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Business and the Environment:

Economic Benefits from Environmental Improvements

by Al Howatson
Business and the Environment
Research Program
The Conference Board of Canada

in conjunction with

Environmental Industries Sector Initiative
Industry, Science and Technology Canada



Industry, Science and
Technology Canada

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In late 1989, the Board of Directors of The Conference Board approved the establishment of a separately funded research program on business and the environment. The program is to focus on economic, managerial, and public policy aspects of environmental issues. A better understanding of market-based instruments for achieving environmental goals was identified as one of its first priorities. The other two major priorities for the first year are the management of environmental issues within organizations and issues concerning the relationship between the global environmental agenda and international competitiveness.

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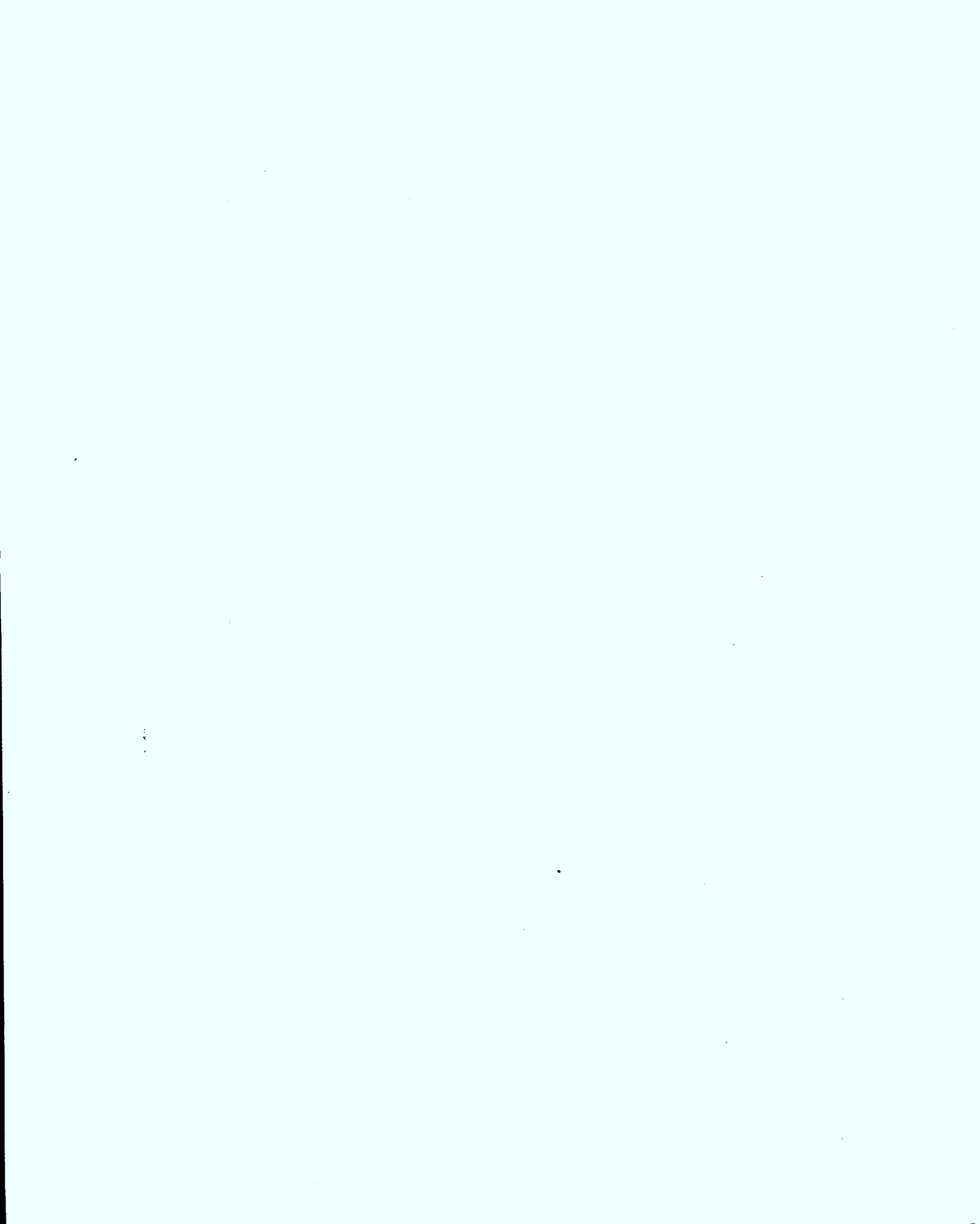
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About the Environmental Industries Sector Initiative

Industry, Science and Technology Canada (ISTC) launched this two-phased project on April 1, 1989. When the Initiative was launched, Canada's environmental industry was facing a situation that could, if left unattended, hinder its ability to garner its share of a burgeoning world market for environmental products, services and expertise. In essence, the Environmental Industries Sector Initiative (EISI) was formed to redress that situation by consolidating the collective knowledge, perspectives and resources of a wide range of public and private sector groups.

Phase I, expected to last for up to three years, is concentrating on two tasks. The first is to build a network—a framework for close consultation between the federal government, the provinces and industry. Through this network, we will collect, synthesize and disseminate information on environmental industries. This information will provide a profile of the sector—its size, products, services, capabilities and existing and potential customers. Such information is an essential step toward completing our second task in Phase I, which is to identify business opportunities and find a way of taking advantage of them. Phase II of EISI, an ongoing phase, will focus on what has to be done to capitalize on those opportunities, thereby developing the sector and its industries.

EISI's primary objective is to improve the competitiveness, at home and abroad, of Canadian industries that produce environmentally related goods and services. Its approach in meeting its objective is based on the 3 Cs—Consultation, Collaboration and Consensus. It has consulted with provincial and federal government departments, businesses and business associations, research organizations and others who might have an interest in a stronger environmental industries sector. Consultation has allowed EISI to foster collaboration among potential stakeholders and

to work toward achieving consensus. *Business and the Environment: Economic Benefits from Environmental Improvements*, funded by ISTC's EISI, is an important step in meeting the objectives outlined above.

To obtain copies of this publication and for further information on the Initiative, please contact your nearest ISTC Regional Office, or

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Contents

| | |
|--|------------|
| Preface | vii |
| Executive Summary | ix |
| Introduction | 1 |
| Purpose | 1 |
| Background | 1 |
| Developments to Watch | 3 |
| Tightening Environmental Standards | 3 |
| A Portfolio of Policy Tools | 4 |
| Environmental Accounting | 4 |
| Reform of Subsidies | 4 |
| Environmental Standards as Non-Tariff Barriers | 5 |
| Multi-Stakeholder Consultation | 5 |
| Industry Self-Regulation | 6 |
| Opportunities in Waste Reduction | 7 |
| Environmental Audits | 7 |
| The Waste Hierarchy | 8 |
| Reduction and Recovery for On-Site Use | 8 |
| Recovery and Re-Use for Off-Site Purposes | 10 |
| Treatment and Destruction | 11 |
| Storage and Disposal | 12 |
| Opportunities in Energy Conservation | 15 |
| Lighting and Heating of Buildings | 15 |
| Industrial Processes | 16 |
| Opportunities in Product Development | 17 |
| Packaging | 17 |
| Energy-Saving Consumer Products | 18 |
| Design for Disassembly | 19 |
| Environmental Choice Programs | 19 |
| Managing Environmental Opportunities | 21 |
| Top Management Support | 21 |
| Line Accountability | 22 |
| Management Systems | 22 |
| Employee Training | 23 |
| Environmental Management—Two Case Studies | 23 |
| Conclusion | 27 |

Preface

GLOBE '90, the international trade fair and conference held in Vancouver in March 1990, was a path-breaking Canadian initiative in several respects. Designed to integrate business and the environment, it brought together government, industry and environmental groups to identify practical solutions to the pressing problems confronting the global community.

The purpose of this report is to highlight the key messages of the GLOBE '90 Conference and Trade Fair which will enable Canadian businesses in the resource processing and manufacturing sectors to enhance their international competitiveness while accelerating the capacity of their industries to anticipate and resolve environmental challenges. The report is written specifically for Canadian business leaders whose decisions have both economic and environmental consequences. Practical methods and concrete examples intended to assist managers make appropriate changes in their operations are included throughout this report.

One of the main objectives of GLOBE '90 was to foster further development of the environmental industry in Canada. In keeping with this aim, a companion report to this document has been prepared to highlight opportunities for suppliers of environmental products, services and technologies. These reports have been prepared by the staff of the Business and the Environment Research Program of The Conference Board of Canada, with the financial support of the Environmental Industries Sector Initiative of Industry, Science and Technology Canada. Together, it is hoped that the two reports will contribute to the vision and goals of GLOBE '90.

James R. Nininger
President and Chief Executive Officer
The Conference Board of Canada

March 1991

Executive Summary

Major Findings

Faced with tightening environmental standards at all levels—regional, national, and international—and for all “receiving media” (land, water and air), Canadian resource processing and manufacturing companies may gain simultaneous economic benefits and environmental improvements from three principal sources:

- **Waste reduction**
- **Energy conservation**
- **Product development**

Reducing wastes, conserving energy, and developing more environmentally sensitive products will provide three benefits for the firm:

- **Savings in production costs** resulting from more efficient use of raw materials and energy, use or sale of recycled wastes, and reduced disposal costs;
- **Minimization of environmental liabilities** resulting from reduced risks of prosecution; and
- **Protection of corporate reputation**, which will foster the preservation of market share, retention and attraction of skilled staff, and public acceptance of future plant sites.

Action Plan

1. **Manage your environmental impacts** by:
 - establishing a written environmental policy to guide the decisions of managers and the actions of staff;
 - appointing a senior manager to oversee environmental improvements;
 - providing management systems to ensure that operations comply with corporate policies and objectives; and
 - ensuring that staff have the knowledge, skill and resources necessary to achieve these goals.

2. **Examine your operations** through environmental audits for:
 - compliance with existing and expected environmental, health and safety regulations;
 - opportunities to further reduce and re-use wastes; and
 - opportunities to conserve energy.

3. **Systematically reduce wastes** through a scheduled program based upon corporate goals, audit results, and economic feasibility.

4. **Implement energy conservation projects** where expected benefits justify the costs.

5. **Redesign your product** if marketing and engineering research indicate that the redesigned product, while still being competitive, will yield environmental benefits in its packaging, use or final disposal.

Introduction

The management of environmental impacts presents firms with a challenge similar to that of other social, economic or technological priorities.

Purpose

The purpose of this report is to highlight the key messages derived from the GLOBE '90 Conference and Trade Fair which will enable Canadian business leaders in the resource processing and manufacturing sectors to enhance their international competitiveness while accelerating the capacity of their industries to anticipate and resolve environmental challenges.

Background

A number of trends have led to the recent increased emphasis on environmental management within Canadian business: growing public concern with pollution and safety, as reflected in opinion polls; the increase in number and complexity of environmental regulations at the provincial and federal levels; and the occurrence of catastrophic events such as Bhopal, Three Mile Island, Chernobyl, and the Exxon Valdez oil spill, with their attendant damage, public exposure, and liability.

The management of environmental impacts presents firms with a challenge similar to that of other social, economic or technological priorities. In recent decades, corporations have had to cope with major changes in such fields as human resources, information technologies, and international trade and investment. In each case, the business bent on surviving, let alone growing, has had to adapt to the changing business climate by identifying and analysing the significant issues; assessing the implications of these issues for the firm; adjusting corporate priorities and policies; ensuring that business strategies, plans and decisions at all levels incorporate such changes; and establishing structures and accountabilities to manage in the new circumstances.

In the industrialized world, the response of corporations to environmental issues has broadened and deepened over the last several decades. In the 1960s and early 1970s, firms tended to respond to environmental problems as they arose: fighting a lawsuit

A whole generation of young adults expects corporations will take seriously their responsibilities to minimize the environmental impacts of their operations.

here, responding to a violation notice there, or replacing faulty equipment causing environmental damage. As the first wave of environmentalism brought an increase in the quantity and complexity of regulations in the 1970s, companies then moved to put in place management systems to ensure that their operations complied with these regulations. With the second wave of environmentalism in the late 1980s, corporations are beginning to realize that compliance with existing regulations is an insufficient response. Discussion of environmental issues today may lead to more regulations tomorrow. A whole generation of young adults, raised with an awareness of environmental issues, expects that the corporations for whom they work and from whom they purchase will take seriously their responsibilities to minimize the environmental impacts of their operations. Moreover, even though a firm may be in compliance with regulations, a company may still face the liability and public outcry which follows in the wake of a major plant accident or oil spill.

The consulting firm Arthur D. Little, Inc., has observed that the evolution of environmental management practices in U.S. corporations has paralleled this historical pattern. A minority of firms are still responding to problems as they arise (Stage 1). The majority of U.S. corporations appear to have established systems and programs to comply with regulations (Stage 2). A further minority of progressive firms have moved beyond compliance (Stage 3). These companies attempt to foresee hazards and regulations and, therefore, work systematically to minimize the effects of their operations on the environment, the health and safety of their workers, and the local community. In so doing, the firm also minimizes its liabilities.

Firms in the first and second stages may be said to be *reactive* in their environmental management stances. Firms in the third stage are *proactive*—actively managing rather than letting events force them to respond. Corporations striving to move into the third stage realize that a “beyond compliance” mentality needs to become part of their corporate culture. A major task, therefore, is the diffusion of an environmental consciousness throughout the entire

Zero emissions . . . will become the target standard for many toxic and hazardous emissions throughout the industrialized world.

organization. Within a large, diversified corporation, however, plants or divisions may be in different stages. The spread of best-management practices takes time and is affected by the firm's experience, the commitment of its managers, and the industries and locales in which it operates.

Developments to Watch

The following trends will have a significant environmental impact on business planning and operations in the next decade:

■ **Tightening Environmental Standards**

Canadian industry must expect tightened environmental standards at all levels—regional, national and international—and for all “receiving media” (land, water and air). *Zero emissions* (paralleling the concept of *zero defects* in quality control) will become the target standard for many toxic and hazardous emissions throughout the industrialized world. The following examples are two from among many that will illustrate this trend.

(i) The governments of Canada and Quebec are co-ordinating efforts to reduce the environmental degradation of the St. Lawrence River. The primary objective of the St. Lawrence River Action Plan is to reduce by 90 per cent, between 1989 and 1993, the liquid toxic waste being discharged into the St. Lawrence by 50 industrial plants that federal and provincial authorities consider prime targets for action.

(ii) In Ontario, the Municipal-Industrial Strategy for Abatement (MISA) is designed to systematically reduce water pollution. A program of monitoring emissions from selected industries will then be followed by regulations which will be tightened over time as abatement technology improves.

Is your firm reactive or proactive in its approach to environmental management? What actions would make your company proactive?

Businesses which are active now in reducing emissions and wastes may benefit in the future by enjoying low effluent fees or spare emission credits to trade.

... some resource extraction activities considered standard today may come to be seen (and measured) as environmental degradation.

■ A Portfolio of Policy Tools

Tightening standards will not necessarily mean only increased regulations. Traditional environmental "command and control" regulations will be supplemented with a variety of market-based instruments such as effluent fees, performance bonds, deposit-refund systems and tradeable emission credits. Government regulators will still establish standards and monitor emission levels, but will also introduce market-based instruments that may be costly for companies that are not proactive in their environmental management. Businesses which are active now in reducing emissions and wastes may benefit in the future by enjoying low effluent fees or spare emission credits to trade.

■ Environmental Accounting

Work is currently proceeding in a number of countries to integrate national economic accounts and environmental indicators. For example, the construction of "satellites" to the system of national accounts is one attempt to quantify the consumption, deterioration, or exhaustion of natural resources. One Indonesian study constructed satellite accounts for forest, oil and land resources. The inclusion of a debit item for these resources resulted in an adjusted Gross Domestic Product (GDP) for 1984, a net national product, which was 4 per cent lower than the traditional measure of Indonesian GDP.

A system of natural resource satellite accounts could have major implications for mining and forestry operations, since some resource extraction activities considered standard today may come to be seen (and measured) as environmental degradation.

■ Reform of Subsidies

Government subsidies, which have historically been used for such purposes as regional development or export promotion, frequently exacerbate environmental problems by inducing over-use of resources. Agriculture, fisheries, forestry and industries that use large quantities of energy and water may find that

... corporations must be prepared to engage in open debate in order to influence the development of environmental policy.

governments will reduce or eliminate such subsidies in order to mitigate negative environmental side-effects. Subsidy reductions may increase overall production costs in some industries, making some plants uncompetitive or proposed investments unattractive. Canadian industries at risk, therefore, need to give thought to the impact of potential subsidy eliminations on their operations.

■ Environmental Standards as Non-Tariff Barriers

The demand for international level *playing* fields in trade is being followed by a similar call for level *green* fields. Environmental standards have the potential to become major non-tariff barriers if some nations bar imports from others based on the claim that the exporter's products or manufacturing processes are environmentally unsound. Canadian exporters will therefore need to keep surveillance on environmental regulatory trends in their export markets.

■ Multi-Stakeholder Consultation

In many fields of public policy development in Canada, a co-operative and consultative approach to problem solving is being sought. In no area is this more apparent than environmental policy. Through a plethora of public hearings, advisory panels, symposiums and task forces, stakeholders (that is, groups that have a stake in the issue at hand) are meeting to hear respective concerns, discuss the implications of proposals, and contribute to the formation of decisions. Governments at all levels now recognize the importance of consulting stakeholders before taking decisions that will have a significant impact on those affected. The implications for Canadian business are clear: corporate plans with environmental impacts must be prepared for the scrutiny of multiple stakeholders before implementation, and corporations must be prepared to engage in open debate in order to influence the development of environmental policy.

... the overall aim of Responsible Care—to take every practical precaution to protect the health of people and the environment throughout the life cycle of their products.

■ Industry Self-Regulation

Responsible firms wishing to minimize the negative impacts of their operations on society must either police themselves through industry self-regulation or press for the appropriate government standards. These firms take the lead in setting environmental standards that others in the industry will eventually need to follow. There are advantages to having all companies in the industry comply with these standards. For example, the industry can avert coercive government regulations that will hamper the flexibility of decision makers in the responsible firms.

The Canadian chemical industry, through the Responsible Care program of the Canadian Chemical Producers' Association (CCPA), is a world leader in environmental management. The chemical industries of the United States, the United Kingdom, France and Australia have implemented programs of their own, patterned on the Canadian model. The 73 member companies of the CCPA are working to put into action seven Codes of Practice that will put muscle into the overall aim of Responsible Care—to take every practical precaution to protect the health of people and the environment throughout the life cycle of their products.

Who in your company is responsible for considering the impact of environmental trends and changing regulations? What will be the impact of these developments on your firm?

Opportunities in Waste Reduction

Systematic efforts to reduce waste should start with an environmental audit.

Waste reduction is one of the most promising improvements through which resource processing and manufacturing firms can gain simultaneous environmental benefits and cost savings. Benefits from a systematic program of waste reduction include:

- **Savings in production costs** resulting from more efficient use of raw materials and energy, use or sale of recycled wastes, and reduced disposal costs;
- **Minimization of environmental liabilities** resulting from reduced risks of prosecution; and
- **Protection of corporate reputation**, which will foster the preservation of market share, retention and attraction of skilled staff, and public acceptance of future plant sites.

* This report uses the term *waste reduction* in the broadest sense to include all efforts by industry to reduce, recover, recycle, treat and dispose of all emissions and wastes, whether gaseous, liquid or solid. Waste reduction, as used here, incorporates the concept of *pollution prevention*—reducing pollutants at the source—as well as the notion of *waste management* in the narrow sense of treating and disposing of wastes once generated.

Environmental Audits

Systematic efforts to reduce waste should start with an environmental audit. Derived from the more familiar health and safety audits, environmental audits are increasingly used by companies as tools to improve their environmental performance. Environmental audits can vary widely in purpose, scope and format. The common compliance audit, as the name suggests, is used to ensure that company operations comply with both government regulations and corporate standards. Acquisition and divestiture audits are used to ensure that neither buyer nor seller

Quaker Oats Canada, based in Peterborough, has reduced wastes going to the landfill by 75 per cent over the past three years—well ahead of the 1992 goal set by Ontario for a 25 per cent reduction. The reduction represents some 3,400 tonnes diverted from municipal landfills through waste prevention, remilling and recycling. It also accounted for a total operational saving of \$800,000 between 1986 and 1989.

in a corporate restructuring is left with unknown skeletons in the environmental closet.

Companies in Ontario may soon be faced with mandatory waste audits. A waste audit program can catalogue wastes by source, type, amounts and hazard levels. Some firms use computerized inventory systems to assist in this task, and also to calculate the potential costs of waste management by product line.

Some large corporations have developed expertise in doing their own audits. However, small and medium-sized businesses may choose from among dozens of environmental consultants who will either assist or perform environmental audits for clients.

The Waste Hierarchy

Once a waste audit has been completed, industries can proceed with their waste reduction programs by using the following waste hierarchy, giving consideration to each step in order of priority:

- reduction and recovery for on-site use
- recovery and re-use for off-site purposes
- treatment and destruction
- storage and disposal

■ **Reduction and Recovery for On-Site Use**

Steps to reduce wastes at the source and to recover wastes for on-site use include the following, moving from the least to the most complex tasks:

- *Improved housekeeping techniques*, such as checking and stopping leaks from faulty equipment, ensuring that plant machinery is well-maintained and optimally run, and using mass balance checks to control material flows.
- *Substitution* of low or non-waste generating process materials for problematic ones. For example, one approach gaining increased use is the substitution of water-based for oil-based solvents.
- *Physical segregation* of wastes, which may allow some to be cleansed and re-used on-site, others to be burned for process energy, and still others to be sold (or carted away at

The Agropur cheese plant at Notre-Dame-du-Bon-Conseil in Quebec has entirely replaced the energy once purchased to run its machinery with power generated from its own wastes. Two anaerobic wastewater treatment plants convert dairy waste into methane gas, which then powers the machinery. The company saves \$30,000 per year in purchased power, and collects \$10,000 per year in net revenue from the sale of excess sludge as an animal food supplement. The largest savings, however, are in avoided landfill costs. A conventional plant without anaerobic digesters would have sludge disposal costs in the order of \$500,000 per year.

no disposal cost) to other firms which can use the wastes as inputs into their own processes. For example, Mother Parker's Foods Limited, in Mississauga, Ont., has achieved an 85 per cent reduction in wastes going to the local landfill since 1987. Wooden pallets and scrap lumber are given away to employees and others. Coffee-bean jute bags end up in local nurseries for shrub coverings. Corrugated cartons and scrap metal are sold to local firms, while waste paper is collected for recycling. A pelletized coffee by-product is picked up by a local farmer for use as a hog-feed supplement. The savings amount to about \$35,000 annually through reduced landfill tipping costs and company trips to the dump, in addition to the minor revenues derived from sale of some wastes.

- *Reclamation and recycling*, particularly of solvents. Solvent recovery, cleansing and re-use has many advantages, including the elimination of costly storage and disposal, savings in solvent purchase, and good returns on the capital invested.
- *Generation of process energy* from waste materials. For example, Du Pont Canada incinerates over 80 per cent of its wastes on-site. By capturing the energy potential of these wastes, Du Pont has reduced its consumption of purchased energy and avoided the disposal costs for these wastes.
- *Process modifications* including closed-loop cycling and the introduction of more efficient equipment to process raw materials.

Which of the above steps, beyond compliance with environmental regulations, might reduce your wastes in an economically feasible manner?

Export Packers Company Ltd. in Winnipeg has converted 100 per cent of a former waste into a profitable by-product. In 1983, the company began a research project to utilize its waste egg shells—approximately 6,800 kg of wet waste egg shells per day. An “Egg Shell Meal” was developed, providing a calcium and protein supplement for chicken feed. With sales of the meal at \$110,000 per year, and a saving in disposal costs of about \$41,000 annually, net annual revenue from the project is approximately \$150,000. Capital costs of plant expansion and machinery for the new venture amounted to about \$125,000, thus yielding an attractive payback period of less than one year.

■ **Recovery and Re-Use for Off-Site Purposes**

Where the recovery of generated wastes may not be feasible for re-use or energy generation on-site, the wastes may none the less be of use to other companies or individuals. Some opportunities include the following:

- *Reclamation and sale of wastes.* For example, valuable metals are now reclaimed from sludges and greases. Oils and solvents are cleaned and sold.

Opportunities exist for technological entrepreneurs in modifying wastes to suit a client's needs. While large organizations may have the facilities and expertise to handle such operations in-house, smaller companies may prefer to sell untreated wastes to, and buy modified by-products from, a specialized “waste modifier”.

- *Regional waste exchanges* have cropped up throughout North America. With the help of computerized inventory systems, firms may find other companies that can make good use of their wastes. The Canadian Waste Materials Exchange, established in 1978, distributes a bulletin six times a year to over 4,000 Canadian firms, listing industrial wastes offered and sought. The value of the raw materials that the transferred wastes have replaced is estimated at about \$11 million per year, compared with the program operating costs of about \$50,000 per year. Up to March 1989, about 3,370 wastes had been listed and 590 successfully exchanged. Ontario, Alberta and Manitoba have established regional waste exchange programs.

- *Product development.* By viewing wastes as by-products, it may be possible to develop a new product line. A classic example can be found in the forest products industry: sawmill chips, once consigned to the burner, are now an essential ingredient in making pulp. In fact, the Canadian industry has seen recent takeovers of sawmills by pulp companies motivated by the need to acquire secure access to chip supplies.

A novel use of waste heat comes from the coast of California. Pacific Gas and Electric has solicited a successful aquaculture firm to explore the possibility of commercially raising shellfish which thrive in the warm waters generated from waste heat from a nearby power plant.

Companies lacking in-house expertise may utilize either public research facilities (e.g., B.C. Research at the University of British Columbia, ORTECH in Ontario or the National Research Council) or private research laboratories in order to develop new products from their wastes.

- *Waste for energy.* Where the production of energy from waste material is feasible but surplus to on-site conditions, potential uses may sometimes be found off-site. For example, many industrial and municipal wastes can provide valuable fuels for cement kilns. The extremely high temperatures in the kilns render many industrial wastes harmless. Cement firms benefit from using essentially "free" fuel, since fuel can account for up to 30 per cent of the average variable costs in the manufacture of cement. Communities may benefit as well, since capital costs for the construction of municipal incinerators can sometimes be avoided.
- *Licensing.* Technology developed by a company to tackle its own waste reduction problems can be licensed to other companies facing similar challenges.

■ **Treatment and Destruction**

When attempts to reduce, recover and re-use wastes for on-site and off-site purposes (including energy generation) have been exhausted, the next step in the waste hierarchy is to examine the treatment and destruction of wastes (on- or off-site). Treatment or destruction is essential when wastes are too hazardous or toxic to be directly re-used or landfilled.

*Is your firm looking for ways to market its wastes?
Could modifications be made to these wastes to make them usable to others?*

Treatment or destruction is essential when wastes are too hazardous or toxic to be directly re-used or landfilled.

Treatment methods include a range of biological, chemical and physical technologies.

- *Biological* treatment is limited to those wastes which can be biologically degraded. Although sewage treatment is the classic example, rapidly developing biotechnologies are being extended to wastes from food and beverage processes, pulp mills, and mining operations.
- *Chemical* treatments range from simple precipitations to complex reactions. Ultrafiltration, reverse osmosis, electrolytic recovery, ion exchange and distillation are illustrative of separation and concentration techniques used in chemical waste treatments. The neutralization and destruction of toxic by-products will continue to be a complex field of research and development activity pursued by chemists and chemical engineers.
- *Physical* treatment commonly involves the thermal processes of incineration or pyrolysis. High-temperature, controlled incineration has been found to destroy toxic organic compounds, with the extra benefit of capturing the energy potential of the wastes for process heat.

■ **Storage and Disposal**

The final element of a waste reduction program is the safe storage or land internment of industrial wastes. However, before considering this practice, it is important to first examine ways to reduce waste through the steps discussed in the preceding sections.

Is your firm incurring costly storage and landfilling charges when one of the above treatment methods might be more economically feasible?

... a full range of commercial environmental services and technologies are available ... to assist companies with their waste reduction efforts.

In summary, a sound waste reduction program progresses systematically in the following order: initial efforts to minimize wastes; recycling and materials recovery; treatment, detoxification or destruction; and finally, long-term storage or landfilling of residuals. While a firm's technical staff may be capable of implementing many of these steps, a full range of commercial environmental services and technologies are available in Canada to assist companies with their waste reduction efforts.

Opportunities in Energy Conservation

Southwire, the largest independent rod, wire, and cable business in the United States, cut its total energy use per pound of product by half in eight years, as one method of coping with the tough economic conditions of the early 1980s. The reductions—about 60 per cent in gas and 40 per cent in electricity—yielded virtually all of the company's profits from 1980 to 1986, and may have saved 4,000 jobs at 10 plants in 6 states.

... if the thousand or so best electricity-saving innovations now on the market were fully installed in U.S. buildings and equipment, they'd save about three fourths of all electricity now used, at an average payback of slightly more than one year, while providing unchanged or improved services.—Amory Lovins, Rocky Mountain Institute, Colorado.

Energy conservation provides an opportunity for Canadian industry to cut production costs and reduce the environmental impacts resulting from energy generation and use. Planning now for energy conservation may be timely, since the imposition of any future carbon tax or a move to marginal pricing of electricity could result in higher power rates.

Site-specific energy audits will enable a company to pinpoint targets for energy conservation in the same way that waste audits can isolate priorities for waste reduction. In general, Canadian industry may look at two promising areas for conserving energy: the lighting and heating of buildings, and industrial processes.

Lighting and Heating of Buildings

Modern fluorescent lights, sophisticated electronic ballasts, and top-silvered blinds are only a few of the lighting options currently available that can cut light bills by 60 to 80 per cent and multiply service life from 6 to 12 times. Such improvements can quickly pay for themselves by reducing replacement costs and reducing the labour expenses for installation and maintenance.

New electronic controls can monitor indoor and outdoor light and temperature. These controls can be used to provide light, heat and conditioned air when and where needed, thereby effectively reducing waste of energy.

Advanced building materials and window systems can sharply reduce heat loss. Condensing furnaces, which absorb much of the heat from exhaust gases, need 28 per cent less fuel and emit fewer pollutants than conventional gas furnaces. Modern commercial refrigeration units use only half the power of units on the market a decade ago.

A typical big industrial motor consumes electricity costing some 10 to 20 times its own total capital cost per year. Over a motor's life, a 1 percentage point gain in efficiency typically adds at least \$10 per horsepower to the bottom line. Direct efficiency gains averaging about 3.5 percentage points are currently possible, which for a motor-intensive company, such as a paper mill, can create enough savings to turn around a foundering firm.—Amory Lovins

Industrial Processes

Electric motors are a fruitful source of power savings. New high-efficiency motors and electronic speed controls can cut power costs dramatically. It is estimated that electronic adjustable-speed drives can save from 14 to 27 per cent of total U.S. motor energy, with paybacks of one to two years.

Co-generation—the combined production of steam and electricity—may hold promise for some large industrial plants. Only about 35 per cent of the energy from the steam produced by a conventional power plant is converted to electricity; in a co-generation plant, this residual unused steam energy is used for heat in other processes.

Firms specializing in energy conservation services can assist companies not only with energy audits, but also with advice and provision of the most recent lighting, building and industrial energy conservation technologies.

Is your firm paying more in power bills than is necessary? What energy conservation projects can you initiate in your plants which will pay back the investment in less than two years?

Opportunities in Product Development

Decisions to market and produce more environmentally sensitive products must be based on analyses that weigh the potential benefits and risks for each situation.

Reducing wastes and conserving energy are two principal areas in which manufacturers may obtain both economic benefits and environmental improvements. In addition, some manufacturers may find opportunities in developing products that allow their customers to reduce wastes and conserve energy. However, while the marketing and production of environmentally sensitive products may present opportunities, it may also present risks: How much convenience will consumers be prepared to forgo to obtain more environmentally friendly packaging? What price premium will the market bear for greener products? Decisions to market and produce more environmentally sensitive products must be based on analyses that weigh the potential benefits and risks for each situation. Four developments toward greener products are worth the attention of Canadian industry:

■ Packaging

Although post-consumer packaging waste accounts for only a small fraction of landfill volumes, its high visibility makes it a target for action by consumers, environmental groups, and governments under pressure to do something about rapidly filling landfills. Procter & Gamble, among other manufacturers of consumer disposables, has responded with their Enviro-paks and other packaging innovations.

Does your packaging make your company vulnerable to loss of market share or to action by government? Can you reduce or redesign your product packaging without increased product damage or lost market share?

The home and transportation domains . . . will also offer promise for manufacturers who wish to improve market share in energy-saving products.

■ **Energy-Saving Consumer Products**

Since home and transportation are the major domains in which individual Canadians have some control over their personal energy expenditures, these markets will also offer promise for manufacturers who wish to improve market share in energy-saving products. Furthermore, governments are giving consideration to tighter energy-efficiency standards for many products over the next decade. Energy-efficient appliances, heating systems and home insulation systems, which were promoted during the energy scares of the 1970s, are likely to be either made mandatory by governments or increasingly demanded by energy-conscious consumers in the 1990s. For example, auto manufacturers, under threat of U.S. legislative pressure for improved fleet-average mileage performance, are developing electric cars for urban commuting as well as engine systems which will run efficiently on gasoline blended with ethanol or methanol.

Is your company developing blueprints for more energy-efficient products before these become mandatory by governments in domestic and export markets?

The German automaker BMW has designed its two-seater Z1 so that the car's plastic skin can be disassembled from its metal chassis in 20 minutes. Sold only in Europe (to date), the Z1 has front, rear and side panels; doors; and bumpers made of recyclable thermoplastics supplied by GE Plastics.

■ Design for Disassembly

While manufacturers of consumer disposables have been the first to be called upon to contribute to reduced consumer waste, producers of durables are also now developing products with recycling in mind. Whirlpool, Digital Equipment, Electrolux and General Electric are a few of the large corporations now incorporating *design for disassembly* (DFD) into product development.

■ Environmental Choice Programs

Consumers, bewildered at the task of trying to discover whether a given product is more environmentally sensitive than another, are looking to *eco-labelling* programs for their "green seals of approval". Canada is one of more than 20 countries that now have ECO-LOGO programs to provide some objective standards by which a product may be judged environmentally superior. Products carrying the ECO-LOGO label could have a competitive advantage over products which are not so labelled.

If you are a manufacturer, can DFD technologies offer a competitive advantage for your firm? Does your firm face threats from competitors that have DFD technologies?

Would an ECO-LOGO label on your current products provide a competitive advantage? Would the cost of redesigning your products to meet environmental standards justify the possible market benefits that may result?

Managing Environmental Opportunities

A further means of demonstrating high-level support for environmental change is the appointment of an environmental champion at the senior level.

A sound business response to the environmental challenge is the incorporation of environmental factors into the bloodstream of a firm's operations. Environmental considerations will then be as natural to the well-managed organization as the budgeting process, customer focus or high quality standards.

How can a company work toward this goal? In particular, how can a firm proceed to benefit from the previously discussed opportunities in waste reduction and energy conservation? How can it work with, rather than against, the trends of "green politics"? The following management practices have been found to be vital by a number of corporations:

■ Top Management Support

Intended organizational change must receive support from the senior levels of that organization. To promote environmental improvements, many corporations have ratified, at the most senior level, environmental policies for corporate-wide application. Many others have struck special environment subcommittees of their boards of directors, or broadened the terms of reference of other board subcommittees to include environmental issues.

A further means of demonstrating high-level support for environmental change is the appointment of an environmental champion at the senior level. While some firms have appointed a Vice-President for Environment, others have added the environment portfolio to the responsibilities of one of the existing senior executives.

Traditional waste management has concentrated on treatment and disposal of wastes at the tail end of the pipe. However, greater benefits can be obtained by considering both ends. Inclusion of the front end of the pipe in waste reduction must involve marketing, engineering and production staff, not simply the environmental personnel who have traditionally

We must ensure that responsible environmental management is operative, visible and accountable, at all levels from the boardroom to the shop floor.—Ian Smythe, President, Canadian Petroleum Association.

cleaned up. Consequently, the full benefits from a comprehensive waste reduction program can only be obtained with top management support, since payoffs may require changes to processes over which environment engineers have historically had little control.

Since many waste reduction projects are economically viable, providing high internal rates of return and quick payback periods, it may be asked: "Why then are such projects not more frequently undertaken by industry?" Lack of attention is the probable cause. The time and energy of executives are focused elsewhere, on more traditional marketing, innovation and investment opportunities. A high-ranking champion, with sufficient clout to influence product and process changes, may therefore provide firms with some attractive, but previously ignored, returns through exploitation of these hidden, internal investment opportunities.

■ **Line Accountability**

In keeping with the principle of pushing decisions and accountability to the appropriate level, many decentralized organizations are placing responsibility for performance on the managers of their divisions and plants. Specialized environment staff then assist the accountable officers as required.

Some companies are experimenting with linking compensation to the environmental performance of managers and plants in order to foster ownership.

■ **Management Systems**

Once environmental policies, operating objectives and organizational responsibilities have been established, it is essential to have control and reporting procedures to ensure that operations do, in fact, comply with corporate policies and goals. Environmental audits stand at the heart of a good environmental management system. Regulatory surveillance, project and program reviews, and risk assessments are also used either independently or as an integral part of an on-going environmental audit process.

Managers who are accountable for the environmental performance of their units . . . provide the strongest possible incentive for employees to "get the message".

■ Employee Training

Employee awareness, training and commitment are essential to the attainment of a firm's environmental objectives. Training methods in the environmental field are as diverse as training procedures for other business skills. Seminars conducted by the specialized environment staff, courses (on- and off-site) taught by environmental consultants, regular features in company newsletters, and more are being used by companies to bring employees onside. Perhaps the most powerful method to ensure learning, however, is the day-to-day involvement of the workforce in the regular activities of an organization that is serious about implementing its environmental policies. Managers who are accountable for the environmental performance of their units—and who in turn hold staff accountable—provide the strongest possible incentive for employees to "get the message".

■ Environmental Management—Two Case Studies

The experience of two companies—one large and one medium-sized—will illustrate a number of the principles discussed.

3M Inc.

3M is a major multinational company, employing over 85,000 people in 52 countries, producing some 60,000 products for business, industry, government and consumer markets. The company's 3P program—Pollution Prevention Pays—has received wide recognition and has been adopted by many other firms. The goal of 3P is to prevent pollution at the source in products and manufacturing. While this concept is not new, 3P is one of the earliest attempts to apply and measure corporate-wide pollution prevention methods.

In its first 14 years of operation (1975 to 1989), 3P was estimated to have cut the firm's pollution in half. Cost savings have amounted to some U.S. \$500 million from over 2,400 projects. A 3P Co-ordinating Committee provides administrative support for the program, while an award program encourages the participation of technical employees.

The ultimate goal is the achievement of as close to zero emissions as is technically possible.

Two of the many 3P projects will illustrate the nature and benefits of the program.

At a facility in Alabama, a 3P project involved recycling cooling water that had previously been discarded with other wastewaters. Recycling the cooling water enabled the company to scale down the size of a planned wastewater treatment operation from 2,100 to 1,000 gallons per minute. The recycling facility cost U.S. \$480,000 but saved the company U.S. \$800,000 alone on the construction cost of the wastewater treatment facility.

Another 3P project redesigned a resin spray booth which had been producing 500,000 pounds of overspray per year. The overspray required special incineration disposal. New equipment installed to eliminate the overspray allowed the firm to save U.S. \$125,000 annually on the U.S. \$45,000 investment.

In June 1989, 3M announced an updated program called 3P Plus. The goal of this program is to cut, from a base year of 1987, all hazardous and non-hazardous releases to air, water and land by 90 per cent, and to reduce the generation of hazardous waste by 50 per cent by the year 2000. The ultimate goal is the achievement of as close to zero emissions as is technically possible.

Emerson Electric Co.

The Emerson Electric plant in Murphy, North Carolina, manufactures stationary power tools. The process involves metal finishing and painting operations with extensive use of chemicals. In the early 1980s, Emerson undertook a comprehensive pollution prevention program. The outstanding features of Emerson's program have been its comprehensiveness and the multiple benefits arising from its implementation.

The major cost saving came from increased annual productivity of about U.S. \$1 million resulting from the substitution of a water-based anodic electrostatic immersion paint system for the existing organic-solvent-based operation. The water-based system allows 99.5 per cent recovery and re-use of paint, resulting in decreased paint costs of U.S. \$600,000 per year. Hazardous waste disposal costs for the painting

The outstanding features of Emerson's program have been its comprehensiveness and the multiple benefits arising from its implementation.

operations dropped from U.S. \$10,000 per year to only U.S. \$300 per year.

A second major saving came through the installation of an automated, metal electroplating system to replace the manual operation. Annual productivity increased by U.S. \$200,000, downtime dropped from 8 to 4 per cent, and chemical consumption dropped by 25 per cent, resulting in an annual reduction of U.S. \$8,000 in raw material costs. Other benefits of this automated electroplating include: reduced water costs; reduced plating wastes (acids, caustics and oils); reduced costs in treating wastewaters; elimination of worker exposure to acids and caustics; and savings of U.S. \$35,000 in personnel and maintenance costs.

A third major saving is attributed to a U.S. \$100,000 computerized energy management system that saves the plant U.S. \$145,000 in electrical costs per year. Other elements of the overall program included establishing the following:

- a comprehensive program for chemical waste management;
- an incentive program for new cost-reduction and product ideas; and
- an ultrafiltration system for process chemical recovery.

Capital costs for Emerson's total program included U.S. \$200,000 for facilities and U.S. \$674,000 on equipment, with annual pollution control costs of U.S. \$380,000. Paybacks on the various elements of the program ranged from 1.1 to 5 years. Annual benefits included:

- U.S. \$1 million in productivity improvements from the new paint system;
- U.S. \$200,000 in productivity improvements from the new electroplating system;
- savings of U.S. \$642,000 on raw materials;
- savings of U.S. \$52,700 on waste disposal costs;
- savings of U.S. \$157,000 on personnel and maintenance costs;
- improved downtime;
- reduced regulatory pressures; and
- decreased worker exposure to organic solvents.

Conclusion

A careful review of corporate operations through environmental audits may reveal previously ignored opportunities for gaining simultaneous economic benefits and environmental improvements.

Companies are facing a future which will be characterized by tightening environmental standards, growing public concern for a cleaner natural environment, and increasing international competitiveness. Firms that take action to reduce the negative environmental impacts of their processes and products will gain three benefits:

- **Savings in production costs** resulting from more efficient use of raw materials and energy, use or sale of recycled wastes, and reduced disposal costs;
- **Minimization of environmental liabilities** resulting from reduced risks of prosecution; and
- **Protection of corporate reputation**, which will foster the preservation of market share, retention and attraction of skilled staff, and public acceptance of future plant sites.

Pollution abatement investments which are required in order to comply with environmental regulations will not always yield favourable benefit-cost ratios for the firm. However, a careful review of corporate operations through environmental audits may reveal previously ignored opportunities for gaining simultaneous economic benefits and environmental improvements. In particular, three areas of operation are worth attention:

- **Waste reduction**
- **Energy conservation**
- **Product development**

A sound business response to this environmental challenge is the incorporation of environmental factors into the bloodstream of a firm's operations. Environmental considerations will then be as natural to the well-managed corporation as the budgeting process, customer focus or high quality standards.

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