues in 1994. The U.S. market, which is primarily interested in equipment, accounted for 80 percent of this total.[10] During the past five years, the number of Canadian EIS firms that are exporting is reported to have doubled to 600, with another 1,200 considered "export-ready." These firms continue to concentrate on the U.S. market, but have also increased efforts to expand their presence in the Pacific Rim, Western Europe and Latin America. Market priorities in the United States include integrated waste and hazardous waste management, air pollution controls and site remediation.[11]

Table 4-5 Employee Classification by Industry Segment (in percent)

CLASSIFICATION	WASTE HANDLING	MANUFACTURING	CONSULTING	LABORATORIES
Scientists/engineers	9	15	40	18
Technicians/technologists	included above	24	30	59
Labour/operators	63	37	0	0
Management/administration	23	24	17	16
Other	5	0	13	7

Source: Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), pp. 83-88.

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8 Ernst and Young, *Human Resources*, p. 80.

9 *Ibid.*, p. 92.

10 Industry Canada and Environment Canada, *Environmental Industry Strategy*, p. 5.

11 Department of Foreign Affairs and International Trade and Industry Canada, *Environmental Equipment and Services*, pp. 1-4.

On the other hand, it should be recalled that more than one third of the Canadian market for environmental equipment is being supplied by imports, 80 percent of which originate in the United States. As a result, Canada runs an environmental trade deficit of close to $1 billion.[12]

In 1992, import penetration of various subsegments of the environmental market was estimated to range from 62 percent for air pollution control and monitoring to 18 percent for waste management. In Canada's most important subsector, water and wastewater treatment, imports accounted for 35 percent of the Canadian market (Table 4-6).[13]

Table 4-6 Imports as a Share of Canadian Market Demand

MAJOR SUBSECTOR ACTIVITY	MARKET VALUE ($ billions)	IMPORTED (percent)
Water & wastewater treatment	2.6	35
Waste management	1.2	18
Air pollution control/monitoring	0.8	62
Other	0.7	46
Total	5.3	40

Source: Doyletech Corporation, *An Analysis of Canada's Supply Capability in Terms of Environmental Products* (Kanata, Ontario: Doyletech Corporation, May 1994), p. 13.

KEY ENVIRONMENTAL INDUSTRY SUBSECTORS

In this section, seven areas of activity are identified, defined and described. These are all areas where Canada has developed, or has the potential to develop, considerable industrial strength. These include the three traditional subsectors of water and wastewater treatment, waste (solid and hazardous) management and air pollution control. In addition, there are four "cross-cutting" subsectors, which impact on the three traditional areas and can also overlap with one another. These are environmental services; biotechnology; remediation and restoration; and information systems, monitoring and instrumentation.

1. Water and Wastewater Management

This subsector includes all equipment, technologies, products and services relating to water and wastewater treatment. A large part of the demand for water pollution control equipment is driven by municipal governments under provincial legislation, but typical end users also include large corporations in industries such as pulp and paper, chemical manufacturing, mining and oil and gas. This mature subsector is backed by a strong research and engineering infrastructure.

Half of the manufacturing firms in the EIS supply water pollution control products, from aerators to filtration plants.[14] In Canada, $2.5 to $3.1 billion is spent annually in water and wastewater treatment, $1.7 to $1.9 billion of it by municipalities and the balance by industries. In addition, about 48 percent of the market for environmental technologies, products and services in Canada is for water and wastewater treatment. Worldwide, $79 billion is spent annually on water and wastewater treatment.[15]

The market for treatment of industrial wastewater is expected to increase 5 to 10 percent annually.[16] Legislated rehabilitation and improvement of existing water quality control systems, particularly in British Columbia and Quebec, will generate billions of dollars in potential additional revenues. Across Canada, the pulp and paper industry is in

12 Industry Canada and Environment Canada, *Environmental Industry Strategy*, p. 6.

13 Doyletech Corporation, *An Analysis of Canada's Supply Capability*, p. 13.

14 Ernst and Young, *Human Resources*, p. 18.

15 Doyletech Corporation, *An Analysis of Canada's Supply Capability*, p. 14; Investment Canada, *Industrial Wastewater Management, Canadian Partners for Global Markets* (Ottawa: Investment Canada, undated), p. 4.

16 Investment Canada, *Industrial Wastewater Management*, p. 5.

the process of installing wastewater treatment systems to deal with organochlorine emissions in compliance with new regulations, at an estimated cost of $2 to $5 billion in capital spending.[17]

Other opportunities for growth include biological and oil/water separation systems, membrane treatment, water filtration systems for petrochemical industries and ultraviolet treatment. An increase in demand for "closed-loop system" technologies (versus "end-of-pipe" solutions) is expected in response to potential cost savings and government emphasis on pollution prevention approaches. The export market for many of these specialized technologies is already strong and will continue to grow.

Trojan Technologies Inc., London, Ontario

This is the world's leading supplier of ultraviolet (UV) light systems to disinfect effluents from wastewater treatment plants. The Trojan UV3000 System and Trojan UV4000 System were both designed and developed in-house to disinfect primary and secondary effluents. This system safely and effectively removes the need to use toxic chemical disinfectants that produce chlorinated and/or oxidation by-products. Gross sales for 1994 totalled $22.6 million, a 42.4 percent increase over the previous year. Export markets in Europe, Latin America, Australia, the Middle East, the Far East and the United States account for over 90 percent of sales. Trojan has additional offices in The Hague and California. Trojan Technologies Inc. was founded in 1976 and has 90 employees.

From, Ontario Ministry of Environment and Energy (MOEE), *Ontario's Green Industry Strategy — For a Clean Environment and a Strong Economy* (Toronto: MOEE, 1994), p. 13; and Industry Canada, *Environmental Solutions Fact Sheet: Trojan Technologies Inc.* (Ottawa: Industry Canada, Environmental Technology Commercialization Program, undated), pp. 1-4.

Gendron Lefebvre, Laval, Quebec

Gendron Lefebvre, an employer of 300, provides environmental engineering services in the areas of municipal and industrial water and wastewater treatment. Its wastewater treatment services include biological treatment; expert systems; and sludge de-watering as applied to municipal and industrial wastewaters, including pulp and paper, mining and food processing. Its potable water treatment services include carbon biological treatment and new clarification technologies. Current R&D activities are in the areas of new de-watering technologies for municipal and industrial sludges, biological activated carbon (BAC) filtration and biological filters. Revenues exceed $15 million, and markets include Canada, the United States, Madagascar, Burundi, China and Turkey.

From, Ontario Ministry of Environment and Energy (MOEE), *Ontario's Green Industry Strategy — For a Clean Environment and a Strong Economy* (Toronto: MOEE, 1994), p. 13; and Industry Canada, *Environmental Solutions Fact Sheet: Gendron Lefebvre* (Ottawa: Industry Canada, Environmental Technology Commercialization Program, undated).

2. Waste Management

The waste management subsector is the oldest and most developed of the environmental industries in Canada. It enjoys an annual growth rate of 7 to 10 percent, which is among the highest of any industry group. This subsector includes solid, hazardous and special waste management equipment and services, as well as recycling technologies and consulting. Facilities operation can also come under this umbrella. Special waste includes difficult-to-handle materials such as biomedical waste. The Canadian waste stream is made up of 57 percent industrial, commercial and institutional waste, 33 percent residential waste and 10 percent from demolition, land clearing and construction.[18]

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[17] Ernst and Young, *Human Resources*, p. 30.

[18] Investment Canada, *Solid Waste Management Industry, Canadian Partners for Global Markets* (Ottawa: Investment Canada, 1993), p. 1.

In Canada in 1990, the waste management subsector captured $1.1 to $1.5 billion of the environmental market, with municipalities constituting its biggest single group of purchasers at $400 to $600 million. Chemical manufacturing companies were the second largest market segment at $100 to $140 million. Large U.S. and Canadian firms, which have operations on both sides of the border, dominate the waste handling business. These include Laidlaw and Philip Environmental in Canada and BFI and Waste Management Inc. in the United States. The Alberta Special Waste Management Corporation (Swan Hills, Alberta) is a government-industry collaborative effort, originally managed and recently purchased by Bovar, which operates one of North America's largest hazardous waste disposal facilities.

Canada and the United States produce a total of 416 million tonnes of garbage annually as well as 186 million tonnes of hazardous waste. More stringent regulatory goals and standards are driving market opportunities in this subsector. The federal government and a majority of the provinces have set a goal of 50 percent waste reduction for the year 2000. A growing trend among municipalities is to contract out waste collection services and the operation of recycling, reduction and resource recovery programs to the private sector. Recycling programs, too, are expanding currently at the rate of 10 percent annually, as the range of materials to be resold and re-used increases.

Growth areas for equipment manufacturers are seen in incineration for volatile organic compounds (VOCs), material recovery facilities, composting processes, recycling technologies and soil cleanup (covered under the site remediation subsector). Growth in waste management consulting services is anticipated in both foreign and domestic markets as local authorities are faced with increasing garbage, a shortage of landfill sites and, in some jurisdictions, a moratorium on incinerators. Work will also increase in litigation consulting, sludge management and other management issues.

Labrie Equipment Ltd., St. Nicolas, Quebec

A manufacturer of recycling and waste collection vehicles, Labrie Equipment's key products include a hydraulic-loading recycler, a side-loading collection truck and a refuse transport trailer. It is best known for curbside recycling trucks with innovative and efficient loading systems. With sales of 300 trucks per year (27 percent in Quebec, 70 percent in the United States, 3 percent in Europe), the company has recently appointed a distributor in Asia. Its annual revenues are in excess of $20 million, and it employs 100 people.

From, Investment Canada, *Solid Waste Management Industry, Canadian Partners for Global Markets* (Ottawa: Investment Canada, 1993), p. 1.

3. Air Pollution Control

Traditionally, this subsector provided "end-of-pipe" solutions using items such as wet and dry scrubbers and filters. More recently, it has expanded rapidly in response to global concerns and international regulations regarding the depletion of atmospheric ozone, acid rain, ground-level ozone in certain areas, control of greenhouse gases and national issues such as indoor air quality resulting from tighter, more energy-efficient buildings.

Current data for air pollution control (APC) sales are restricted to equipment sales. These were estimated at $637 million in 1994,[19] with exports accounting for 22 percent of the total. APC equipment, filters and filter media, fans and exhaust systems, and instruments, detectors and monitors top the list of products sold.[20] The industry in Canada is largely controlled by foreign-owned companies, primarily from the United States.

Companies that are devoted entirely to air pollution control and prevention are very new. A recent list of 30 APC companies includes only 11 that existed prior to 1985, and many were not solely engaged in this subsector at that time.

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[19] Doyletech Corporation, *An Analysis of Canada's Supply Capability*, p. 28.

[20] *Ibid.*, p. 29.

The world APC market was estimated at US $15 billion in 1994.[21] This market is expected to grow rapidly in the wake of regulations covering atmospheric and ground-level ozone, NOx/VOCs and the anticipated follow-up to the Framework Convention on Climate Change. The U.S. market alone is forecast to reach US $44 billion by the year 2000.

The demand for monitoring and testing activities will increase in the short term; over the long term, a shift to control and clean technologies is expected. As greenhouse gas emission targets are gradually adopted, there will be a strengthening of the market for technologies that reduce or eliminate the release of carbon dioxide, methane and nitrogen oxides.

New markets are opening up with as small firms such as dry cleaners, auto-body shops and printers move to control the use of VOCs. The expanding market for indoor air quality is creating opportunities for monitoring, ventilation and filtering equipment as well as other low-pollution products to meet the needs of the estimated 42 million North American residents who are extremely sensitive to airborne contaminants. Exports are considered crucial to this industry, but lagging legislation in comparison to other countries may put Canada's companies at a competitive disadvantage.[22]

Engine Control Systems Ltd., Newmarket, Ontario

Engine Control Systems Ltd. designs and manufactures equipment to clean exhaust gas from industrial and off-road vehicles. It has developed the "CATTRAP," a particulate (soot) filter that removes 90 percent of the soot and most carcinogenic substances from the exhaust of diesel engines. Awarded Canada's 1990 Gold Trophy Award for Business Excellence in the Environmental Category, the firm has revenues of $10 million and employs 55 people: 45 in Canada, eight in the United Kingdom and two in South Africa. About 80 percent of its products are exported to markets in the United States, Europe, North and South Africa and the Middle East.

From, Department of Foreign Affairs and International Trade (DFAIT) and Industry Canada, *Clean Air Technologies, Canadian Expertise,* company insert (Ottawa: DFAIT, undated).

4. Environmental Services

Generally, this broad subsector takes in all environmental activities that do not create products. Using this definition, about 75 to 80 percent of all environmental companies provide environmental services, many connected with waste management activities. Other environmental services include construction; education and training; laboratory services; consulting services such as engineering; environmental management; environmental auditing; legal services; environmental impact assessments; natural resource conservation and protection; pollution abatement; and environmental research.

The size of businesses ranges from single consultants to large consulting and engineering firms with more than 200 employees. Public research institutions form an important part of this group, often providing strong R&D support to the industry. Training is also a growing area of activity both domestically and internationally.

Environmental services revenues were estimated to be $1.5 to $2 billion in 1992. Consultant services constituted the largest part of this market, accounting for $800 to $1,150 million in sales. With 333 firms employing between 8,000 and 14,000 people, engineering consulting firms are an important part of the environmental services sector. Highly skilled professionals such as engineers, scientists and technical staff are critical to this subsector, accounting for 70 percent of consultants and 77 percent of laboratory personnel.[23]

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21 R.W. McIlvaine, "International Environment 'Air pollution Industry'," *Emerging Clean Air Technologies and Business Opportunities, Proceedings of the First North American Conference and Exhibition,* Toronto (September 26-30, 1994), p. 34.

22 Environment Canada, *Technology Opportunities in Air Pollution Control* (Hull: Environment Canada, Clean Air Technologies Branch, August 1992), p. 2.

23 Ernst and Young, *Human Resources*, p. 16.

The subsector has many small firms, a number of which are merging or being taken over to form larger entities, which should be able to compete better on the international market. Some of the larger Canadian consulting companies, such as SNC Lavalin, AGRA Earth & Environmental, Jacques Whitford Group, Gartner Lee and Bovar-Concord, have developed strong overseas capabilities. International and domestic demand for environmental services will remain strong, particularly in the areas of national and corporate environmental management and planning, the development of international standards, impact assessment and ecosystem conservation and protection. The Convention on Biological Diversity is also expected to increase the demand for specialists in all areas of biodiversity management.

In contrast to most activity in this subsector, the laboratory services market has actually declined since 1989, when it was estimated at $130 to $180 million.[24] Optimism in the 1980s, which was fuelled by new environmental regulations, especially in Ontario, eventually led to considerable overcapacity and a severe cut in prices. By 1993, a major consolidation of the industry was under way, with several companies, such as Beak and Bovar, moving out of the business.[25]

Biothermica International Inc., Montreal, Quebec

The Biothermica thermal-chemical process engineering team has developed, manufactured and marketed a proprietary regenerative oxidation process called BIOTOX for the destruction of volatile organic compounds (VOCs) and condensable organic compounds. The destruction efficiency exceeds 98 percent and uses over 90 percent of the heat generated by the combustion of the VOCs and natural gas to preheat the gases for destruction. Its first commercial application was for asphalt roofing plants, but it is applicable for all manufacturing plants concerned about organic emissions. Biothermica has also developed and patented a stainless steel hot gas fabric for particulates that is effective up to 600°C. Its first application was in two bark-burning boilers for a pulp and paper company. The firm is part of a consortium in developing a biogas collection system and a 25 megawatt generating station at a landfill site in Montreal. Markets include Canada, the northeast United States and Mexico.

From, Department of Foreign Affairs and International Trade (DFAIT) and Industry Canada, *Clean Air Technologies, Canadian Expertise*, company insert (Ottawa: DFAIT, undated).

Gartner Lee Ltd. Markham, Ontario

Gartner Lee is a science-based consulting firm, with fully integrated in-house planning and engineering capabilities. It specializes in environmental problem solving. Incorporated in 1972, this consulting company offers a wide range of environmental services in the area of solid waste management and is recognized internationally for solving problems with complex soils, water contamination and waste management. Revenues in 1993 exceeded $10 million, with international markets in Europe, the United States, Asia and the Middle East. Gartner Lee Ltd. has grown to over 115 staff and has been noted for its human resource management practices, particularly in the areas of recruitment and in-house training.

From, Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), pp. 205-216; Investment Canada, *Solid Waste Management Industry, Canadian Partners for Global Markets* (Ottawa: Investment Canada, 1993), p. 18.

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[24] Ernst and Young, "*Competitiveness Analysis of Canada's Environmental Services Industries*," (Toronto: Ernst and Young, February 1994), pp. 50-51.

[25] C. Mahood, "Lab Business Cooling Off," *The Globe and Mail*, (December 28, 1993), pp. B5-6.

Waterloo Centre for Groundwater Research

The Waterloo Centre for Groundwater Research is a scientific facility that focuses its research activities on the development and application of scientific techniques to groundwater management. It was established in 1987 as one of seven Centres of Excellence by the Government of Ontario's Technology Fund and has become one of the leading centres for hydrogeology in North America.

Through its Industrial Associates Program, the Centre links academia and industry, providing industry with:

- knowledge and technologies from leading researchers;
- access to facilities and resources for testing;
- access to a pool of new resources developed by researchers;
- training for highly skilled scientists; and
- an international academic network for highly specialized expertise.

Industry-oriented research is directed at developing technologies that industry can either use directly in their own processes or market. The Centre also does groundwater consulting and develops marketable products and technologies such as the "Waterloo System," a unique device that obtains groundwater samples from various depths within a single borehole.

From, Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), pp. 230-241.

5. Remediation/Decommissioning

The remediation subsector involves the cleanup or rehabilitation of polluted sites such as landfills, mines, industrial complexes and leaking underground tanks; the cleanup of groundwater or soil contaminated by chemicals, fuels, heavy metals or radioactive substances; and the decommissioning of industrial facilities. Depending on the type of contamination involved, methods used in soil remediation include vapour extraction (18 percent), low-temperature thermal desorption (36 percent), bioremediation (9 percent), soil washing (3 percent) and solidification-stabilization (26 percent). The restoration of degraded environmental systems, such as watersheds, fish habitats and the renewal of depleted soils, is also part of the subsector.

Sometimes viewed as a part of waste management, the importance of remediation activities has increased as better technologies have emerged. The establishment of the U.S. Superfund program to clean up large landfills, chemical dumps and abandoned military dumps has led to a dramatic growth in this subsector in recent years, and Canadian firms have captured a portion of this expanding business.

A number of the large and diverse environmental companies such as Philip Environmental, Acres International, Golder Associates and Komex International are active in remediation in both Canada and the United States, as are some of the larger solid waste management firms. In addition, several firms in Alberta, British Columbia and Nova Scotia have developed considerable expertise in cleaning up oil sites and marine oil spills.

Leaking underground storage tanks (USTs) present a growing market for Canadian companies. Environment Canada estimates that 3 to 5 percent of the 200,000 to 250,000 USTs are leaking. In the United States, the Environmental Protection Agency (EPA) estimates that within the next 30 years, $70 to $100 billion will be spent in meeting new UST regulations.

Today, few financial institutions will fund the purchase of industrial or commercial properties without a site assessment to determine whether there is any potential environmental

contamination. This factor, plus the increasingly strict regulations regarding toxic sites and the threat of legal liability, has made this a rapidly growing industry. Because of increasing waste disposal costs, there is a strong emphasis on waste minimization in the construction and demolition industries.

Delsan Environmental Group

A good example of progress in decommissioning is offered by Delsan Environmental Group. It decommissioned the Ault Dairy site in Ottawa with 94.1 percent re-use or recycling of the materials. Asbestos and polychlorinated biphenyls (PCBs) were removed according to required procedures, equipment and tanks were sold for re-use, and metal and wood were sorted and sold for re-use or recycling. Next, the concrete and bricks were broken and pulverized, then used for backfill on the site, with the surplus given to a competitor on a nearby site. Finally, some contaminated soil was removed and shipped to a hazardous waste facility. After grading, the site was then ready for redevelopment.

From, J. Sbrolla, "Decommissioning in Ottawa," *Hazardous Materials Management* (December 1994), pp. 73-75.

6. Biotechnology

Biotechnology is the application of science and engineering through the direct or indirect use of living organisms in their natural or modified forms. The primary focus of activities in this subsector is bioremediation, in which firms apply microbial systems to break down contaminated wastes or contaminated emissions in air, water and soil.

In 1993, the industry consisted of about 70 firms, over three quarters of which were located in Ontario (42.6 percent), Quebec (23.8 percent) and British Columbia (16.7 percent). Most companies are SMEs with limited assets. Nonetheless, biotechnology is one of the most rapidly growing environmental subsectors. Between 1989 and 1993, average annual growth in sales was an astonishing 80 percent, moving from $6.4 million to $66.7 million. The workforce is small but highly specialized in scientific and engineering disciplines. It too has grown quickly to total about 1,700 experts in 1993.

Boojum Research Ltd., Toronto, Ontario

The company's mission is to develop innovative, durable and low-cost environmental management solutions based on ecological engineering and biological polishing. These provide natural solutions to decommissioning waste management areas in the mining industry. Wetlands are created that provide natural cleaning processes in polishing ponds. The firm now has annual revenues of $1 million, employs 13 people and is pursuing markets in the United Kingdom as well as Canada.

From, Hickling Corporation, *Environmental Solutions for the Mining and Mineral Processing Industries* (Hull: Canadian International Development Agency, April 1994), pp. 1-14.

The market for bioremediation services is expected to double between 1992 and 2000. This growth will be fuelled by the trend toward on-site treatment of hazardous wastes, rapid expansion of the UST market, expansion into the bioremediation of nuclear wastes and penetration of markets for the analysis of air, water and soil as well as for biomonitoring.

While there appears to be a growing use of biocultures among bioremediation firms, the movement toward the commercial use of genetically engineered microorganisms in Canada will be slowed by a lack of understanding of the processes used and the high costs of R&D. In addition, government hurdles and possible legal liabilities will slow the growth of the industry.[26]

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[26] T. McIntyre, Commercial Chemical's Branch, Environment Canada, note to authors (April 1995); J.A. Heller, *Background Economic Study of the Canadian Biotechnology Industry*, unpublished report (Ottawa: Environment Canada, March 1995).

Applied Ecologies Inc., Vancouver, British Columbia

Applied Ecologies Inc. develops and sells products that apply microorganisms to the rehabilitation of soils and other contaminated material. Its BioPro Process has been used in Washington, California and Texas. The BioPro Process has gained substantial credibility and regulatory acceptance in California. Known as "Safe Soil," it is fully permitted by the California Department of Health. The company has a strategic alliance with Ensite Inc. of Atlanta, Georgia, for the marketing of the BioPro Process in the United Staes.

From, Province of British Columbia, *Environmental Technologies, British Columbia, Canada* (Victoria, 1994), pp. 37-38.

7. Information Systems, Monitoring and Instrumentation

These highly specialized activities are often an extension of Canada's excellence in the efficient and innovative application of software systems. The subsector involves the application of a wide range of software-based tools and instruments to monitor water, air and land quality. For example, software tools are used to analyze and simulate waste and wastewater treatment procedures and to measure emission levels.

The subsector includes software specialists, makers of advanced control and monitoring equipment and the geomatics industry. Their products and services are developed to serve both industry and government for the monitoring, measurement and assessment of pollutants and the observation of changes on land, in oceans and in the atmosphere.

Canada is a recognized leader in geomatics, an industry that includes firms active in surveys, mapping, monitoring and analysis of natural resources and the environment. It includes earth observation from satellites and geographic information systems (GIS). High-technology companies, such as MacDonald Dettwiler, serve markets throughout the world.

Advanced instrumentation has been identified as a "sunrise" environmental industry that is expected to grow rapidly as the demand for more information and a better understanding of environmental systems increases.

Axys Group Ltd., Sidney, British Columbia

Axys Environmental Instrumentation developed INFILTREX II, a self-contained monitoring instrument for *in situ* sampling of trace organics, metals and radionuclides in water. It includes a microprocessor-controlled pump, flow meter and power supply. All functions are selected from menu-driven software run from an IBM-PC compatible computer or terminal. Axys also designs and manufactures meteorological/oceanographic buoys that are used for operational marine weather and sea-state forecasting and for monitoring the marine environment. With clients in the pulp and paper industry; oil and gas sector; and government and government agencies, the firm employs 100 people and markets to Canada, the United States, Asia, Europe and New Zealand.

From, Province of British Columbia, *Environmental Technologies, British Columbia, Canada* (Victoria, 1994), pp. 49-50.

Unisearch Associates Inc., Concord, Ontario

Unisearch Associates Inc. developed the DOAS system, which provides simultaneous measurements of a number of important gases with good sensitivity for stack monitoring and remote sensing over long paths such as perimeter monitoring. The LASAIR represents new technology using small laser diodes. It provides a highly selective instrument for specific gases with no possibility of interference from other gases. It has high sensitivity and time response as low as a fraction of a second. It is ideally suited for stack monitoring and vehicular emissions.

From, H.I. Schiff *et al.*, "Innovative Optical Methods for Air and Emission Monitoring," *Emerging Clean Air Technologies and Business Opportunities, Proceedings of the First North American Conference and Exhibition,* Toronto (September 26-30, 1994), p. 316.

THE ENVIRONMENTAL SECTOR BY PROVINCE AND REGION

Environmental industries are important components of the provincial economies. A good snapshot of the size and distribution of the major sectors by region is given in Table 4-7. The data are for manufactured products only.

Table 4-7 Market Segment by Region or Province (products only)

	WATER AND WASTEWATER	WASTE MANAGEMENT	AIR	OTHER	TOTALS
Atlantic provinces					
Number of companies	39	32	6	2	79
Employment	203	252	26	43	524
Revenues ($)	25,143,300	27,821,700	2,868,800	4,774,000	60,607,800
Exports ($)	3,545,650	6,463,920	358,600	3,819,200	14,187,370
Quebec					
Number of companies	183	102	61	16	362
Employment	4,696	1,409	996	354	7,455
Revenues ($)	544,843,900	156,031,600	109,601,250	38,986,750	849,463,500
Exports ($)	83,727,735	18,277,855	14,795,825	9,785,600	126,587,015
Ontario					
Number of companies	383	130	126	41	680
Employment	9,932	3,867	3,660	758	18,217
Revenues ($)	1,228,961,900	486,530,650	414,370,350	83,410,250	2,213,273,150
Exports ($)	219,833,780	78,566,240	106,955,765	39,103,213	444,458,998
Prairie provinces					
Number of companies	144	32	28	6	210
Employment	2,915	495	681	53	4,144
Revenues ($)	281,661,575	54,700,000	74,963,625	5,874,000	417,199,200
Exports ($)	46,138,856	7,628,975	24,878,013	3,445,200	82,091,044
British Columbia					
Number of companies	87	41	18	13	159
Employment	1,091	788	322	119	2,320
Revenues ($)	126,153,600	87,005,000	35,438,400	13,040,500	261,637,500
Exports ($)	25,892,525	24,355,350	19,140,420	6,286,775	75,675,070
Totals for Canada					
Number of companies	836	337	239	78	1,490
Employment	18,837	6,811	5,685	1,327	32,660
Revenues ($)	2,206,764,275	812,088,950	637,242,425	146,085,500	3,802,181,150
Exports ($)	379,138,546	135,292,340	166,128,623	62,439,988	742,999,497

Source: Doyletech Corporation, *An Analysis of Canada's Supply Capability in Terms of Environmental Products* (Kanata, Ontario: Doyletech Corporation, May 1994), p. 28.

The figures cited in Table 4-7 confirm the dominance of Ontario in the industry and show that significant activity is taking place in Quebec and the four western provinces. The industry in each province faces considerable competition from out-of-province and foreign suppliers. Only Ontario has the depth and critical mass to meet a wide range of market needs. Several Canadian firms, such as the major waste management and consulting companies, have operations located across Canada.

1. Ontario

The Green Industry Ministerial Advisory Committee (GIMAC) has calculated that the market size of Ontario's broader "green industry" in 1992 was between $6.8 and $10.4 billion, or 2.3 to 3.5 percent of Ontario's Gross Domestic Product (GDP). This compares to an estimate of only $2.5 billion in 1990, reported by Ernst and Young in its study of Ontario's environmental protection subsector. These revenues were generated by an estimated 1,500 to 2,000 firms employing approximately 30,000 people. This made the environmental protection industries the third largest employer in Ontario in 1990.

Ontario, particularly the greater Toronto area, is home to 40 to 50 percent of the national environmental protection industry. This subsector has experienced an average annual growth rate of 8 percent. Ontario firms now supply about 90 percent of the province's market for services and about 75 percent of its demand for goods, while 25 percent of product sales and 10 to 15 percent of service sales are out-of-province and to countries abroad, including developing countries. The most common export markets, however, are the northeast United States and Western Europe.[27]

In 1994, on the advice of the GIMAC, the Ontario government adopted a Green Industry Strategy. It specified initiatives in three key areas: technology development, business development and trade promotion. The Strategy includes steps to stimulate innovation, streamline approvals, expand local markets, certify green products and services, enhance investment and skills, provide market intelligence, promote sector industries abroad and encourage partnering.

Albarrie Canada Ltd., Barrie, Ontario

Albarrie Canada Ltd. specializes in clean air technology and waste containment. It is a global leader in the removal of particulates from industrial gases and also produces geo-synthetic clay liners for landfills. Its composite filter media for dust collectors are the only products capable of operating at relatively high velocities without deterioration in emissions or increase in pressure drop. In the past five years it has enjoyed a 25 percent increase in both sales and jobs, and it now employs 200 people across Canada. Exports account for 50 percent of sales, primarily to the United States, but also to Central and South America, Europe and the Pacific Rim.

From, Green Industry Ministerial Advisory Committee (GIMAC), *Green Industry Sector Strategy for Ontario* (Toronto: Ministry of Environment and Energy, April 1994), p. 12.

2. Quebec

Quebec accounts for 20 to 24 percent of the environmental industry in Canada. A 1993 study by the Quebec Centre de Recherche Industrielle du Québec (CRIQ) estimated that there were close to 900 environmental firms in Quebec. These firms employed 11,000 to 18,000 workers and had annual revenues of $1.7 billion. About one quarter of the firms were involved in manufacturing, 10 percent in distribution and 67 percent, or over 550 firms, in environmental services (Table 4-8).

Most firms are small and lack the financial resources and marketing or management skills required to compete internationally or to resist out-of-province competitors. About 20 percent of products or services are exported, primarily to the United States, accounting for 6 percent of annual sales.

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[27] GIMAC, *Green Industry Sector Strategy*, p. 10.

Table 4-8 Breakdown of Quebec Environmental Companies by Activity (number of companies)

ACTIVITY	PRODUCTS	DISTRIBUTION	SERVICES
Water and wastewater management	99	54	181
Air pollution (including indoor)	67	36	97
Soil remediation	—	—	208
Waste management & recycling	56	26	468

Source: Ministère du Commerce, de la Science et de la Technologie, *Le modèle québécois – Horizon 2003* (Québec: Ministère du Commerce, de la Science et de la Technologie, 1994), pp. 4-13.

Service firms, which include large companies such as SNC Lavalin, Tecsult and Roche, generated 80 percent of employment and 55 percent of industry revenues in 1992. A large proportion of the service industries were in the waste management subsector, providing collection, disposal and treatment of solid and hazardous waste and the design of waste management services. Out-of-province interests have focused on this subsector and now control it.

In the water and wastewater management subsector, Quebec industry has benefited from a number of provincial support programs that have helped it maintain a 75 percent share of the market. However, they account for only 20 to 30 percent of the industrial market and are largely dependent on foreign suppliers.

The Quebec government has committed $1 billion toward the cleanup of over 800 contaminated sites. In addition, leaking USTs and polluted river sediments are major problems. These cleanup opportunities should provide the impetus to develop a stronger Quebec presence in the remediation subsector.

3. Western Canada

Environmental businesses are becoming increasingly important in the economies of the western provinces. Estimates based on a 1992 survey of the industry in the four western provinces indicate that there were more than 2,000 firms in the sector. They employed almost 20,000 people and generated annual sales between $1.4 and $1.8 billion in 1990. Anticipated annual growth rates are expected to be in the area of 5 to 15 percent. In size and distribution, the industry generally reflects the economic and demographic differences among the provinces (see Table 4-9).

Biogenie Inc., Sainte-Foy, Quebec

Biogenie Inc. specializes in the study and treatment of soils and water contaminated by organics and provides services in the development, construction and operation of treatment processes. The firm's remediation processes use indigenous organisms in about 95 percent of the cases. Its client base includes petroleum, industrial and government customers, including Hydro-Québec. It has research arrangements with provincial and federal research organizations as well as Laval University. R&D efforts comprise about 10 percent of revenues. It employs 120 workers, mostly highly skilled scientists, engineers and technicians, and had revenues of about $12 million in 1994.

From, Ernst and Young, *A Brief Examination of the Canadian Bioremediation Industry* (Hull: Environment Canada, November 1994), p. 12.

Table 4-9 Western Provinces — Breakdown of Revenues and Employment

PROVINCE	REVENUES ($ million)	EMPLOYMENT
Alberta	650	8,000
British Columbia	650	8,000
Saskatchewan	175	2,000
Manitoba	200	2,000

Source: Sentar Consultants, *Western Provinces Environmental Industries Business Development Study, Main Report* (Calgary: Sentar Consultants, January 1993).

The Western Environmental Industry Survey indicates that the average western Canadian environmental firm tends to be small — median firm size is six employees — and is probably in the service sector. It is undercapitalized and lacks the funds needed to conduct medium- to long-term technology development. About a quarter of the firms are very young, having been in existence less than five years. They also tend to be parochial, with one third reporting no sales outside their home province (see Table 4-10). Only 15 percent of the companies surveyed derived most of their revenues from manufacturing. Average annual sales reported for service sector companies were $1 million, and for manufacturers, more than $2 million.

Consulting organizations are the largest constituents of the environmental industry in western Canada. Even though most do not do R&D, the industry is clearly technology-driven, and "*most within the industry acknowledge that technology development will be fundamental to future business development.*"[28]

While spending on R&D was generally low, a few companies reported R&D activity that amounted to a significant proportion of their revenues. In Saskatchewan, for example, the average reported expenditure was 22.7 percent of revenue, reflecting the importance of a small group of high-tech companies clustered at the University of Saskatchewan's research park. Many of these companies are developing innovative technologies that will position them to provide the impetus for growth of the sector in western Canada.[29]

The environmental industry relies heavily on the health of primary resource industries for its own economic well-being. Also, the environmental industry is evolving rapidly. The speed with which new companies are being created and legislation and regulations are being framed demonstrates a dynamism currently found in no other industry.[30]

Table 4-10 Sales Derived from Export (percent)

MARKET	BRITISH COLUMBIA	ALBERTA	SASKATCHEWAN	MANITOBA	AVERAGE
Within province	56	61	54	71	60
Other provinces	19	19	14	28	19
U.S.	12	13	27	1	13
Europe	1	3	2	—	2
Pacific Rim	11	3	3	1	5

Source: Sentar Consultants, *Western Provinces Environmental Industries Business Development Study, Main Report* (Calgary: Sentar Consultants, January 1993).

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28 Sentar Consultants, *Western Provinces Environmental Industries Business Development Study, Main Report* (Calgary: Sentar Consultants, January 1993), p. 61.

29 *Ibid.*, p. 30.

30 *Ibid.*, p. ii.

a. British Columbia

A 1994 B.C. government publication, *Environmental Technologies, British Columbia, Canada,* states that the environmental industry in the province "*consists of companies that provide products and services that improve, analyse or protect environments and resources.*" It states that the sector consists of 400 firms with an annual average growth rate of 33 percent. Exports account for 30 percent of products and services, and sales are expected to reach $1.5 billion by the year 2000. These projections may be conservative, however, as the defined number of firms is only half that estimated in the Western Environmental Industry Survey.

Both reports emphasize the importance of technology and exports to the B.C. industry. The U.S. market is particularly important to British Columbia, and some of its companies have taken advantage of the sophisticated California market to test their leading-edge technologies.

Key subsectors in the province are water and wastewater treatment; environmental information systems; waste management; water and marine monitoring; air pollution control and alternative fuels; oil spill control; and cleanup.

Ballard Power Systems Inc., North Vancouver, British Columbia

Ballard has a distinguished record in producing new technology breakthroughs in the electrochemical field. The Ballard fuel cell converts a fuel such as hydrogen, methanol or natural gas into electricity, heat and pure water. It can be used for stationary facilities, from houses to hospitals and factories, and in automobiles. It provides clean, reliable and inexpensive power through a cell that is small, light and easily transportable, making it ideal for remote locations. Customers include the U.S. Army, the Department of National Defence, and shipbuilding and automobile companies in the United Kingdom, Switzerland and the United States.

From, Province of British Columbia, *Environmental Technologies, British Columbia, Canada* (Victoria, 1994), pp. 55-56.

b. Alberta

Originally developed as an offshoot of the oil and gas industry, the environmental sector is one of the fastest growing industries in Alberta. With the only hazardous waste treatment facility located in western Canada, a considerable level of expertise has developed in the province. Notable in this respect is the Swan Hills Special Waste Treatment Centre, which, in 1993, underwent a $60 million expansion to quadruple its capacity. This centre alone has spawned a substantial supporting industry.

In addition to hazardous waste management and equipment, Alberta companies are strong in recycling, solid waste management and on-site treatment, natural resource management and professional services.

Procor Sulphur Services Inc., Calgary, Alberta

In conjunction with Apollo Environmental Systems Corporation, Willowdale, Ontario, Procor Sulphur has recently developed a proprietary technology that reduces the amount of highly toxic hydrogen sulphide in industrially produced sulphur to concentrations of 1 or 2 parts per million (ppm). This is well below new environmental regulation levels (10 to 30 ppm) and below levels (10 ppm) that can build up, when sulphur is stored, to create hazardous or lethal concentrations in enclosed areas or bleed into the atmosphere. This process reduces the concentration of hydrogen sulphide being produced as the sulphur is being manufactured, controlling the problem at the source, and replacing previously existing systems, which were much more costly and less effective.

From, *Industry Canada, Environmental Solutions Fact Sheet: Procor Sulphur Services* (Ottawa: Industry Canada, Environmental Technology Commercialization Program, undated).

c. Saskatchewan

Saskatchewan has the smallest share of the EIS in western Canada. There is a relatively small market within the province, and Saskatchewan firms develop products and services to meet the needs of that market, exporting very little beyond it.

A strong asset to development and opportunities in the sector is a research centre in the province made up of Discovery Park's environmental technology companies, the University of Saskatchewan and the Saskatchewan Research Council. The proximity of these institutions to each other creates a valuable "critical mass" of scientific knowledge and facilitates the exchange of ideas and information.

Saskatchewan's environmental industries are active in environmental instrumentation, hydrology, bioremediation and collection and recycling of post-consumer wastes.

Dutch Industries, Regina, Saskatchewan

Dutch Industries is a multi-faceted manufacturing and agricultural support firm that concentrates on energy conservation. It manufactures a variety of wind energy products, including instrument towers for wind measurement and wind turbines. It also makes a wind-powered water pump for rural needs. Markets include Canada, Europe, the United States, Australia and Africa.

From, Western Economic Diversification Canada, *Saskatchewan Environmental Sourcebook* (Saskatoon: Saskatchewan Environmental Managers Association, January 1995), p. 18.

d. Manitoba

The EIS in Manitoba is centred in Winnipeg. As a result, it exhibits a coherent structure and seems to display a consensus on the strengths and future direction of the sector in the province.

As in Alberta and British Columbia, Manitoba's companies follow emerging trends in the United States. Manitoba tends to be especially influenced by the situation in Minnesota, the Dakotas and the mid-west. Manitoba has also developed stronger links to eastern Canada than the other western provinces, and its market area includes northern Ontario.

Important components of the sector are the Whiteshell research facility, maintained by Atomic Energy of Canada Ltd. (AECL), and the Manitoba Hazardous Waste Corporation, which is working toward the development of a hazardous waste facility in the province. Other areas of strength are environmental services and equipment manufacturing.

Bioclear Technology Inc., Winnipeg, Manitoba

Bioclear Technology Inc. designs and manufactures waste treatment systems and equipment for industrial and municipal wastewater treatment facilities. It employs 20 people and sells in Canada, the United States and Europe. The company's products are primarily marketed to municipal wastewater treatment facilities, but a strong emphasis on R&D is creating technologies with applications in industries such as food processing, pulp and paper, dairy and other industries with biologically treatable wastewaters.

From, Investment Canada, *Industrial Wastewater Management, Canadian Partners for Global Markets* (Ottawa: Investment Canada, undated).

4. Atlantic Canada

Atlantic Canada has the smallest representation of environmental industries in Canada. The region accounts for only about 5 percent of the total revenue generated by Canada's EIS.[31] There are 1,200 environmental firms in the region, most of them small, with total annual sales of about $700 million. About 65 percent are in the service subsector.

[31] Ernst and Young, *Human Resources*, p. 13.

Between 15 and 20 percent of the firms are exporting, largely to the United States, and half of these firms export to more than one market. Key export areas are in water and wastewater treatment, site remediation and GIS and remote sensing, an offshoot that originally developed to provide services to the offshore oil and gas industry.

While figures are not available for all Atlantic provinces, a 1993 study on Newfoundland reports that there are 90 to 95 companies providing environmental products or services in Newfoundland, 45 to 50 of which are predominantly environmental. Three quarters are in the services subsector. The industry employs 500 to 550 people and has total revenues of $40 to $50 million annually. Areas of strength are consulting, industrial cleanup and waste management.[32]

Jacques Whitford Environment Ltd., Fredericton, New Brunswick

A firm specializing in solid waste management, Jacques Whitford Environment Ltd. earns annual revenues of more than $30 million. The firm is unusual in that it is employee-owned, maintaining a network of over 340 consulting engineers, scientists and environmental planners in 15 offices in Atlantic Canada, Ontario, Quebec, Alberta and the United States. Established in 1985 as a division of the J.W. Group, it specializes in environmental sciences and planning and environmental engineering. Among the environmental services it offers are environmental impact assessments, marine/freshwater biological studies and environmental protection planning. It has developed expertise in all aspects of waste management, providing a full range of solid waste management services. Jacques Whitford actively seeks strategic alliances with industry, government and universities, regardless of their location. It serves markets in Canada, the United States, Russia, Asia, Africa, South America, Mexico and the Caribbean.

From, Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), p. 218.

THE CANADIAN ENVIRONMENT INDUSTRIES ASSOCIATION (CEIA)

One of the clearest indicators of the growth and development of the environmental industry in Canada is the recent proliferation of industry organizations and associations. There is a great deal of activity in all regions of the country, much of it stimulated by considerable government support. The Canadian Environment Industries Association (CEIA) is a national umbrella organization representing the nine provincial environmental industries associations that have developed over the last 10 years. Prince Edward Island does not have an association.

The CEIA has received assistance from both federal and provincial governments to establish a national office and additional provincial organizations. By providing support, the provincial and federal governments are responding to the need for strong and coordinated programs to help the industry grow. At the beginning of 1994, the national office was moved from Toronto to Ottawa to give the industry a stronger voice in national environmental policies. This move was seen as critical to carrying out key elements of the federal government's environmental industry strategy. The strategy recognizes that government-industry cooperation is crucial to meeting the twin goals of sustainable environmental and economic development.

The CEIA promotes the interests and development of Canadian companies that are in the business of supplying environmental technologies, products or services. It now has a total membership of between 1,200 and 1,500 members, who become affiliated with the national umbrella by joining their local provincial association. The CEIA provides services to its members in areas such as government relations, trade promotion, information exchange, human resource needs and raising the industry's overall visibility.

[32] K. Hann, *The Environmental Industry in Newfoundland*, unpublished report (St. John's: Newfoundland Department of Industry, Trade and Technology, April 1993), p. ii.

As a lobby group, the CEIA presents its members' concerns to government and Parliament through presentations at various levels. In October 1994, for example, it made a presentation to the Parliamentary Committee on Sustainable Development regarding the review of the *Canadian Environmental Protection Act* (CEPA). Other presentations have been made on topics such as the proposed removal of inter-provincial trade barriers, the development of simpler and more user-friendly procedures in government procurement and the incorporation of environmental standards into government procurement.

In addition, the CEIA is committed to holding an annual conference, the first of which took place in Ottawa in March 1995. It publishes a quarterly newsletter, participates in trade fairs and conferences showcasing Canada's technologies and expertise and frequently acts as a consultant to government on issues of importance to the sector. The CEIA also uses cooperative agreements to maintain relationships with other national associations. At present, it has established links in Mexico, Malaysia, Taiwan, Korea and Singapore.

In the provinces that have experienced strong industry growth such as Ontario, Quebec and Alberta, thriving associations have been in existence for some time. The first such association was the Environmental Services Association of Alberta, which has been in existence for a decade and grew out of services provided to the oil and gas sector. These associations are already active in their provinces, providing a variety of services to members (e.g., the Ontario monthly faxletter, the Alberta program of week-long courses) and participating in the formation of environmental policies and training programs.

In other provinces with a smaller industry base, such as the Atlantic provinces and Saskatchewan, most organizations are less than two years old. In these associations, a single part-time employee manages the office while volunteers are responsible for program development. With growing membership in each province, the ambitious plans of the CEIA will receive good regional support. The goal in each office is to bring together the diverse members of the industry through monthly meetings and annual conferences, to become part of a valuable information network, to provide training for members and industry users and to give the industry a voice in each province.

The active participation of provincial associations is critical to the successful operation of several government-sponsored activities. For example, the federal government is cooperating with provincial governments and the CEIA to establish three Canadian Environmental Technology Advancement Centres (CETACs) in Ontario, Quebec and western Canada. The goal of these centres is to help small and medium-sized businesses successfully commercialize their environmental technologies by providing full technical services, access to investment capital, business counselling and regulatory and market analysis.

The CEIA is also working closely with the Canadian Council for Human Resources in the Environment Industries (CCHREI), which was established by Employment and Immigration Canada to address the training needs of the industry. In cooperation with four provincial industry associations and educational institutions, it has already embarked on a three-year work internship program for environmental technicians. The program, which is managed by the associations, is designed to meet the anticipated shortage of skilled technicians in the industry.

Established activities and organizations continue to be important to the sector and will flourish with the added participation of a well-organized association. The Globe Series of biannual conferences, established in 1990 by Environment Canada and now managed by the Globe Foundation in Vancouver, has become an internationally important venue for exchanging ideas and demonstrating key environmental technologies. In addition, several subsector associations, such as the Air and Waste Management Association, the Water Environmental Association, the Association québécoise des techniques de l'environnement and the Canadian Advanced Technology Association, have existed for many years and can work closely with the CEIA on shared projects and concerns.

Finally, as part of the Canadian Environmental Industry Strategy, CEIA representatives have become members of the Steering Committee implementing the federal industrial strategy. Further, to provide the kind of recognition given to other industry sectors, the Strategy called for the establishment of an environmental Sector Advisory Group for International Trade (SAGIT). The first

meeting of the newly created Environmental Products and Services SAGIT was convened in the spring of 1996. With active participation in this group, the CEIA members, and the association itself, will have a strong voice in reviewing policies and priorities and in making recommendations to help Canadian firms in the international marketplace.

STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS IN THE ENVIRONMENTAL SECTOR

Companies in the environmental sector exhibit many of the strengths and weaknesses of Canadian companies in general. The problems associated with small size, limited access to funds and relatively low rates of R&D expenditures are similar to the difficulties faced by other industrial sectors in Canada. In the environmental sector, however, these difficulties are counter-balanced by a highly educated workforce, excellent research institutions and the development of several leading-edge technologies for niche markets.

Companies in the EIS experience special difficulties because the sector is so strongly fuelled by technological innovation and driven by government policies and regulations. The uncertainties associated with rapid technological change and with government regulation and enforcement significantly increase risks for the companies and for their investors. A growing concern regarding the proliferation and uncertain application of regulations appears to have slowed the already modest venture capital interest in the sector.[33] However, recent announcements of SME funding programs by all the major banks may help to alleviate this problem.

As with many high-technology SMEs, the shortage of management skills is a major weakness in this sector. The dominance of scientists and engineers in the sector means that few have training or experience in managing a business. The Ernst and Young report *Human Resources in the Environment Industry* found a lack of skills in most areas of business management, including resource management, strategic planning, marketing and communications.[34] Without these skills, it is difficult for SMEs to grow or take advantage of domestic and foreign markets.

Nonetheless, the opportunities for significant continuing growth in this sector cannot be ignored. Many Canadian firms, particularly those providing environmental services, highly sophisticated software systems and specialized niche market equipment, are competitive both domestically and internationally. They are ready to tap into growing markets in Canada, in both the public sector and the resource industry. Helped first by the Free Trade Agreement and now the North American Free Trade Agreement (NAFTA), they are moving into the United Stated and Mexico. They are also exploring opportunities in Asia, Eastern Europe and Latin America.

The enumeration of the sector's strengths, weaknesses, opportunities and threats in Table 4-11 summarizes the findings of numerous industry studies completed over the past five years. These items supply the building blocks of emerging government and industry policies. The competitiveness of the industry will be determined by the effectiveness with which strengths are identified and built upon while weaknesses are minimized. It will also depend on how the industry positions itself to take advantage of the tremendous opportunities available in Canada and overseas.

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33 D.J. Doyle and M. Macdonald, *The Identification of Concerns of Suppliers of Capital to Canadian Environmental Companies*, prepared for Environmental Industries Directorate, Industry Canada (Ottawa: Doyletech Corporation, March 1994), p. 28.

34 Ernst and Young, *Human Resources*, p. 5.

Table 4-11 Canada's Strengths, Weaknesses, Opportunities and Threats in the Environmental Sector

FEATURE	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Human resources	• strong educational system • strong employment growth • wide range of skills	• shortage of management skills • diverse subsectors • many small companies	• lack of strong entrepreneurial culture • employment growth • international markets • carry out recommendations of CCHREI	• declining graduate rate in science and engineering • shortage of trained engineering talent • reduced funds for education/retraining
Market access	• strong resource sector provides domestic market • reputation for strong environmental ethic • proximity to U.S. market • customer service focus • ability to provide smaller, tailored solutions • highly competitive in the supply of environmental services • many firms are already active in foreign markets • international market intelligence through DFAIT and CIDA • some leading-edge environmental standards e.g., B.C. forestry, pulp & paper	• foreign procurement by foreign-dominated manufacturing industries • SMEs lack expertise, size and funds to penetrate foreign markets • inconsistent implementation and enforcement of regulations and policies • shifting government priorities • poor linkage between producers and users • small, fragmented domestic market • low wage competition from parts of U.S. and developing countries • limited opportunity to develop track record in Canada • concern for ability of Canadian industry to compete • non-strategic use of ODA instruments	• partnering with federal government on environment priorities, e.g., CFCs, global warming • NAFTA — access to U.S. government contracts over US $50,000 • size of domestic and foreign public-sector markets • ODA funding for environment	• multinationals joining sector, providing full-service turnkey solutions • competitors with better developed industry-government partnerships • regulatory inaction • buyer preference for U.S. exports • earlier introduction of regulations gives foreign competitors advantage

(continued on next page)

Table 4-11 Canada's Strengths, Weaknesses, Opportunities and Threats in the Environmental Sector *(continued)*

FEATURE	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Access to technology	• excellent institutional research capabilities • centres of excellence that link industry and academic research • introduction of CETACs • sector open to innovation and entrepreneurship	• few pilot and demonstration facilities • confusing and unpredictable regulations • low level of corporate R&D • no synchronization of technology development and regulatory enforcement • shift to pollution prevention could impact some subsectors • length of product development • Canadians lack confidence in Canadian technology • failure to seek out technology ripe for commercialization	• Canada's growing demand for technology • as resource sector "greens" and restructures, new technologies required • move to sustainable development of public infrastructure • need to clean up water and site contamination	• inconsistent application and enforcement of regulations discourages R&D • prohibitive approvals process and lack of standardized field testing
Finance	• establishment of a number of environment-oriented venture capital and mutual funds • government institutions such as Innovation Ontario invest in small to medium-sized technology firms • union funds set aside for environment-related investment • government interest in economic instruments	• access problematic for start-up and early stage projects • no system of standards for new green products and technology • no funds to move beyond prototype to commercial production • inadequate information on risks and opportunities • inconsistent regulations make investment less secure	• take advantage of investment in manufacturing and real estate • education and information could increase investor knowledge • a lead fund umbrella could foster "expert corporations" • general public willing to invest interest in green accounts	• lagging and uncertain regulation may slow down investment • dumping of obsolete technologies and products • strict regulations can increase user costs • missed opportunities due to absence of venture capital
Other	• Canadian consultative approach in demand in foreign markets • interdisciplinary multi-stakeholder model	• Canada's reputation as an environmental leader • inadequate company knowledge of market trends	• limited horizontal coordination in federal government	

INDUSTRY TRENDS — THE FUTURE

Pollution control currently remains the focus of most firms in Canada's EIS. Early environmental concerns centred on wastewater treatment, waste disposal and recycling and the reduction of toxic wastes. Governments responded with a system of regulations that largely focused on pollution control technologies. This resulted in the development of a number of "end-of-pipe" solutions that have been adopted by industry and in the creation of considerable expertise in monitoring, testing and measuring pollutants.

More recently, the pollution control model has been subjected to increasing criticism. Its environmental effectiveness in some areas is questioned widely. More importantly, the users have found the approach inefficient economically. Operating and capital costs can be high without adequate environmental or financial returns. In addition, this model tends toward technological rigidity, which can reduce the capacity of the user for technological change. Both regulators and manufacturers are opting for a more flexible system that sets standards of performance without limiting the methods used to reach these standards. As a result, technologies that prevent pollution or reduce energy requirements through changing processes are increasingly being chosen by industry. In some cases, such methods have the potential to reduce or eliminate pollutants, improve efficiency and cut production costs.

For example, Thermco Canada of Mississauga uses its Terminator Technology to cut down on the use and wastage of chlorofluorocarbons (CFCs) in large-scale refrigeration systems (e.g., in supermarkets) while improving energy efficiency by 20 percent. Dynamotive Canada of Vancouver uses salt-water electrolysis and ultrasound for cleaning the oxide layer off fresh steel. This provides a cheaper, safer method than the current process, which involves toxic acids. Both are examples of a new breed of environmental companies that offer their clients environmental solutions and cost savings at the same time.

> *Regulations, economics, and common sense continue to shift the focus of the environmental industry more and more away from waste treatment and control to waste reduction and prevention. This broadening and redefinition of the industry is reflected by current corporate interests in concepts like strategic environmental management and "industrial ecology," and the growing industrial focus on design for environment (DFE) and design for disassembly (DFD) manufacturing techniques. We are witnessing a true "sea change" in industry's approach to the environment, and it will continue to reverberate through the commercial environmental industry for the next several years. In the process it will transform the business as we know it. Many sectors of the original "haul and dump" waste disposal business — the original environmental business — will be increasingly rendered a thing of the past as environmental practices evolve, giving rise to a new "industry" focused more on recovery and prevention services.*[35]

The demand for control technologies will continue to be strong in Canadian and international markets. There are many instances where control is the best solution, and the initial capital outlay for some process changes may be too expensive for smaller companies. It is clear, however, that Canadian firms that offer cost savings and improved environmental performance should be well placed to succeed in the marketplace.

As testing capabilities have become more sophisticated, the need to clean up and restore degraded sites has been widely recognized, and remediation of areas contaminated by toxic, hazardous or nuclear materials has become an important part of the sector.

The growth in demand for solid and special waste management and services and related equipment is expected to be rapid. The market could rise at a rate of 21 percent per year according to some estimates.[36]

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[35] R.S. Maxwell, *Update on the Commercial Environmental Services Industry* (TechKNOWLEDGEy Strategic Group, September 1994), p. 1.

[36] Ernst and Young, *Human Resources*, p. 31.

Management and engineering firms are also responding to higher demand. Most major Canadian engineering firms now have large environmental divisions. Auditors, accountants and lawyers are developing expertise in environmental audits and impact assessments. Canadian resource managers have become skilled in conservation and the sustainable management of resources — skills that are in demand both within Canada and abroad.

As Canadians have embraced the concept of "blue boxes" and other lifestyle changes, technologies to reduce, re-use and recycle products are finding a market. Recycling, in particular, is a fast-expanding industry, currently estimated to be growing at a rate of 10 percent annually (Table 4-12).[37] The need to reduce waste and the demand for recycled products have opened up major opportunities for recycling firms. Urban wastes are now seen as valuable commodities bringing closer the day when cities become urban "mines" and "forests." Their importance as a source of recycled materials for a wide variety of products and processes continues to rise.[38]

Table 4-12 Increases in the Recycling of Packaging Wastes in Canada (thousands of tonnes)

MATERIAL	1988	1992
Plastic	22	136
Wood (estimate)	22	64
Paper	437	1600
Glass	57	292
Metal (all types, aluminum, steel, etc.)	57	303

Source: D. Wilson, "Recycling Finally Hits Pay Dirt," *The Globe and Mail* (November 29, 1994).

The privatization of municipal utilities will also continue and will probably accelerate as cost-cutting measures increase at all levels of government. This trend, initially seen in the area of waste disposal, has now extended to wastewater treatment facilities. The operation of such facilities offers important opportunities to private firms in Canada and abroad. Canadian companies are scrambling to develop capabilities in this highly competitive market, where firms from France, the United Kingdom and the United States are already making inroads in Canada. As a reflection of the importance of this issue, the National Round Table on the Environment and the Economy recently decided to work with municipal governments in support of Canadian procurement, thereby stimulating Canadian environmental technologies. This appears to be part of a general trend to support green procurement at both provincial and federal levels.

Finally, the speed with which Canada responds to its commitments under the Framework Convention on Climate Change will impact on the speed of adoption of clean air technologies and energy conservation. However, even with a limited early response on the part of Canada, international and public concern regarding global warming will ensure that there will be a growing market for firms at the forefront of this subsector.

CanFibre, Vancouver, British Columbia

Worldwide wood panel producers face declining forest inventories, increasing costs and environmental restrictions on current manufacturing processes. CanFibre presents a solution to all these issues by utilizing 100 percent post-consumer waste wood to manufacture North America's first "green" recycled panel-board, without urea formaldehyde resins. It does so at a delivered cost advantage of up to 45 percent over standard fibre-board producers. The technology was developed by Forintek Canada Corp., a non-profit company dedicated to research for Canada's wood products. CanFibre is currently finalizing joint ventures with several of North America's leading decorative woodworking manufacturers.

From, Industry Canada, *Environmental Solutions Fact Sheet: CanFibre* (Ottawa: Industry Canada, Environmental Technology Commercialization Program, undated).

[37] D. Wilson, "Recycling Finally Hits Pay Dirt," *The Globe and Mail* (November 29, 1994), p. B24.

[38] J. Young, "The New Materialism: A Matter of Policy," *WorldWatch* (September-October 1994), p. 34.

Chapter 5 — Canadian Public Policy: Standards, Guidelines and Government Support for Industry

INTRODUCTION

Governments play a critical role in the health of the environment. The environmental policies adopted by government are carried out through legislation, regulation, including requirements for product certification and labelling, taxation, industry support programs, procurement, international agreements and public information. Viewed as a package, these activities provide the framework for the protection and preservation of the environment. As governments have become committed to the concept of sustainable development, awareness of the importance of all parts of this package has increased.

Canadian governments, at all three levels, are continuously examining and adjusting their environmental policy framework. Central to this process is the integration of both environmental and economic goals. This objective has been recognized by successive federal governments and in the sustainable development strategies of provincial and municipal governments.[1] In effect, governments have accepted that the environmental industry sector (EIS) can best be advanced by taking measures to solve environmental problems while also adopting policies that will support the development of a strong, competitive industry.

There is a direct link between an effective environmental policy framework and the strength of the sector. Strong environmental regulations are frequently cited as a crucial element in the growth of the EIS. *"Canadian firms will be in the strongest position in those areas where future regulatory requirements in Canada lead those of other countries."*[2]

Historically, major industrial users of environmental services and technologies have argued that regulation increases costs and reduces competitiveness. Others, however, take the opposite view that adoption of new pollution prevention measures will not only decrease pollution but also lower energy use and reduce industry costs. Addressing these divergent views is one of the many challenges faced by government.

Environmental regulations, legislation and economic instruments such as taxes and economic development programs are policy instruments available to government to promote environmental goals. Direct assistance to the environmental sector is also important. But policies have to be devised and implemented with a view toward both the long and short terms. Tax policies and programs to promote economic growth have to be particularly sensitive to environmental objectives, as these can have either a negative or a positive impact on the environment and the EIS. Recent policies supporting the "greening" of government and "green" procurement also promote environmental goals while supporting the environmental industries, providing they are maintained consistently.

In this chapter, the elements of the environmental policy framework in Canada are discussed with a view to examining their impact on the state of the EIS. The section on the legislative environment focuses on regulation and economic instruments. It is followed by a section that looks at the government programs that provide support to the sector.

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1 Projet de société, *Planning for a Sustainable Future, Canadian Choices for Transitions to Sustainability, Vol. 5, Toward a National Sustainable Development Strategy for Canada* (Ottawa: National Round Table on the Environment and the Economy, January 1995), p. 4.

2 Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), p. 68.

THE LEGISLATIVE ENVIRONMENT

In many countries, including Canada and the United States, there is an ongoing debate about the proper role of government in managing a country's social and economic affairs. Reacting to the growth of both government and government spending over the past three decades, some critics support downsizing government by privatizing or eliminating many of its activities. Their goals are deregulation and deficit and debt reduction or elimination.

The environmental sector is in the thick of this debate. Industries in the sector together with environmental groups call for more and better regulations. Industry in general, however, tends to oppose more regulation. A growing number of observers see regulations as essential to the health of both the environment itself and the environmental sector but conclude that the rigid, complicated and intrusive regulations of the "command and control" era of the past 20 years are themselves a problem: something better is needed. That "something better" may not be deregulation but rather re-regulation – the creative use of economic instruments and voluntary initiatives backed by effective government limits or guidelines and enforcement.

A combination of these three approaches – regulation, economic instruments and voluntary or hybrid agreements – currently exists in Canada. The addition of pollution prevention as a critical component of these approaches is now under consideration by the federal government and most of the provinces. The challenge is to find the right balance of measures that will both protect the environment and maintain overall industrial competitiveness. It is a challenge that Canada shares with most other countries of the world.

In framing environmental legislation, the primary concern is normally environmental protection or conservation and the health and safety of the general public. However, the impacts on regulated industries and the EIS are also key considerations.

1. Regulated Industries and Competitiveness

The relationship between environmental regulations and industrial competitiveness is complicated. Michael Porter, the Harvard expert on competitiveness, has argued that while there may be an initial increase in costs, environmental regulations can pressure firms to upgrade their competitive advantage by improving product and process quality.[3]

Studies have borne out Porter's contention, but only when there is a large domestic market, a predictable regulatory approach, regulators who understand both markets and industry and a supportive institutional framework. This may be the case in countries such as Germany and Japan, but these conditions do not apply to Canada. For example, in the Canadian pulp and paper industry, environmental regulations did not stimulate innovation in the industry.[4] In part, this was due to weak enforcement. When upgrades were made, over time, it was for a variety of reasons, only one of which was Canadian government regulation. In fact, regulations in other countries were often a more important stimulus.[5]

In general, environmental regulation has not been found to be a principal determinant of industrial competitiveness. Other factors, such as management quality, capital costs, workforce skills, market access and technological innovation, play a more significant role in competitiveness.[6]

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3 M. Porter, "America's Green Strategy," *Scientific American* (April 1991), p. 168, quoted in R. Doering *et al.*, *Environmental Regulations and the Pulp and Paper Industry: An Examination of the Porter Strategy* (Ottawa: National Round Table on the Environment and the Economy, November 1992), p. 1.

4 Doering *et al.*, *Environmental Regulations*, p. 17.

5 *Ibid.*, p. 28.

6 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment – Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 18.

Notwithstanding the competitiveness issue, industry began to change its approach to environmental regulation around the mid-1980s. It began to accept responsibility for pollutants and to see that there were advantages as well as disadvantages to making changes. Since that time, many firms have made substantial adjustments, from an environmental perspective, in the way they do business.

In its exhaustive study of industry and the environment, the U.S. Office of Technology Assessment (OTA) found that regulatory changes involve compliance costs for industry, but that they are generally less than industry expects (though more than environmentalists claim). The costs vary significantly from industry to industry, with very high costs for heavily polluting industries, such as chemicals, and marginal costs for others that pollute less. "End-of-pipe" solutions were generally found to be the most expensive, while source reduction or recycling offered the best returns.[7]

The OTA study also noted that environmental leaders such as 3M claim to have saved hundreds of millions of dollars through pollution prevention and control.[8] Some argue that such putative savings ignore all costs of these efforts. But then the cost of pollution is also not considered. If the polluter pay principle were applied, the savings for 3M would be even more impressive. Moreover, 3M enjoys good public relations from its practices. Good environmental behaviour can provide a competitive advantage.[9]

Cleaning up and Saving Money

3M Worldwide — Since 1975, almost 1,900 projects have resulted in the annual elimination of almost 400,000 tonnes of pollutants. Between 1975 and 1989, pollution was reduced by 50 percent per unit of production and US $516 million was saved.

Ashland Chemicals, Mississauga — Ashland reduced water consumption, separated and re-used material previously discharged and recycled samples back into production. Over $600,000 was saved between 1985 and 1990.

Philips Paint Products, Winnipeg — Philips discontinued its use of toxic isocyanate by developing a superior, but more environmentally friendly, alternative. Research lasted for over 18 months, but the firm now receives over one quarter of its revenue from the new product.

From, B. Mausberg, *Great Lakes Pollution Prevention Bibliography* (Sarnia, Ontario: Great Lakes Pollution Prevention Centre and the Canadian Institute for Environmental Law and Policy, September 1994), pp. 5-6 and 5-11.

2. Regulation and the Environmental Industry Sector

As mentioned above, a strong regulatory system provides a competitive advantage to the EIS. Regulatory consistency is also important, since investors require some certainty: inconsistent regulation and enforcement are weaknesses that frighten away investors and limit the development of innovation. Regulations are seen as providing an opportunity to capture and maintain domestic markets and to move into foreign markets.

Uncertain, weak and poorly enforced regulations are seen to impact negatively on several critical aspects of the industry, including technology development, financing and access to markets. In the United States, for example, the constantly changing attitude to the *Clean Air Act* has already led to the creation and demise of many air emission equipment companies, a process that may be repeated once again with the adoption of *"Contract America"* legislation, an anti-regulatory approach. Conversely, in Ontario, the relatively strict enforcement of the Municipal/Industrial Strategy for Abatement (MISA) Program since 1986 has helped to foster a strong water and wastewater treatment industry in that province.

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7 *Ibid.*, p. 234.

8 *Ibid.*

9 P. Carson, "Green Procurement," comments at the First National Conference, Canadian Environment Industries Association (CEIA), *Towards a Sustainable/Competitive Environment Industry*, Ottawa (March 28, 1995).

U.S. *Clean Air Act*

A compelling demonstration of the pivotal role of regulations in driving (or inhibiting) environmental industries is the roller coaster history of U.S. air quality legislation with its attendant unsettling ride for the sector. Because of the 1970 *Clean Air Act* (CAA), the U.S. air pollution control market grew from US $100 million in 1969 to US $1.1 billion in 1980. It then collapsed in the 1980s because there were no follow-up regulations and because those that did exist were not enforced. The pattern was repeated with the passage of the *Clean Air Act* Amendments of 1990. *"By 1989, demand for APC [air pollution control] equipment had rebounded in anticipation of the CAA Amendments."*[10]

Unfortunately, this surge did not last because of a series of delays in implementation and lack of enforcement of this very strong and comprehensive legislation. *"During the early 1990s, the U.S. air pollution industry had fewer bookings than it did in the years prior to the Act's passage. As a result, the capital structure of the industry's members was decimated, many companies merged or went out of business."*[11]

Despite these setbacks, the CAA created tens of thousands of high-tech jobs and made the APC equipment subsector the leading contributor to the U.S. environmental product trade surplus.

From the point of view of the EIS, there are several key elements of Canada's regulatory system that provide support to the industry and to their clients in regulated industries. These are:

- environmental effectiveness;
- predictability – which means simple rules, effectively enforced;
- cost-effectiveness – for both industry and regulator;
- acceptability – which involves stakeholder input and reasonable time lines; and
- technology driving – which means addressing ends, not means.

3. Environmental Regulation in Canada

Responsibility for environmental regulation in Canada is shared by the federal, provincial, territorial and municipal governments. In general, the federal role covers recognized areas of national concern such as standards to protect public health and safety, control of transboundary pollution, international treaties, environmental research and the preservation of parks, wildlife, aquatic life, federally owned natural resources and threatened regions.[12]

Natural resources fall under provincial jurisdiction and cover land, water, minerals and wildlife (except seacoast and inland fisheries). Over 5,000 municipalities exercise delegated provincial authority over such items as sewage and water facilities, planning and land use. Governments at each level have created additional agencies and special-purpose bodies to carry out their environmental mandate.[13]

The primary vehicle for carrying out the federal role is the *Canadian Environmental Protection Act* (CEPA). Proclaimed in 1988, CEPA's mandate is the identification and control of toxic substances. Its approach to toxins covers emissions on land, air and water and regulates their use from manufac-

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[10] Environment Canada, *Technology Opportunities in Air Pollution Control* (Hull: Environment Canada, Clean Air Technologies Branch, August 1992), p. 47.

[11] J.C. Smith, "Success Through Networks and Partnerships," *Emerging Clean Air Technologies and Business Opportunities, Proceedings of the First North American Conference and Exhibition*, Toronto (September 26-30, 1994), p. 3.

[12] Environment Canada, *Canadian Environmental Protection Act, Report for the Period April 1993 to March 1994* (Hull: Environment Canada, 1994), p. 2; D. Estrin and J. Swaigen, *Environment on Trial* (Toronto: Emond Montgomery Publications Ltd., 1993), p. 480.

[13] Doering *et al.*, *Environmental Regulations*, pp. 3-4.

ture through to final disposal, to the extent that these aspects of regulation do not fall under provincial responsibility.[14] CEPA's focus is preventative, using regulations and enforcement together with a package of non-regulatory approaches, such as guidelines, codes of practices, incentives and the development and transfer of pollution measurement and control technologies.[15]

In practice, provincial regulations have tended to follow the federal lead. Where provincial regulations are "equivalent" or stronger, these apply in place of CEPA regulations. Where CEPA applies, federal-provincial administrative agreements frequently delegate the responsibility for applying the regulations to provincial ...orities. There is a broad variation in the extent ...ss of provincial regulations. Ontario, ...itish Columbia have developed the ... regulations. Ontario's MISA Program, for ...ple, is frequently referred to as the most comprehensive environmental legislation in Canada.

The resultant "system" has been characterized in numerous studies as fragmented and inconsistent, in both formulation and application. Overlapping, duplicating and conflicting rules have created a jurisdictional maze that has steadily increased as environmental concerns and regulations have proliferated. In a study of the Toronto waterfront, for example, it was found that over 100 public authorities had jurisdiction over water quality in the city. In addition to the confusion and administrative difficulties, jurisdictions can "pass the buck" when problems arise, and the fragmented system strengthens opposition to regulation of an kind.

Enforcement, the critical component of any regulatory system, has been weak and sporadic. Rather than providing the final word, regulations have often been the starting point for negotiation between the regulator and the regulated. Follow-u through prosecutions and fines has been relatively rare.[16]

In addition to the conflict and confusion created b jurisdictional fragmentation, the Canadian enviro mental regulatory system is also characterized by the preponderance of broad prosecutorial discretion, resulting in very inconsistent enforcement in virtually all environmental sectors and in all regions. Study after study over a period of 25 yea has concluded that traditional rule-making and enforcement by

Passing the Acid Test

In 1985, tough Ontario provincial acid rain regulations required the province's major industrial polluters — Inco, Ontario Hydro, Algoma, Falconbridge — to cut sulphur dioxide emissions from 1.99 million tonnes in 1980 to 665,000 tonnes in 1994. The polluters *"howled, saying they couldn't afford to clean up."* However, by 1994 they had achieved the goal — at a cost of more than $3 billion. The result: a reduction in acid rain, the renewal of some lakes, reduced impact on the health of children's lungs, and $70 million annually in productivity gains for Inco (through a $530 million investment in new processes and modernized equipment). Credit for the success goes to explicit deadlines and reporting requirements. The Minister responsible in 1985, Jim Bradley, noted *"that the usual arguments for doing nothing were advanced both by government insiders and industry.... But the regulations' strict timetable gave everyone goals to meet and made companies accountable."*

From, D. Israelson, "Big Polluters Pass Acid Test," *Toronto Star* (December 30, 1994), pp. D1 and D3.

14 Estrin and Swaigen, *Environment on Trial*, p. 480.

15 Environment Canada, *Canadian Environmental Protection Act*, p. 2.

16 Doering *et al.*, *Environmental Regulations*, p. 4.

imposition of penalty are almost wholly absent m the Canadian environmental regulatory stem.

It is surprising, then, how persistent has been the myth that we have some kind of command and control system for environmental regulation. We have neither command nor control. Rather, ***bargaining*** *is the essence of environmental regulation in Canada.*[17]

legislation creating CEPA called for a liamentary review after five years. The process eview by the Standing Committee on vironment and Sustainable Development is now der way. The federal government can point to portant successes for CEPA, such as engthened health protection and disease vention through reduced exposure to toxins, proved connections between science and decision making, enhanced dialogue with the public and industry and better intergovernmental coordination.[18]

Critics, however, note a failure to back up these successes with effective enforcement of regulations. The Canadian Institute for Environmental Law and Policy, in its CEPA review submission, points to the low level of prosecutions under CEPA (Table 5-1) and the *Fisheries Act* (averaging 10 per year) and questions the ability of the federal government to preserve the regulatory legitimacy it will require to carry out its pollution prevention and sustainable development goals.[19] An independent review by Resources Future International, commissioned by Environment Canada, found that while CEPA helps the federal government assert national leadership in environmental protection, implementation has been hampered by a patchwork of regulations and enforcement schemes.

Table 5-1 Prosecutions Under CEPA

CHARGED UNDER	NUMBER OF PROSECUTIONS	PERCENT OF TOTAL
Ozone-depleting substance regulations	25	42
Ocean dumping provisions	14	24
Polychlorinated biphenyl (PCB) storage regulations	11	19
Gasoline regulations (later withdrawn)	8	7
Conviction rates	80 percent or higher	
Fines	48 out of 78 were less than $10,000	
Highest fine	$1 million for 36 violations	

ource: M. Winfield, ed., *Reforming the Canadian Environmental Protection Act, A Submission to the Standing Committee on nvironment and Sustainable Development* (Toronto: Canadian Institute for Environmental Law and Policy, September 1994), . 6.

Ibid., p. 5.

Environment Canada and Health Canada, *Reviewing CEPA: An Overview of the Issues* (Ottawa-Hull: Environment Canada and Health Canada, 1994), pp. 2-3.

M. Winfield, ed., *Reforming the Canadian Environmental Protection Act, A Submission to the Standing Committee on Environment and Sustainable Development* (Toronto: Canadian Institute for Environmental Law and Policy, September 1994), p. 5.

The command and control approach of some regulations, such as Ontario's MISA Program, has proved to be complicated and expensive for both government and industry. Requirements for the use of the Best Available Technology (BAT) or Best Available Technology Economically Achievable (BATEA) require the regulator to possess information about the abatement costs of each firm, which in itself opens the door to lengthy negotiations. For example, the process followed by the Ontario Ministry of Environment and Energy consists of the following steps:

> *Consultation with each industrial sector through joint technical committees; review of available data from various studies, monitoring programs and similar regulations in other jurisdictions; completion and review of economic studies, including the recommendations of the MISA Advisory Committee; and public review of regulations and supporting studies. Only through this rigorous process will the ministry identify and set BATEA discharge limits.*[20]

In addition to the complexity and expense of this approach, it can actively encourage endless bargaining and discourage innovation. In the end, it is simpler for the polluter to adopt the technology suggested by the regulator than to search for the best and least expensive alternative. Furthermore, the tendency to focus on emission controls, which set out a fixed limit (e.g., so many parts per thousand), does not take into account the carrying capacity of the receiving body (lake, stream, valley), the impact of increased plant capacity or the construction of additional facilities.[21]

There is no question that progress has been made under this system, but it has hardly been as environmentally effective or as cost-effective as it might have been. Worsening environmental conditions point in the direction of more stringent requirements. The test will be to find ways that are cost-effective, provide a competitive advantage for the environmental sector and avoid adverse competitive impacts on Canadian industry.

4. Approaches to Environmental Regulation

To address industry complaints and respond to the need to remove barriers, reduce costs and increase efficiency, federal and provincial authorities are working toward the harmonization of environmental regulations. A draft Environmental Management Framework Agreement (EMFA) is expected to be completed and submitted for public consultation late in 1995. It will make changes in responsibility and administration but will maintain federal government accountability.[22] This process has raised concerns with environmental organizations and others who fear that harmonization will reduce standards to the "lowest common denominator."

The downsizing of government and the concern about government debt mean there will be fewer resources available for many traditional government activities. There is a danger that government will be unwilling or unable to carry out its legitimate regulatory role. Indeed, some observers have expressed the concern that program reviews, harmonization and regulatory flexibility will eventually result in an abandonment of public environmental responsibility.[23]

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[20] B. Laplante, "Environmental Regulation: Performance or Design Standards," in G.B. Doern, ed., *Getting It Green, Case Studies in Environmental Regulation* (Toronto: C.D. Howe Institute, 1990), p. 69.

[21] *Ibid.*

[22] J. Bax, "Breaking Down Internal Barriers to Trade," comments at the First National Conference, Canadian Environment Industries Association (CEIA), *Towards a Sustainable/Competitive Environment Industry*, Ottawa (March 28, 1995).

[23] P. Muldoon, "Breaking Down Internal Barriers to Trade," comments at the First National Conference, Canadian Environment Industries Association (CEIA), *Towards a Sustainable/Competitive Environment Industry*, Ottawa (March 28, 1995).

Montreal Protocol — A Canadian and International Success Story

Praise for the Montreal Protocol on Substances that Deplete the Ozone Layer is almost universal. Governments, social and economic observers, environmental groups and businesses all agree that it has been a success. The path to this situation has not been entirely smooth.

The WorldWatch Institute was very critical of the Protocol in 1991: *"The Montreal Protocol ... was considered a remarkable diplomatic achievement when it was signed by 24 nations in September 1987. The ink was hardly dry, however, when new studies revealed that ... even with the agreement, ozone loss could lead to 5 to 20 percent more ultraviolet radiation reaching populated areas in the next 40 years.... At the time of its signing, the treaty was so riddled with loopholes that the protocol would not even accomplish its limited objectives of halving CFC consumption by 1998 and freezing halon consumption by 1992."*[24]

However, by 1995, both the Protocol and WorldWatch's opinion of it had changed dramatically. *"The hallmark of international governance to date is the Montreal Protocol on the Depletion of the Ozone Layer. First agreed to in September of 1987 and strengthened two times since then, the protocol now stipulates that the production of CFCs in industrial countries must be phased out altogether by 1996.... In a remarkably short period of time, the Montreal Protocol has become the international law of the land.... Because of the quick and dramatic reduction in global CFC emissions as a result of the pact, chlorine concentrations will begin to level off soon."*[25]

Some reasons for success:

- transfer of technology and funding to developing countries to allow change was critical;
- the transfer of resources was an open, democratic, fair process;
- flexibility arose from the trading and banking of controlled substances;
- trade sanctions were imposed against countries who did not participate; and
- clear, concrete goals were established and improved when this was feasible.

Lessons learned:

- developing and developed countries can cooperate if the needs of both are met;
- no substance or process is irreplaceable — the barriers are not technological;
- the cost of changing is less than predicted because of unforeseeable technological and social innovations;
- adopting a precautionary approach — lack of absolute scientific proof is no excuse for delay;
- performance standards are preferable to command and control regulations;
- a careful combination of "carrots and sticks" drives technological innovation and organizational efficiency;
- solutions should be industry- and product-specific; and
- changes should be at minimum cost and disruption, or companies and countries will be unwilling to cooperate.

Canada has been a central player in the world's attempts to deal with the destruction of the atmospheric ozone layer. It was the first country to ratify The Vienna Convention for the Protection of the Ozone Layer. It operates the World Ozone Data Centre, which has been collecting and distributing ozone data for the past 20 years. Canadians also developed the world's most accurate instrument for measuring ozone, the Brewer Spectrophotometer. The Montreal Protocol has benefited Canada in several ways. In addition to the location of the Secretariat in Montreal, a number of new technologies and companies have emerged that are dealing with the capture, recycling and replacement of ozone-depleting substances.

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[24] L. Brown, ed., *The WorldWatch Reader on Global Environmental Issues* (New York: W.W. Norton & Company, 1991), pp. 60-61.

[25] L.R. Brown *et al.*, *State of the World 1995* (New York: WorldWatch Institute, W.W. Norton, 1995), pp. 172-173.

The actors must maintain a clear focus on what is essential. An optimally efficient system will arise when government concentrates on "ends" (goals, targets) and business is allowed to determine the "means" of achieving these goals. Obviously, business and other stakeholders should have a part in setting those goals and determining what is feasible, but, once set, they should be strictly enforced by government. With such an approach, a range of options is available that will bring greater consistency, efficiency, effectiveness and fairness to the system (Table 5-2). Some suggestions regarding the best options for strengthening the EIS are included in Chapter 6.

Table 5-2 Approaches to Environmental Regulation

ELEMENTS	PREVAILING SYSTEM	INNOVATIONS
Rule-making process	Adversarial	Negotiated or mediated where possible
Policy tools	Regulations	Regulations may be supplemented by incentives and voluntary programs
Pollution targets	"End-of-pipe" treatment and disposal	Priority given to source reduction
Breadth of regulations	Single media	Multimedia if possible
Specificity of control	Individual sources controlled (one facility may need many permits)	Facility-wide prevention and control
Level of emission	Uniform release rates by facility	Flexible, determined by taxes or marketable permits
Enforcement mode	Sporadic but inflexible	Systematic but flexible
Agency organization	Media-organization (e.g., air office, water office)	Industry sector focus (e.g., petroleum refining, metals finishing)
Training	Narrow, focused on single media	Broad-based, but with technical focus
Technical development and assistance to industry	Minor focus	Important focus
Intergovernmental mode	EPA-led (headquarters-oriented)	EPA-state partnership (e.g., negotiated strategies)

Source: U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment, Competitive Challenges and Business Opportunities* (Washington, D.C.: U.S. Government Printing Office, January 1994), p. 24.

5. Economic Instruments

The purpose of integrating cost into pricing is not to provide a toll road for polluters, but a pathway to innovation. The incentive to lower costs is the same one that currently operates in all businesses, but in this case the producer's most efficient means to lower them is not externalizing these costs onto society, but implementing better design.[26]

[26] P. Hawken, *The Ecology of Commerce* (New York: HarperBusiness, 1993), p. 83.

Table 5-3 Economic Instruments

TYPE OF INSTRUMENT	GENERAL DESCRIPTION
Effluent charges	Paid on discharge into the environment and are based on the quantity and/or quality of the effluent
User charges	Payments for the cost of collective or public treatment of effluent
Product charges/taxes	Additions to the price of products that are polluting or are difficult to dispose of
Administrative charges	Control and authorization fees
Grants	Non-repayable forms of financial assistance, contingent on the adoption of pollution abatement measures
Soft loans	Low-interest loans linked to abatement measures
Tax allowances	Accelerated depreciation, tax or charge exemptions, and rebates if pollution abatement measures are adopted
Deposit refund system	Surcharges are laid on the price of waste, then refunded on the return of the product or its residuals
Market creation	Artificial markets in which companies can buy and sell rights for actual or potential pollution
Emissions trading	Within a plant, within a firm or among different firms
Market intervention	Price intervention to stabilize markets, typically secondary materials (recycled)
Liability insurance	Polluter liability leading to insurance market

Source: Projet de société, *Planning for a Sustainable Future, Canadian Choices for Transitions to Sustainability, Vol. 5, Toward a National Sustainable Development Strategy for Canada* (Ottawa: National Round Table on the Environment and the Economy, January 1995).

Economic instruments are legislative tools that use economic incentives or disincentives to influence behaviour and, in some instances, to raise revenues as well. Water rates, for example, are being raised not only to cover the costs of water, but also to reduce use. Economic instruments are also frequently cited as an important tool for achieving pollution prevention and as a superior alternative to regulation (Table 5-3).

Canada has very little experience with using economic instruments to achieve environmental goals. In fact, some existing economic incentives, such as those to support the growth of the petroleum sector or the use of pesticides, are disincentives for more environmentally sound practices, such as energy conservation or the reduction or elimination of pesticide use. Even one of the few environmental incentives, the Accelerated Capital Cost Allowance (ACCA), introduced in 1983 to cover air and water pollution control equipment, has recently been criticized for encouraging "end-of-pipe" investments rather than pollution prevention.[27]

The use of economic instruments can have a strong impact. Gasoline and carbon taxes in Europe have had a profound influence on the efficiency of cars. Increased dumping fees at landfill sites have spawned waste reduction measures and a wide range of recycling initiatives. Effluent fees stimulate input reductions through substitution or internal recycling. Emissions trading systems can encourage the adoption of technologies that reduce emissions to a minimum.

27 M. Winfield and H. Sawai, *Environmental Technology Support Programs in Canada* (Toronto: Canadian Institute for Environmental Law and Policy, May 1993), p. 26.

a. Task Force on Environmental Instruments

In July 1994, the Ministers of Environment and Finance announced the establishment of a multi-stakeholder task force to find effective ways to use economic instruments to protect the environment and identify barriers and disincentives to sound environmental practices.[28] Because the Task Force had only six months for deliberations and the preparation of a report, it restricted its investigation largely to energy issues. Prominent among its recommendations was a 1995 federal budget commitment to create a level playing field in the energy sector, specifically in the areas of R&D funding for renewable energy and equitable treatment of energy efficiency in the tax system. The Task Force also made longer-term recommendations for the establishment of a tradeable permit system to control air pollutants such as sulphur and nitrogen oxides, as well as benzene in gasoline. It also recommended the introduction of realistic water pricing and fuel efficiency premiums. No action has yet been taken on these recommendations.

b. Emissions Trading

Emissions trading systems are seen as one of the best economic instruments for minimizing the cost and intrusiveness of regulations, while at the same time encouraging the development of innovative technologies. First proposed in the United States about 20 years ago, they have been applied only in the past two to five years. It is still early, therefore, to assess some of the advantages claimed by their proponents.

When setting up an emissions trading system, a region or "bubble" is defined, and overall limits for the pollutant(s) are established within that bubble. The bubble can be a city, a river valley, a nation or the entire world. Each source of emissions within that bubble is given a permit to emit a certain amount of the pollutant annually. If the source reduces its level below the allowable limit, it earns a credit, which it is free to sell to one or more other plants within the bubble. Plants that can reduce emissions most easily and cheaply will tend to do so first, giving the most efficient overall reduction in costs. Firms with more difficult technical or capital situations have the option of buying credits to avoid being shut down for failure to comply, a step regulators are reluctant to take.

As standards are tightened, the supply of credits decreases. This increases the price of credits, providing more incentive for the plant to reduce its emissions. Again, the firm can choose what to do and when. None of this, however, is at the expense of the environment. When new plants are built or old ones expanded, they must either have a pollution-free process or purchase credits from an existing source. This contrasts with command and control regulations, where a plant would be allowed to pollute at the legal limit, thus raising the overall pollution in the region.[29]

The most important aspect of emissions trading is the fact that there is a built-in and continuing economic incentive for industries to reduce their emissions well beyond that required by regulations. Because of the rising costs of credits over time, companies will have more incentive to invest in pollution control equipment or a cleaner process. This can provide a great stimulus to environmental technology development.

Some environmentalists originally opposed emissions trading as somehow sanctioning a "right to pollute." This initial negative attitude has diminished, however, as successful examples emerged. The banking and trading of CFCs has been used in the Montreal Protocol's phase-out of ozone-depleting substances (ODS) and was allowed in the U.S. program for reducing sulphur oxides, though this particular approach would not be suitable for toxic substances. The Regional Clean Air Incentives Market (RECLAIM) program in the Los Angeles basin was initiated to control ground-level ozone by developing *"an enforceable program*

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[28] Task Force on Economic Instruments and Disincentives to Sound Environmental Practices, *Economic Instruments and Disincentives to Sound Environmental Practices, Final Report* (Ottawa-Hull: Department of Finance and Environment Canada, 1994), p. 1.

[29] C.W. Bartels, "Emissions Trading Programs in North America: Cleaner Air and Better Business," *Emerging Clean Air Technologies and Business Opportunities, Proceedings of the First North American Conference and Exhibition*, Toronto (September 26-30, 1994), pp. 97-98.

that would lower the cost of attaining clean air." It reports that compliance costs have been cut in half for nitrogen and sulphur oxides.[30] Such examples suggest that there is merit in restricting the government's role to setting targets and enforcing them, establishing performance standards and then leaving the methods employed to the emitter. This approach produces innovation and efficiency by allowing government and industry each to play its appropriate role.

6. Voluntary and Hybrid Agreements

The impetus for voluntary action can come from either the private sector or government. Such actions are particularly important in Canada, where cooperation and multi-stakeholder consultation are preferred to a command and control approach. Because such agreements lack both economic incentives and legally enforced regulations to produce action, there remains only community spirit, peer and/or public pressure or the recognition that cost savings could be achieved. Since most arrangements are very new, their effectiveness in reaching environmental goals has yet to be established.

The ARET (Accelerated Reduction/Elimination of Toxics) Program is a good example of this approach. In the spring of 1994, the ARET Committee challenged Canadian companies and government facilities to meet government targets for the elimination of certain toxic substances. After less than a year, 138 companies and seven government departments reported emissions reductions of 10,300 tonnes from 1988 levels and have committed to an additional 8,500 tonnes by the year 2000. The ARET process allows emitters to participate with maximum flexibility. If the system is effective in meeting its environmental goals, it can significantly reduce the costs of compliance to both government and the affected industries.[31] It should be added, however, that the ARET Committee originally included environmental and labour groups, but they withdrew when consensus could not be reached on elimination rather than reduction of toxic substances.

ARET is one of several government-corporate agreements that involve voluntary action. In Ontario, there are sector-focused programs involving the automotive, metal-finishing, dry-cleaning and publishing industries. For example, the Automotive Manufacturing Pollution Prevention Project (Table 5-4) is a cooperative effort of the Canadian Motor Vehicle Manufacturers' Association (MVMA), Environment Canada and the Ontario Ministry of Environment and Energy. Begun with the three large car makers, Chrysler, Ford and General Motors, a goal was established to *"produce a verifiable reduction of persistent toxic substances as well as other environmental contaminants of concern used, generated or released by the participating member companies."*[32] As a result, an initial 65 substances were identified. The companies are now working with suppliers on the early reduction of 29 of the 65 targeted substances. A similar process is also under way in the Automotive Parts Manufacturers' Association, with a goal of reduction and/or elimination of identified substances.

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30 P. Leyden, "Regional Clean Air Incentives Market (RECLAIM), A New Regulatory Program for the South Coast Air Basin, *"Emerging Clean Air Technologies and Business Opportunities, Proceedings of the First North American Conference and Exhibition,* Toronto (September 26-30, 1994), p. 720.

31 ARET Secretariat, *Environmental Leaders 1, Voluntary Commitments to Action on Toxics Through ARET* (Hull: Environment Canada, March 1995), pp. 3-4.

32 Projet de société, *Planning for a Sustainable Future, Canadian Choices for Transitions to Sustainability,* p. 4.

Table 5-4 Canadian Automotive Manufacturing Pollution Prevention Project: Summaries of Selected Projects

PLANT POLLUTION PREVENTION PROJECT	TARGET SUBSTANCE	RESULTS/ ADVANTAGES	MEDIA ADDRESSED
Elimination of sealer waste	Hazardous and non-hazardous sealers	• Expanded use of reusable sealer totes • Addition of plastic liners to 45-gallon drums has eliminated waste sealers • Re-use of clean drums • $50 per drum net savings (1992 costs) • Over $30,000 in savings annually	• Off-site disposal
Toluene elimination and VOC reduction program	Toluene and VOCs	• 311 lb./year toluene reduction (72 percent reduction) • 45,000 lb./year total VOC reduction (35 percent reduction)	• Air emissions
Use of water-based paints for maintenance of building and equipment	Various solvents, including naphthalene, toluene and xylene	• Alternative waterborne finish has been found • 21,500 lb. solvents reduced to date • Results shared with other plants for consideration	• Air emissions • Off-site disposal
Re-use of grinding swarf or sludge	Iron/steel and aluminum particles, which contain chromium, copper, nickel and other alloys	• 430 tonnes of aluminum grinding swarf diverted from landfill to metal recycling operation • 495 tonnes of iron/steel swarf diverted from landfill to recycling • $60,000 annual savings • Results shared with other similar operations	• Off-site disposal
Elimination of chlorinated solvents in paint line strippers	Methylene chloride	• Product substitution with non-chlorinated cleaner • 37 percent cost savings • Eliminated 77,300 litres of methylene chloride per year	• Waste disposal • Air emission
Re-use of "ELPO" dip	"ELPO" formulation, which contains lead	• 225,000 litres of "ELPO" dip transferred to other facility for use • $650,000 savings in replacement and disposal costs	• Off-site disposal
Use of polymers to replace traditional waste treatment plant chemicals	Zinc, nickel, sulphuric acid, caustic and calcium chloride	• Improved effluent quality by removal of metals • Costs reduced by $250,000 • Sludge volume reduced by 50 percent	• Discharge to sewer • Off-site disposal
New wastewater treatment plant	Zinc, chromium, lead, nickel and phosphorus 554 kg/year of chromium reduced (63 percent reduction)	• 1,223 kg/year of lead reduced (82 percent reduction) • 936 kg/year of nickel reduced (86 percent reduction) • 3,191 kg/year of phosphorus reduced (83 percent reduction)	• Effluent concentrations on process water

Source: Task Force of the Canadian Automotive Manufacturing Pollution Prevention Project, *Second Progress Report* (April 1994), pp. 7-9.

Other important initiatives to promote voluntary action programs include the chemical industry's "Responsible Care" initiative, the Canadian Manufacturing Association's (CMA) Manufacturing Environmental Performance Program, the federal government's Volunteer Challenge and Registry Program to encourage firms to reduce greenhouse gases and Ontario's Pollution Prevention Pledge Program.

The National Pollutant Release Inventory (NPRI) is a hybrid program, in that firms are required to report to Environment Canada on their emissions of 178 specified substances "of concern," but are not required to do anything about them. The system, which is modelled on the U.S. Toxics Release Inventory (TRI) of 331 substances, does not police or control the amounts, but will make an annual report of releases by company available to the general public. The first deadline for reporting was June 1, 1995. Public accessibility is key to this program. It is believed that inaccuracies will be reported by employees, communities, competitors or environmental groups. It is also expected that concerns over negative public reaction to high emissions will encourage reductions.[33]

U.S. Toxics Release Inventory (TRI)

The World Resources Institute reports that independent estimates suggest that TRI figures may underestimate U.S. releases *"for some important toxins by as much as a factor of 10.... Thus the TRI must be approached cautiously; at best, its data represent lower-bound estimates...."* However, the spectre of public accounting *"prompted business managers, many of whom had no overall picture of company emissions, to rethink their operations. Despite limitations in the TRI, it has become a bench-mark for measuring companies' commitment to cleaning up and thus a powerful public relations tool for use against reluctant industries."*

From, World Resources Institute (WRI), *World Resources 1994-95* (New York and Oxford: (WRI)/International Institute for Environment and Development, 1994), pp. 217-218.

7. Pollution Prevention

The pervasiveness of environmental problems in the 1980s served to highlight the limited success of pollution control efforts and led to calls in the 1990s for more effective ways to preserve the environment. With the wide acceptance of the concept of sustainable development, emphasis has shifted to pollution prevention.

There are a number of different definitions of pollution prevention, some of them centred on whether the final goal is to be elimination or reduction of a pollutant and whether energy conservation should be included. The key point, however, is that the goal is prevention rather than cure or control. Preventative steps normally change the production process. Frequently, changes involve lateral thinking, with a complete shift in the way processes are carried out. Northern Telecom's elimination of CFC-producing solvents is an example of this process. Rather than using substitute solvents for cleaning circuit boards, the solution was to change the circuit boards so that they no longer required any cleaning at all. The result eliminated not only the CFC problem, but also the need to deal with regulators, and it saved the company many millions of dollars.

Pollution prevention methods may be developed by the environmental industries or by the manufacturers themselves. It thus becomes crucial that the environmental industry develop the technological capacity to assist its clients in finding effective and efficient preventative solutions. *"It is argued that the new technology curve or frontier will be occupied primarily by pollution prevention technology – that is, new products, inputs or production processes. The use of initiatives to bring firms into environmental compliance using new technology is termed innovation-driven pollution prevention."*[34]

[33] Multi-stakeholder Advisory Committee, *A National Pollutant Release Inventory for Canada: Final Report* (Hull: Environment Canada, December 1992), pp. 1-5; Environment Canada, "Are You Required to Report? National Pollutant Release Inventory," (brochure 1994).

[34] N.A. Ashford, "Understanding Technological Responses of Industrial Firms to Environmental Problems: Implications for Government Policy," in K. Fischer and J. Schot, eds., *Environmental Strategies for Industry, International Perspectives on Research Needs and Policy Implications* (Washington, D.C.: Island Press, 1993), p. 279.

Provincial and federal governments are now actively supporting pollution prevention initiatives. The Canadian Council of Ministers of the Environment (CCME) made a national commitment to pollution prevention in 1993. The federal government has established a pollution prevention office and plans to incorporate policies supporting pollution prevention into the revised CEPA.[35] Key elements of this policy include regulatory harmonization with provincial programs, a more open toxics management policy that will give industry greater freedom in how it chooses to meet established targets,[36] greater regulatory flexibility (such as the contentious Bill C-62, which allows for contractual agreements between the government and individual companies) and a number of steps to bring environmental considerations into the operations of the government.

Pollution Prevention

Pollution prevention is about expanding the range of cost-effective options for environmental decision making. It is about innovation in product design and production. It encourages cost savings through efficiencies and conservation. It is about on-site re-use and recycling, equipment modification and training. It insists on sound management of persistent, bioaccumulative and toxic substances and on eliminating their use where necessary. It offers Canadians an opportunity to achieve their environmental goals in a way that is more effective than the traditional means of environmental protection — in a way that stimulates innovation and our ability to compete.

From, Environment Canada, *Pollution Prevention: Towards a Federal Strategy for Action,* draft (Hull: Environment Canada, undated), p. 4.

8. "Greening" Government

The "greening" of government practices, like "greening" industry practices, will be a long, slow process. While governments have preached the importance of integrating environmental considerations into the decision-making process, they have been slow to act internally. Recently, the pressure for government to "lead the way" has strengthened, and steps have been taken by the federal and some provincial governments. British Columbia has created the B.C. Purchasing Commission to help develop "green" purchasing policies, and Manitoba has made sustainable development an integral part of its cabinet decision-making structure.

These are important steps for the environmental industry, since governments are among the largest consumers of its products and services in developed countries. In the United States in 1993, for example, the Clinton administration introduced a requirement that paper purchased by the government (the largest purchaser of paper in the United States) have 20 percent post-consumer recycled content by the end of 1994 and 30 percent by the end of 1998. This is having a major impact on paper makers in the United States. Every state in the United States has regulations or policies encouraging the procurement of products with some recycled content. While the majority are focused on paper, others cover items such as compost and motor oil. At present, some 38 states apply a price preference for paper with secondary content.[37]

In Canada, a number of recent federal government initiatives will contribute to the process of making the government more responsive to environmental considerations. These include the proclamation of the *Canadian Environmental Assessment Act*, the appointment of a Commissioner of the Environment and Sustainable Development and an initiative to provide standards for government-wide "green" procurement.

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35 Environment Canada, *Pollution Prevention: Towards a Federal Strategy for Action,* draft (Hull: Environment Canada, undated), pp. 1-7.

36 Environment Canada, *Toward a Toxic Substances Management Policy for Canada,* a discussion document for consultation purposes (Hull: Environment Canada, September 1994), p. 10.

37 M. Winfield and J. Rabantek, *Putting the Environment in Green Industry Strategies: The Role of Environmental Industries in Restructuring for Sustainability* (Toronto: Canadian Institute for Environmental Law and Policy, April 1995), p. 32.

"Greening" a Government: The "Environment First Policy" of Waterloo, Ontario

In the past, the environment often took a secondary role to other management and development decisions such as planning, engineering and finance. This new approach places the environment at the same level of importance. This thinking was the result of a study undertaken in 1989 to address a range of environmental issues in the city, including pesticide use, water quality, recycling, woodlot protection and community stewardship. An Environmental Think Tank, which included all the key players in the city, including the mayor, developed the policy, which involved the 350 employees of the city in its implementation. With the cooperation of City Council, staff and the community, the following actions have been taken:

- conversion of city vehicles to propane or natural gas;
- installation of energy-efficient lights;
- reduction of pesticide, road salt and sand use;
- new park/open space design;
- naturalized planting system;
- acquisition of environmentally important areas;
- recycling and composting; and
- environmentally friendly city supplies and practices.

From, "Municipal Planning, City of Waterloo, Ontario," in B. Mausberg, *Great Lakes Pollution Prevention Bibliography* (Sarnia, Ontario: Great Lakes Pollution Prevention Centre and the Canadian Institute for Environmental Law and Policy, September 1994), section 9.

Reforms to the Environmental Assessment and Review Process, announced in 1990, included the creation of the *Canadian Environmental Assessment Act*, which was intended to ensure that environmental considerations were included in federal government planning and decision-making processes. The Act came into effect in October 1994 and applies to projects for which the federal government holds decision-making authority. The Act is administered by the Environmental Assessment Agency, which operates at arm's length from the government.

As a further measure to ensure that the government does act on its commitment to sustainable development, a Commissioner of the Environment and Sustainable Development has been appointed under the *Auditor General Act*. The Commissioner will monitor and report to Parliament on the government's performance in integrating environmental concerns into its decision making.

The federal government purchases close to $9 billion worth of consumer, commercial and industrial goods and services annually. It also owns or manages 41 percent of Canada's land mass. It is Canada's largest commercial landlord and owns or leases 25 million square metres of office space in more than 50,000 buildings and facilities.[38] Its commitment to "green" procurement and the "green" enhancement of the Federal Building Initiative announced in the Canadian Environmental Industry Strategy will open up new markets for environmental goods and services.

GOVERNMENT SUPPORT PROGRAMS

1. Areas of Support

Government support programs for environmental industries promote the development, growth and market access of environmental technologies and services. While there is a wide variety of programs offered by both federal and provincial governments, programs in Canada tend to be

[38] Environment Canada, *Pollution Prevention*, p. 7.

focused on applied research, technology development and export development. Over the years, programs have been responsive to changing needs. They do not reflect a coordinated approach to these young industries. However, some programs point to the emergence of new government strategies designed to provide more effective support to the industries.

Canada's historically low level of research and development (R&D), particularly in the private sector, and our small domestic market have been important factors in determining the focus of government support. While industrial R&D expenditures in Canada have risen in the past 20 years from 0.4 percent to 0.81 percent of Gross Domestic Product (GDP), it is still one of the lowest ratios for all Organisation for Economic Co-operation and Development (OECD) countries. The small size of many Canadian companies accounts for much of this. In 1991, almost half of all R&D expenditures in Canada were accounted for by only 25 companies.[39] Other contributing factors are the branch plant nature of many large firms and limited access to the capital needed to support technology development. Environmental small to medium-sized enterprises (SMEs) face the same difficulties as other high-technology SMEs in accessing adequate investment capital to support moving from concept to commercialization.

Government funding for research and technology development has thus been critical to the growth and survival of small technology-driven environmental companies. The importance of government participation at the early stages of development is shown in Table 5-5. Sources of capital vary as the firm develops. Initial funds tend to come from family and personal resources, private investors and government. As the firm moves from product development into full commercial production and sales, all-important sources are government, banks and private and venture capital investors. Only when the firm is profitable, or at least breaking even at the mezzanine stage, do established institutional sources provide the funds for further expansion.

Table 5-5 Financing Sources for SMEs at Various Stages of Development

SOURCE	START-UP	DEVELOPMENT	GROWTH	MEZZANINE
Personal and family resources	Major	Minor		
Banks	Minor	Major	Major	Major
Governments	Major	Major	Minor	
Private investors	Major	Major		
Venture capital companies	Minor	Major	Major	
Institutional investors			Minor	Major
Stock market		Minor	Major	Major
Industrial investors		Minor	Major	Major

Source: "Financing Issues for Small to Medium Sized Environmental Companies," cited in Industry Canada and Environment Canada, *Environmental Industry Strategy for Canada, an Interdepartmental Consultation Paper* (Ottawa: Industry Canada and Environment Canada, January 1994), p. 24.

2. The Shifting Agenda

Cooperation with industry representatives has helped to identify gaps in government support for funding, commercialization, future human resource requirements, management and marketing. Federal and provincial governments are exploring new ways to support science and technology (S&T) and the EIS in an era of diminishing budgets and increasing international competitiveness.

[39] Task Force on Sustainable Wealth and Job Creation, *Towards an Innovation Strategy, Final Report* (Ottawa: Government of Canada, December 1994), Preamble.

To address the needs of a new agenda, a review, prepared by the federal Interdepartmental Task Group on Sustainable Wealth and Job Creation, argues that Canada must develop a systematic approach to innovation, *"a strategy that mobilizes powerful new combinations of people, capital, resources and ideas."*[40] The study recognizes that government support of S&T has been a critical factor in the development of innovation in Canada and describes a new role in which government acts as a facilitator of interactions between distinctly operating components — educational, industrial, university and governmental.

> *The connection between S&T and wealth creation is through innovation — the process by which new or improved products and processes are developed and introduced into the marketplace. Innovation is no longer conceived as a linear process, solely dependent on technology-push and market-pull. It is a dynamic, iterative and turbulent process involving scientific discovery, applied research, development, investments, marketing and sales.*[41]

A close and cooperative relationship between government and industry has been the hallmark of environmental industry development in many European countries and Japan. Government departments of industry frequently work closely with private industry to mobilize and leverage environmental technology development. In the Netherlands and Denmark, for example, environmental technology policies focus on cooperation between users, suppliers, developers and consultants to ensure at an early stage that the technology is what the user needs.[42] In Canada, there is a growing tendency toward greater cooperation among stakeholders, though rarely do they involve participation of both users and suppliers.

The following review of government programs provides a sampling of current activities. These reflect the shifting priorities of governments and the continuing unsettled status of many programs, some of which will be affected by federal government cutbacks.

Some of the programs discussed in this chapter are focused solely on the environmental sector, while others provide support to Canadian industry in general. Of particular interest are technology support, research, development, commercialization and demonstration, financing, management and technical skills and access to international markets.

a. Government Cutbacks

At the federal level, many of the programs initiated under the 1990 Green Plan have reached the end of their five-year budget commitment, and this, along with the spending cuts announced in the 1995-1996 federal budget, makes their future uncertain. It is reported, for example, that 73 percent of the $57 million set aside for the implementation of the federal government's Environmental Industry Strategy has been cut from the budget.[43]

Following the introduction of the budget, Industry Canada announced sweeping reductions in its business support programs. Of its 54 programs, nine were terminated immediately, 34 will not be renewed and only 11 programs are to be continued. All sectors have been affected by this decision. The St. Lawrence River Environment Technology Development Program was terminated, with its 1995-1996 budget reduced to $100,000. The technology programs that are to continue, such as the Environmental Technology Program, will receive no new commitments pending a *"Cabinet review of support for technology development."*[44]

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40 *Ibid.*

41 *Ibid.*, p. 5.

42 U.S. Congress, Office of Technology Assessment, *Industry, Technology and the Environment*, p. 300.

43 W. Immen, "Earth Day Birthday Cause for Optimism," *The Globe and Mail* (April 22, 1995), p. A6.

44 Industry Canada, "The Impact of the Budget on the Industry Canada Portfolio," *Information Bulletin* (Ottawa: Industry Canada, 1995), p. 5.

Industry Canada's expenditures on S&T agencies, which represent about 30 percent of the government's total S&T spending, are to be cut by about 15 percent by the 1997-1998 fiscal year.[45] This will affect the National Research Council (NRC), but the impact on the environmental programs managed by NRC has yet to be determined. Similar cuts are anticipated in Environment Canada.

3. Government Research Establishments

Canada has a well-established tradition of government-supported technology development. Some 200 federal R&D laboratories, technology centres and support programs have come into existence over the past few years. The most important federal institutions include NRC, the Canada Centre for Mineral and Energy Technology (CANMET) and Environment Canada, all of which have facilities that are important to the EIS. More recently, they have been joined by government-owned and contractor-operated (GoCo) institutions such as Environment Canada's Wastewater Technology Centre, which has been transformed into a commercially viable research organization. All of these institutions have been critical to the development of environmental research in Canada and offer a variety of services to industry. They are particularly important to SMEs that do not have in-house expertise or access to highly specialized and expensive testing equipment.

a. Institute for Environmental Research and Technology (IERT)

This NRC group, with a staff of 160 engineers, scientists and technologists, deals in four areas: reducing airborne emissions, managing solid and liquid wastes, energy efficiency and measurement of contaminants. It provides scientific and testing services to industries, enters into joint ventures with clients and licenses products and processes to companies for commercialization. For example, IERT's high-efficiency atomizer for gas scrubbing operations has been commercialized and marketed by a Canadian company. NRC's current total budget of $430 million is slated to be reduced by $76 million over the next three years, and this may have an impact on IERT programs.

b. Energy Research Laboratories (ERL)

Founded in 1974, ERL has 130 scientists and technologists within CANMET, which is part of Natural Resources Canada (NRCan). Its goal is to *"develop innovative, environmentally friendly technologies for competitive production and efficient use of hydrocarbon fuels and energy."*[46] ERL transferred a ceramic filter technology used to clean underground mine air to Engine Control Systems Ltd. It is now sold throughout North America for bus diesel engine emission control. Funding comes from the Program of Energy Research and Development (PERD) and the Green Plan. ERL works closely with industry, which invests about $9 million annually. In turn, ERL contributes over $6 million per year for R&D to industry, universities and provincial research establishments.

c. Environment Canada

Environment Canada operates 8 national and 29 regional laboratories, which deal with the entire range of environmental issues. The older institutes are less directly connected to industry, being mainly involved in basic research and studies of air and water pollution, waste management, toxic chemicals, wildlife, and weather forecasting as well as global environmental security issues, such as acid rain, global warming and climate change and stratospheric ozone depletion. These activities provide background material critical to informed environmental decision making by government and industry. They also provide the basic scientific data on which environmental regulations are formulated.

The newer laboratories, such as the Environmental Technology Centre, conduct projects in partnership with the private sector and other government bodies to develop, evaluate, demonstrate and commercialize new environmental technologies. For example, the Microwave-Assisted Process (MAP) technology was developed at River Road for liquid-phase extraction. It has been licensed to three Canadian companies: CEM Corporation,

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45 *Ibid.*, p. 6.

46 Canada Centre for Mineral and Energy Technology (CANMET), *ERL Highlight*, brochure (Ottawa: Natural Resources Canada, undated).

CWT-TRAN International Inc. and Pronatex Inc. All have entered into technology transfer agreements with Environment Canada to develop further applications of the technology in various fields and areas of the world.[47]

Research results and advice from the National Water Research Institute (NWRI) helped Trojan Technologies develop ultraviolet (UV) sterilization processes for sewage and drinking water treatment systems. Trojan is the world's leading supplier of UV disinfecting systems, with 70 percent of the global market and activity in 35 countries.[48]

d. Provincial Research Institutions

All of the provinces except Newfoundland, Prince Edward Island and Manitoba have research establishments, as do Hydro-Québec and Ontario Hydro. Many were formed in the 1940s to conduct research and provide scientific and technical assistance to the resource sectors of their region. As part of their mandate, they are all currently involved in environmental projects.

4. Technology Development

As the industry has evolved, a number of newer technology support programs have been developed both federally and provincially. Most of these programs are less than five years old. Since 1990, the federal government, Ontario, Quebec, Nova Scotia, Manitoba, Saskatchewan and Alberta have initiated environmental R&D support with commitments totalling approximately $220 million for 1992-1997. Ontario has been the most active in promotion of the sector, with the development of a "green" industry Industrial Policy Framework in 1992. Programs have concentrated on waste reduction and diversion, tire re-use and recycling, industrial energy efficiency and site remediation.[49]

Cooperative arrangements with provinces, academic institutions and, more recently, industry are increasingly important as the government focus shifts from science and research to R&D for economic development. While the future of some programs is in doubt, it is anticipated that the federal government's new Science and Technology policy, to be announced this year, will confirm the importance of environmental technologies as well as reinforce the government's commitment to concentrate 25 percent of all R&D funding on this sector.

a. Filling in the Financial Gap

Many of these programs address the difficulty SMEs have in obtaining sufficient investment capital for start-up and early growth. While some programs are designed to encourage private investment, they have had limited success thus far. Even venture capitalists, who should not be risk-averse if a sufficient rate of return is possible, have been reluctant to invest in environmental firms. Absence of specialized knowledge appears to be a serious impediment. Without this knowledge, it is difficult for financial institutions to evaluate the commercial potential of an environmental technology. Lack of understanding of environmental issues and technologies in the financial community and preference for "known" areas of investment work against environmental companies. This serves only to fuel concerns regarding environmental liability.

Uncertainty about environmental regulation also deters investors. In both the United States and Canada, changing approaches to regulations (which frequently accompany political changes) and the confusing and haphazard application of regulations increase the risk associated with an environmental investment.

The result is that seed financing comes largely through grants from government agencies, such as Innovation Ontario. Venture capital has not materialized to any large extent, though some is available from non-traditional sources. Labour-sponsored venture capital funds, spurred by tax incentives, have added considerably to the venture capital pool, particularly in Quebec. EnviroCapital,

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47 Environment Canada, *Pathways to a Greener Future – Environmental Industry in Canada* (Ottawa: Minister of Public Works and Government Services Canada, 1995), pp. 4, 5 and 8.

48 *Ibid.*, p. 9.

49 Winfield and Sawai, *Environmental Technology Support*, pp. 1-6.

Regulatory Uncertainty = Declining Investment

Sierra Ventures of California has US $10 million in five companies in the environmental sector, yet has made no new investment in the last two years in spite of substantial profits from these investments. *"The real turnoff for Sierra is the general political and enforcement/regulatory climate. Many were optimistic that the Clinton Administration might prove more favorable to the industry, but that certainly hasn't happened.... There's less action than under Bush,"* according to partner, Peter Wendell.

From, G. Ferrier, "Air Quality Markets and Investment Perspective on the Environmental Industry," *Emerging Clean Air Technologies and Business Opportunities, Proceedings of the First North American, Conference and Exhibition,* Toronto (September 26-30, 1994), pp. 425-426.

for example, was formed specifically to invest in environmental technology firms and is supported by the Solidarity Fund of Quebec. It is, however, one of only two environmental venture capital firms in Canada.

Funding mechanisms include outright grants, shared-cost arrangements and contracts. Government funding to environmental industries was relatively low in the 1980s, amounting to approximately $10 million prior to 1990. In that year, the Green Plan was launched with a commitment of $3 billion in new money. The $100 million Technology for Environmental Solutions Program, one component of the Green Plan, is designed to develop, transfer, commercialize and implement technologies to prevent or to clean up pollution.

b. Environmental Technology Commercialization Program

This is the largest element of the Technology for Environmental Solutions Program, which has a six-year budget of $80 million and expectations of attracting an additional $150 million of private-sector support. It provides financial assistance to SMEs for 75 percent of the cost of preliminary studies (up to a maximum of $50,000) or up to 50 percent of demonstration costs (up to a maximum of $5 million) to develop and commercialize new environmental technologies. Examples of projects undertaken through this program are provided in Appendix V.

c. D-RECT Program

Established by Environment Canada and NRCan in 1978, this program encourages the demonstration of innovative new technologies that reduce pollution and recover energy from wastes. Eligible projects must be energy-saving and have commercial viability. The program has an annual budget of $1 million.

d. Program of Energy Research and Development (PERD)

Started by NRCan in 1991, this program supports 9 percent of all energy-related R&D. Its stated objective is *"developing the science and technology for Canada to produce and utilize its energy resources in an environmentally responsive and cost-effective fashion."*[50] Table 5-6 shows how PERD distributes its funding.

e. Industrial Research Assistance Program (IRAP)

This is a long-standing program administered by the NRC. It provides small and medium-sized firms with funding and technical information, industrial engineering and expertise to reduce the financial risk of implementing new environmental technologies.

f. Environmental Innovation Program (EIP)

With $20 million to be spent over six years, this program was initiated in 1992 to encourage a broad range of ideas and funding to deal with air, water, land and other environmental issues by forming partnerships with other government departments, universities, industry and the applicants. To encourage specific products, Environment Canada uses contracts rather than grants. Projects must be sponsored by a federal government department

50 Interdepartmental Panel on Energy Research and Development, *Plan of the Program of Energy Research and Development (PERD)* (Ottawa: Natural Resources Canada, April 1994), p. 2.

Table 5-6 Distribution of Funding by PERD, 1994-1995

AREA OF ACTIVITY	$ MILLIONS	PERCENT OF TOTAL
Alternative transportation fuels	20.8	24
Oil, gas, electric	15.8	18
Energy efficiency	14.7	17
Coal	9.6	11
Fusion	8.4	10
Renewable energy	8.1	9
Coordination, international	7.1	8
Generic environmental	1.7	2

Source: Interdepartmental Panel on Energy Research and Development, *Plan of the Program of Energy Research and Development (PERD)* (Ottawa: Natural Resources Canada, April 1994), p. 11.

and be *"a unique idea which can result in a tangible, new environmental product, process or service... in the areas of natural, social or human health sciences."*[51]

Since its inception, EIP has leveraged $12 million in outside funding to supplement its own contribution of $3 million: 40 projects had been approved by November 1994. For example, an Acoustic Ocean Thermometer for Detection of Global Warming has been developed by JASCO Research Ltd. of Sidney, British Columbia. Roughly 30 percent of the total project funding of $190,000 was provided by EIP. The objective is to improve the measurement of mean ocean temperatures to predict minute changes in atmospheric mean temperatures. The technology can be used in an international network of monitoring systems.

g. Technology Transfer Program

This $18 million program assists Canadian firms in locating, assessing, transferring and promoting environmental technologies.

h. Research Partnerships Program

This program, administered by the Natural Sciences and Engineering Research Council of Canada (NSERC), encourages partnerships between universities and private-sector organizations by providing funding and technical support.

i. Applied Pollution Prevention Program, Ontario

The program was initiated in 1990 (as the Environmental Technologies Program) with a five-year budget of $30 million. It concentrates on the development, refinement and commercialization of innovative environmental products or processes. For example, EcoLogic International received funding in 1991 to test a portable gas-phase reduction reactor on sediments containing polychlorinated biphenyls (PCBs) and other toxic organic compounds. Environment Canada was a funding partner in the successful demonstration. In 1992, a larger successful test was carried out in the United States under EPA sponsorship. As a result, EcoLogic has the only patented method for the proven destruction of a number of hazardous wastes without incineration. It is cost-competitive with incineration, it avoids the public opposition to burning toxic wastes and its portability eliminates the need to transport the wastes or fight Not In My Backyard (NIMBY) over the location of a permanent destruction site. The estimated market for PCB and dioxin destruction in the United States alone is between US $200 and $500 million over the next few years.[52]

j. Province of Quebec Support

The Quebec Ministère de l'Environnement has a five-year budget of $50 million to support new environmental technologies. This is a way of developing environmental industries by funding research in environmental protection and development of innovative technologies.

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51 Environment Canada, "The Environmental Innovation Program Success Story," *Innova* (Spring 1994), p.1.

52 D. Stoffman, "The Big Clean-Up," *Report on Business Magazine* (November 1994), pp. 48 and 51.

5. Resources for Management and Technical Skills

a. Canadian Environmental Technology Advancement Centres (CETACs)

Designed to assist environmental SMEs in their technology and business development, these centres provide expertise and information that is not available in smaller companies. They follow a Green Plan commitment to create a *"facility or infrastructure that will accelerate and increase the exploitation of environmental technology opportunities through the provision of key services to Canadian small and medium-sized enterprises."* Doyletech Corporation subsequently proposed the creation of a centre, based on the U.S. National Environmental Technology Applications Corporation (NETAC), which could address perceived barriers to the commercialization of environmental technology. The barriers identified by Canadian SMEs were largely regulatory and financial, and the solution they identified was access to technical information, testing facilities, technology assessment and sources of equity capital.

In 1994, a partnership between the federal and provincial governments, environmental industry associations and the private sector led to the establishment of three CETACs to assist the Canadian EIS. These not-for-profit corporations, Enviro-Access Inc. in Sherbrooke, the Ontario Centre for Environmental Technology Advancement (OCETA) Inc. in Toronto and the Canadian Environmental Technology Advancement Centre – West (CETAC – WEST) in Calgary, provide a wide range of technical and business services to small and medium-sized firms. *"The priority is on helping firms move environmental technologies through the commercialization process. Canadian technology developers can then refine their product and carry out actual production and distribution without the corporation's assistance."*[53]

This is achieved through:

- technical assessment and evaluation of environmental technologies;
- technology demonstration and R&D scale-up assistance;
- access to networks for locating new sources of environmental technology;
- provision of matchmaking tools that facilitate strategic alliances;
- regulatory and environmental analyses;
- advice on funding sources in both the public and private sectors; and
- general business counselling, including market research, and planning and analyzing business and financial plans.[54]

b. Canadian Council for Human Resources in the Environment Industries (CCHREI)

The Department of Immigration and Employment commissioned Ernst and Young in 1992 to prepare a detailed study of human resources in the environmental industry. With employment now at approximately 150,000, the environmental sector is already one of the largest employers in the economy. The problem identified by the study is to ensure a supply of the skilled managers and technicians needed for continued growth.

Government and industry moved to address these issues. Human Resources Development Canada provided $2.03 million in funding over three years to establish a permanent Canadian Council for Human Resources in the Environment Industries (CCHREI). Members of CCHREI include provincial environmental industry associations, academia, professional associations and interest groups.

Headquartered in Calgary, CCHREI's first task was to define occupations and employment functions in order to facilitate national standards and certification. This is the first step toward developing better management and technical skills, managing industry change and meeting industry needs. A *Compendium of Environmental Training Courses and Programs,* listing 12,000 courses offered by educational institutions in Canada, was published in 1994.

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53 Environment Canada, *Canadian Environmental Technology Advancement Centres (CETACs),* information brochure (undated), p. 3.

54 *Ibid.,* pp. 1-5.

c. National Youth Internship Project

This cooperative program, initiated in early 1995, is funded by Human Resources Development Canada and managed by four provincial environmental industry associations. Courses are offered by community colleges in the participating provinces. It is an experimental program involving 50 to 60 interns in each province. Over three years, they will attend classes for three months and work in an environmental firm for nine months. This will earn them technical certification upon completion. If successful, it will help to meet the growing need for skilled technicians in the industry.

6. Export Support

a. Department of Foreign Affairs and International Trade (DFAIT)

Initiatives to support exports in the environmental sector are primarily the responsibility of DFAIT. The focus of these programs is the promotion of Canadian companies through the preparation of export capability directories, intelligence gathering, targeted trade missions and shows (in Canada for foreign buyers and overseas for Canadian sellers), the facilitation of strategic alliances with foreign partners and a series of workshops in Canada to strengthen the international orientation and marketing capacity of Canadian firms.

DFAIT has also prepared an International Trade Business Plan for environmental equipment and services for 1995-1996, which outlines *A Strategy for the Canadian Environmental Industry*. It proposes 10 strategic directions to be carried out with other departments and agencies. These include market intelligence programs, training in developing countries, alliances with NAFTA partners for trade, investment and technology transfer and targeted pursuit of contracts offered by international financial institutions. In addition, close to 80 missions and trade shows are planned for fiscal year 1995-1996, with 50 percent taking place in the United States.

b. Other Departmental Initiatives

Several other departments support export activities, including Industry Canada, Environment Canada, the Canadian International Development Agency (CIDA) and NRCan. Because the industry is so strongly dominated by service companies, programs to support overseas consulting and training through multilateral and bilateral programs are also important. The Environmental Technology Advancement Directorate (ETAD) of Environment Canada, for example, sponsors a number of overseas training initiatives and exchanges, provides support for trade shows and is developing a technology cooperation project with the environmental sector in India. ETAD has also introduced several Canadian companies to foreign markets through the bilateral funding provisions of the Montreal Protocol. Through its Industrial Cooperation Division, CIDA has financed 232 environmental projects worth $35.4 million over the past five years, projects that are normally carried out by Canadian firms.[55]

c. The Globe Series

Another important event supported by many government departments and agencies and the province of British Columbia is the Globe Series, which takes place in Vancouver every two years. This private/public series is organized by the Globe Foundation through the Asia Pacific Foundation and has become a major trade show and conference for the international EIS, as well as a major opportunity to feature Canadian capabilities to international buyers.

d. Canadian Environmental Training Opportunities Program (CETOP)

CETOP was initiated by the ETAD of Environment Canada to promote Canadian training capabilities to the international community. Short courses offered by environmental firms and organizations are expected to benefit Canadian industry through international exposure. Provincial and federal departments as well as private consulting firms offer technical courses through this program.

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[55] Innovest Group International, S.A., *CIDA and the Canadian Environmental Industry Strategy*, unpublished report to Canadian International Development Agency's (CIDA) Partnership Branch (September 1994), p. 48.

e. Export Support Agencies

Although not specializing in the environmental sector, two agencies offer important services to Canadian exporters. The Canadian Commercial Corporation (CCC) gives Canadian suppliers the backing of government in order to enhance their credibility and competitiveness. Its services include assistance at all stages of bidding and contract negotiations, contract administration and securing the collection and disbursements of payments to suppliers. The Canadian Export Development Corporation (EDC) supports trade and foreign investment through risk management services such as insurance, financing and guarantees to Canadian companies and their customers overseas.[56]

[56] *Ibid.*, pp. 55-56.

Chapter 6 – Toward the Future

INTRODUCTION

The state of the world's environment constitutes a permanent source of concern. Environmental conditions may get worse, or they may improve, but they can never be taken for granted. They present a challenge to Canada and the rest of the world to find the means of sustaining our industrial societies in the face of our current dependence on the planet's finite resources and limited absorptive capacity.

What is encouraging is that there seem to be few limits on the ingenuity and ability of people to find solutions to the environmental problems they have created. This means that technological progress and innovation are of key importance in addressing environmental needs. That, in turn, requires the commitment of resources, a commitment that can derive from the "push" or "pull" factors – the push of public and private policies or the pull of the marketplace.

On the push side, public perceptions of the environment have been irrevocably changed by the growing understanding of the scope of the environmental challenge facing the world. Consequently, there will be demand for actions and policies to clean up and preserve the environment. Equally important is the continuing push for greater efficiency and lower costs. The expensive and wasteful processes of the "old economy" are fading as new technologies make available newer, cleaner and cheaper production methods. These forces are creating new markets for environmental products and services, a pull that will drive the growth of the environmental industy sector (EIS).

Changes in public thinking have been reflected within governments and in the corporate world. There is a near-universal increase in the realization of the importance of the environment and the acceptance of environmental concerns as a priority for government, multilateral agencies and industry. Cross-border solutions are becoming more common, as can be seen in various international agreements, the environmental component of the North American Free Trade Agreement (NAFTA) or European harmonization of environmental standards and policies. There is also a conscious effort on the part of most countries to stimulate an indigenous EIS.

Increasingly, good environmental practices are being recognized as good business practices that improve environmental conditions while selling products. There is a money-saving shift to pollution prevention as opposed to the traditional, and more costly, "end-of-pipe" solutions of pollution alleviation or remediation. At the same time, business is creating environmentally friendly products to meet growing consumer demand. And business leaders are promoting cleaner production practices, which in turn ultimately obviate the need for extensive regulation.

> *Fortunately, many businesses are discovering the "green economics" is the economics of efficiency: rethinking manufacturing processes to protect the environment can be both profitable and a tool for competition. Innovative solutions to domestic environmental problems can be marketed worldwide.*[1]

Despite these encouraging signs, there is much that remains to be done. A comprehensive approach to the EIS by government and industry is important to the development of a strong environmental sector. It can promote innovation that will both solve environmental problems and give Canadian companies a competitive edge. Government policies and programs now geared toward jobs and wealth creation are moving in this direction as they put into place the elements of a strategic program that will ensure that the EIS continues to be an important contributor to Canadian economic development.

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[1] Liberal Party of Canada, *Creating Opportunity: The Liberal Plan for Canada* (Ottawa: The Liberal Party of Canada, 1993), p. 66.

In this final chapter, we look to the future: the calls for action, the emerging opportunities and the strategies adopted by governments to position the sector for future growth.

THE CASE FOR CONCERTED ACTION

Global trends in spending, changes in public opinion and the evolution of government policy all point to the emergence of a rapidly expanding and highly competitive environmental market. The shift to pollution prevention, energy renewal, biotechnology, re-use and recycling is now apparent in many developed countries, and it is virtually certain they will dominate market demand in the future. Success, however, will go to those firms that can position themselves strategically now.

1. The Cost of Inaction

Warnings of the consequences of inaction have come from many sources. In *Creating Opportunity*, the Liberal Party notes:

> *In the next decades, the development of stricter environmental standards will be propelled by a number of international environmental, moral and market forces. Canada cannot remain isolated from these trends. We have only two choices: resisting the future, lagging behind, and bearing the brunt of painful adjustments and imposed practices; or leading, defining, and benefiting from the economic efficiencies of improved environmental processes and the expanding environmental industries market.*[2]

In a similar vein, the Canadian Institute for Environmental Law and Policy notes in its 1995 study of environmental industries that important domestic opportunities have been or may be lost. For example, many Canadian pulp and paper mills have adopted Scandinavian effluent treatment processes, and French and British firms have become aggressive in offering municipalities the means to privatize their water treatment facilities.[3]

In its consultations with municipal governments, the National Round Table on the Environment and the Economy discovered that many municipal governments in Canada are unaware of the capabilities of Canadian companies to meet their wastewater treatment needs. As a strategic response, the Round Table sponsored a series of six industry-municipal round tables in major centres across Canada in the spring of 1995.[4]

Doyletech, in its study of Canada's environmental technology exploitation capability, suggests that inadequate action now may create the same opportunity loss as that experienced by Canada in the late 1940s, when we did not convert our pool of war-time know-how into technologies for the resource sector:

> *Our resource industries have served us well over the years but we have not used them as test beds for new technologies and new products in the same way that other countries have. Our mines, sawmills, pulp and paper mills, refineries, fish processing plants and our oil fields have been used by countries such as Finland, Norway, Sweden, Germany, the U.S. (and even Iceland) to exploit new technologies. These countries have not stood still; they have taken the products they developed for the resource industries and applied them to other industries (particularly those that were growing and that needed technology). The result is that even though the demand for most resource-based products is now declining around the world, these countries no longer rely on them as heavily as they once did, either for direct or indirect wealth creation.*[5]

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2 *Ibid.*, p. 66.

3 M. Winfield and J. Rabantek, *Putting the Environment in Green Industry Strategies: The Role of Environmental Industries in Restructuring for Sustainability* (Toronto: Canadian Institute for Environmental Law and Policy, April 1995), p. 13.

4 E. Nyberg, National Round Table on the Environment and the Economy, Interview, Ottawa (March 16, 1995).

5 D.J. Doyle, *Building a Stronger Environmental Technology Exploitation Capability in Canada.* Prepared for Environment Canada and Industry, Science and Technology Canada (Kanata, Ontario: Doyletech Corporation, July 1992), p. 5.

Support in principle for expansion of the EIS often fades when it is suggested that there is a trade-off between environmental protection and jobs. In reality, a report of the Economic Policy Institute in the United States denies that such a trade-off exists. Findings in the report showed that environmental regulation produces a neutral or small positive effect on overall employment; that very few shut-downs of plants occur from environmental protection; and that environmental regulation provides jobs disproportionately weighted to blue-collar sectors and away from government and private-sector services. It is estimated that in 1992, environmental protection created four million jobs in the United States.

> *As a rule, money spent on sectors which are both more labour intensive and have a higher domestic content will generate more jobs. Environmental spending is often both; in addition, it pumps investment dollars into the economy during recessions.*[6]

Lack of effective action eliminates future options for government and industry and exports jobs to other countries. And because many of the industry's activities are home-based, it ignores an important opportunity to develop and demonstrate Canadian capabilities in the home market as a first step in leveraging them into international markets.

Government programs are now poised to address these issues and to take advantage of the growing opportunities in the EIS.

Waterloo Centre for Groundwater Research (WCGR)

The WCGR focuses on groundwater management. Established in 1987 as one of the seven Centres of Excellence by the Government of Ontario's Technology Fund, it demonstrates how linkages among representatives of industry and academic institutions can be used to the advantage of both. It has attracted leading researchers and ensured that their activities are focused on areas of technology that have industrial applications. It has also initiated programs that strengthen its relationship with industry. It is recognized as one of the leading centres for hydrogeology in North America. Industry interaction includes the Industry Associates Program, which includes six Ontario companies involved in the manufacture and distribution of advanced groundwater-related instrumentation. The Centre tests products for the firms, and they market products developed by researchers at the Centre. In 1991-1992, industry provided $1.5 million through contracts with the WCGR.

The development of marketable products and technologies is an important part of its activities. For example, the "Waterloo System" is a device that obtains groundwater from various depths within a single borehole. This is marketed by an associate company, Solinst Canada Ltd. Other combined Centre-industry commercial ventures are also under way.

Such a facility requires considerable government funding: $8 million in 1988-1992 and $11 million between 1993 and 1998. On the other hand, this investment reaps significant rewards. It serves a growing industry, produces skilled graduates in hydrogeology and increases Canada's profile and its capability to compete in a highly specialized area.

From, Ernst and Young, *Human Resources in the Environment Industry* (Ottawa: Employment and Immigration Canada, March 1993), pp. 230-241.

[6] E. Goodstein, "Jobs or the Environment? No Trade-off," *Challenge* (January-February 1995), pp. 41-45.

2. The Benefits of Action – Capitalizing on Opportunities

The success of the EIS will depend on identifying anticipated areas of growth and targeting opportunities for Canadian firms. The Global Environment Facility (GEF) Trust Fund (1993 Market Survey) estimates that high-technology areas such as energy efficiency, biotechnology, production efficiency, analytic software, renewable energy and monitoring and instrumentation will have annual growth rates of 20 to 35 percent to the year 2000. These industries are seen as central to the anticipated "revolution in energy and environmental technologies," which is expected to generate huge international markets (with annual sales in excess of $800 billion) and become a major source of high-wage jobs in the next century.[7]

SECTOR	GROWTH RATE (percent)
Energy efficiency	35
Biological technologies	35
Industrial pollution prevention and production efficiency	30
Environmental analytic software	30
Renewable energy production	20
Environmental monitoring and instrumentation	20

Each of these areas offers opportunities for Canada. As the review of the EIS in Chapter 4 indicated, Canadian companies are competing successfully in biotechnology, analytic software, monitoring and instrumentation. And while work in energy efficiency and renewables has suffered from a national focus on fossil fuels, with some support, new and existing companies in this field could be well positioned to take advantage of expanding markets – and help Canada meet its international commitments under the Framework Convention on Climate Change. The changes announced in the 1996 budget that help to create a level playing field for renewable and non-renewable energy firms are an important step in this direction.

Recent reviews of the market for renewable energy[8] highlight the enormous potential of just one of these areas of opportunity. Technology developments are moving so quickly now that several of the key energy alternatives to non-renewables – photovoltaics, fuel cells, wind power – are plummeting in cost and growing steadily in efficiency and convenience. Related to these developments is growth in energy management systems, advanced electronics and new materials.

The demand for these technologies is expected to be exponential. As Christopher Flavin of WorldWatch notes, an explosion of inventions created today's energy economy in just 20 years, from 1890 to 1910. The next energy revolution is coming just as quickly. *The Economist* agrees:

> *Once [renewable energy] was the province of mad scientists and dreamers.... No longer. Little noticed, the costs of many renewables have recently been tumbling. Fossil fuels are still almost always cheaper, but a battle has begun on the fringes of the mighty $1 trillion-a-year fossil-fuel industry that could force it into retreat early in the next century.*[9]

And the interest in renewables is not limited to Western markets. Solar energy use is growing in countries as diverse as Sri Lanka, China, Mexico, Israel, Jordan, Zimbabwe, Switzerland and Germany. Germany is also the world's largest user of wind energy, but the second largest is India, where the power grid has been offered to independent developers, tax incentives are given for the development of renewables and land values in windy regions are rising. Other countries with sizable wind projects include Brazil, China, Greece and Mexico.

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7 J. J. Romm and C.B. Curtis, "Mideast Oil Forever," *The Atlantic Monthly* (April 1996), p. 74.

8 As discussed in the Romm and Curtis *Atlantic Monthly* article cited above and in C. Flavin, "Power Shock, the Next Energy Revolution," *WorldWatch* (January-February 1996), pp. 10-21.

9 *The Economist* (October 7, 1995), quoted in "Power Shock," *Ibid.*, p. 12.

The forces that are changing the world's energy economy are new technologies, industry restructuring – particularly the break-up of public utility monopolies – and tougher environmental laws. When combined with the international threat of climate change and the problems of urban air pollution, the momentum for change is unlikely to diminish significantly.[10]

To a large extent, these same forces are at work in all the industries identified for rapid growth by the Global Environment Facility Trust Fund. The chart below itemizes the benefits of taking action in each area and the actions that could encourage development and growth:

ENERGY EFFICIENCY AND RENEWABLES	
Benefits	• Targeted for rapid growth, renewables will dominate future markets • Canada's high per capita use of energy means there is a large market available • Opportunity to reduce costs for regulated industries, institutional and government markets • Reduction in level of greenhouse gases • Help re-establish Canada's "good environmental citizen" role • Move to sustainability – help to preserve share of dwindling petroleum resources for future generations • Increase employment
Actions	• Eliminate all energy subsidies for non-renewables – provides a level playing field • Support energy-efficient technologies • Provide assistance for firms to access international financial institutions (IFIs), particularly the Global Environment Facility Trust Fund, which has much of its funding targeted for climate change (e.g., International Environmental Eco-conventions and Agreements Program)

(continued on next page)

[10] *Ibid.*, pp. 17-18.

(continued)

SOFTWARE ANALYTICS, MONITORING AND INSTRUMENTATION	
Benefits	• Market for advanced instrumentation is expected to increase dramatically as need for monitoring, measurement and control instruments continues to rise • Strong export potential • Builds on Canada's strength in software systems, geomatics and remote sensing • Suited to specialization of SMEs • Supplements activities of many Canadian service companies, especially in environmental planning and management services
Actions	• Technical support through centres of excellence, e.g., Waterloo Centre for Groundwater Research (WCGR) • Assistance for commercialization and demonstration
RECYCLING	
Benefits	• Reduction in waste • Recapturing of valuable inputs • Significant cost savings for user industry • Employment intensive
Actions	• Build on public support for recycling by funding research, development and commercialization • Use economic instruments to support recycling, e.g., tax savings for use of recycled material, government preference for recycled materials
BIOLOGICAL TECHNOLOGIES	
Benefits	• Cleanup of toxic and hazardous sites • Canadian market for bioremediation is expected to double in 1982-2000 • Develop capability to meet domestic needs
Actions	• Provide R&D support for biomonitoring of air, water and soil to meet growing expansion of market • Maintain key government-university-industry linkages

CURRENT STRATEGIC APPROACHES

The growth of the EIS and its potential for expansion and increased employment have made it a priority sector for both the federal and provincial governments. The federal government's commitment to jobs and growth is creating a positive investment climate for all industries. And its focus on technological innovation and SME development is of particular importance for the EIS. The opportunity to support economic goals while meeting environmental needs has become increasingly important as governments work with declining staff and budgets. There is greater use of cooperative approaches and a continuing movement toward partnering with various stakeholders in legislation and support programs.

The importance assigned by governments to the EIS and environmental issues is reflected in the various environmental industry strategies and programs announced by the federal and several provincial governments in the first half of the 1990s.The most important of these are discussed below. Canadian governments at all levels began to take steps to build a stronger environmental sector. As government programs across the country have been scaled back or eliminated, the challenge now is for government and industry to "do more with less."

1. Federal Environmental Industry Strategy

The Canadian Environmental Industry Strategy has three principal components:

- a core strategy consisting of 20 initiatives involving $15 million in funding (this figure does not include the EIS share of the $250 million Technology Partnerships Program);
- continuing programs and activities of a number of federal departments and regional agencies; and
- new initiatives to be developed to assist and support Canadian environmental industries.

The federal Strategy was introduced in 1994, following extensive consultations with industry, provincial governments and other stakeholders across the country. Using a "Team Canada" approach, implementation of its initiatives is the responsibility of a stakeholder committee that includes government and industry representatives.

The core strategy's major focus is improved access to domestic and global markets. The 20 initiatives are divided into the following four areas:

1. Delivering federal government support to the industry in a direct, easily accessible, service-oriented and cost-effective way. (two initiatives)
2. Supporting the development and commercialization of innovative environmental technologies. (three initiatives)
3. Improving access to domestic and global environmental markets for Canadian companies. (12 initiatives)
4. Partnership with the Canadian environmental industry. (three initiatives)

The 1996 update of the Strategy indicates that though three of the original initiatives have been eliminated, considerable progress has been made in getting it under way. Key initiatives include:

- the creation of focal points, or "hubs," which will provide a full range of government support services. A 1996 pilot project in Ontario will facilitate the development of a national network on a province-by-province basis.
- plans for the verification of environmental technologies, equipment and equipment-based services. Following stakeholder consultations in 1995, a government/industry steering committee recommended the development of a program based on verification of vendors' claims. If the program proves feasible, its introduction is planned for 1997.
- a government/industry initiative to augment the demand for environmental goods and services by raising the awareness of Canadian SMEs on the importance of environmental performance to their profitability and competitiveness.
- international initiatives that will improve access to business opportunities through international agreements and institutions, the transfer of environmental management expertise under the International Environmental Management Initiative and strengthened participation in international

development programs. This includes bilateral cooperation agreements with countries such as Poland, Mexico, Chile and Romania, plus support for industry exhibits at meetings of the Biological Diversity and Climate Change conventions.

- the establishment of a national statistical database on the EIS, which will provide comprehensive information to government and industry. A stream of domestic market data for environmental goods and services will be released by Statistics Canada in 1996, and data on the industry should be available in 1997.

- the enhancement of environmental market intelligence, including the preparation of sector market reports for countries such as Thailand, Malaysia, India and Brazil. Industry Canada has also introduced two electronic programs: Canadian Environmental Solutions (CES), to raise awareness of EIS capabilities, and ENV-I-NET, a bulletin board service that provides environment-related information.

- environmental training for trade commissioners and Canadian representatives to international organizations so they are equipped to promote Canadian expertise and products.

- activities to support "green" procurement and environmental management in federal government departments.

- support for the Canadian Environment Industries Association (CEIA) and its active involvement in programs for the EIS. The CEIA is a member of the implementation steering committee for the Strategy and a member of the newly created environmental Sector Advisory Group for International Trade (SAGIT).

Two technology demonstration and commercialization programs were frozen in the 1995 federal budget. These have been replaced by Technology Partnerships Canada, which is examined in Chapter 5 and Appendix VI.

In addition to the national Strategy, the federal government also supports more regional-oriented programs and activities.

2. Western Economic Diversification Canada (WD)

The environmental industry is one of western Canada's fastest growing sectors. Its annual regional environmental sector sales were estimated at around $2 billion in 1993, and it employed around 20,000 workers. Both sales and employment, however, are expected to double by the year 2000 if these companies build on their share of the domestic market and succeed in penetrating the global market.[11]

Assisting them in this effort is a new Environmental Technologies Loan Program of Western Economic Diversification Canada (WD), Environment Canada and the Toronto Dominion Bank. This $40 million, seven-year loan program is designed to lay the foundation for the long-term stability and growth of western SMEs in the sector.

To increase both the growth rate and market share of the western EIS, all four of the western environmental industry associations signed a Memorandum of Understanding to establish the Western Environmental Industry Network. The intention is to use the network to create new knowledge-based jobs, generate significant export revenue, displace imports and support progress toward sustainable development. All four western provinces and WD have encouraged and supported the formation of the Network as well as the development of a comprehensive strategy for the regional environmental industry.

The Network is industry-led and represents a strategic alliance of more than 550 environmental companies that will work in partnership with government, institutional supporters and other key stakeholders to coordinate industry/government activities in all four western provinces. The Network will also serve as a means of articulating and giving voice to regional views, interests and concerns, as well as to pursue activities important to the development of the western Canadian

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[11] Environment Canada and Industry Canada, *A Strategy for the Canadian Environmental Industry* (Ottawa: Minister of Supply and Services Canada, September 1994), p. 27.

Privatization of Government Facilities

In 1987, Stuart Smith, President, Rockcliffe Environmental, proposed that Environment Canada's Wastewater Technology Centre (WTC) be operated as a government-owned and company-operated (GoCo) facility. It would work on a non-profit basis for the Crown and on a profit basis for the private sector. Based on the expectation that applied research can be more efficient and effective if it is dependent on the market, Rockcliffe slowly converted the WTC into a private institution. By its third year, it was making a substantial profit, and its employees left the public service. At the same time, it actively created new technologies to meet the needs of its new clients.

As the WTC expanded into foreign markets, it became clear that there is a growing need for private companies to operate water utilities. It created a company and proposed to the Regional Municipality of Hamilton-Wentworth that the new company take over the region's water treatment facilities. When the region expressed concern about the relatively small size of the company, the WTC formed a partnership with Philip Environmental, creating Philip Utilities Management Corporation, with Stuart Smith as President, and signed a 10-year contract with the region. This public-private partnership is the largest in North America and has so far demonstrated the ability of the private sector to operate facilities more efficiently, while continuing to address labour and community concerns.

Service has improved, the facility saved $800,000 in its first year, the staff received a raise and no one was fired. After the company makes its first million, profits will be shared on a 60-40 basis with the region. Employees are inundating management with new ideas, and new technologies are being submitted that will save more money. And if a new technology looks good, the company buys an interest in it and demonstrates its application. Now Philip Utilities is establishing offices overseas, ready to take advantage of the expanding market for the private management of wastewater facilities. This is a win-win situation where the private sector has the flexibility to make deals and the public sector gets better service at a reduced cost.

From, S. Smith, "R&D/S&T Contribution to Competitiveness in the Canadian Environment Industry," Comments at the First National Conference, Canadian Environment Industries Association, Ottawa (March 28, 1995).

industry. The establishment of the Network is a significant step toward coordinated action on the challenges and opportunities facing western environmental industries.

3. Atlantic Canada Opportunities Agency (ACOA)

The Atlantic Canada Opportunities Agency (ACOA) also has an important role to play in achieving the goals of the Canadian Environmental Industry Strategy. ACOA is building on its role as managing partner of the Atlantic Canada Business Service Centres, to develop ways of meeting the needs of Atlantic Canada's environmental industries. ACOA also looks for opportunities in other federal initiatives, such as business networking and procurement related to the sector. In pursuing a coordinated, collaborative approach with other federal departments, provincial governments and other partners in the region, ACOA is expected to have a synergistic effect on efforts to develop a regional EIS.

4. Federal Office of Regional Development/ Quebec

The Federal Office of Regional Development/ Quebec is responsible for a series of activities that serve to strengthen the environmental industries in Quebec. These include:

- fostering strategic alliances among the various environmental industry stakeholders through networking of SMEs and industrial associations, strengthening of existing and new partnerships and improving access to government programs;

- providing support through regular programs for R&D for environmental technology, demonstration, marketing and transfer projects;
- encouraging the establishment and development of SMEs in the environmental sector;
- supporting sector initiatives that contribute to making Montreal an industrial centre of excellence in the environmental sector;
- helping SMEs gain access to the federal procurement process;
- assisting young entrepreneurs by encouraging training and education that focus on business management; and
- helping SMEs develop export markets through cooperative efforts with Industry Canada and DFAIT.

5. Ontario's Green Industry Strategy

Most provinces have programs in place to assist local environmental industries. The most ambitious of these provincial efforts and the closest to a comprehensive strategy is Ontario's Green Industry Strategy, which was introduced in 1992. In the words of the Ontario government of the time, the long-term vision behind the establishment of this strategy was that of an *"innovative and internationally competitive green industry sector in Ontario which offers high quality jobs and develops leading edge environmental solutions for domestic and export markets."*[12]

One of the few environmental initiatives preserved by the new government in Ontario, the Green Industry Strategy is managed by the Green Industry Office in the Ministry of Environment and Energy. With a complete regulatory review pending and all business support programs frozen, the present activities of the Office are focused on market development and promotion.

The objectives of the Strategy are:

- to stimulate the growth of the green industry sector, thereby creating new wealth and highly skilled, long-term jobs;
- to enhance the competitiveness of all industries by promoting the use of green products and services; and
- to promote environmental protection, pollution prevention and resource conservation.

Like the federal Environmental Industry Strategy, the Ontario Strategy is important because it situates the environmental industries within the larger context of the province's economic development and was explicit in defining the long-term benefits derived from a strong environmental sector. This will *"help Ontario adapt to changes in the world economy, making the adjustment from a resource-based to a knowledge-based economy, which will be the main source of job growth in the future."*[13] In this context, the Strategy includes the following elements:

- technology development, to promote the development of new green technologies and help them to market by stimulating innovation and streamlining approvals;
- business development to expand local markets, certify green products and services, enhance investment in the sector and enhance the skills of the sector; and
- trade promotion to help the green industry sector capitalize on growing opportunities in international markets by providing market intelligence, promoting sector industries and encouraging partnering.

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[12] Ontario Ministry of Environment and Energy (MOEE), *Ontario's Green Industry Strategy – For a Clean Environment and a Strong Economy* (Toronto: MOEE, 1994), p. 2.

[13] *Ibid.*, p.3.

A cornerstone of the Ontario Strategy was the establishment of partnerships between governments, industry, labour and the environmentalist community. This close cooperation was seen as the means of ensuring the environmental sector's continued adaptability and flexibility. Finally, the domestic regulatory environment was viewed as a crucial starting point for "green" technology development. Although the Strategy did not question government's leadership role in giving direction and identifying environmental objectives, it also made clear that well-designed government regulations can support both the environment and environmental industries and that industry has a crucial role to play in their development. *"Ontario green industries need to be more involved in and informed about the development of regulations so that they can develop the needed technologies before these regulations are announced."*[14]

Because it included regulation, partnership, technological innovation and business development, the Ontario Strategy offered a unified vision of the sector based on concerns for long-term economic development and expansion.

Re-engineering Fluids Management — Ford Motor Company

Re-engineering processes at Ford's St. Thomas Assembly Plant created a more efficient system while developing an innovative approach to pollution prevention. The Total Fluids Management Program (TFMP) builds on Ford's previous success with supplier partnerships in its total quality management program. TFMP represents a partnership for dealing with the purchase and use of liquid processing aids and chemicals. The program is based on a team approach in which suppliers become responsible for the optimal use of their chemical products in the customer's facility. The supplier is paid for the chemical and service on the basis of the number of vehicles produced at a set cost per unit, not on the basis of chemical usage. This provides an incentive for the chemical supplier to minimize instead of maximize usage. The program seeks to increase the rate of technological advance in the application of the chemical by more closely aligning supplier and customer goals. The chemical supplier provides full-time technical representatives in the customer's facility, manages inventory, develops operating manuals and maintenance schedules, provides training and participates in joint teams to achieve quality, cost, protection and environmental objectives. The benefits of TFMP include reduced chemical consumption, reduced waste generation, cost reduction, quality improvement and energy savings. The program has resulted in chemical reductions in discharges and annual savings of US $200,000 per year at the St. Thomas plant. This success, in turn, has resulted in its extension to all North American Ford plants as well as to other producers in the industry.

From, Great Lakes Pollution Prevention Centre, *Pollution Prevention Success Story: At the Source* (Fall 1994), p.4.

Transforming Organic Matter into Energy

Agropur Coopérative Agro Alimentaire of Granby, Quebec, has installed an anaerobic wastewater treatment system, which transforms organic substances into methane. This gas now produces all the energy needed to operate the plant. The Agropur cheese factory in Notre Dame-du-Bon-Conseil generates energy using products it once discharged into the river. A conventional treatment system would have cost $5 million and consumed 2000 kW, while the anaerobic system produces approximately $60,000 worth of biogas a year, more than the energy required to operate similar treatment equipment, and results in net profits of $10,000 annually. Benefits include land conservation, energy savings ($150,000 annually) and improved water quality.

From, Environment Canada, *Pathways to a Greener Future — Environmental Industry in Canada* (Ottawa: Minister of Public Works and Government Services Canada, 1995), p. 34.

[14] *Ibid.*

TOWARD THE FUTURE

> *Although Canada has a global reputation as an environmental leader and policy innovator, we have done little so far to benefit from the commercial advantages of this reputation. To do so will require supporting sustainable development initiatives taken by business, adopting strict environmental standards that spur the development of cutting-edge technologies, and funding research and development for green technologies. A Liberal government will make environmental technologies and services a major component of Canada's strategy for economic growth.*[15]

The Canadian government has taken considerable steps in this direction over the past two to three years. The Environmental Industry Strategy is not only part of the government's business development strategy, it is also part of a comprehensive package of policies that foster environmental protection and the development of an innovative and competitive EIS. Included in this package is the new *Canadian Environmental Protection Act* (CEPA), Environment Canada's Pollution Prevention Strategy, "Greening" Government Operations and a new national science policy that targets environmental technologies as an important growth sector.

The funding for the current Environmental Industry Strategy is scheduled to terminate in the 1997-1998 fiscal year. As the Strategy comes up for review, it will provide an important opportunity to consider the effectiveness of the current program and various options for its continuation.

1. Options

The present federal government Strategy has a strong international marketing focus. Through Canada's International Business Strategy (CIBS) program, it comprises a well-orchestrated approach that provides the kind of support industry needs to identify and sell in both domestic and international markets. Recognizing that many essential parts of such a strategy already exist, the following paragraphs include further elements that could be considered as part of a comprehensive EIS strategy.

A broader approach could encourage the complementary use of important strategic tools, such as economic instruments, fiscal policies, regulatory measures and targeted industry support programs, thus providing an opportunity to improve environmental conditions and encourage the development of innovative technologies through a wider variety of instruments. It would also make it possible to review policies and programs that sometimes function at cross-purposes (e.g., tax policies designed to promote the use of non-renewable sources of energy that are in conflict with support programs for the development of renewable sources of energy).

In the same vein, disincentives for non-sustainable practices and incentives that promote sustainable ones could be considered, as could alternative means of funding the development of important emerging technologies. As the shift to green taxes continues in Europe, the advantages of cutting income and payroll taxes and replacing them with taxes on energy use, waste generation or pollution is worth examination.[16]

A broader strategy could also build on the actions encouraged in pollution prevention and "greening government" programs, further supporting the transition of Canadian industry and institutions to cleaner, more efficient production. Such moves can facilitate the diversion of corporate funds from "consumption to investment" and help to build an important market for the EIS.

Complementary programs at the local and regional level can also be part of a multi-level approach. From nature walks to water conservation to home "green-ups," local action can stimulate industry, provide jobs and create informed public support.

2. A Sustainable Future

The environmental sector is already well developed in Canada. It is making a significant contribution to jobs and wealth creation. The challenge is to maintain what we have achieved while taking advantage of expanding opportunities through foresight and long-term plans. As businessman-environmentalist Paul Hawken

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[15] Liberal Party of Canada, *Creating Opportunity*, p. 67.

[16] D.M. Roodman, "Green Tax Shift Begins in Europe," *World Watch* (March/April 1996), p. 6.

suggests, it is also important to be realistic and practical.

> *In any endeavour, good design resides in two principles. First, it changes the least number of elements to achieve the greatest result. Second, it removes stress from a system rather than adding it. Bad design is pinning our hopes for environmental and cultural survival on a change in human consciousness and behaviour alone, because we therefore depend on the highest number of uncontrollable elements – people – to undergo a great change. Likewise, bad design is having to institute several hundred thousand rules and restrictions under the jurisdiction of the government and expecting business to know them all, much less obey them.*[17]

Canadian governments have adopted environmental strategies based on the principles of sustainability. This means continuing to develop strong linkages and partnerships among stakeholders in industry and government. It means examining a wide range of instruments that include both incentives and regulations, keeping in mind the twin objectives of environmental protection and economic development.

This last principle is perhaps the most important. Where traditionally environmental protection was seen as occurring at the expense of economic development, in the new paradigm, industry, the public and government all understand that environmental protection and economic development are really complementary objectives that can mutually reinforce each other when effectively pursued. Policies and programs that reinforce this new way of looking at the issues have provided critical steps toward achieving Canada's most important strategic objectives in the environmental area.

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17 P. Hawken, *The Ecology of Commerce* (New York: HarperBusiness, 1993), p. 166.

Appendix I Summaries of International Agreements with Implications for Industry

NAME	PURPOSE	DATE INTO FORCE	SUBSTANCES INVOLVED	COMMITMENTS & TARGETS	IMPLICATIONS & OPPORTUNITIES
Convention on Long-Range Transboundary Air Pollution; Protocol on the Reduction of Sulphur Dioxide Emissions and their Transboundary Fluxes	To provide for a 30 percent reduction in sulphur dioxide emissions and their transboundary fluxes by 1993.	1987	Sulphur dioxide.	30 percent reduction by 1993.	Air pollution control and monitoring services and technology in the fossil fuel power generation and non-ferrous mineral smelting industries.
Convention on Long-Range Transboundary Air Pollution; Protocol Concerning the Control of Emissions of Nitrogen Oxides and their Transboundary Fluxes	To provide for the control or reduction of nitrogen oxides and their transboundary fluxes.	1988	Nitrogen oxides.	Reduction to 1987 levels by 1994, further reduction by 1996.	Combustion and precombustion control technology; NOx monitoring technology. Asia is fastest growing region for air pollution equipment; 33 percent growth per year in Mexico.
Convention on the Protection of the Atmosphere's Ozone Layer; Protocol on Substances that Deplete the Ozone Layer	To protect the ozone layer by taking precautionary measures to control emissions of substances that deplete it.	1989	Ozone-depleting substances (ODS), including CFCs, HBFCs, halons, carbon tetrachloride, methyl bromide and methyl chloroform.	100 percent elimination of halons by Jan. 1/94. 100 percent elimination of carbon tetrachloride by Jan. 1/95. 100 percent elimination of CFCs, HBFCs and methyl chloroform by Jan. 1/96. 25 percent reduction in methyl bromide consumption by Jan. 1/98.	New refrigeration technology; monitoring, collection, recycling and control of ODS. Replacement technologies and materials for ODS processes.
International Convention on Environmental Impact Assessment in a Transboundary Context	To take all appropriate and effective measures to prevent, reduce and control significant adverse transboundary environmental impact from proposed activities; to ensure that an environmental impact assessment is (EIA) undertaken prior to a decision to authorize an activity that is likely to cause a significant adverse transboundary impact.	1991			Consulting firms with experience in the EIA field.

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Appendix I *(continued)*

NAME	PURPOSE	DATE INTO FORCE	SUBSTANCES INVOLVED	COMMITMENTS & TARGETS	IMPLICATIONS & OPPORTUNITIES
Declaration on the Protection of the Arctic Environment (Finnish Initiative)	To provide a forum for cooperation by the circumpolar countries to protect the Arctic environment.	1991		To carry out the Arctic Environmental Protection Strategy, a broad plan outlining cooperative activities that the Arctic Eight will undertake over the next few years.	Environmental consultants with Arctic expertise.
Canada-U.S. Air Quality Agreement	To cooperate on acid rain reduction and related monitoring, R&D and protecting visibility in pristine areas. It includes objectives for stationary and mobile sources of sulphur dioxide and nitrogen oxides as precursors to acid rain, as well as an objective for each country to achieve a national overall emissions "cap" for sulphur dioxide emissions. The agreement can be used at a later date to address other issues.	1991	Sulphur dioxide, nitrogen oxides.	Permanent national cap of 3.2 million tonnes of SO_2 by the year 2000. Reduction in NOx emissions of 100,000 tonnes (from stationary sources) by the year 2000. Eastern Canada reduction of SO_2 to 2.3 million tonnes by 1994 and maintenance at that level through 1999.	SOx pollution control and monitoring services and technology in the fossil fuel power generation and mineral smelting industries. Combustion and precombustion control technology, NOx monitoring technology.
United Nations Convention on Biological Diversity	Conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources, and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.	1992	Ecosystem, species and genetic diversity.	Each signatory is required to develop national strategies for the conservation and sustainable use of biodiversity.	Sustainable agriculture, sustainable forestry, wildlife management, eco-tourism, fishing and aquaculture, consulting in biodiversity management, biological inventory and assessment, country studies and action plans, remote sensing and geographic information systems (GIS).

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Appendix I *(continued)*

NAME	PURPOSE	DATE INTO FORCE	SUBSTANCES INVOLVED	COMMITMENTS & TARGETS	IMPLICATIONS & OPPORTUNITIES
Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	To ensure that the generation and transboundary movement of hazardous wastes are reduced to a minimum; to control the export of hazardous wastes by requiring the formal consent of the importing country and by establishing a tracking system from the point of generation to its final disposal.	1992	Substances defined as hazardous.	No specific targets. Involves procedures and regulations only.	Will encourage/require the development of appropriate treatment of hazardous wastes within Canada.
United Nations Framework Convention on Climate Change	Stabilization of greenhouse gas concentrations in the atmosphere at a level preventing dangerous anthropogenic interference with the climate system and allowing ecosystems to adapt naturally or to proceed sustainably.	1994	Carbon dioxide, methane, nitrogen oxides.	Stabilize greenhouse gas emissions at 1990 level (526 megatonnes CO_2 equivalents) by the year 2000. Develop options for further progress by 2005.	Energy conservation technology, renewable energy technology, public transit, fuel efficiency in combustion activities (transportation, heating, power generation), methane capture technology in landfills and coal mines.

Appendix II Definition of the Environmental Industry Sector*

A. SUMMARY OF ENVIRONMENTAL GOODS AND SERVICES CLASSIFICATION

1. Goods/Systems/Equipment

Air Pollution Control: for absorption, air handling, catalytic conversion, chemical recovery, dust control, precipitation, filtering, scrubbing.

Water Pollution Control: for aeration, biological treatment, centrifuging, chemical feeding and mixing, chemical recovery, filters and media, gravity sedimentation, ion exchange, oil/water separation, water treatment and purification, screening/straining, sewage treatment, water handling (pipes, pumps, tanks and valves).

Solid Waste Management: for incineration, recycling, energy-from-waste, waste collection, disposal, handling, separation and management.

Noise Control: for acoustical testing, noise deadening, vibration control.

Chemicals for Pollution Control: for absorption, agglomeration/pelletizing, bacteria/enzyme treatment, cleaning, corrosion/scale control, dust control, water treatment.

Instruments for Pollution Control: for detecting, measuring, monitoring, sampling, data acquisition, remote sensing and freshwater and marine image analysis, information management and software, processing and control systems.

Scientific, Research and Laboratory Equipment: for analysis and calibration, environmental chambers, laboratory equipment, reagents and supplies.

Natural Resource Conservation and Protection: for sustainable agriculture, forestry, fisheries (including aquaculture), energy conservation and alternative energy.

2. Services

Consulting Services: environmental and process engineering, surveys and impact assessments, potable water, waste management, site and risk assessment, contingency planning, environmental education/training and technology transfer, legal and expert witness, socio-economic cross-cultural, computer modelling and information services, regulations and standards, alternative energy, environmental management, environmental monitoring.

Pollution Assessment and Control: ambient air and indoor air quality, atmospheric and climatic modelling, source characterization, environmental audits and waste surveys, soil and water quality (freshwater and marine).

Construction of Pollution Control Facilities: services involved directly and indirectly in construction of pollution control facilities, such as wastewater treatment plants, pipelines, reaction vessels and equipment.

Waste Handling and Environmental Facility Operation: emergency response and spill cleanup, integrated special waste management/treatment facilities, solid waste, sewage treatment, incinerators and energy-from-waste, site reclamation and tailings disposal, recycling and composting, waste reduction, transportation and transfer.

Laboratory Services and Related Field Services: sampling, monitoring and analytical services, quality assurance.

Environmental Research: private, federal, provincial and university facilities.

* As defined by Industry, Science and Technology Canada, 1990.

Natural Resource Conservation and Protection: related to agriculture, fisheries and aquaculture, forestry, marine and land management, water resources, parks, ecosystems and habitat management, mapping, remote sensing and image analysis, geographic and land information services, energy conservation.

B. FOUR ENVIRONMENTAL INDUSTRY TYPOLOGIES

1. Dedicated Environmental Technologies, Products and Services

Companies dedicated to supplying environmental technologies, products and services are often called environmental companies or environmental industries. They tend to be primarily small and medium-sized companies dedicated to solving environmental problems related to water, air quality, municipal and toxic waste systems and associated issues. This sector is quite different from traditional industrial sectors, such as the automotive or lumber industries, in that environmental companies constitute a horizontal weave throughout the economy. There is a great diversity of activities. Firms may be engaged in waste handling, whether municipal solid waste or hazardous waste. They may be involved in the treatment of water, preparing it for domestic or industrial use or cleaning it for discharge back into lakes and rivers. They may be involved in reducing air emissions and in incineration. They may also be involved in the associated scientific and engineering activities: monitoring, remote sensing, environmental engineering and the many dimensions of environmental consulting, from environmental impact and risk assessment to site analysis and environmental audits.

2. Multi-Purpose Technology, Products and Services

There is a wide variety of technologies, products and services such as pipes and pumps that have many applications, of which the environment is only one. In general, these are standard products, and the supplier may have little or no interest in the use made of them. However, as the demand for new investment to meet environmental regulations and goals expands, so will expenditure on these multi-purpose products and services.

3. Clean Industrial Processes

Firms in many industries are redesigning both their products and their processes to meet rising environmental standards and to reduce costs of production. Familiar examples include closed-loop pulp mills, solar-powered cars and new processes for printing and dry cleaning. Some of this activity is done within the firm, and some of it is undertaken on behalf of manufacturers by their traditional suppliers. Both the users and the suppliers of industrial processes have the opportunity to develop clean industrial processes in response to regulations and public demand.

4. Environmentally Friendly Consumer Products and Services

Consumer products and services in every area of household needs are being redesigned to satisfy more rigorous environmental standards and changing consumer preferences. Common examples include cloth diapers, non-phosphate detergents, environmentally friendly lawn care and the "Green Products" marketed by various grocery chains.

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Appendix IV Key Federal and Ontario Environmental Legislation

A. FEDERAL ENVIRONMENTAL LEGISLATION

Clarification and harmonization of the roles of federal and provincial governments in environmental protection is under way with the goal of eliminating duplication and overlaps among programs by making legislation and regulations more consistent across the country. Initial steps toward this end were made through the adoption of the *Canadian Environmental Protection Act* (CEPA) and the *Canadian Environmental Assessment Act* (CEAA). CEPA includes provisions for the creation of administrative agreements between the federal and provincial governments that are to reduce overlap in federal and provincial initiatives and provide a single government window for industry. Administrative agreements also allow federal and provincial governments to share the work of administering regulations in areas such as inspection, enforcement, monitoring and reporting. Under these arrangements, the federal government is to remain accountable and to report annually to Parliament on the agreements.

(Environment Canada, *CEPA, Report for the Period April 1993 to March 1994*, p. 4)

1. *Canadian Environmental Protection Act* (CEPA)

CEPA was proclaimed in 1988 as a cornerstone of federal environmental protection. It was designed to consolidate disparate elements and authorities contained in five Acts administered by Environment Canada in order to ensure greater consistency in enforcement and to answer the need for control of toxic substances. Among its primary focuses are:

- to fill the gaps that existed in management of toxic substances by providing a life cycle approach – that is, the control of all stages of the life cycle of a potentially harmful chemical or toxic substance from creation and use to destruction;
- pollution prevention through strong regulations, increased penalties and enforcement mechanisms;
- the creation of environmental quality objectives, guidelines, codes of practice and regular reporting on the state of Canada's environment;
- to provide for intergovernmental agreements;
- stipulation of federal-provincial and public consultation on specific environmental matters;
- to enable Canada to fulfill specific international obligations in environmental protection; and
- recognition of the federal government's shared stewardship of the environment with businesses and consumers and other levels of government nationally and internationally.

CEPA requires a review of its administration by a parliamentary committee within five years of its enactment and a report to Parliament of any suggested changes to the Act or its administration. The committee began its review in June 1994, and included in its deliberations will be evaluations of CEPA contributed by a number of organizations and interested groups.

(Projet de société, *Canadian Choices for Transitions to Sustainability*, January 1995, p. 39; Environment Canada and Health Canada, *Reviewing CEPA: An Overview of the Issues*, 1994, p. 1; Environment Canada, *CEPA, Report for the Period April 1993 to March 1994*, pp. 1-5)

2. *Canadian Environmental Assessment Act* (CEAA)

In June 1990, the Minister of the Environment announced reforms to the Federal Environmental Assessment and Review Process that included new environmental assessment legislation, an environmental assessment process for new policy and program proposals and enhanced public participation in the process, including a new participant funding program.

The intention of the reforms was to ensure that environmental considerations are included in federal government planning and decision-making processes to support sustainable development. The process would give consideration to the possible

harmful environmental effects of development projects, programs and policies in the early planning stages so that adverse environmental effects can be identified and minimized.

The *Canadian Environmental Assessment Act* (Bill C-13) received royal assent, and the legislation came into force in January 1995. The legislation contained in the Act will apply to projects for which the federal government holds decision-making authority. Following the development and publication of the four key regulations for the implementation of the Act, further regulations are being developed, including those for projects outside Canada, for Crown corporations and for Indian lands.

The Canadian Environmental Assessment Agency (CEAA) officially replaced the Federal Environmental Assessment Review Office (FEARO) in January 1995. It is charged with putting the Act into practice and reports directly to the Minister of the Environment. It operates independently of any other federal department or agency.

(Projet de société, *Canadian Choices for Transitions to Sustainability*, January 1995, p. 39; and Canadian Environmental Assessment Agency, *Fact Sheets Series*.)

B. ONTARIO

1. The Municipal Environmental Legislation Industrial Strategy for Abatement (MISA)

This legislation is the cornerstone of Ontario's regulations for controlling discharges into the province's waterways. Introduced in 1985, regulations covering nine targeted sectors have been added slowly over the past 10 years. Direct discharges of the following sectors are covered by the Act: petroleum refining, organic chemicals, pulp and paper, iron and steel, metal mining and refining, industrial minerals, electric power generation, inorganic chemicals and metal castings. In February 1995, draft water abatement regulations were released for public comment for the last two sectors to be covered, iron and steel and electric power generation. Once final regulations are issued, companies will have up to three years to comply with their requirements.

MISA is frequently referred to as the most comprehensive environmental legislation in Canada. It has had a significant impact on the development of the wastewater industry in Ontario.

(Ernst and Young, *Human Resources in the Environment Industry*, pp. 162 to 63, Canadian Environment Industries Association, *Environmental Intelligence Faxletter*, February 1995, p. 1)

Appendix V Environmental Technology Commercialization Program — Sample Projects

COMPANY	TECHNOLOGY	ENVIRONMENTAL ASPECTS	COMPETITIVE ADVANTAGES	SUPPORTED
Zenon Environmental Inc. Burlington, Ontario (Strategic alliance with **General Motors**)	ZenoGem oily wastewater biological treatment system, for automotive manufacture.	Reduces sludge. Captures oil and water for re-use.	Lower capital cost than alternatives, easy to operate, low operating and maintenance costs.	Full-scale project
Apollo Environmental Systems Corp. Willowdale, Ontario **Procor Sulphur Services Inc.** Calgary, Alberta	Degassing hydrogen sulphide from elemental sulphur by gas-liquid mass transfer.	Reducing residual hydrogen sulphide from 450 to 2 ppmw at source.	Compact unit, short residence time, purer sulphur.	Full-scale demonstration project.
Mobil Computing Corporation Toronto, Ontario	Weigh-in-motion cart lifting, fully automatic mobile weighing/ computer/communication system.	Encourages reduction in waste by having the user pay garbage collection by weight.	No driver input labour.	Technology development and demonstration project.
Halozone Recycling Inc. Mississauga, Ontario	Blue Bottle Halosorb	Captures CFCs, HCFCs and HFCs, prevents loss or leakage to atmosphere.	Reclaimed, purified for resale.	Development and demonstration.
Trojan Technologies Inc. London, Ontario	Trojan UV4000 ultraviolet disinfection of water.	Cleans wastewater without using toxic chemicals or producing chlorinated or oxidizing by-products.	Instantaneous, no tanks required, handles fluctuating load safely.	Development and demonstration.
Polyphalt Inc. Toronto, Ontario	Polymer-modified asphalt (University of Toronto invention).	Creates market for waste rubber, plastic.	Better rutting resistance, lower oxidation deterioration than base asphalt.	Feasibility study.
The CanFibre Group Ltd. Vancouver, B.C.	"Green" recycled fibre, medium-density fibreboard (MDF) (Forintek Canada developed).	100% post-consumer waste wood fibre, formaldehyde-free resins.	45% cheaper than standard MDF, reduces cure time, increases maximum thickness.	Technology feasibility study.

Appendix VI The Federal Government Response

The government of Canada recognizes the importance of a world-class environmental industry and is committed to aggressively promoting this sector. The Prime Minister expressed the importance of the Canadian environmental industry in the *Red Book*. To fulfill this commitment, Environment Canada and Industry Canada consulted extensively with other federal departments, agencies, the industry, provinces and other stakeholders in September 1994 to develop the Canadian Environmental Industry Strategy (CEIS). The Strategy encourages environmental industries in Canada through:

(1) a core strategy of 22 initiatives with $15 million of new and redirected funding;

(2) continuing existing programs and activities of a number of federal departments and regional agencies; and

(3) new initiatives that are being developed by federal government departments and agencies that already provide support to the environmental industry.

Significant programs and planned actions are highlighted in the joint Environment Canada/ Industry Canada report entitled: *"A Strategy for the Canadian Environmental Industry – March 1996 Update."*

Federal Objectives and Initiatives for the Environmental Industry

Environment Canada has three objectives in supporting environmental industries — all are central to the federal government's CEIS:

(1) increasing development and commercialization of innovative green technologies;

(2) improving access to domestic and global market opportunities for Canada's environmental companies; and

(3) delivering cost-effective and streamlined federal government support to the environmental industry.

To support the environmental industry, the federal government has established several initiatives to spur growth in the private sector and funds research institutions that will help Canadian companies become a force in the global environmental industry market. The following is a snapshot of how the federal government is nurturing environmental industries in Canada.

International Environmental Management Initiative

The International Environmental Management Initiative (IEMI) is a key component of the CEIS. The IEMI demonstrates the federal government's commitment to the principles of sustainable development by promoting environmental technologies, products and services.

The initiative transfers public- and private-sector expertise relating to regulations, policies and technical programs to developing countries and countries in transition. The transfer of Canadian expertise on environmental management infrastructure helps promote Canadian environmental technologies and services to developing nations, improves the global environment and spurs economic growth in Canada.

All IEMI projects require federal government sponsorship and management through the auspices of federal government departments and agencies. Applications to the departments and agencies that include the participation of Canadian environmental companies and associations, universities and environmental organizations will be given a high priority. Proposals submitted to Environment Canada are reviewed by an Implementation Committee that includes technical experts within Industry Canada, the Department of Foreign Affairs and International Trade, the Canadian International Development Agency (CIDA) and the International Development Research Centre. The Committee will pursue projects that advance key global environmental issues, bilateral and multilateral agreements and related subjects such as ozone depletion, toxic substances, climate

change and biodiversity. Projects qualifying for sponsorship demonstrate the transfer of Canadian expertise in environmental infrastructure and the extent to which the technology transfer addresses the actual needs of the country. Other considerations include the immediate and the downstream possibilities for the transfer of Canadian environmental products, services and technologies.

The Committee works closely with the Canadian Environment Industries Association to ensure the active participation by Canadian environmental companies in the project. During its inaugural year (1995-1996), the IEMI provided over $400,000 of funding, or one seventh of the total $3 million spent by the sponsored companies on various projects.

IEMI projects are under way in every region of the world and in countries at different stages of economic development. Project sites include Argentina, China, Pakistan, Mexico, Poland and Russia. And whether it is preparing an implementation plan for air quality enhancement in the Sogamoso Valley in Columbia or assessing the key environmental priorities and needs of the southern region of Chile, Canadian environmental industries benefit by the closer ties and the increased business opportunities derived from the projects.

Technology Partnerships Canada

Technology Partnerships Canada (TPC), an initiative of Industry Canada, enhances wealth creation by making Canadian firms more innovative. In partnership with the private sector, TPC invests in research, development, demonstration and market development of environmental technologies. These include pollution prevention and protection, water treatment, recycling technologies and clean car technologies. Environment Canada works jointly with Industry Canada to support the development of environmental technologies under TPC. TPC also works directly with the biotechnology sector, selected information technologies and aerospace and defence industries.

TPC is an investment program and does not subsidize businesses. All of the money committed by the government is fully repayable. The government shares with the private sector both the risks and the rewards of the investment — including a share of the profits. TPC has an annual budget of up to $250 million — with money coming from existing government funding programs and repayments from companies with successful TPC projects. Investments will range from 25 to 30 percent of project costs in most cases. The program is results-oriented and will focus only on the near-market end of the research and development (R&D) cycle and on proven companies with high-risk projects in identified markets.

Key environmental considerations of a TPC project include the extent to which the project supports sustainable development and the extent to which the project offers solutions to priority environmental problems. Encouraging technological innovation will improve productivity, increasing the competitiveness of Canadian business and leading to economic growth and job creation.

Canadian Environmental Technology Advancement Centres

In partnership with provincial governments, environmental industry associations and the private sector, Environment Canada's Technology Transfer Office has established three Canadian Environmental Technology Advancement Centres (CETACs) to meet the needs of Canada's growing environmental industry. Serving every region of the country, CETACs help small and medium-sized enterprises (SMEs) commercialize environmental technologies by providing comprehensive technical services, access to investment capital, business counselling and regulatory and market analysis.

Although Environment Canada has provided seed funding for CETACs, they are private non-profit corporations that operate at arm's length from government. Opened in the summer of 1994, the Centres provide advice on everything from undertaking the scale-up of R&D and business and marketing planning to technology demonstration.

The CETACs' priority is to help firms move environmental technologies through the commercialization process. However, the environmental industry is knowledge intensive and service-oriented. Competitive strengths are derived from new ideas, technologies and services — assets that are often intangible and difficult to value. With the CETACs' assistance, Canadian companies designing a new technology can access funding to refine their product and carry out actual

production and distribution. The Centres can also help by promoting clients and their technology to private investors and government funding programs and by assisting a company in developing a solid commercialization strategy.

Environment Technology Centre

Since 1975, the Environment Technology Centre (ETC) has been the focal point for much of the technical support and R&D for many of Environment Canada's activities. With over 150 engineers, scientists, technicians and students, the ETC develops and transfers pollution measurement, prevention, control and remediation knowledge, and new technology, in areas related to air pollution and unplanned releases of oil and other hazardous materials. The ETC also provides relevant specialized sampling and analytical expertise to support the development of regulations and quality environmental standards.

The ETC deals primarily with technologies for measuring air pollution and for responding to emergencies like oil and chemical spills and cleanup of leaking hazardous waste sites. Most of the R&D work and some of the technical support services are undertaken with collaborators in the public, private and academic sectors. Some of the R&D is also done in cooperation with foreign partners. The economic potential in environmental technology is dramatically increasing, especially in developing countries and those with economies in transition. The ETC forges alliances with Canadian companies to give them an edge in the rapidly expanding internationally competitive environmental industry. For the past 15 years, the ETC has been very successful at building such alliances with other public- and private-sector organizations and even other countries. These partnerships will become even more important in the next few years.

A good example of the commercialization of a patented technology developed by the Centre is the Microwave-Assisted Process (MAP). This technology is a revolutionary method of extracting soluble products from a wide range of materials using microwave energy. This substantially reduces the cost to purchase and dispose of hazardous organic solvents.

Environment Canada has secured intellectual property rights to this technology in a number of countries, including Canada, the United States, France, Japan and China, and has been actively soliciting licences for the technology. As of August 1, 1996, over $565,000 in kind and cash had been obtained in "signing fees" for licensing agreements for the technology.

Wastewater Technology Institute

Established in 1971 by Environment Canada as an R&D laboratory, the Wastewater Technology Institute (WTI) is the foremost Canadian facility in developing and evaluating treatment and disposal technology for municipal and industrial wastewater and associated residues. The WTI was established to develop the technologies needed to support regulation. In its development of technology, the WTI always considers what is economically viable and environmentally acceptable. However, for the wastewater technology to flourish in Canada, it is absolutely necessary that the industry enters the international market. The environmental market in Canada is very mature, and there is a disproportionate number of qualified professionals and wastewater treatment design and operation potential to business opportunities. With this excess capacity, Canada can be a world player in the international wastewater treatment field. A good international example that Canada could follow is Finland, which has a population of only 4 million people, but has profited by developing and demonstrating a technology at home and then selling it to international buyers.

Recently, the WTI has focused on training in Mexico. Over half the wastewater treatment plants in Mexico are either not in operation at the present time or not operating anywhere near capacity. By training Mexican wastewater treatment plant operators, Canadians are establishing contacts and credibility that should prove invaluable in the future when they are looking to purchase new, or upgrade existing, technology.

Global Environment FacilityTrust Fund

In March 1996, Canada and the World Bank agreed to establish a $2 million Global Environment Facility (GEF) Trust Fund to support the participation of Canadians in World Bank-funded projects. The timely establishment of a targeted trust fund for project preparation work was identified as an initiative with the potential to greatly enhance Canadian access to downstream project implementation funds. Financed jointly by CIDA and Environment Canada, the GEF Trust Fund will provide grant and concessional funds to recipient countries for projects that aim to protect the global environment.

Under the provisions of the GEF, as much as $US 2 billion will be committed to projects between 1994 and 1998. Moreover, GEF grant funds will play a significant role in levering additional World Bank project funds in the form of loans. Significant procurement opportunities are available — particularly in relation to climate change technologies, but also to technologies relating to biodiversity, ozone-depleting substances and the protection of international waters.

The GEF will also facilitate the technology twinning concept through the private-sector transfer of energy-efficient and clean technologies. This in turn will strengthen the Canadian environmental industry while simultaneously facilitating bilateral environmental cooperation and building trust in host countries.

Environmental Technologies Loan Program

In March 1996, Environment Canada, Western Economic Diversification Canada and the Toronto Dominion Bank announced a $40 million Environmental Technologies Loan Program (ETLP) to help small and medium-sized environmental companies in western Canada have additional access to debt capital. The environmental industry is knowledge intensive and service-oriented. However, competitive strengths are derived from new ideas, technologies and services. Therefore, assets are often intangible and difficult to value. Consequently, access to both debt and equity financing is a common problem for these businesses during product development from the R&D to the marketing stages.

The ETLP offers smaller firms patient debt financing on terms uniquely designed to help satisfy their needs. Companies that could qualify for a loan include those that are engaged in the production or supply of technologies, products, processes or services that monitor and assess pollutants, prevent pollution, control pollution or clean up and restore the environment. Qualifying companies must also have annual sales of less than $10 million and fewer than 150 employees, have a solid business case and commercial viability and operate in western Canada.

Montreal Protocol Multilateral Fund

In 1987, Canada was instrumental in the creation of the Montreal Protocol on Substances that Deplete the Ozone Layer, an international framework to curtail the depletion of the ozone layer.

In the past nine years, Canada has reduced its use of ozone-depleting substances much faster than required under the Montreal Protocol or its own regulations. In no small part, this success is because Canadian businesses are setting a new standard for industry and regulation around the world. Canadian businesses have also been able to benefit from the bilateral arrangements available under the Montreal Protocol Multilateral Fund. Bilateral arrangements made directly with developing countries are highly desirable because they help achieve the environmental objective of eliminating ozone-depleting substances, provide international leadership visibility for Canada and Canadian business, promote the development of Canadian environmental industries and spin-off business opportunities and have no net cost (since Canada contributes to the Fund whether or not bilateral arrangements are negotiated). Canada currently has bilateral arrangements with Venezuela, India, Brazil and China.

Environmental Technology Verification Program

Environment Canada will be launching the Environmental Technology Verification (ETV) Program in the spring of 1997. The Program will provide a "seal of approval" to Canadian technologies that are environmentally friendly. This is an important first step in reversing Canada's negative trade balance for environmental

technologies. The ETV Program builds on Canada's reputation by emphasizing our capabilities and credibility in the environmental market. This voluntary program will assure buyers that a vendor's claims of performance for an environmental technology are valid, credible and supported by suitable demonstration test information. The Program was developed in conjunction with other federal departments, the environment industry and environment industry associations.

To enhance the international credibility and competitiveness of our environmental industry, Environment Canada and the California Environmental Protection Agency will be signing a Memorandum of Understanding on the Verification of Environmental Technologies. The Memorandum opens the door for Canadian environmental companies doing business in the United States.

The ETV Program is now entering the pilot phase in which a number of environmental technologies will be verified at selected accredited testing facilities. The pilot verifications will help develop generic and technology-specific protocols, accurately gauge verification costs and create a critical mass of verified technologies. To compare verification procedures and to gain practical reciprocity experience, the Canadian and Californian ETV Programs will verify several technology performance claims by vendors from both countries.

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Appendix VII – List of Acronyms and Abbreviations

ACCA	Accelerated Capital Cost Allowance
ACIE	Association Canadienne des Industries de l'Environnement
ACOA	Atlantic Canada Opportunities Agency
ADB	Asian Development Bank
AESEQ	L'Association des Entrepreneurs de Services en Environnement du Québec
AFDB	African Development Bank
AID	Agency for International Development
APC	air pollution control
ARET	Accelerated Reduction/Elimination of Toxics
ASEAN	Association of Southeast Asian Nations
BAC	biological activated carbon
BAT	Best Available Technology
BATEA	Best Available Technology Economically Achievable
BFCE	Banque Française du Commerce Extérieur
CAAA	*Clean Air Act* Amendments
CANMET	Canada Centre for Mineral and Energy Technology
CBSCs	Canada Business Service Centres
CCC	Canadian Commercial Corporation
CCHREI	Canadian Council for Human Resources in the Environment Industries
CCME	Canadian Council of Ministers of the Environment
CDC	Commonwealth Development Corporation
CEA	Canadian Exporters' Association
CEAA	*Canadian Environmental Assessment Act*; Canadian Environmental Assessment Agency
CEIA	Canadian Environment Industries Association
CEIS	Canadian Environmental Industry Strategy
CEPA	*Canadian Environmental Protection Act*
CES	Canadian Environmental Solutions
CETAC	Canadian Environmental Technology Advancement Centre
CETOP	Canadian Environmental Training Opportunities Program
CFC	chlorofluorocarbon
CH_4	methane
CIBS	Canada's International Business Strategy
CIDA	Canadian International Development Agency
CIELAP	Canadian Institute for Environmental Law and Policy
CMA	Canadian Manufacturing Association
CO_2	carbon dioxide
CRIQ	Centre de Recherche Industrielle du Québec
DDT	dichlorodiphenyltrichloroethane

DEG	German Finance Company for Investments in Developing Countries
DFAIT	Department of Foreign Affairs and International Trade
EBI	Environmental Business International
EBRD	European Bank for Reconstruction and Development
EDC	Export Development Corporation
EIA	environmental impact assessment
EIP	Environmental Innovation Program
EIS	environmental industry sector
EMFA	Environmental Management Framework Agreement
EPA	Environmental Protection Agency
ERL	Energy Research Laboratories
ESAA	Environmental Services Association of Alberta
ETAD	Environmental Technology Advancement Directorate
ETC	Environment Technology Centre
ETLP	Environmental Technologies Loan Program
ETV	Environmental Technology Verification
EU	European Union
FBDB	Federal Business Development Bank
FEARO	Federal Environmental Assessment Review Office
FINNFUND	Finnish Fund for Industrial Development Cooperation
FMO	Netherlands Development Finance Company
FSU	former Soviet Union
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIMAC	Green Industry Ministerial Advisory Committee
GIS	geographic information system
GNP	Gross National Product
GoCo	government-owned and contractor-operated
HBFC	hydrobromofluorocarbon
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
IBRD	International Bank for Reconstruction and Development
IDB	Inter-American Development Bank
IEA	International Energy Agency
IEMI	International Environmental Management Initiative
IERT	Institute for Environmental Research and Technology
IFC	International Finance Corporation
IFI	international financial institution
IFU	Industrialization Fund for Developing Countries
IIC	Inter-American Investment Corporation
IISD	International Institute for Sustainable Development
IRAP	Industrial Research Assistance Program
kg	kilogram
km	kilometre
lb.	pound
LRTAP	long-range transboundary air pollution
MAP	Microwave-Assisted Process

MDB	multilateral development bank
MDF	medium-density fibreboard
MEIA	Manitoba Environmental Industries Association
MISA	Municipal/Industrial Strategy for Abatement
MIT	Massachusetts Institute of Technology
MVMA	Motor Vehicle Manufacturers' Association
N_2O	nitrous oxide
NAFTA	North American Free Trade Agreement
NEFCO	Nordic Environment Finance Corporation
NEIA	Newfoundland Environment Industries Association
NETAC	National Environmental Technology Applications Corporation
NIB	Nordic Investment Bank
NIMBY	Not In My Backyard
NOx	nitrogen oxides
NPRI	National Pollutant Release Inventory
NRC	National Research Council
NRCan	Natural Resources Canada
NSERC	Natural Sciences and Engineering Research Council
NWRI	National Water Research Institute
OCETA	Ontario Centre for Environmental Technology Advancement
ODS	ozone-depleting substance
OECD	Organisation for Economic Co-operation and Development
OECF	Overseas Economic Cooperation Fund
OPEC	Organization of Petroleum Exporting Countries
OPIC	Overseas Private Investment Corporation
OTA	Office of Technology Assessment
PCB	polychlorinated biphenyl
PERD	Program of Energy Research and Development
PMA	polymer-modified asphalt
ppm	parts per million
ppmw	parts per million by weight
R&D	research and development
RECLAIM	Regional Clean Air Incentives Market
SAGIT	Sector Advisory Group for International Trade
SEMA	Saskatchewan Environmental Managers Association
SMEs	small to medium-sized enterprises
SOx	sulphur oxides
S&T	science and technology
SWSAS	Special Waste Services Association of Saskatchewan
SWEDFUND	Swedish Fund for Industrial Cooperation with Developing Countries
TFMP	Total Fluids Management Program
TPC	Technology Partnerships Canada
TRI	Toxics Release Inventory
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
UST	underground storage tanks
UV	ultraviolet
VOC	volatile organic compounds
WCGR	Waterloo Centre for Groundwater Research
WD	Western Economic Diversification Canada
WTC	Wastewater Technology Centre
WTI	Wastewater Technology Institute

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