Status of Pollution Prevention in North America

Commission for Environmental Cooperation

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Commission for Environmental Cooperation

Three nations working together to protect the Environment.
A North American approach to environmental concerns.
The **Commission for Environmental Cooperation (CEC)** was established by Canada, Mexico and the United States in 1994 to address transboundary environmental concerns in North America. While the idea to create such a commission originated during the negotiations of the North American Free Trade Agreement (NAFTA), it derives its formal mandate from the North American Agreement for Environmental Cooperation (NAAEC).
The NAAEC builds upon and complements the environmental provisions established in the NAFTA. It creates a North American framework whereby goals related to trade and the environment can be pursued in an open and cooperative way.
In broad terms, the NAAEC sets out to protect, conserve and improve the environment for present and future generations. How? The parties to the Agreement set out the following objectives:

- to protect the environment through increased cooperation;
- to promote sustainable development based on mutually supportive environmental and economic policies;
- to support the environmental goals of the NAFTA and avoid creating trade distortions or new trade barriers;
- to strengthen cooperation on the development of environmental laws and enhance their enforcement; and
- to promote transparency and public participation.

In signing the NAAEC, the governments of Canada, Mexico and the United States committed themselves to a core set of actions, including:

- reporting on the state of the environment;
- striving for improvement of environmental laws and regulations;
- effective enforcement of environmental law; and
- publication and promotion of information.

Mission Statement

The CEC facilitates cooperation and public participation to foster conservation, protection and enhancement of the North American environment for the benefit of present and future generations, in the context of increasing economic, trade and social links between Canada, Mexico and the United States.

Overview and Acknowledgments

One of the objectives of the North American Agreement on Environmental Cooperation (NAAEC), signed by the government of the United States of America, Canada, and Mexico in 1993, is to promote pollution-prevention policies and practices. In Article 10.2 of the Agreement, the Council of the Commission for Environmental Cooperation (CEC) is empowered to consider and develop recommendations regarding pollution-prevention techniques and strategies.

The Commission has retained Dr. Alberto Bustani Adem of the *Instituto Tecnológico y de Estudios Superiores de Monterrey* in Mexico, Mark Haveman from the Waste Reduction Institute for Training and Applications Research in the US and Colin Isaacs of Contemporary Information Analysis Ltd. in Canada to report on the status of pollution prevention in each of the signatory countries; to identify common elements and needs; and to develop recommendations to the Commission on how it might proceed in implementing its mandate in this area. Each consultant has prepared a report addressing the status of pollution prevention in his own country. These can be found in the present document as chapters III to V.

The first chapter contains a brief overview of the status of pollution prevention in North America, compiled from the three national research reports. It also includes a set of draft recommendations, which were prepared by the consultants, with input from the Secretariat of the Commission for Environmental Cooperation, for discussion at a technical meeting of pollution-prevention experts held in Montreal on 13-14 December 1995. The intent of these draft recommendations is to aid the meeting participants in developing a set of strategic recommendations that would assist the CEC in designing a pollution-prevention program to meet the mandate of Article 10.2 of the Agreement.

Hernado Guerrero
Program Manager
Capacity Building
June 1996

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Acronyms

ANIQ	*Asociación Nacional de la Industria Química*, National Association of the Chemical Industry
AO_X	organochlorines
APELL	Awareness and Preparedness for Emergencies at the Local Level
ARET	Accelerated Reduction/Elimination of Toxics
BECC	Border Environmental Cooperation Commission
CAC	Coal Association of Canada
CAINTRA	*Cámara de la Industria de Transformación de Nuevo León*, Association of the Manufacturing Industry of Nuevo León
Canacintra	*Cámara Nacional de la Industria de Transformación*, National Chamber of the Manufacturing Industry
CANMET	Canada Centre for Mineral and Energy Technology
CCME	Canadian Council of Ministers of the Environment
CCPA	Canadian Chemical Producers' Association
CEC	Commission for Environmental Cooperation
CETAC	Canadian Environmental Technology Advancement Centres
CFC	Chlorofluorocarbons
CFE	*Comisión Federal de Electricidad*, Federal Electricity Commission
CIMO	*Programa de Calidad Integral y Modernización Integral*, Quality and Modernization Program
CMA	Canadian Manufacturers' Association
CMPP	Comprehensive Municipal Pollution Prevention
CN	Canadian National (Railways)
CNA	*Comisión Nacional del Agua*, National Water Commission
CONABIO	*Comisión Nacional para la Biodiversidad*, National Commission on Biodiversity
CONAE	*Comisión Nacional de Ahorro de Energía*, National Commission to Save Energy
Concamin	*Confederación de Cámaras Industriales*, Confederation of Industrial Associations
CP	Canadian Pacific (Hotels)
CSA	Canadian Standards Association
EETINA	Environmental Education and Training Institute of North America, *Instituto de Educación y Capacitación Ambiental de Norte América*
EFP	Environmental Farm Plan
EIS	Environmental Impact Study
EMFA	Environmental Management Framework Agreement
EPA	Environmental Protection Agency (US)
EPCRA	Emergency Planning and Right-To-Know Act (US)

EPIC	Environment and Plastics Institute of Canada
FIDE	*Fideicomiso de Apoyo al Programa de Ahorro de Energía del Sector Eléctrico,* Energy Saving Program Support Fund
FLEP	Federal Law on Environmental Protection (Mexico)
FOMCEC	*Fomento a la Cultura Ecológica*
GA	governmental agencies
GEF	Global Environment Facility
GIAR	Green Industrial Analysis and Retrofit Program
GLPF	Great Lakes Protection Fund
GLPPC	Great Lakes Pollution Prevention Centre
GPSC	Grower Pesticide Safety Course
HCFCs	hydro chloroflourocarbons
HDPE	high-density polyethylene
ICLEI	International Council for Local Environmental Initiatives
IISD	International Institute for Sustainable Development
IJC	International Joint Commission
IMIQ	*Instituto Mexicano de Ingenieros Químicos*, Mexican Institute of Chemical Engineers
INE	*Instituto Nacional de Ecología*, National Institute of Ecology
INF	*Instituto Nacional Forestal*, National Forestry Institute
INP	*Instituto Nacional de Pesca*, National Fisheries Institute
IPA	*Instituto de Protección Ambiental*, Institute of Environmental Protection
IPM	Integrated Pest Management
IPN	*Instituto Politécnico Nacional*, National Polytechnic Institute
ISO	International Standards Organization
ITESM	*Instituto Tecnológico y de Estudios Superiores de Monterrey*, Monterrey Technological and Higher Education Institute
LGEEPA	*Ley General del Equilibrio Ecológico y la Protección al Ambiente*, General Law of Ecological Equilibrium and Environmental Protection
MBA	Master of Business Administration
MERC	Mercury Elimination and Reduction Challenge
MIACC	Major Industrial Accidents Council of Canada
MISA	Municipal-Industry Strategy for Abatement
MOEE	Ontario Ministry of Environment and Energy
MOU	Memorandum of Understanding
MSDSs	Material Safety Data Sheets
MVMA	Motor Vehicle Manufacturers' Association
NAAEC	North American Agreement for Environmental Cooperation

Nafin	*Nacional Financiera,* National Development Bank (Mexico)
NAFTA	North American Free Trade Agreement
NEB	National Energy Board (Canada)
NGOs	Non-governmental organizations
NIST	National Institute of Standards and Technology
NOMS	*Normas Oficiales Mexicanas,* Mexican Official Standards
NPRI	National Pollutant Release Inventory
NRC	National Research Centre (Canada)
NRCan	National Resources Canada
ODS	ozone-depleting substance
OECD	Organization for Economic Cooperation and Development
PAM	*Programa Ambiental de México,* Environmental Program of Mexico
PBTS	substances that are persistent, bioaccumulative, and toxic
Profepa	*Procuraduría Federal de Protección al Ambiente,* Federal Attorney General for Environmental Protection
PTDLs	Patent and Trademark Depository Libraries
RCRA	Resource Conservation and Recovery Act
SAB	Science Advisory Board
SARA	Superfund Amendments and Reauthorization Act
SCC	stress corrosion cracking
SECOFI	*Secretaría de Comercio y Fomento Industrial,* Secretariat of Commerce and Industrial Development
SEDESOL	*Secretaría de Desarrollo Social,* Secretariat of Social Development
Semarnap	*Secretaría del Medio Ambiente, Recursos Naturales y Pesca,* Secretariat of Environment, Natural Resources and Fisheries
SEP-CONACYT	*Secretaría de Educación Pública-Consejo Nacional de Ciencia y Tecnología,* Secretariat of Public Education-National Council for Science and Technology
SHCP	*Secretaría de Hacienda y Crédito Público,* Mexican Treasury and Public Credit Secretariat
SME	small- and medium-sized enterprises
SNET	*Sistema Nacional de Educación Tecnológica,* National System of Technological Education
SP	*Secretaría de Pesca,* Secretariat of Fisheries
SVP	*Société pour vaincre la pollution*
SWMANA	Solid Waste Management Association of North America
TRI	Toxic Release Inventory (US)
UNAM	*Universidad Nacional Autónoma de México,* National Autonomous University of Mexico
UNEP	United Nations Environmental Program

VOCs	volatile organic compounds

I. Overview of the Status of Pollution Prevention in North America

Across North America, governments, industrial organizations, and non-governmental organizations (NGOs) are promoting the use of pollution prevention as an environmentally and economically effective alternative to pollution control. In effect, they advocate a policy that emphasizes not so much controlling pollution, as not polluting in the first place.

What is Pollution Prevention?

Achieving consensus on a definition of pollution prevention has proved difficult. Mexican legislation defines pollution prevention as a set of provisions and measures taken to avoid anticipated environmental harm. In the United States, no precise definition has been codified into law; perhaps the closest equivalent comes from the Pollution Prevention Act of 1990, which declares that pollution should be prevented or reduced at the source, wherever feasible. The government of Canada has defined pollution prevention as "the use of processes, practices, materials, products or energy that avoid or minimize the creation of pollutants and waste, and reduce overall risk to human health or the environment". A similar, though somewhat longer, definition has been adopted by the Pollution Prevention Task Group of the Canadian Council of Ministers of the Environment (CCME).
Pollution prevention is thus widely regarded as referring to activities that benefit the environment through source reduction of waste and/or emissions; improved efficiency in the use of resources and inputs; and elimination/reduction in the use of environmentally harmful substances or activities. This working definition has been accepted throughout the present report. The alternative environmental management strategy known as pollution control— the limiting of environmental harm through "end-of-pipe" technology or other control mechanisms— is not included in this definition of pollution prevention.
In general, pollution-prevention strategies include some or all of the following characteristics:

- they reduce input and operating costs;
- they are more cost effective than pollution control and often more cost effective than doing nothing;
- they are more environmentally effective than pollution control and should, if their instigators possess adequate training, pose less risk to the environment;
- they exceed regulatory requirements in as much as pollutants are eliminated at the source, rather than being controlled after emission into the environment;
- in cases of material substitution, they reduce the burden on governments for inspection and enforcement, in as much as the likelihood of non-compliance is diminished or even eliminated;
- they often, but not always, involve the use of cleaner production technologies, improved employee training, and additional knowledge-based problem solving. Indeed, when compared to pollution control technologies, they are less likely to employ the conventional environmental technologies often directed at pollutant control. They also improve process understanding; and
- aside from addressing the primary environmental objective for which they were adopted, they often bring about supplementary benefits, such as: improved efficiency, lowered costs and reduced peripheral emissions.

However, despite growing support at senior policy levels in governments and major corporations, pollution-prevention strategies are still used far less frequently than pollution control technologies to address the environmental challenges facing industry in North America. This report summarizes the key reasons for this situation.

Legislative and Policy Framework

Environmental activities in the NAFTA region have seen continuous growth and evolution during the last thirty years. Most efforts in the United States have focused on environmental regulation, oriented towards command and control mechanisms. Only recently has the pollution-prevention approach to solving environmental problems begun to gain acceptance within the NAFTA region.
During the 1970s, most environmental legislation followed the abatement or "command and control" approach. The name of the game was technology-forcing, and it required potential polluters to obtain government approval

for every installation, or change to an installation under preparation. Officials could require that companies install specific control technologies to ensure that harmful emissions were held to levels deemed acceptable by the regulator. The enforcement of laws and regulations, however, was by no means uniform across North America.
In the United States, pollution prevention has matured during the last two decades. Originally an operational concept employed by a few manufacturers, it became a philosophical foundation for environmental protection with the passage of the US Pollution Prevention Act in 1990. Nevertheless the Act, although it established the concept as the nation's preferred environmental strategy, has had little impact on the overall US regulatory system.
In Canada, pollution prevention advanced considerably after passage of the Canadian Environmental Protection Act (CEPA) in 1986. Since then, even though the current Act is still being amended to support more comprehensive pollution-prevention strategies, the concept of pollution prevention in Canada has accelerated. These proposed amendments will constitute the first test of pollution prevention as a major policy initiative, for in effect, North American governments have yet to incorporate the concept as a cornerstone of their environmental legislation.
In Mexico, the evolution of environmental protective philosophies started in the 1970s with an anthropocentric interpretation of the environment and priorities emphasizing remediation. In the 1980s, the move toward a more systemic interpretation of the environment included the assignment of priorities to prevention and control measures. In the last few years, the shift has been from command and control mechanisms to a strategy based on economic instruments.
A significant number of laws and regulations that directly or indirectly require installation of pollution-control technologies remain on the books, particularly in Canada and the United States, where the formulation of the environmental legislative framework took place in the early 1970s, before pollution prevention was developed as a strategic approach to environmental improvement. Although pollution prevention has begun to gain national recognition and acceptance, in part through the efforts of companies and their pollution-prevention programs, development of a coordinated policy remains a slow process in the NAFTA region. Indeed, in all three countries, incorporation of pollution prevention into national and local laws and regulations is still a piecemeal activity, with low levels of public and private spending, perhaps because abatement and control requirements pre-empt prevention in the budgeting process.
Consistent with this slow movement toward a prevention-based approach to pollution is a growing interest in "multi-media" approaches to environmental problems (i.e., the study of how pollutants affect more than one aspect of the environment at a time). Increasingly, the seriousness of the combined impact of a multitude of non-point, or very small point sources is being recognized. More attention is being paid to risk-based planning and management, market-oriented approaches— including a wide range of economic instruments, and the integration of environmental considerations into economic decision-making. All these approaches encourage pollution prevention as the preferred alternative to pollution control.
Government policy has also been directed toward so-called "voluntary mechanisms". One example was the US Environmental Protection Agency's (EPA) "33/50" program, in which companies voluntarily agreed to reduce emissions of 17 target chemicals, 33 percent by 1992 and 50 percent by the end of 1995. Canada has a similar program known as Accelerated Reduction/Elimination of Toxic Substances (ARET). Although the incorporation of pollution prevention is not specifically required, these programs strongly encourage the use of such an approach.
A recent addition to the government's arsenal of pollution-prevention policies is the International Standards Organization (ISO) 14000 series of voluntary environmental-management standards. In Mexico, consideration is being given to their formal adoption as (voluntary) industrial, environmental management standards. As well, federal and state/provincial agencies in the United States and Canada are showing interest in encouraging the publication and adoption of these standards to help promote industrial pollution-prevention objectives.
The United States and Canada have many organizations focused on pollution prevention, plus a wide variety of other organizations and outreach programs emphasizing awareness building and information transfer. In Mexico, the situation is very different; the organizations promoting this concept are few in numbers and the means of support is minimal. Overall, the three countries have a paucity of comprehensive strategies designed to encourage the application of pollution prevention with site-specific advice. Moreover, the pollution-prevention efforts are largely scattered and uncoordinated.
A variety of institutions support pollution prevention in the three NAFTA countries. They include: industrial and trade associations; industrial extension programs; universities; foundations, and national boards; federal, state/provincial, and municipal agencies; industry-government partnerships; sectoral environmental coalitions; professional associations and non-governmental organizations (NGOs). Often individuals constitute an institution

in their own right. The initiatives these institutions support can be characterized as fairly mature in the United States, in a maturing stage in Canada, and still under development in Mexico (see Section IV).
As a whole, the NAFTA region has relatively little experience with the application of economic instruments to pollution prevention. Some economic instruments, however, are being used in the three countries. These include deposit/refund schemes (for beverage containers), product charges (for used tires), legal liability (to deter potential polluters), direct regulation (such as bans on the use of specified substances, and requirements to use the best-available technologies) and subsidies (such as accelerated depreciation, tax credits, or other fiscal benefits).

Status and Trends

The increasing priority given to prevention activities, rather than to control or remediation methods, has been key in the evolution of environmental strategies developed by the NAFTA countries. Indeed, during the process of establishing consistent priorities and budgets, the conflicting requirements of pollution control, remediation, and emergency response not only competed with the requirements for pollution prevention, but also influenced the regulatory programs in the three countries. As well, environmental matters must compete for public attention with other social, political, and economic concerns. This situation is perhaps more evident and critical in Mexico than in Canada or the United States.
The experiences of the individual states and provinces of the NAFTA countries in integrating pollution prevention into environmental policy vary widely. Canada's governmental structure has led to some overlap in government policies and regulations, as well as widely varying activities in each province. Currently, the provinces and the federal government are working to harmonize environmental regulations. In Mexico, the trend is toward giving state and local governments greater responsibility in environmental policy-making and enforcement. Currently, the 31 states have environmental legislation and statutes but the bulk of policy-making is still carried out at the federal level. In the United States, some states have undertaken ambitious efforts while others have done much less. Many states have established pollution-prevention programs, with their regulatory agencies serving as information sources and providing guidance for regulatory integration.
Toxic-release reporting requirements have been established both in the United States, with the Toxic Release Inventory (TRI) in 1986, and in Canada, with the National Pollutant Release Inventory (NPRI) in 1991. Mexico is currently reviewing the existing reporting systems, worldwide, in order to develop its own.
Although, environmental-protection activities have traditionally been the responsibility of government, governments cannot do the job alone. The increasing number of industrial processes, the growing awareness of the environmental effects of activities once considered benign, and the limited governmental resources earmarked for enforcement have made it difficult to regulate all potentially polluting activities. Moreover, regulation, although it may ensure compliance, does not necessarily motivate industry to improve. Most state and municipal governments promote pollution-prevention programs to some extent. However, the general perception in industry seems to be that governmental agencies have not yet taken a very active role in this field. Industry also feels that government agencies should increase their credibility in pollution-prevention promotion and assistance, as well as in policy actions.
While many companies in the NAFTA region have adopted pollution-prevention programs, much still needs to be done. This is particularly true for the small- and medium-size enterprises (SMEs) which, in most cases, have neither the resources nor the expertise to implement pollution-prevention programs. In Canada, pollution-prevention initiatives exist at all levels of government, in all parts of the country, and in all major sectors of the economy. A significant proportion of the large corporations in Canada have adopted environmental-management and pollution-prevention programs. More recently, they have begun to introduce the concept of pollution-prevention planning. This includes a more comprehensive examination of the operations at their facilities, with the goal of avoiding, eliminating, or at least reducing pollution in the successive stages of production.
In Mexico, most of the companies that have established pollution-prevention programs are large. Usually subsidiaries of international corporations, they have based their programs on the principles and administrative practices of their parent corporations. Yet even as these large companies are investing to modernize their facilities so as to improve their environmental performance, many SMEs have hardly begun to establish pollution-prevention programs. As a rule, SMEs are more concerned with pollution control and compliance with environmental regulations than with pollution prevention. In general, SMEs seem to believe that pollution prevention is costly.

In the United States, the concept of pollution prevention is fairly well established in many companies, although they comprise but a small subset of US businesses. In fact, many companies that have adopted the concept have made great economic and environmental progress. Pollution-prevention outreach activity can be classified in the United States as:

- mature initiatives, or efforts with an extensive history and track record;
- growing initiatives, that build on the experiences gained through mature initiatives; and
- emerging initiatives, such as the attempts to integrate pollution prevention into high-performance, supply-chain management practices in order to integrate prevention practices within mainstream manufacturing-improvement concepts and service deliveries.

Although awareness of the importance of pollution prevention is growing within industry throughout the NAFTA region, its economic benefits are still not well understood. Although implemented by many companies, pollution-prevention program initiatives, are frequently are random and disconnected. NAFTA-region industries still do not perceive pollution prevention as an opportunity for business improvement. Indeed, only a small number of the SMEs in the region have established high-quality pollution-prevention programs or realized that prevention rather than control is the best strategy.

Many of the obstacles to moving the pollution-prevention concept forward are due to lack of information, lack of technology, and last but not least, a general lack of money. In Canada, for instance, only a small group of environmental managers truly understand the economic benefits of pollution prevention, as compared to pollution control. Technologically, even though a systematic emphasis is placed on pollution control, pollution-prevention programs should predominate. Indeed, training and management systems should take precedence, as well as “clean technologies” in the form of new, more efficient, but not specifically environmental technologies. In Mexico, there is a clear need to develop ways of promoting and disseminating pollution-prevention concepts. As well, more attractive financial packages are required to encourage technical assistance and training programs, and to facilitate equipment acquisition and process improvement.

The US experience suggests that pollution prevention faces two unique obstacles, both of which limit implementation and help explain why information, financial resources, and promotion are still not enough: the first is the inadequacy of current perceptions and budgeting for pollution prevention, which thus inhibits its implementation; the second is the inadequacy of integration of pollution prevention into the business issues, relationships, and organizations that influence business decision-making.

Certainly, the three NAFTA participants differ greatly in the size and composition of their overall economies. Moreover, not all economic sectors or regions of the three countries will prosper equally or simultaneously. A similar situation occurs in environmental protection. But, the NAFTA countries need to work jointly in pollution prevention to enhance the protection of human, animal and plant life; health; and the environment. To this end, the NAFTA parallel agreement presents great challenges that should be discussed by organizations from all three nations. By proposing innovative ways of collaborating, the NAFTA participants should be able to address the environmental priorities of the NAFTA comprehensively, and decide on an equitable sharing of costs.

Recommendations

To encourage implementation of pollution prevention, the consulting team proposes that activities be undertaken in the following areas:

1. information exchange;
2. pollution-prevention assistance;
3. demonstration projects;
4. financial mechanisms for pollution prevention; and
5. manufacturing policies and practices.

1. Information Exchange

The present study has shown that the many pollution-prevention activities now underway are often quite isolated one from another. According to the research, the various programs have few ways of sharing information and materials, learning from each other, developing collaborative relationships, or building on successful initiatives for increasing the implementation of pollution prevention. In times of generally declining government support, it is particularly important to encourage networking among pollution-prevention agencies. Resources and know-how must be used in the most effective possible way. We therefore recommend that:

specifically designed activities, such as conferences, roundtables, and workshops, be undertaken to encourage the formation of a pollution-prevention network in North America and to expand the membership of that network into all areas and all sectors.

One of the deficits this study identified was the lack of criteria for pollution-prevention programs. Such criteria could assist in the implementation of pollution prevention by providing managers with information on practices in use within their particular sector. For example, one of the tools being applied with increasing frequency in industry today is benchmarking. Benchmarking provides a set of criteria by which an organization can measure its achievements relative to other, similar organizations. We recommend that:

a system of benchmarking for pollution-prevention activities be developed, outfitted with a series of scales appropriate for a range of industrial sectors.

Despite the range of pollution-prevention activities currently underway, this study revealed that the benefits of pollution prevention are well understood by only a small percentage of North American businesses and governmental organizations. It would be desirable for an organization, perhaps somewhat removed from government, to promote the concept of pollution prevention throughout North America. We foresee:

large benefits resulting from an extensive program of pollution-prevention promotion activities designed to ensure that all North Americans clearly understand the benefits of the pollution-prevention approach.

2. Pollution-Prevention Assistance

The present study found that even when decision-makers are aware of the concept of pollution prevention, knowledge is often lacking as to the detailed steps required for undertaking a pollution-prevention program. While extensive sales forces have been deployed to provide information on pollution-control technologies, the same cannot be said of the pollution-prevention sector, where implementation more often requires technological change, knowledge-based approaches, training, or cleaner production technologies. Training, education, and industrial support programs already exist throughout North America. Rather than establishing more programs to provide information and education on implementation of pollution prevention, we recommend:

encouraging governments and other organizations to include pollution-prevention implementation assistance in existing industrial and institutional education, training, and support programs.

We also recommend that:

pollution-prevention assessments be sponsored within individual companies and organizations. These would identify opportunities for program applications and provide management with information on the activities necessary to implement a pollution-prevention program. Resulting information could be made available to others to stimulate similar assessments in other organizations.

A significant amount of development in North America is taking the form of industrial parks. Within such parks, developing good relationships between companies in diverse industries can be an effective tool. We therefore propose:

the establishment of a program to encourage companies with implemented pollution-prevention programs to take on a mentoring role for other local industries.

3. Demonstration Projects

One of the most effective ways to introduce a new approach, or to convince managers of the effectiveness of a new approach, is through demonstration projects. Although pollution prevention has been practised in North America for at least the last 20 years, this study has shown that its fundamentals and the environmental/economic benefits that it provides are still not widely understood. Many existing projects are proprietary, located in closed plants, or just not well enough known to the broader business, government, and technical communities. We think that other demonstration projects, undertaken in regions and sectors where pollution prevention is not widely employed and which are open for public and business inspection, would help overcome some of the ignorance about the subject. We therefore suggest:

that new pollution-prevention demonstration projects be sponsored and/or promoted in regions and sectors where pollution prevention is not yet widely employed.

The research conducted for this project indicated that, in several communities, local efforts have successfully initiated community-wide pollution-prevention efforts. Moreover, leadership provided by local business people and pollution-prevention advocates, and communications among peers at the community level can be among the most

effective tools for increasing understanding of, and motivation for, pollution prevention. Friendly rivalry between communities can also be a significant driver for community-based programs. We therefore recommend:

that community-level efforts for pollution prevention be encouraged, perhaps by providing information on demonstrated "best practices" in community pollution prevention and by encouraging community efforts to put these practices into effect.

4. Financial Mechanisms for Pollution Prevention

Our research has shown that financing pollution-prevention programs can pose a problem for SMEs, particularly when a proposed program involves purchase and installation of equipment of substantial cost, with financial returns that are not readily evident. Typically, lenders find it hard to quantify increased efficiency and improved returns from pollution-prevention programs applied to an existing plant, preferring instead to lend money for plant expansion and new installations. However, because they involve greater efficiency, reduced losses, and lower production costs, pollution-prevention programs could be candidates for novel financing packages. This has already been illustrated in energy and water-use efficiency, where innovative financing from the private sector yielded substantial economic benefit from the implementation of pollution-prevention activities. We therefore recommend:

that creative ways of financing pollution-prevention programs be developed and promoted to the business community.

It is also true that some financial institutions may lack understanding of the economic benefits of pollution prevention. Where they have taken the time to gain such an understanding, the result has been increased availability of financing for implementation of such programs. Leadership and information directed toward the financial community will assist in overcoming this barrier. We recommend:

coordinated work with the financial services industry that encourages the extension of existing financing mechanisms to encompass pollution-prevention programs.

5. Manufacturing Policies and Practices

Increasingly, businesses are adopting environmental-management techniques and pollution-control standards. However, many of these are based on strict compliance with environmental regulations, and only a small percentage currently include pollution-prevention programs. One of the most successful approaches that does do so is the supply-chain relationship. Here, a large company establishes its own set of environmental management standards based on a pollution-prevention approach, and then requires all its suppliers to adopt similar strategies and environmental-management techniques. This approach has been successfully employed by industries as diverse as the automotive, food, and paper products. We therefore recommend:

encouraging and assisting companies to build supply-chain relationships that incorporate the principles of pollution prevention.

Manufacturing philosophy and practice is substantially influenced by the attitudes of senior managers and technical professionals within the organization. Well-received educational initiatives targeting these groups can therefore expect to have a direct and relatively immediate impact on the firms represented. We therefore recommend:

the sponsoring of a series of pollution-prevention workshops for senior industry managers. These workshops might be cosponsored by NGOs or governmental organizations and operated on a cost-recovery basis.

To reach technical professionals with pollution-prevention education, we recommend:

developing of a series of distance learning tools that deal with pollution-prevention techniques and benefits in English, Spanish, and French to assist scientific, technical, financial, and managerial professionals.

II. Proposals from the Meeting of Experts

A meeting of pollution-prevention experts was held in Montreal on 13-14 December, 1995. This chapter summarizes the discussions that took place along with the consultants' interpretation of the meeting's principal conclusions.

The discussion at the meeting, and the research presented by the consultants there, confirmed the perception that, today, pollution prevention is really the "name of the game"— truly an issue at the forefront of the environmental field and one that requires a special approach, both qualitatively and quantitatively. The type of information required is technological as well as organizational, experiential, financial, and societal. In addition, individuals, companies, communities, states and provinces need information focused at different geographic levels local through international.

The requisite information about pollution prevention must be directed at a wide, complex, and heterogeneous audience that includes:

- local and national-level governments that legislate, plan, approve, and regulate environmental matters;
- banks and financial institutions that fund environmental efforts by individuals, companies, and governments;
- the general public; and
- executives involved in upper management of various companies and enterprises.

As well, environmental professionals require information to resolve the environmental problems that confront them. Since pollution prevention as a distinct focus is an emerging discipline, assembling and disseminating the information needed for audience education will require a special effort.

Much information already exists. But it is scattered among various industries and businesses as proprietary or experiential data; or it is reported in diverse professional journals, technical reports, and data banks. In either case, a special effort at networking will be required to assemble it all. Proper packaging will then be important to render it accessible or convenient for use. Assuming that information can be found, assembled, and properly formatted, there remains the organizational problem of how to disseminate, promote, and implement pollution prevention as the keystone policy in environmental thinking.

The following three topics have been defined to help focus action in the near term:

1. ***Information development*** includes gathering information on pollution-prevention techniques, technologies, and relevant programs that employ this approach; and improving the packaging of this information. It also entails developing information concerning the benefits and value of pollution prevention to help stimulate interest in the subject among industry audiences in the NAFTA countries.
2. ***Dissemination of knowledge*** entails making use of opportunities to improve the sharing of pollution-prevention information among the three NAFTA countries. Development of new channels of cooperation for the transfer and promotion of information, including the dissemination of information to appropriate audiences, will also be important.
3. ***Encouraging action*** entails making use of diverse opportunities to support the implementation of various approaches to pollution prevention. This includes aiding actual economic development in any way possible. Discussions encouraging action on pollution prevention should be part of any information package developed.

The following discussion and analysis treats these topics and their associated challenges for action. Reflected are the ideas of the consulting team, as well as the perspectives of the expert group members. Potential program opportunities are highlighted, although they are not to be considered *a priori* as specific endorsements or recommendations for action by the CEC or any other particular group.

Information Development

1. Status

Although experiences within individual countries and locations vary, a substantial amount of information on pollution-prevention techniques, technologies, and approaches clearly exists already. The necessity for new information is probably less critical than the need to communicate and evaluate existing information more efficiently and effectively.

The experiences of the three countries suggest that the primary challenges and needs pertaining to information development should centre less on issues of content than on strategy. This study uncovered two critical strategy issues:
The importance of developing information that is tailored to the needs of specific audiences. To date, much pollution-prevention information has been oriented to environmental and engineering audiences, rather than to business and operations decision-makers.
The need to develop information that communicates the economic and manufacturing side of the various implementation approaches, not just their technical availability and feasibility. Information that demonstrates the value of pollution prevention has proven to be as important as material that conveys how pollution prevention is accomplished.
Another pertinent issue is the different learning and investment efforts of each country with respect to information development. The status reports suggest that the supply of information, although perhaps ample in certain geographic areas, is lacking in others— a logical state of affairs in such a new field.

2. Opportunities for Information Development
Many diverse audiences now need information about pollution prevention and its potential for implementation in North American industry. Users of this information are not limited to companies; in fact, a target audience might consist of organizations and government agencies whose policies and programs influence a company's decision-making.
The present study has shown that development of the following types of information about pollution prevention is needed:

- *information on how governmental policies treating fiscal matters, economic development, regulatory practices, and trade already influence policies and programs, but can be modified to further the adoption of pollution-prevention practices:*governmental policies of all types, not just environmental regulations, can serve either as incentives or disincentives for adopting prevention-based approaches. A systematic examination and sharing of information on these topics by the three NAFTA countries could be instrumental in creating a general North American business climate supportive of prevention-based approaches.
- *information on examples of cooperation between businesses and with business stakeholders so as to advance prevention-based strategies:* numerous examples exist of productive collaboration between businesses, organizations, and other stakeholders for pollution prevention. Information on these existing models and how such collaborations can be successfully managed are nearly as important as the techniques and technologies themselves.
- *performance benchmarking information for industries:*at its core, pollution prevention has proven to be a process-improvement issue— an activity seldom undertaken without a preexisting, recognized need that drives the change. Companies need information that not only stimulates interest in process improvement, but also helps identify areas in which their performance trails their competitors. A systematic effort to expand existing benchmarking to identify the best industrial practices for a material's use and release could provide a catalyst for increased involvement in pollution prevention.

Dissemination of Knowledge

1. Status
Throughout North America, the cornerstones of pollution-prevention promotion and technical-assistance programs have been transfer and dissemination of information. As a result, a vast amount of information on pollution-prevention technologies and management practices is currently available. But no coordinated efforts have been made to disseminate this knowledge. This study identified one of the primary issues as the need to establish more formal relationships between information providers and pollution-prevention promoters so as to avoid unnecessary duplication of effort and achieve the maximum impact from limited program resources. Despite the greater efforts now being made to link and coordinate these activities, few ways exist by which programs can share information and materials, learn from each other, develop collaborative relationships, or build on successful initiatives for increasing the implementation of pollution prevention. In times of generally declining government support, it is particularly important to encourage networking among the agencies concerned so that resources and know-how can be used in the most effective way possible.

Several organizations are currently working to establish a North American Pollution Prevention Information Network, based on the concept of a distributed clearinghouse system. The CEC is currently working to establish a North American Clearinghouse on Pollution Prevention Techniques and Environmental Technologies which would supplement the work of the North American Pollution Prevention Information Network. Rather than establish one centralized clearinghouse of information, the North American Network intends to emphasize the use of regional clearinghouses, making databases and information held in one region available across the continent. Such a system will enable users to have access to more information than any single program can compile using its own resources independently. Five regional pollution-prevention clearinghouses in North America (four in the United States and one in Canada) are now linked through the network, sharing a variety of information and delivery systems. The value of the distributed clearinghouse concept is demonstrated by the remarkably low 5 to 10 percent overlap of information between any two regional centres.

The need for high-quality information networking has increased with the advent of the NAFTA. Substantially more manufacturing-related commerce can be expected to cross national borders. Providing uniform, high-quality information on waste-reduction techniques and technologies can thus promote manufacturing competitiveness throughout the continent. But manufacturers in all areas must be able to compete in countries where consumers demand high environmental standards. Manufacturers also need to understand and adopt the most cost-efficient methods of production, based on a broad base of research and experience. Companies that wish to enter the market as producers of environmentally-related technology and services will need state-of-the-art information. They must also be able to promote their products across national borders. Finally, all companies, governments, and citizens will need access to a uniform, high-quality source of information in order to develop policies for a sustainable environment. The fact that the North American Pollution Prevention Information Network will be a key element in meeting all these needs enhances its value.

A second knowledge-dissemination issue is the ability to reach the appropriate audience. A common problem identified in this study was that the individuals traditionally targeted for information dissemination efforts are not the managers primarily responsible for the firm's decisions on operations or technology changes. Although manufacturing policy and practice is primarily directed by senior business and operations managers, pollution prevention has traditionally been marketed to company environmental officials through environmental management channels. The need to reach senior industry decision-makers is now becoming an increasingly important theme in disseminating knowledge. Likewise, the need to expand dissemination efforts to include bankers, financial institutions, and other organizations whose relationships with industry affect decision-making, is being recognized worldwide.

It is clear from this study that dissemination needs vary in individual countries. A multinational perspective is clearly needed to deal with this subject. However, redirecting existing networks and information sources and targeting new audiences are concerns applicable to all NAFTA partners.

2. Opportunities for Dissemination of Knowledge

The challenge in knowledge dissemination is to facilitate the sharing and networking of pollution-prevention information across the entire North American continent. Persuading new audiences of the value of the practice will prove to be a formidable task. Increased coordination, however, offers the potential to redirect existing pollution-prevention program investments in new and powerful ways.

This present study recommends pursuing the following dissemination efforts:

a) **Expand the North American Pollution-prevention Network into Mexico.** Creating a link without frontiers between Canada, Mexico, and the United States that pertains to information on technical and best-management practices for pollution prevention would have great utility. Especially important would be the establishment of a regional information clearinghouse in Mexico, serving both Mexico and the southwestern United States. As both a regional resource for manufacturers and an information gateway connecting already existing regional resource centres, this clearinghouse would contribute greatly to the efforts to eliminate the differences in access, quality, promotion, and dissemination of information that currently exist between the NAFTA partners. As well, given the importance of having access to information on patents and trademarks, it would be appropriate to consider establishing one or more Patent and Trademark Depository Libraries (PTDLs) in both Mexico and Canada, as additions to the 77-member, century-old PTDL system in the United States. PTDLs help provide surer and swifter access to the information needed for pollution-prevention's

innovative process modification and invention, which requires hands-on access to information about patents and trademarks.

b) **Create carefully designed and focused pollution-prevention conferences, seminars, and workshops.** Seminars and educational programs are an excellent means of promoting and advancing pollution prevention. Questions have been raised, though, about their success in fostering actual implementation and even about their ability to attract the most appropriate audience. The study suggests that carefully focused multinational workshops on specific pollution-prevention topics would be a worthwhile investment. Specific issues include:
    - ways of integrating knowledge about pollution prevention into international finance and lending practices;
    - a North American needs assessment that would help environmental ministries target multinational pollution-prevention activities; and
    - ways of integrating knowledge about pollution prevention into international outsourcing activities and industrial park development.

Other seminars of a more traditional, promotional nature, that explore economic benefits, examine technological case studies, etc., and target company representatives, may still be needed in locales where pollution prevention remains a relatively new concept or lacks an organizational infrastructure.

Encouraging Action

1. Status

Aside from deficiencies in the development and dissemination of information about pollution prevention, there is a need to create a North American business climate that supports ongoing pollution-prevention implementation. Increasingly, attention is shifted to the existing relationships between various stakeholders banks, customers and suppliers, and local communities— and industrial firms.

a) **Banks.** According to the research conducted for this study, financing pollution-prevention efforts can pose a problem for small- and medium-sized manufacturers, particularly if the proposed project involves purchase and installation of capital equipment when financial returns are not readily evident. Lenders, meanwhile, associate pollution prevention with the historically costly area of environmental management. They thus prefer to lend money for such traditional activities as plant expansion and new installations.
   Despite these challenges, banking relationships can greatly influence the implementation of pollution-prevention activities. Often traditional financing and lending programs and institutions are unaware of the economic and risk-reducing benefits of prevention-based approaches. Even for aware institutions, translating such knowledge into practical guidance for lending policies remains an issue. Analytical tools and clear criteria are thus needed to enable financing organizations to judge whether the systems and practices adopted by a business will reduce operating risks and increase competitiveness.

b) **Customers** Customer relationships are proving to be one of the most powerful reasons for companies to investigate and adopt new manufacturing strategies, techniques, and technologies. Throughout North America, a number of pollution-prevention initiatives have been built around supply-chain relationships. Such cooperative ventures address the adoption of management practices among interconnected firms. They also target efforts to reduce or eliminate specific materials, thus improving environmental performance among both buyers and suppliers.

c) **Local communities** Several local efforts exemplify successful community-based, pollution-prevention efforts. Leadership provided by local businesses and pollution-prevention advocates, and communication between peers at the community level are two particularly effective tools for increasing the understanding of, and motivation for, pollution prevention. Indeed, mobilizing neighborhoods, schools, and other local institutions is increasingly considered an essential part of successful “consciousness raising” for pollution prevention. Although community involvement in environmental issues has grown substantially, NAFTA country participants have largely focused on control, remediation, and clean-up, as opposed to prevention. Yet using a country’s organizational infrastructure and energizing it to promote pollution prevention may eventually allow the policy to evolve into an established part of everyday community, commercial, managerial life, thereby eliminating the need for specialty pollution-prevention programs and initiatives.

A final issue highlighted in this study was the role and feasibility of demonstration projects in encouraging action. Examples do exist of innovative pilot projects that promote new approaches and convince managers of their value.

But other less successful efforts have demonstrated the critical need for targeting audiences and clearly identifying objectives and needs before undertaking these efforts. Demonstration projects on pollution prevention are best evaluated on a case-by-case basis.

2. Opportunities for Encouraging Action

Opportunities abound to encourage action *apropos* pollution prevention. For the most, they are largely based upon existing ideas, relationships, and programs — ones already credible and desirable to businesses. The challenge is to direct them in new and creative ways that support the adoption of pollution prevention.

This study identified four primary opportunities for encouraging action on pollution prevention:

a) **Provide direction and guidance to make existing lending policies supportive of adopting pollution prevention.** Opportunities to build capacity within lending, insurance, and financing programs exist, the aim being to support the adoption of pollution-prevention practices. Current opportunities for "consciousness raising" within the financial community relate to:

- the benefits and value added by pollution prevention;
- the design and management of financing programs and lending protocols with embedded pollution-prevention objectives; and
- the integration of pollution-prevention practices into existing economic development programs and development bank efforts.

b) **Facilitate and promote "best practice" community-level involvement in pollution prevention.** The study underlines the importance and appropriateness of a concurrent "bottom up" approach to pollution prevention through community involvement and capacity building among local institutions. Existing organizations, such as schools and local citizen groups, have proven to be important and effective voices for encouraging change within industry. A wide range of community interaction models could be promoted and disseminated among the NAFTA partners, including "sister cities" programs. Sponsorship at the community level is also advocated for research activities dealing with economic transition strategies and programs that address economic and employment dislocations that might occur as a result of implementing pollution prevention and sustainable development policies.

c) **Facilitate and promote "best practice" supply-chain models in pollution prevention.** Individual projects across North America have shown how interfirm purchasing and procurement agreements can be used to encourage good pollution-prevention results. But expanding model programs nationally and internationally, and using national trade organizations to take efforts to other NAFTA member countries are also potentially useful vehicles.

d) **Promote and/or sponsor demonstration projects in regions and industrial sectors where pollution prevention is not yet widely employed.** Demonstration efforts in the previously listed areas must be designed in light of the culture and needs of the organizations in each targeted region. In certain areas, demonstrations of technology may be most valuable. In others, the greatest need may be for plans for financing protocols, supply-chain management programs, or industrial park designs with embedded pollution-prevention objectives. Regardless of the type of demonstration project, the key point is to improve the dissemination and awareness of ongoing efforts on a multinational level.

Conclusion

Pollution prevention is fast becoming the principal environmental paradigm in North America today. This is appropriate not only because it presents a lower-cost approach for achieving environmental goals, but also because it is consistent with improvements in overall economic efficiency. Although this report has focused primarily on pollution prevention in the industrial context, it must be remembered that such preventive measures are not the exclusive responsibility of government and large industry. As a key element in the implementation of sustainable development, pollution prevention requires the involvement of all types of business and non-business activity, and must become the dominant strategy for addressing non-point, as well as point sources of pollution. By following the basic recommendations of this report, the Commission for Environmental Cooperation will be able to assist and accelerate the adoption of pollution-prevention strategies by all sectors of business in North America.

III. Pollution Prevention in Canada

Introduction

Across North America, governments, industrial organizations, and NGOs are promoting the use of pollution prevention as an environmentally and economically effective alternative to pollution control.
One of the objectives of the North American Agreement on Environmental Cooperation (NAAEC), signed by the governments of the United States of America, Canada, and Mexico in 1993, is to promote pollution-prevention policies and practices. In Article 10.2 of the Agreement, the Council of the Commission for Environmental Cooperation is empowered to consider and develop recommendations regarding pollution-prevention techniques and strategies.
The Commission retained Colin Isaacs, Contemporary Information Analysis, Ltd., to prepare a summary report on the status of pollution prevention in Canada. The work is intended to assist the Commission in developing strategies and programs to help meet its pollution-prevention mandate and is not intended to be a comprehensive description of pollution-prevention activities in Canada. The information contained in this report has been collected through a review of published sources, information sheets, and on-line databases, as well as through a limited series of interviews with pollution-prevention service providers, implementers, and experts.

Legislative and Policy Frameworks for Pollution Prevention

1. Background

The modern environmental movement in Canada began in the late 1960s. It focused on harm to human health and the environment at the local and regional level. Highly visible environmental effects, such as fish kills, the eutrophication of lakes, dramatic reductions in bird populations, and the effects of acid rain, spurred action. The primary governmental response was legislation and regulatory controls designed to reduce pollution through treatment and pollution control technologies. This approach produced positive results for the environment, but often with a high economic price for polluters.
Today the environmental challenge is changing. Issues with global implications are of increasing importance. The environmental agenda in Canada currently addresses such matters as persistent bioaccumulative toxic chemicals, depletion of the ozone layer, climate change, and loss of biodiversity.
The economic challenge has changed too. Both the private and public sectors are under pressure to restrain spending. In response to the limitations of a treatment-based approach to environmental protection, Canada is now showing increased attention to reducing the creation of pollutants and waste, with the involvement of many different organizations and authorities, including international jurisdictions, First Nations, provincial, regional and municipal governments, businesses, labour, and private individuals. The programs put into effect so far have yielded improvements in both environmental and economic performance.

2. Government Pollution-prevention Initiatives at the National Level

Constitutionally, jurisdiction over environmental matters in Canada is shared between the federal and provincial governments. Hence some national pollution-prevention initiatives emanate from the federal government while others are joint programs of the federal government and the provinces, produced by a body known as the Canadian Council of Ministers of the Environment (CCME).
In November 1993, the CCME issued a document entitled, “A National Commitment to Pollution Prevention”. This document outlined the core concept of pollution prevention and committed the provincial and federal governments to promote it in their respective jurisdictions. A follow-up strategy to fulfill CCME commitments has been approved by the Environmental Protection Committee of CCME and will be considered for approval by the Council of Ministers.

3. Federal Government Initiatives

The Canadian government released a Cabinet-approved pollution-prevention strategy in June 1995. The strategy, entitled “Pollution Prevention: A Federal Strategy for Action”, recognizes pollution prevention as key to the

government's sustainable development agenda and provides federal government departments with direction to carry out this policy shift through use of legislation, regulation, voluntary initiatives, and economic instruments. Other goals include:

- supporting national pollution-prevention efforts by providing information and tools;
- encouraging Canadian involvement in international pollution-prevention efforts; and
- placing more emphasis on private sector involvement in pollution prevention.

The concurrent release of the federal Toxic Substances Management Policy gave further guidance on use of the pollution-prevention approach especially where life cycle management of toxic substances is anticipated. The 1995 decision by Cabinet to appoint a Commissioner of the Environment and Sustainable Development, although not yet implemented, will create an administrative position accountable for reporting progress on implementing federal pollution-prevention strategy.

Canada's major piece of environmental protection legislation, the "Canadian Environmental Protection Act", is being updated and the revision is expected to emphasize pollution prevention. The federal government is also considering requiring pollution-prevention planning and tracking pollution-prevention progress under the "National Pollutant Release Inventory". The new "Canadian Environmental Assessment Act" also offers opportunities to promote the pollution-prevention approach. It will influence environmental decision-making at the earliest stages of development.

While the results of these recent policy and legislative initiatives cannot be measured yet, pollution-prevention activity in Canada is on the increase. Federal environmental policy-makers in Canada have identified, and are focussing on three broad approaches to promote pollution-prevention: voluntary programs, legislated programs, and market-based programs.

The federal department of the environment, known as Environment Canada, provides Canada with the highest level administrative and technical foundation for pollution prevention and emphasizes its economic contribution through:

- minimizing or avoiding the use of pollutants, many of which represent a risk of future liability;
- promoting the development of technologies with domestic and worldwide value for source reduction;
- emphasizing greater resource and energy efficiency;
- reducing enforcement costs; and
- reducing future clean-up costs.

The federal "Green Plan for a Healthy Environment" contained these pollution reduction targets:

- virtual elimination of the discharge of persistent toxic substances into the environment; and
- a 50 percent reduction in waste generation in Canada by the year 2000.

Although the Green Plan has not been renewed, these targets have been maintained.

4. Multilateral Agreements

International agreements, to which Canada is a signatory and in which Canada often plays a leadership role, frequently provide a basis for national and provincial legislation and other activities in the environmental area. A few offer support to pollution-prevention initiatives. Although international agreements in force over a long period of time, are "subject to slippage, back-pedalling and renegotiation", and evolve throughout their existence, they are important indicators and drivers for change[1].

The Montreal Protocol on Ozone Depleting Substances

Along with other countries, Canada is a co-signer of the 1987 Montreal Protocol and the 1992 Copenhagen amendment. Federal ozone-depleting substance (ODS) regulations cover the import, manufacture, use, sale, and export of ODS such as chlorofluorocarbons (CFCs) and halons, and also encompass pollution-prevention principles. Canada has plans to accelerate the phase-out of HCFCs (hydro chloroflurocarbons), targeted by the Copenhagen amendment for the year 2030 (by 2020 actually, with the exception of air conditioning and refrigeration equipment). Provincial regulations have also been introduced[2].

The agreement has led to many business activities in CFC recycling and banking, alternate refrigeration and air-conditioning technologies, and changes in cleaning of electronic equipment. The "Blue Bottle", a technology

[1] *Earth Enterprise Tool Kit* Winnipeg, MB: IISD, 1993, p. 52.

[2] "HCFCs to be phased out entirely by 2020" *The Environmental Compliance Report* Vol. 12, No. 9, September 1995, p. 2.

developed by Halozone Recycling Inc. is one example of Canadian pollution-prevention developments arising from the agreement.

Framework Convention on Climate Change

The Climate Change Convention, concerned with emissions of greenhouse gases, asks that signatory countries make commitments to reduce greenhouse gas emissions to 1990 levels. Canada is currently developing tools and programs to meet the goals of the Convention; virtually all of these involve application of pollution-prevention principles.

Great Lakes Water Quality Agreement

The International Joint Commission (IJC) is a binational agency with responsibility for reporting on the progress made on the 1978 Great Lakes Water Quality Agreement between Canada and the United States. State and provincial governments are also involved. The aim of the agreement is to minimize release of toxic substances through various media such as soil, water, and air into the Great Lakes. Article 2 calls for the virtual elimination of the discharge of any or all persistent toxic substances[3]. Over 20 years, the work of the IJC has resulted in a number of pollution-prevention initiatives. To achieve reductions of such toxic substances in the Great Lakes, the Advisory Boards of the International Joint Commission recommended in 1995 that Canada and the US undertake the following:

- Develop standardized criteria on a binational basis for assessing chemical management laws, programs, and data collected.
- Design and implement studies on the concentrations and influx of toxic chemicals in the Great Lakes.
- Identify significant regulatory barriers that prevent adoption of a life-cycle approach to create a sustainable materials economy in which so-called wastes are treated as resources.
- Develop goals and policies for pollution prevention.
- Re-evaluate inventory and data collection in order to develop quantity measures which provide timely and appropriate information. The purpose is to demonstrate the positive impacts of pollution prevention which are often not well served by the current routine data collection.
- Strengthen pollution-prevention programs in order to reduce or eliminate the creation of pollutants or wastes at the source.[4]

The International Joint Commission Biennial Meetings on Great Lakes Water Quality are forums for the public, industry, and governmental and non-governmental organizations to hear success stories on pollution-prevention efforts around the Great Lakes, as well as scientific presentations and other information on environmental issues and activities.

Lake Superior Binational Program

In a pilot zero discharge program, Canada and the US, together with Ontario, Michigan, Minnesota, and Wisconsin, are developing a coordinated pollution-prevention strategy. Aspects of the program include direct technical assistance to improve wastewater discharges by avoiding or limiting toxic inputs and developing community plans to prevent pollution.

5. Federal-Provincial Initiatives

CCME National Commitment to Pollution Prevention

The CCME is "a major intergovernmental forum in Canada for discussion and joint action on environmental issues of national, international, and global concern. The 13 member governments work as partners in developing national consistent environmental standards, practices, and legislation.[5]"

Canadian federal and provincial governmental philosophy has shifted somewhat towards pollution prevention. In November 1993, the CCME adopted a "National Commitment to Pollution Prevention".

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[3] Great Lakes Water Quality Board. *Legislative and regulatory considerations for virtual elimination of persistent toxic substances. Report to the Virtual Elimination Task Force and the International Joint Commission.* Compiled and edited by Michael Gilbertson, Secretary, Great Lakes Water Quality Board. Windsor, ON, IJC, 1995, p. 1. See also, *International Joint Commission. 1993-1995 priorities and progress under the Great Lakes Water Quality Agreement.* Windsor, ON: IJC, 1995.

[4] "Advisory boards review IJC priority issues". *EcoLog Week.* Vol. 23, No. 35, 1 September 1995, pp. 1-2.

[5] Canadian Council of Ministers of the Environment. *1995 Environmental Scan.* Prepared by Thompson Gow & Associates. Winnipeg, MB, 1995. Table of Contents.

The CCME program is being developed in cooperation with the provinces. Linkages in Ontario have been made to automobile parts manufacturers, printing and graphic arts associations, metal finishers and electroplaters, municipalities, and to small operations such as dry cleaners.

Harmonization

As explained previously, there is no clear constitutional division of responsibility for environmental matters in Canada. Hence activities and regulations can overlap and become inconsistent amongst the federal, provincial, and territorial governments. The CCME has agreed "to examine fundamentally, the federal/provincial/territorial roles and responsibilities for environmental protection in Canada". A December 1994 discussion draft on harmonization indicated that the Ministers would support a national "Environmental Management Framework Agreement (EMFA)".[6] Detailed schedules would be compiled on specific topics with one of the topics being pollution prevention.

A draft discussion paper released in November 1995 proposes that "pollution prevention is the preferred strategy for protecting the environment. Other strategies, in order of preference, are off-site reuse and recycling, treatment and control, disposal/destruction, and remediation/cleanup."[7] The parties to the agreement are asked to commit to a number of principles and to work together to remove barriers and disincentives to pollution prevention. The initiatives identified include:

- the development of "green" policies that apply to government departments and operations;
- procurement activities;
- the harmonization of legislation, regulations, and policies in the area of pollution prevention;
- the development of market-based instruments and other policy alternatives;
- the undertaking of demonstration projects;
- strengthening partnerships between governments and the private sectors;
- enhancing the ability of small and medium-sized businesses to apply pollution prevention;
- facilitating on-site technical assistance;
- developing practical tools through cooperation with industrial associations;
- developing measuring tools to prove progress on reductions is actually taking place;
- developing guidelines and codes of practice;
- promoting information and technology transfer, including a National Clearinghouse;
- developing training materials and providing education and training— including the training of government officers;
- supporting the development of national and international standards such as CSA and ISO;
- developing a recognition program;
- helping consumers use their purchasing power to support environmental protection;
- encouraging the use of life-cycle analysis and other means of true-cost accounting; and
- developing approaches that link corporate competitiveness with pollution prevention.

Provinces are also cooperating bilaterally with the federal government to harmonize environmental regulations. For example, agreements have been reached between Saskatchewan and Canada on water quality, between Canada and Alberta and Quebec on pulp and paper regulations, and between the Atlantic Provinces and Canada on environmental cooperation.

CCME National Packaging Protocol

The CCME was instrumental in developing the National Packaging Protocol, that sets guidelines for waste reduction from packaging, develops environmental profiles to help industry identify the environmental impacts throughout the life cycles of packaging materials, and studies packaging production systems.

6. Federal Quasi-judicial Agencies

In Canada, quasi-judicial agencies also have a role in actions relating to pollution prevention. One example is the National Energy Board (NEB), which has initiated a public inquiry on stress corrosion cracking (SCC) in oil and

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[6]Canadian Council of Ministers of the Environment*Harmonization Initiative, Discussion Draft*Winnipeg, MB, December, 1994.

[7]Canadian Council of Ministers of the Environment*Environmental Management Framework Agreement. (EMFA)* Discussion draft only. Winnipeg, MB, October 1995, p. 114.

gas pipelines due to pipeline ruptures such as the leak in one belonging to TransCanada Pipelines in Manitoba.[8] The NEB will collect data on the issue and if necessary, review previous decisions on pipeline safety. The following issues will be addressed by the three-member panel, which has the power to subpoena and take evidence under oath:

- studying SCC, including its prevention;
- promoting coordinated efforts of the various parties to share technical data and research & development (R&D) results; and
- evaluating standards and making decisions to eliminate or mitigate the hazards of SCC.

7. First Nations

Aboriginal people in Canada have rights arising from treaties or comprehensive land claim agreements that give them control over certain natural resources and lands. Their traditional knowledge, based upon preventing pollution and on the sustainable use of resources, is gaining respect and is being used to complement scientific knowledge in solving environmental problems in the Arctic and other areas.

8. Provincial Governments

Canadian provinces are engaged in a wide range of pollution-prevention activities. This section provides some illustrative examples.

British Columbia

A discussion paper, entitled "New Approaches to Environment Protection", recommends a pollution-prevention approach so that new legislation would require specific targets for achieving reductions in the use of toxic chemicals, and a plan would be mandatory in order to obtain permit approvals.

The Pollution Prevention & Pesticide Management Branch of B.C. Environment takes a systems approach to environmental management, with an emphasis on shifting "the burden of accountability for environmental protection to those who are responsible for creating the pollution in the first place".[9] The polluter-must-pay principle is currently applied in stewardship strategies with full life-cycle programs for paint and commercial pesticide containers. A "Product Stewardship Regulatory Continuum" will track British Columbia's move from government-managed product stewardship to full industrial responsibility for any hazardous products created. The industry end of the continuum is designed to pressure those who produce hazardous residual materials to "solve, rather than manage, the hazard residual problem by closing the production loop".[10] British Columbia's "Paint Care Program", which requires industry to collect surplus paint, is the first in North America to use such a range of techniques as full-cost accounting, communications, industry cooperation, and product stewardship.

The strategy for the Pollution Prevention & Pesticide Management Branch includes:

- shifting the focus from management **of** environmental problems to solutions **for** problems;
- producing specialized training courses;
- fostering integrated stewardship;[11]
- auditing industrial stewardship programs, pollution-prevention plans, and effective formal partnerships and cooperative projects;
- taking a lead role in the transition to a more effective, more efficient way of doing business; and
- developing and using "success indicators" to measure improvement in performance. Indicators relevant to pollution prevention include:
    - the number of pollution-prevention plans, pest management plans, and codes of practice;
    - tracking levels of selected substances in the environment and their impact on it; and

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[8] "NEB to conduct public inquiry on pipeline cracking", *EcoLog Week*, Vol. 23, No. 33, 18 August 1995, pp. 3-4. See also, "Terms of reference set for stress corrosion cracking probe", *EcoLog Week*, Vol. 23, No. 36, 8 September 1995, p. 3.

[9] B.C. Environment. Pollution Prevention & Pesticide Management Branch. *Strategic Plan 1995-1997*. Victoria, BC, 1995, p. 5.

[10] "Working towards Product Stewardship: the regulatory continuum", *Environmental Protection Programme Bulletin*. (B.C. Ministry of Environment, Lands and Parks), October 1995, p. 1.

[11] Integrated stewardship is defined as "a comprehensive management system that ensures responsibility and accountability for environmental protection is assumed by the appropriate parties". B.C. Strategic Plan, 1995, p. 3.

- tracking amounts of hazardous substances kept out of landfills through stewardship programs.

Actions to implement pollution-prevention strategies include:

- promoting the adoption of pollution prevention through partnerships with public, environmental, and community groups, and with industry and other government agencies;
- conducting demonstration projects to provide models;
- developing legislation, regulations, policies, and incentives programs to implement pollution prevention;
- developing and implementing strategy to ensure the adoption of stewardship programs for household hazardous products, commercial pesticide products, and pesticide containers;
- supporting the development and implementation of a federal strategy to classify household hazardous products with the goal of assisting the consumer to purchase environmentally "friendly" products;
- setting up systems to have pollution-prevention plans replace existing permits in industrial sites;
- reviewing and updating legislation relevant to pollution prevention;
- developing policies and incentive programs to encourage industry in consumer product stewardship; and
- managing electronic databases for province-wide administration.[12]

A pulp and paper regulation, drafted in British Columbia in 1992, but still in review, sets "zero discharge" of AOX (organochlorines) as a requirement for pulp and paper facilities by the year 2002.

Ontario

The Ontario Water Resources Act and the Environmental Protection Act contain the authority to issue orders and certificates of approval for the operation of facilities and the discharges from them. The objective of the "Municipal-Industry Strategy for Abatement" (MISA) is the virtual elimination of persistent toxic contaminants from discharges into Ontario waters. Ontario's "3Rs" regulations, issued under the Environmental Protection Act, require large companies to prepare waste audits and waste reduction plans, specifying their implementation and deadlines. Packaging users are required to prepare packaging audits and packaging reduction plans.

Quebec

The Quebec Environmental Quality Act states that:

> *Every person has a right to a healthy environment and to its protection, and to the protection of the living species inhabiting it, to the extent provided for by this Act and the regulations, orders, approvals, and authorizations issued under any section of this Act.*[13]

Potential litigation is constrained by provisions that limit any action if the government has issued permits or approved particular programs. The act confers authority to the government to protect the environment by:

- defining standards for the protection and quality of the environment or any of its parts in Quebec;
- establishing standards for the installation and operation of any piece of apparatus or equipment; and
- regulating or prohibiting the use of any contaminant or the presence of any contaminant in products sold, distributed, or utilized in Quebec.

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[12]Definition of Pollution Prevention in draft B.C. legislation: "To avoid, eliminate or reduce the creation, the use or the release of polluting substances. The Pollution Prevention and Pest Management Branch of B.C. Environment has developed a Pollution Prevention Hierarchy which is defined as follows:

"To avoid the creation of polluting substances or to eliminate the release of these substances to our environment through a hierarchy of activities including the:

> avoidance, elimination or substitution of polluting products;
>
> reduction in the use of polluting products;
>
> elimination of, and reduction in, the generation of polluting by-products;
>
> reuse and recycling of polluting by-products;
>
> recovery of energy from polluting by products; and if necessary
>
> treatment or containment of polluting residual by-products; and
>
> remediation of contaminated sites."

B.C. Strategic Plan, 1995, p. 13-14.

[13]Quebec. "Environment Quality Act. R.S.Q. 1977, Amended 1994 and 1995". As printed in *EnviroLog Canadian Pollution Legislation* Southam, Toronto, ON, September 1995. Que 5.0-8.4, p. 5.2.

Nova Scotia
Nova Scotia has consolidated its environmental laws and regulations, in the process streamlining 18 statutes and 40 sets of regulations, and produced a new Environment Act that mandates economic instruments, an electronic environmental registry, a waste management system, and a rationalized assessment process.[14]

9. Economic Instruments
Canada has limited experience in the direct application of economic instruments to pollution prevention. However, some are used, though primarily at the provincial level. Examples are deposit fees for beverage containers, taxes on such items as tires, and user fees for garbage collection. There has been considerable discussion on the wider use of market-based, incentive-driven measures for environmental protection purposes.
Economic instruments, which are often implemented through regulations, are tools in pollution prevention because once objectives have been set by the government, companies can decide on the most cost-effective way and the most appropriate technologies for achieving those goals.[15] Industry representatives suggest that a strong incentive would be faster, easier (i.e., less costly) approval processes for innovative technologies that meet environmental protection goals.
Various provincial and federal task forces have studied this subject and made recommendations on the role financial incentives might play in encouraging sustainable development and pollution prevention. One such task force, for example, is the Environment Council of Alberta Task Force on Economic Instruments for Waste Reduction. In a November 1994 report entitled, "Environmental Instruments and Disincentives to Sound Environmental Practices", a federal task force recommended that taxation and other economic instruments be directed towards encouraging environmental technologies and products.[16]
One such a financial incentive is the use of tax credits to support research and development. The current practice is to allow expenditures on research and development to be deducted from taxable income. Federal funding for environmental research and development includes the Technology Development and Demonstration Program supported by Environment Canada and the Environment Technology Program support by Industry Canada. Some of the initiatives under these programs include pollution prevention. However, all government funding in Canada is being reduced in the face of the current climate of fiscal restraint.
British Columbia developed an environmental tax through a multi-stakeholder group focusing on the provincial forest industry. Increased stumpage fees are expected to raise C $2 billion which will be reinvested to improve silviculture practices, repair damage done by earlier logging practices, retrain workers in new methods, and develop value-added processing that will increase employment.
One industry association, the Environmental Services Association of Alberta, recommends in its "Code of Practice" that members bid on tenders based on full-cost accounting. The Association is also working with multi-stakeholder groups to develop full-cost accounting for waste management.

Support and Promotion Mechanisms for Pollution Prevention

1. Government Funding
Environment Canada aids sustainable development on a local level through the Environmental Partners Fund, which since 1989 has supported 1313 projects. Grants are also given for such programs as implementing the Montreal Protocol, supporting the Canada/Nova Scotia Agreement on Sustainable Development, and furthering river projects like the Technological Development and Demonstration Program for the St. Lawrence River and the Sustainable Management Program for the Fraser River Basin. Industry Canada also provides funding for such programs as the Technology for Environmental Solutions Initiative.
Various provinces provide funding for research and development. Manitoba's Environmental Industries Development Initiative is one of few directed towards environmental research.

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[14]CCME Scan, 1995. Sec 5.4.1.
[15]Environment Canada, CEPA Office.*Reviewing CEPA: the issues #7. Pollution Prevention*Environment Canada, Hull, PQ, 1994, p. 6.
[16]*Task Force on Economic Instruments and Disincentives to Sound Environmental Practices. Final report of the Taskforce*. Ottawa, 1994.

2. Technology Transfer

Assisting companies in developing new environmental technologies and commercializing them is the role of three Canadian Environmental Technology Advancement Centres (CETAC) located in Quebec, Ontario, and Western Canada. Some of the technologies being developed are relevant to pollution prevention.

Industry associations have entered into partnerships with research institutions to solve particular industry pollution problems. Research partnerships between such groups as industry associations, government agencies, and academic or other research facilities also help develop the technology needed for pollution-prevention projects. Another type of technology and information transfer is carried out through clearinghouses which usually have specific mandates to provide information and also more tangible types of assistance. The government also carries out research and development itself through centres such as the National Research Centre (NRC) and specialized departments within it, such as the Canada Centre for Mineral and Energy Technology (CANMET), which also arrange partnerships and joint ventures with the private sector.

3. Great Lakes Pollution Prevention Centre

The Great Lakes Pollution Prevention Centre (GLPPC), founded by Environment Canada in 1992, has a mandate to promote technology transfer, and provide policy, program, legislative, and financial information on pollution prevention.[17] The Centre offers a Pollution Prevention Advisory Service, encouraging small and medium-sized companies to implement environmental protection initiatives. The Service provides help by:

- assessing operations;
- identifying opportunities to reduce pollution;
- estimating the full cost of wastes;
- showing how to reduce the use of toxic substances;
- supplying information on alternative and clean technologies; and
- identifying management and technological options through confidential, non-regulatory services.

GLPPC will use retired and other industry professionals to provide advisory services, beginning with the metal finishing industry. The Centre also publishes the *Great Lakes Pollution Prevention Bibliography*, which compiles pollution-prevention policies and programs, funding sources, technical and training resources, and information sources. Success stories for small- and medium-sized businesses are included.

4. International Institute for Sustainable Development

The International Institute for Sustainable Development (IISD), located in Winnipeg, Manitoba, gathers together information about Canadian and international projects, institutions, and experts working in the field of sustainable development.[18] Its Earth Enterprise® project is directed to entrepreneurs in small and medium-sized companies who wish to become "green" businesses, that is, that focus on operations and products that minimize damage to the environment. The Earth Enterprise® Tool Kit is a resource guide which includes such topics as pollution-prevention technologies, listings of investors for sustainable enterprises, contacts for green industries, discussion of the use of industry standards, and how to set up in-house pollution-prevention teams.[19] IISD is also working with industry on ways to standardize reporting methods and facilitate the comparison of related companies.

5. Industry/Research Facility Cooperation

The Environment and Plastics Institute, with support from the American Plastics Council, has initiated a number of projects in cooperation with the National Research Council (NRC) and some private companies. One project with NRC's Industrial Materials Institute examines methods for reprocessing high-density polyethylene (HDPE)

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[17] Lines, Marianne (Great Lakes Pollution Prevention Centre, Hamilton-Wentworth). "Building a community vision", *At the Source* (Great Lakes Pollution Prevention Centre). Vol. 2, No. 3, Winter 1995, pp. 1-2. See also, "Pollution Prevention Advisory Service", *At the Source* (Great Lakes Pollution Prevention Centre). Vol. 2, No. 3, Winter 1995, p. 2.

[18] Winnipeg 2000 Economic Development Corporation. *Winnipeg Facts.* Winnipeg, MB, 1995.

[19] *Earth Enterprise Tool Kit* Winnipeg, MB: IISD, 1993.

plastic containers once used for oil.[20] A change in cleaning processes would eliminate the oil contamination in wash water.

6. Cross-sector Connections
The Canadian Construction Association acts as a bridge to markets and other sectors to help industry reduce waste and prevent pollution.[21] In a pilot project in Ottawa designed to demonstrate proper management of construction waste in the refurbishment or demolition of a building, the association identified markets for surplus materials. The Association has also worked with the Transport Association of Canada to examine ways of replacing aggregate with construction waste in road building. While much of the emphasis is still on recycling and reuse, incorporating new practices and finding available technologies that protect the environment and provide a competitive advantage is also an important consideration.

Data Collection, Inventories and Targets

Reporting and setting targets are ways of motivating key stakeholders to be accountable for achieving goals. Development, standardization, and implementation of key indicators in pollution-prevention levels the playing field and avoids the common charge that corporations are indulging in "greenwashing", that is, obscuring adverse environmental impacts behind public relations activities. Some corporate reporting happens because shareholders and customers expect or demand it. For instance, companies like Shell Canada and TransAlta Corporation issue "Sustainable Development" reports.
Information on pollution can positively affect prevention by:

- forming the basis for policy developments;
- evaluating the success of pollution-prevention initiatives;
- assessing trends;
- targeting specific facilities, regions, or industries for priority prevention initiatives;
- ensuring that efforts prevent pollution rather than simply transfer it from one media to another;
- investigating and enforcing standards; and
- tracking pollution over time and linking it to health and other environmental impacts.

Non-Compliance Reporting can provide a significant incentive for pollution-prevention activities. Some provinces, such as British Columbia and Ontario, publish lists of companies convicted of environmental offences or found to be in non-compliance.[22] This can be an effective deterrent, especially now that the lists are readily accessible electronically through the Internet (URL: http://www.env.gov.bc.ca).

1. National Pollutant Release Inventory (NPRI)
A multi-stakeholder advisory committee, set up by Environment Canada in 1991, recommended the design of the database that became the National Pollutant Release Inventory (NPRI). It was intended to provide information on the release of hazardous pollutants from industrial and transportation sectors. Companies were to report on an annual basis. Any facility manufacturing, processing, or otherwise using 10 tonnes annually or more of a substance on the NPRI list and whose employees collectively work 20,000 or more person-hours per year was required to furnish data on substance release and transfer. Begun in 1994, the program covers about 1,500 facilities and 178 substances, with additional parameters required to encourage the use of pollution prevention. The government intends to expand the program to include tracking of pollution-prevention initiatives and results.

Voluntary Programs

There are a large number of voluntary programs in Canada that directly or indirectly address pollution-prevention goals. The following may serve as illustrations:

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[20]"(Environment and Plastics Institute of Canada) EPIC participates in waste plastics reduction projects", *EcoLog Week*. Vol. 23, No. 36, 8 September 1995, p. 2.
[21]Bouchard, Pierre, Director of Special Services. Canadian Construction Association, Ottawa, ON. Personal communication, 8 November 1995.
[22]For example, see "Noncompliance hits new high in British Columbia", *The Environmental Compliance Report* Vol. 12, No. 9, September 1995, p. 2.

1. Accelerated Reduction/Elimination of Toxics (ARET)
Quantitative pollution-prevention targets that do not dictate the means to be used in their accomplishment encourage pollution prevention. Areas in which such targets have been applied include hazardous waste, air emissions, release of specified toxic substances, ozone-depleting substances, and greenhouse gases.
The Federal Office of Pollution Prevention, established in 1991, works with industry on the Accelerated Reduction Elimination of Toxics (ARET) Program to achieve voluntary reduction or elimination of targeted substances. ARET's history began with a multi-stakeholder group, New Directions, comprised of industry executives and environmentalists, who met in 1990 to improve ways by which organizations make environmentally-related decisions. Their report formed the basis for the ARET initiative, launched by the Minister of the Environment in 1991.
Members of ARET included invited representatives from industry, health and professional organizations, industry, and provincial and federal governments. Some environmental and labour stakeholders withdrew in 1993 but the initiative is still continuing. Administrative support is provided by Environment Canada with provincial participation funded by the Canadian Council of Ministers of the Environment.
ARET has targeted 14 substances which are persistent, bioaccumulative, and toxic (PBTS) for a 90 percent emissions reduction by the year 2000 and another 87 specified substances for a 50 percent reduction.[23] Any initiative reaching the target is acceptable. The program involves about 200 facilities, both public and private. To date, reported emissions have been reduced by about 10,300 tonnes, including a reduction of 49 percent for high priority, A-1 chemicals, although the system itself does not measure to what extent pollution prevention has been implemented. The original reduction targets are intended to be just the beginning; about one-third of participants have plans for further reductions. Several industrial associations are involved, and others have said that they will involve their members in the program.

2. Ontario Pollution Prevention Pledge Program
The Pollution Prevention Pledge Program, administered by the Pollution Prevention Office of the Ontario Ministry of Environment and Energy (MOEE), focuses on efforts by companies to use pollution prevention to reduce hazardous waste. As of September 1993, facilities could take part in the program by agreeing to reduce emissions to levels below those required for compliance. The aim of this program, known as P4, is to reduce the release of specified, persistent, toxic, and bioaccumulative chemicals by 50 percent by 1995 and by 90 percent by the year 2000, based on 1990 levels. The companies are not required to use pollution-prevention methods to achieve the results — any methods are acceptable if the targets are reached.
Similar goals are the focus of a cooperative program between MOEE and Environment Canada, called "Pollution Prevention Planning Partnership", which is designed for industrial associations. First efforts have been made with the Motor Vehicle Manufacturers' Association, the Automotive Past Manufacturing Association, and the Canadian Association of Metal Finishers. Initiatives with the Canadian Chemical Producers' Association and the Aerospace Industries are in the planning stages.

3. Green Industry Audits
The "Green Industrial Analysis and Retrofit Program" (GIAR) is a partnership program between companies and the Ontario Ministry of Environment and Energy (MOEE). It involves audits of industrial operation, with 75 percent of the funding provided by MOEE. The objectives are to reduce waste generation, air and water emissions, and the use of energy and water. Where the payback period covers a longer period of time, MOEE provides capital grants up to a certain percentage of the total project. However, the program has recently been scheduled for discontinuation due to fiscal reasons.

International Agreements between Industries

International cooperation agreements between businesses have the potential to stimulate higher standards in technology and environmental quality. For example, agreements between Gaz Métropolitain (Montreal, Quebec)

[23] ARET Secretariat. *Environmental leaders 1. Voluntary commitments to action on toxics through ARET*. Ottawa, ON, 1995.

and French and US companies are providing partners for development of energy efficient equipment, and clean industrial processes.[24]

1. Memoranda of Understanding between Government and Industry

Vinyl Industry

A Memorandum of Understanding is planned between the Vinyl Council of Canada, Environment Canada and Industry Canada.[25] Protection of the environment during the manufacture, use, disposal, and waste recovery of vinyl products, and setting targets for industrial performance will be among the initiatives of the industry.

Automobile Pollution Prevention Project

The Canadian and US governments have developed agreements with the automobile industry to address persistent substances in the Great Lakes, to advance pollution prevention within the auto industry and its suppliers, and to address regulatory barriers that hinder pollution-prevention efforts. In Canada, the project is known as the Automotive Manufacturing Pollution Prevention Project. It was initiated in May 1992, and includes Chrysler Canada, Ford Motor Company of Canada, General Motors of Canada, the Motor Vehicle Manufacturers' Association (MVMA) of Canada, the federal government and the province of Ontario.[26]

As a result of the agreements, the big automobile companies are playing an active role initiating their own pollution-prevention programs and assisting in various ways with the development of pollution-prevention strategies for their suppliers. Among the actions taken are:

- providing pollution-prevention case studies for technology transfer to auto suppliers and other companies;
- sponsoring workshops on waste reduction and energy efficiency;
- presenting teleconferences on such topics as waste reduction in spray painting and coating;
- promoting pollution prevention to the manufacturing community through professional and industrial associations;
- participation in a joint Canadian-US workshop on 20 October 1995, with case studies of suppliers on such topics as, "Design for the Environment", "Clean Production Technologies", and "Competitive Initiatives;"
- giving plant tours for suppliers to show how equipment and process changes implement pollution technologies;
- participating in consortia that attempt to integrate pollution prevention into engineering and technology transfer; and
- initiating a pollution-prevention internship which gives engineering students the opportunity to evaluate ways of reducing pollution, waste, and costs of car production, and recommend better practices.

Climate Change Challenge Program

The federal government and the Coal Association of Canada (CAC) have signed a Memorandum of Understanding (MOU) on global climate change. The association represents coal miners as well as power producers who use coal to make electricity. Similar agreements have been signed with the Canadian Association of Petroleum Producers, the Canadian Electrical Association, the Canadian Energy Pipeline Association, and Natural Resources Canada (NRCan). The MOU seeks to:

- help implement Canada's commitment to stabilize greenhouse gas emissions at 1990 levels by the year 2000;
- promote the Climate Change Challenge and Registry Program;
- develop action plans to limit greenhouse gas emissions;
- encourage Canadian shareholders to support the goals; and
- establish a registry recording reductions.

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[24] "Gaz Métropolitain reports international co-operation accords" *EcoLog Week*. Vol. 23, No. 38, 22 September 1995, p. 4.

[25] "Vinyl Council plans active campaign to foster understanding" *EcoLog Week*. Vol. 23, No. 33, 18 August 1995, p. 4.

[26] American Automobile Manufacturers Association (AAMA), Chrysler Corp., Ford Motor Co., General Motors Corp. and Michigan Dept. of Natural Resources *Progress report II: Automotive pollution prevention project* Detroit, MI: AAMA, 1995.

Codes of Practice

The Responsible Care® Program of the Canadian Chemical Producers' Association has been voluntarily adopted by many within the industry— in fact, the Canadian model has served as the basis for a similar program by the US sister association. Forest Care, another code of practice, was developed by the Alberta Forest Products Association. In 1995, the Mining Association of Canada updated its Environmental Policy, first issued in 1989, which:

- commits its member companies to the concept of sustainable development;
- makes environmental management a priority;
- supports improved technologies, practices, and associated research;
- encourages the industry to work with government and the public to develop and implement environmental protection; and
- sets out methods for reclaiming sites in relation to site specific criteria.[27]

The Canadian Manufacturers' Association has put together a detailed manual called "The Manufacturing Environmental Performance Program" to serve as a guide for its members.[28]

1. External Auditing

External audits of industry, resource, and government operations by certified auditors or professional consultants is a means of ensuring that desired policies are put into action. The Canadian Pulp and Paper Association has adopted a position favouring independent audits of the practices of member companies.

2. Ontario Environmental Farm Plans

The Ontario Farm Environmental Coalition (the Ontario Federation of Agriculture, Christian Farmers Federation of Ontario, AGCare, and the Ontario Farm Animal Council), in consultation with other farm groups, developed the Environmental Farm Plan (EFP). The Ontario Soil and Crop Improvement Association administers local EFP workshops and facilitates a peer review of completed EFP Action Plans. Videos and workbooks are also used in the process.

Technical assistance in preparing the EFP document and delivering EFP workshops was provided by the Ontario Ministry of Agriculture and Food. Expertise was also provided by the Ontario ministries of Environment, Energy, and Natural Resources; Environment Canada; Agriculture Canada; the University of Guelph; and conservation authorities.

A pilot series of workshops was held in 1993 and involved 460 farmers. The opportunity to discuss farm environmental concerns with their peers was judged to be invaluable by many of the participants. Farmers felt the workshops should provide more time for the discussion of solutions to environmental problems and provide assistance in developing action plans. When workshops treated such concerns such as well-water quality, farmers wanted access to practical information such as well installation, sealing and filling abandoned wells, treatment systems for drinking water, water testing services and costs, management practices for wells, and septic systems.[29] Many farmers looked on the EFP as a report card or rating of their farm. However, the goal of the EFP, instead, was to be, "… an educational process that identifies items of concern that may need to be managed differently".[30] Barriers to change included:

- lack of financial resources;
- no realistic solution; and
- the fact that it was not considered an immediate priority.

Farmers in Ontario who have voluntarily completed EFPs have expressed serious concerns about the information being used against them by regulators such as the MOEE.[31] Self-audits are a new idea and AGCare, as the

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[27] "Mining Association updates policy", *The Environmental Compliance Report*, Vol. 12, No. 9, September 1995, p. 7.

[28] MacDonald, Greg (Director, Public Affairs and Communication). Canadian Manufacturers Association. Personal communication, November 1995.

[29] "Environmental farm plans offered across Ontario", *AGCare Update* (Agricultural Groups Concerned About Resources and Environment, Ontario). Vol. 3 No. 4, Fall, 1993, p. 1.

[30] "Peer education through environmental farm plans", *AGCare Update* (Agricultural Groups Concerned About Resources and Environment, Ontario). Vol. 2, No. 1, Winter 1992, pp. 1, 3.

umbrella group of agricultural organizations in Ontario, recommends that guidelines are needed for using information generated voluntarily by business, industry, and individuals so that there is no possible threat of prosecution. AGCare believes that the farm community can accomplish far more to instill the environmental ethic through education and initiatives than regulations could. MOEE has agreed that, except in exceptional circumstances, it will not request self-audits as part of its regulatory activities.

Environmental Procurement

Government purchasing strategies can serve to promote pollution prevention if the accompanying purchasing specifications address such issues as environmental management and source reduction. At the federal level, purchasing is decentralized and consideration of pollution prevention is not required when individual departments are buying products or services. However, some federal departments have adopted "A Code of Environmental Stewardship" and as a result, are developing Environmental Action Plans. The Office of Environmental Stewardship within Environment Canada is charged with ensuring that departments show awareness of environmental concerns in their purchasing and give consideration to substituting alternatives for hazardous substances. Forthcoming initiatives, including the requirement that departments prepare Environmental Action Plans and the monitoring of such plans by the Commissioner of the Environment and Sustainable Development, should help ensure that pollution prevention is included more often in procurement planning and decisions.

1. Environmental Choice Program
The Environmental Choice Program, a government initiative now supervised by the private sector, labels products meeting certain environmental standards with the "Ecologo". Availability of these "green" products helps encourage other producers in the market to meet higher standards.[32] However, only a limited number of "Ecologo" products are available and, in most cases, there are other, non-certified products available that meet yet higher standards.

2. Supplier Partnerships
An innovative change used to pay suppliers reduced chemical usage at a Ford Motor Company plant in St. Thomas, Ontario; suppliers were paid based on the number of vehicles produced at a preset per-unit cost, rather than on the volume of chemicals used.

Recognition Programmes

Recognition, or the possibility of it, through awards, logos, and achievement programs can provide a stimulus for implementing pollution-prevention programs. By means of annual "Environmental Achievement Awards" Environment Canada recognizes corporate initiatives that are judged to contribute to a sustainable future through a cleaner, healthier environment. Companies are eligible for the "Corporate Environmental Leadership Award", recognizing innovative and/or exemplary conduct by a Canadian corporation, institution or association ~~in~~ industrial or other. The winner will have shown that environmental concerns can be reflected in economic decisions. Winners have included such companies as Champion Photochemistry Ltd., of Mississauga, for its "NatureCare Program", which eliminated the dumping of photochemical waste into sewers.
Environment Canada also publishes "Success Stories" that highlight specific activities undertaken by different companies in the environmental area.[33] These often include pollution-prevention initiatives.
Various cities also recognize local initiatives.[34] The "GO GREEN Air Quality Award" is an interesting example of a local award that is offered by an innovative partnership called the Air Quality Network (Environment Canada,

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[31]"Confidentiality of Environmental Farm Plans",*AGCare Update*(Agricultural Groups Concerned About Resources and Environment, Ontario). Vol. 3 No. 1, Winter 1993.
[32]Porter, Michael and Claas van der Linde. "Green and Competitive",*Harvard Business Review* September-October 1995, pp. 120-34.
[33]Environment Canada.*An Environmental Success Story: The Chateau Halifax*Halifax, NS, 1995. (Electronic version: http://atlenv.bed.ns.doe.ca/success). Environment Canada.*An Environmental Success Story: Maritime Fishermen's Union -Clean Ocean Committee*New Glasgow, NS, 1995. (Electronic version: http://atlenv.bed.ns.doe.ca/success).

B.C. Transit, B.C. Ministry of Transportation and Highways, and the Greater Vancouver Regional District). The award recognizes alternative transportation programmes and related efforts to reduce air pollution. One winner was B.C. Systems Corporation for its carpooling and other commuting-reduction programmes for employees.
Environmental groups also play a role in recognizing the achievements of communities, individuals, governments, and businesses in achieving environmental protection goals. One example is the "Lieutenant Governor's Conservation Award", administered by the Conservation Council of Ontario, a coalition group of ENGOs. In these awards, issued since 1987, recognition is given for outstanding achievements in conserving and protecting the natural environment in Ontario. Winners have included the Canadian Chemical Producers' Association (CCPA) for their initiation of and commitment to the "Responsible Care Initiative", and Canadian Pacific (CP) Hotels for their "Green Partnership" initiative.[35]
Industry associations offer their members environmental awards. For example, in 1994 Consumers Gas was the winner of the first environmental award offered by the Canadian Gas Association. In this way, the association plays a role in promoting environmental initiatives as well as providing an opportunity for publicizing excellence in their industry. The "Ron Hayter Award" is offered by the Environment and Plastics Institute of Canada (EPIC). Established in 1991, the award recognizes the efforts and achievements of designers, producers, and packaging users who act to create environmentally-responsible plastic packaging. Winners have included companies such as Northern Telecom for its blister package for circuits, that reduces shipping bulk.

Education and Training

Education and training is an important component of pollution-prevention programs. Educational materials take the form of workshops, training sessions, directories of sources and experts, college and university course materials, instruction manuals and guidebooks, fact sheets, videos, and electronic technical assistance. The Canadian Council for Human Resources in the Environmental Industry has produced a directory listing educational and training opportunities in Canada. The Council is also attempting to develop the skills in environmental protection needed by the labour force through accreditation and certification.
Another approach is through the informal educational system. For example, ENGOs have played an important role in advocating pollution prevention in multi-stakeholder meetings and at the various Canadian Round Tables. Pollution Probe published the first edition of its excellent book, *Profit from Pollution Prevention*, in 1982. In December 1994, the same organization began the first phase of its "Mercury Elimination and Reduction Challenge" (MERC) which identified sources of mercury and estimated the total amount of mercury released into Lake Ontario.[36] Phase II will seek partners in industry to work towards eliminating mercury by finding alternatives or changing processes. A group of ENGOs conducted a briefing in Montreal on the data on fish contamination in the St. Lawrence in July 1995. Greenpeace, Great Lakes United, and the *Société pour vaincre la pollution* (SVP) called for local communities to take action to protect their health. The event included a "toxic fish buffet" and the beginning of the tour of the Greenpeace MV "Moby Dick", which was to visit communities along the Great Lakes.[37]
Labour often participates in multi-stakeholder consultations related to such pollution-prevention issues as the ARET process. Brian Kohler, speaking as a representative of the Communications, Energy, and Paperworkers Union of Canada, which represents 150,000 workers in sectors such as chemical, oil and gas, pulp and paper, pharmaceutical, communications, electronics, and the media, said that failure to protect the environment would lead to economic catastrophe. However, environmental issues need to be considered in the broader context of social and economic impacts. In some cases, such as phase-outs of toxic chemicals and process changes, workers in those

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[34]Zimmer, Ron (Director, Corporate Services). Correspondence and leaflet. Federation of Canadian Municipalities, Ottawa, ON, 10 October 1995.
[35]Contemporary Information Analysis Ltd. (CIAL). *Awards Available to Canadian Companies*. Stoney Creek, ON, January, 1995.
[36]"Mercury project report", *ProbeAbilities* (Pollution Probe Foundation, Toronto, ON). Number 2, Summer 1995, p. 7.
[37]Greenpeace Toxics. "Greenpeace's MV 'Moby Dick' launches tours of Great Lakes", Press release. Greenpeace Canada, Montreal, PQ, 26 July 1995.

industries "will pay 100 percent of the costs of transition to a cleaner economy".[38] Instead of a "polluter-must-pay principle", which would penalize workers in those sectors most harmful to the environment, labour suggests a "shared industrial responsibility", providing assistance to affected workers through a partnership between industry and society.

A few examples of the more formal pollution-prevention education and training programs in Canada are cited below.

1. Maritime Fishermen's Union

The Clean Ocean Committee, formed in 1989 by the Maritime Fishermen's Union, examined the role of fishermen in dumping such trash as plastic debris, robes, beverage pack rings, and chemicals into the marine habitat and set up a program called the "Ship to Shore Trash Campaign". The program even included educating children at school, who often persuaded their parents to improve their practices, as well as radio and television spots and printed material, including signs at wharves that read, "It's not just ugly, trash kills". The campaign was so successful that the wharves had to improve their garbage handling drastically because so much trash came back to land.[39] For this program the Maritime Fishermen's Union received financial assistance from Environment Canada's "Environmental Partners Fund".

2. University of Calgary

The first MBA (Master of Business Administration) in Environmental Management is being offered at the University of Calgary. Among the purposes of the program is "factoring environmental [sic] into managerial decision-making in a pro-active rather than a reactive manner".[40] The curriculum includes accounting for environmental costs, sourcing and trading relationships which recognize upstream and downstream effects, cooperation and collaboration between organizations to solve environmental problems, life-cycle planning and costing, and sustainable development. Because of the location of the university in an area dominated by resource industries, the emphasis is on oil and gas, tourism, forestry, fisheries, mining, and agriculture. The University also offers a Ph.D. in Management with a focus on Environmental Management.

Conferences

Organizations such as the Recycling Council of Ontario hold conferences that bring together government, industry, NGOs, and the public to discuss initiatives and strategies. One example is the Recycling Council of Ontario Conference and Trade Show (1995 witnessed the sixteenth annual event) that focuses on procurement policies, design for sustainability, progressive products and materials, and waste diversion programs.

Industry associations also hold conferences and seminars to provide information on current issues in the environmental arena. Most commonly this is done by those industries most affected by environmental regulations, such as those in the resource sector. Other examples of "information events" of this kind include those sponsored by the Canadian Pulp and Paper Association, which deals with industry-specific issues, and the Major Industrial Accidents Council of Canada (MIACC), which addresses prevention, preparedness, and response to major industrial accidents and environmental releases.

Management/Employee Commitment

Sometimes managers and employees can be the drivers and trainers for major pollution-prevention initiatives. A commitment by management to adopt a high standard of environmental responsibility was made in 1990 by Canada's largest hotel company, Canadian Pacific (CP) Hotels and Resorts.

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[38]Kohler, Brian (National Representative, Health, Safety and Environment). "Getting to Sustainability: the Need for Transition Programs", Labour presentation to the International Joint Commission on the Great Lakes, Biennial Meeting, Duluth, Minnesota, 23 September 1995. *Communications*, Energy and Paperworkers Union of Canada, Ottawa, ON, 1995.

[39]Environment Canada. *An Environmental Success Story: Maritime Fishermen's Union -Clean Ocean Committee* New Glasgow, NS, 1995. (Electronic version: http://atlenv.bed.ns.doe.ca/success).

[40]University of Calgary, Faculty of Management. *Environmental Management and Sustainable Development Programs*. Calgary, AB, 1995.

The result was a comprehensive, sixteen-point action plan promoted throughout the company. Individual hotels spread the word through all departments, including housekeeping, catering, and administration. Among the resulting initiatives are energy-efficient lighting, water-saving shower heads and toilets, use of alternate fuels to heat hot water, less laundry when guests agree to keep their towels and sheets, bulk purchasing to reduce packaging, cleaning of paint thinner for reuse.
Initiatives include other activities that prevent pollution and at the same time, save the hotel system a considerable amount of money. Hotel management says that the process is employee-driven, which adds greatly to its success. In a survey of employees, 92 percent of the employees expressed support for the environmental action program.[41]

Ontario Pollution Prevention Planning Document

A comprehensive training manual called, *Pollution Prevention Planning Document and Workbook*, was released by the Ontario Ministry of Environment and Energy in 1993 to serve as a model for pollution-prevention planning.

Atlantic Provinces Pest Management Program

Some education programs directed towards pollution prevention cross jurisdictional lines. For example, Newfoundland's Environment Department is leading an interprovincial pesticide management program, involving the four Atlantic provinces and the federal government, which aims to reduce or eliminate the use of chemical pesticides and promote Integrated Pest Management (IPM).[42] Fact sheets and brochures on pesticide safety will be displayed where the chemicals are sold.

Farmers and Pest Management

Compulsory certification is the means used to encourage education of pesticide users in Ontario. Farmers in Ontario are required to complete the Grower Pesticide Safety Course (GPSC) before being allowed to apply chemicals on field and horticultural crops. By the end of 1994, over 42,000 farmers had been certified in the safe use, handling, transportation, and application of agricultural pesticides. Recertification is required every 5 years.[43]

Demonstration Projects

Demonstration projects help to reinforce the practical applications of research. This serves a number of purposes. Skeptics who assume that the risk of trying new technology (whether physical or knowledge-based) is too high, may be convinced by the cost-effectiveness of a pilot project. Sometimes companies will realize that other aspects in their operations need to be adjusted to accommodate the new technology. Demonstrations also assist those seeking to commercialize new technology in determining what obstacles may be encountered. For example, employees may need different skills or the technology may have "bugs" that need to be fixed. Examples of pilot projects already in existence are the use of alternate fuel in buses and composting toilets at provincial parks.

"Green Clean"

A number of organizations, including environmental groups, are part of the Memorandum of Understanding (MOU) for "The Green Clean Project", a voluntary pollution-prevention project of water-based technologies and processes in fabric cleaning. The goal of the project is to reduce the use of non-aqueous solvents, especially perchloroethylene, in the dry-cleaning industry through demonstrations of "Green Clean" in several sites in

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[41] Paton & Royal Communications. Business and the Environment. A guide to the green office exhibit. Toronto, ON, 1993, p. 5.
[42] "Newfoundland leads Atlantic pesticides education program", *EcoLog Week*. Vol. 23, No. 33, 18 August 1995, p. 3.
[43] "Over 42,000 farmers certified in safe pesticide use", *AGCare Update* (Agricultural Groups Concerned About Resources and Environment, Ontario). Vol. 4, No. 1, Winter 1994, p. 3.

Ontario. The three-year project is a partnership with the Ontario Fabricare Association, Korean Dry Cleaners' Association, Environment Canada, and the Ontario Ministry of Environment and Energy.[44]

Ecorail

Transport is a major energy user with high air emissions and impacts on greenhouse gases, and other aspects of the environment. Canadian National and Ecorail, a subsidiary of CN, are offering an environmentally improved freight service in an effort to convince trucking firms to use rail to transport truck trailers. The system, 3R International, makes use of light trains instead of heavy locomotives and railcars for short distance shipping of trailers.[45]

Horticulture Industry

A closed-loop system that recirculates fertilizer in commercial greenhouses is a joint venture between the greenhouse industry and Environment Canada. The industry is sponsoring the technology transfer research through two non-profit foundations, The Cecil Delworth and the Joseph Memorial Foundations, which represent greenhouse producers in Canada, and the US Members of Flowers Canada have identified key environmental issues for their industry, including greenhouse waste, water quality, and air quality. Costs for waste disposal, increased by large amounts of plastic from pots, flats, tags, paper packaging, and corrugated as well as organic plant material, were about $0.28 a pound. Instead of discarding plant material, it is ground up and used for mulch and fertilizer at neighbouring farms. Reuse options include re-rolling the plastic covering used for transporting plants by truck.[46]

Municipal Demonstration Initiatives

Municipalities are playing an increasingly important role in providing leadership and a good example for pollution prevention. In 1995 the Federation of Canadian Municipalities issued the *Canadian Municipal Environmental Directory* which lists more than 1,200 environmental initiatives and infrastructure projects from 850 municipal governments. Some of these qualify as pollution-prevention initiatives. The International Council for Local Environmental Initiatives (ICLEI) World Secretariat is located in Toronto, Ontario, and has the objective to serve as "an international association of local governments, dedicated to the prevention and solution of local, regional, and global environmental problems through local action". The ICLEI:

- acts as an international clearinghouse for sustainable development and environmental protection policies;
- applies research and expertise to major problems in local communities;
- oversees research and expert problem solving related to local community issues;
- integrates the efforts of local communities with the international organizations; and
- sponsors-specific initiatives. Examples of this are the ICLEI Consultant Network, the Urban CO_2 Reduction Project, the Municipal Leaders Summit on Climate Change, and the Great Lakes and Ontario-Municipal Energy Collaborations. About thirty Canadian municipalities have joined the Cities for Climate Change campaign, with an objective of reducing local CO_2 levels for the year 2000 by 20 percent from what they were in 1990.

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[44]Project Partners. *The Green Clean Project: a voluntary pollution prevention initiative for the dry cleaning industry.* Great Lakes Pollution Prevention Centre, Sarnia, ON, September 1994. (Project Partners are Environment Canada, Korean Dry Cleaners Association, Ontario Fabricare Association and the Ontario Ministry of Environment and Energy in cooperation with non-government environmental organizations, municipal and U.S. Government Agencies.) See also, "Earthwhile launches Perclean products", *EcoLog Week*. Vol. 23, No. 38, 22 September 1995, p. 5.

[45]"New rail transport method saves energy, reduces emissions", *EcoLog Week*. Vol. 23, No. 35, 1 September 1995, p. 5.

[46]"Greenhouse growers address environmental issues", *AGCare Update* (Agricultural Groups Concerned About Resources and Environment, Ontario). Vol. 3, No. 1, Winter 1993, p. 3.

1. Healthy Cities
The "Healthy Communities Project" was active in Canada from 1988 to 1991 with funding from Health and Welfare Canada.[47] Although the project is no longer funded, it continues nonetheless through the Canadian Healthy Communities Network. There are 120 communities participating in British Columbia, 92 in Quebec, and 15 in Ontario. Although the programs are very specific to the community, including such activities as youth education and tree-planting among many others, hazardous waste and waste reduction are often addressed.

2. Hamilton-Wentworth Regional Municipality, Ontario
Hamilton, Ontario, has been designated as Canada's model "Local Agenda 21" city, by ICLEI as part of the implementation of United Nations Agenda 21. In addition, a pollution-prevention plan has been implemented for the Regional Municipality of Hamilton-Wentworth as part of the goals of Vision 2020, the Comprehensive Municipal Pollution Prevention (CMPP) projects are intended to integrate pollution prevention into regional operations, planning, resource use, and policies.[48] Among its facets are:

- an inventory of existing policies, bylaws, energy use, water consumption, waste management practices, fleet management, purchasing practices, and air emissions; and
- an outreach program to the 5,000 small- and medium-sized businesses. Instead of focusing totally on compliance, one of the abatement officers assists companies to reduce and eliminate waste with primary attention to profitability.

3. Winnipeg, Manitoba
A clean and healthy environment is one of the elements of economic development promotion in Winnipeg, Manitoba. The city is participating in ecological stewardship programmes and is one of the cities in Canada which has produced a "State of the Environment Report". It has implemented energy efficient street lights, adopted the "Power Smart Program" which supports labelling for energy efficient products, introduced waste minimization, and actively promotes water and energy conservation. Blue Box, Green Box, and Red Box recycling collects metals, plastics, glass, paper, and oil. Winnipeg's litter rating for 1994 was 1.36, compared to about 10 for most US cities. "Keep America Beautiful", a 600-member organization, recognized Winnipeg as one of North America's cleanest cities. It is also the home of the International Institute for Sustainable Development (IISD).

4. Montreal, Quebec
The City of Montreal issued its first "State of the Environment Report" in 1991 and has initiated more than 120 environmental projects. One example is the Energy Efficiency Program, designed to reduce energy consumption in municipal buildings. The program gives the Environment Unit of the Planning and Coordination Department overall responsibility to coordinate policies, but each department has responsibility for its own environmental program.

5. Regina, Saskatchewan
Regina set an objective to reduce the amount of CO_2 produced by municipal activities. As part of this, research was conducted in 1993 using two ethanol-fueled buses. They were the first such vehicles on the road in North America used to determine fuel efficiency, labour requirements, and exhaust emissions. Comparison studies are continuing on alternate fuel use.[49]

Present Situation and Trends

While some leaders in the corporate sector, particularly in large corporations, have adopted environmental management systems and pollution-prevention strategies, much still needs to be done. A 1994 KPMG survey of the top 1,000 companies in Canada showed that fewer than 50 percent of those responding from the manufacturing

[47]"Canadian Healthy Communities", *National Round Table Review* Summer 1994 , p. 12.
[48]Kendrick, Martyn. "Hamilton-Wentworth Changes Course", *National Round Table Review* Summer 1994, pp. 4-7.
[49]Saskatchewan. "Environment and Resource Management 95-430". Press Release, Regina, SK, October 1995. (Electronic version)

sector ranked environmental issues as important in their strategy and planning. Interestingly, in the same survey, only 20 percent of Canadian financial institutions considered environmental issues in their planning.[50]

Industry associations and other business entities in Canada have played an important role in fostering pollution-prevention initiatives. Some of the barriers associations face are:

- downsizing that leaves them with fewer staff and smaller resources;
- membership-driven demand for value— associations have to do what their members feel is of greatest importance, which often does not include initiating pollution-prevention programs; and
- limitations due to the mandate of the association. For example, the Canadian Manufacturers Association (CMA) is a "horizontal" association, comprised of a diverse pool of manufacturers, and acts primarily as a lobby group. The CMA does not see itself as having a role in communicating environmental progress with the public. Other associations, though, which may link to the CMA, are specific industry groups that are "vertical", representing all aspects of their industrial sector.

Many companies have for some time instigated activities that produce pollution-prevention benefits. What is more recent is the concept of pollution-prevention planning, which includes "a comprehensive examination of the operations at a facility with the goal of avoiding, eliminating or reducing pollution, and encompasses the successive stages in the life cycle of products[51]. For such initiatives, though, a well-developed environmental services, products, and equipment supply industry is essential. The factors that support the environmental industry are:

- stringent regulations and standards;
- belief by the public and decision-makers in the concept of sustainable development, that is, that the environment and the economy are interrelated;
- companies acting on pollution prevention due to regulations and voluntary initiatives;
- support of environmental initiatives by global funding agencies in developing countries;
- trade rules and export markets that demand certain environmental standards;
- lending institutions that require assurance of environmental performance; and
- purchasing decisions by government, the public, and companies that take environmental quality into account.

The International Standards Organization (ISO) Technical Committee 207 (TC 207) is in the process of developing the environmental standard, ISO 14000. Many in the environmental industry are hopeful that Canadian industry, most likely the medium to large firms, will adopt the standard, although to what extent this will happen cannot now be predicted. The ISO standard allows the company to set its own objectives and establish an internal monitoring system to verify that the objectives are reached. It does not inherently require a pollution preventive approach, but leadership in industry may encourage use of the standard for that end.

Barriers

Barriers to more widespread implementation of pollution prevention can be found in all of the areas described in this report:

- lack of legislation;
- lack of explicit government direction, more particularly at the provincial level than at the Federal level, though our research found that few environmental managers in Canada were yet aware of the "Pollution Prevention: A Federal Strategy for Action" document;
- lack of financing;
- inadequate technology development and transfer;
- lack of data, inventories, and targets;
- lack of familiarity with voluntary programs;
- lack of market benefit;
- insufficient recognition for pollution-prevention initiatives;
- insufficient education and training; and
- inadequate "proof" that pollution-prevention works.

[50]CCME Scan, 1995, sec. 5.4.2.
[51]Env. Canada, CEPA #7, p. 24.

Much of this can be summarized in one word: risk. Businesses of all kinds perceive that pollution control comes with a guarantee; pollution prevention appears to come with a big risk. For example, Earthwhile Developments has produced environmentally "friendly" cleaning agents and solvents for the North American dry-cleaning industry to replace perchlorethylene. But for the many small facilities in the dry-cleaning business shifting to such technology implies too big a risk.

Various barriers mitigate against the development of pollution-prevention legislation that effectively protects the environment:

- Lack of political priority. Many complex issues impinge on the political agenda and environmental issues are often pushed to the background.
- Lack of centralized authority. Successful programs rely on harmony among different jurisdictions and goodwill between the parties. Although efforts to harmonize have begun in Canada, recent severe cuts to CCME funding may jeopardize those efforts.
- Tensions between science, public policy, economics, and environmental priorities. For example, regulators often seek a higher degree of certainty than science can provide.
- Uncertainty in the ways of measuring damage to the environment and humans. Inability to identify damage is a serious barrier to action; many ecosystem effects are subtle and long-term.
- Gaps in information linking the cause— pollution— to effects such as injury to marine life, humans, water quality, etc.
- Difficulties in preparing and presenting a scientific basis for legislation. Funding for research is often linked to concrete results and frequent publication. Finding a cause-effect link takes a long time and few scientists have the skills or funding to carry out this type of work.
- The absence of clear solutions.
- The need to defend against litigation.
- Existing legislation that does not adequately deal with issues, for example by not taking a multi-media approach.
- The long time it takes from the point of recognizing harmful effects to the moment at which government takes effective action to limit the damage.[52]

The solution may not always lie in legislation. A "Waste Management Forum", sponsored by the Ontario Waste Management Association, the Solid Waste Management Association of North America (SWMANA) and the Association of Municipalities of Ontario, held in Toronto in September 1995, identified frequent problems with environmental legislation.[53] These were:

- uncertainty in the legislation. Proponents feel they ought to be able to assess in advance whether they are breaching the law or are likely to get approvals;
- "red tape" and excessive amounts of time, money, and effort needed to meet requirements that often do not translate into benefits for the environment;
- political interference and influence in decisions;
- too much emphasis on process and not enough on impacts;
- the lack of clear standards and guidelines;.
- the need to make a better determination of appropriate solutions; and
- the lack of consultation in the decision-making process to seek alternative solutions.

The following issues were identified as areas of concern by various industrial associations:

- Even if companies are complying and doing better, the regulatory atmosphere requires them to spend excess time and money to prove it.
- The paperwork is onerous.
- Regulations sometimes set requirements that are contradicted by other regulations. For example, a provincial regulation requires that an empty halon fire extinguisher must be filled before the aeroplane can take off again but another regulation forbids any supplier to supply halon even from halon banks.[54]

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[52]GLWQB, 1995,p. 6.

[53]"Waste management forum targets approvals problems", *EcoLog Week*. Vol. 23, No. 38, 22 September 1995, pp. 1-2.

[54]Markerogou, Levon (Industry Analyst, Aerospace Industries Association of Canada). Personal communication, Ottawa, ON, November, 1995.[55]More than 150 telephone interviews were attempted around the country with

This suggests that pollution prevention might best be encouraged through education, demonstration, economic instruments, and so on. From our interviews it seems that lack of awareness of the opportunity afforded by pollution prevention is a particular problem in smaller companies that lack the resources to become well informed about pollution prevention. On the other hand, some of the larger companies are taking a lead role because they have the means to do so. Eventually a filter-down effect will occur because large companies increasingly are demanding pollution-prevention standards from their suppliers. However, this is a very slow process.

Although our research has identified numerous pollution-prevention initiatives at all levels of government and in all sectors of industry in Canada, the following summarizes the characteristics of most pollution-prevention programs:

- Initiatives are frequently scattered and disconnected.
- The majority of federal and provincial legislation is designed for implementation of pollution control rather than pollution prevention. While not specifically excluding a pollution-prevention approach, legislation and regulations frequently direct emitters to pollution control solutions rather than to pollution prevention.
- Many emitters are compliance-driven, installing only those systems required by regulation or by government approvals branches. There are, as yet, few regulations that require application of pollution-prevention strategies.
- There are few comprehensive strategies designed to encourage application of pollution prevention. Most programs are designed to meet environmental goals through any mean~~s~~ – pollution control, or pollution prevention.
- The economic benefits of pollution prevention as compared to pollution control are not well understood except among a discreet group of environmental managers.
- Measurement and evaluation of the cost effectiveness of pollution control technologies are well known and well understood. Similar measurement and evaluation techniques, both environmental and economic, are not well developed for pollution-prevention strategies.
- No overall assessment of the success of pollution-prevention programs has been undertaken.
- A systematic emphasis on environmental technology tends towards pollution control, where “hard” technology is more important, and does not give equal priority to pollution prevention. In pollution-prevention programs, “soft” technologies, like training and management systems, and such “clean technologies” as new, more efficient but not specifically environmental technologies, predominate.
- Outside a small circle of government experts there is no consistent definition for pollution prevention. While it may appear unimportant, weak, indecisive answers to the question, “What is pollution prevention?” can cause many senior managers to shy away from the approach.

Despite these negative points, pollution prevention is gaining a significant toehold in environmental protection planning in Canada. Pollution-prevention initiatives now exist at all levels of government, in all parts of the country, and in all major sectors of the economy.

IV. Pollution Prevention in Mexico

Introduction

Across North America, governments, industry organizations, and non-governmental organizations (NGOs) are promoting the use of pollution prevention as an environmentally and economically effective alternative to pollution control. The present document is devoted to analyzing pollution prevention in Mexico.

Frame of Reference for this Report

The North American Commission for Environmental Cooperation (CEC) decided to carry out an analysis of pollution prevention in North America, following the directive of its executive council to develop recommendations regarding pollution-prevention techniques and strategies. To that end, the CEC contracted a trilateral group of independent experts from each country to conduct a study of pollution prevention in the North American Free Trade Agreement (NAFTA) region and to formulate proposals for appropriate CEC responses.

The objectives of the study were:

- to examine the status of pollution prevention in each of the NAFTA countries;
- to develop a report synthesizing that information for the NAFTA region; and
- to formulate expert advice for the CEC.

This individual report was written to address the Mexican situation. The main focus will be on the adoption of pollution prevention by business and industry with the following topics to be addressed:

- how pollution prevention has been incorporated into each country's legislation;
- financial incentives available to encourage pollution prevention;
- modes of institutional support and promotion, and identification of governmental, business, and non-governmental organizations promoting pollution prevention;
- degree of participation of industrial associations and state governments;
- how pollution prevention has been incorporated into the business environment, including trends on how companies have adopted pollution-prevention strategies; and
- examples of pollution-prevention success stories.

Evolution of Mexican Environmental Strategy

Environmental protection strategy in Mexico has seen a continuous evolution during the last 30 years. Originally based on a rather anthropocentric interpretation of the environment, with priorities emphasizing environmental remediation, these strategies have evolved towards a systemic interpretation with the assignment of priorities to prevention and control measures. Finally, during the last few years, they have moved from command and control mechanisms to a focus on economic instruments.

Interpretation of Pollution Prevention

Mexican environmental legislation incorporates the concepts of preservation, prevention, and protection. Preservation is defined as the set of policies and measures to maintain the conditions that favor the evolution and continuity of the natural processes. Pollution prevention is defined as the set of provisions and anticipated measures to avoid environmental harm. Protection, on the other hand, is defined as the set of policies and measures to improve the environment as well as prevent and control its deterioration.

The fact that prevention is considered to be any action conducive to the avoidance of environmental damage means that, in fact, the concept embraces what are called activities of environmental control. For example, in the industrial sector, the wide interpretation of prevention means that inherent process modifications, as well as end-of-the-pipe technologies are prevention mechanisms. The Mexican legal interpretation of prevention implies that the following can be considered prevention activities: technological process modifications; end-of-the-pipe technologies; environmental impact assessments, risk reduction and related activities; as well as environmentally-related prohibitions, regulations, standards, final disposition of wastes; the creation of protected natural areas; and practically all environmental policy instruments not related to remediation or minimizing the effect of pollution. On the other hand, a restrictive interpretation of "prevention" means avoiding the generation of pollutants in the first place, rather than controlling them after they have been produced and before they are released to the environment. This restrictive interpretation is common in the other NAFTA partner countries.

The present document, however, analyzes prevention activities in Mexico using the more restrictive interpretation of pollution prevention in order to facilitate comparison with other environmental policies, in particular, those of the other two countries in the region. In fact, an important element in the evolution of Mexican environmental strategy has been to increase the priority given to prevention activities over those of control or remediation. Indeed, the conflicting requirements of pollution control, remediation, and emergency response compete with the requirements for pollution prevention in the process of establishing consistent priorities and budgets. The country really needs a "Marshall Plan" approach to resolve this dilemma, since both ends of the environmental spectrum require sufficient budgeting to be effective. Thus, there is a growing risk to public health and the environment implicit in the current status of environmental provisions, aside from considerations of the adequacy of legislation currently on the books. There is no doubt that environmental matters compete for public attention along with other current social, political, and economic issues.

Traditionally, little competitive advantage has been found in Mexico for spending on pollution prevention. This, however, is not representative of the situation worldwide, where the interaction of business competitiveness and environmental standards is a major issue. With the globalization of the world economy, there is every reason to believe that international competition will come to affect Mexican environmental policy-making.

Description of the Document

This report presents an analysis of policies on pollution prevention prevailing in Mexico, based on information available from very diverse sources. A literature search was carried out on the topic of pollution prevention, together with a search for articles on the subject in 15 of the most country's major newspapers which carry national coverage and which spanned the period from 1988 to 1995. In addition, more than 40 telephone interviews were conducted with environmental consultants, NGOs, companies, financial institutions, and government officials.[55] This was brought together with the expertise of the Center for Environmental Quality of the *Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM)* accumulated during the last three years on pollution prevention. Following this introduction, the second section of the document presents a brief description of **environmental policy** emphasizing prevention. The third section considers **environmental legislation** and related bylaws that constitute the framework for prevention activities. The fourth section considers **existing institutional support for promotion of pollution prevention mechanisms**, and the last section summarizes the **present situation and trends** in prevention activities around the country.

Legislative and Policy Framework

1. Environmental Policy

For several generations there has been a growing deterioration in the country's ability to renew natural resources and maintain environmental quality. The main metropolitan areas face pollution problems which exceed environmental standards; about 30 percent of municipal solid waste is not collected and is abandoned in open spaces and streets; each year seven million tons of hazardous industrial wastes are generated; and in various regions of the country, ecosystems have been drastically altered. Also, Mexico has one of the highest rates of deforestation in Latin America, especially because of changes in land use patterns in the tropical zones and by forest fires in the temperate zones. The misuse of land has caused a drop in soil fertility in over 80 percent of the national territory. Twenty-nine of the 37 hydrological regions are characterized as contaminated and over-fishing has seriously affected the population of several species.

Damage accumulated over the years and reduced productive opportunities due to the misuse of natural resources will not be easily overcome in the near term. Attention should center on stopping ecological deterioration and establishing the basis for a transition to sustainable development. With respect to environmental regulations the strategy should centre on strengthening and integrating effective standards and then enforcing them. In particular, the application and use of environmental impact assessments and the regulations related to hazardous wastes management should be strengthened.

The idea underlying environmental regulation is that a system of incentives, incorporating standards and economic instruments, will influence producers and consumers to adopt decisions that support environmental protection and sustainable development. The use of economic instruments attempts to avoid the transfer of environmental costs to other producers or consumers and provides incentives for furthering activities that protect the environment and preserves natural resources.

Policies and actions affecting the environment and natural resources attempt to inculcate responsibility and social participation. They seek to provide better information to society and to strengthen social participation in the public policy decision-making process.
The success of these strategies depends on the development of a pollution-prevention culture, together with the sustainable use of natural resources and improvement in the quality of life of the population. The advancement of these objectives is one of the main tasks shared by the state and society.[56]

2. Environmental Legislation

Constitutional Basis

The 1917 Constitution of the Mexican United States (Mexico) is the Supreme Law of the Union.[57,58] The principle of constitutional supremacy is therefore the basis for examining legislation seeking to protect the environment. Article 27 of the 1917 Mexican Constitution establishes that the nation will always have the right to regulate the use of natural resources. The purpose of this provision is to guarantee an equitable distribution of the public wealth and to preserve it. This is how the principle of "conservation" of natural resources was introduced into the Constitution, although it was later modified to incorporate the concepts of "preservation" and "restoration" of the ecological equilibrium.[59] Besides these provisions, there are others in the Constitution that refer to certain areas that could suffer or generate environmental damage, such as land use, water resources, seas, atmosphere, minerals, electric energy, nuclear energy, human settlements, industrial activities, etc.
Until the end of the 1960s the term "environmental protection" was used in the Constitution mainly in the limited context of protecting human health from environmental hazards, and not in the more general context of protecting the environmental systems beyond the concern for human health. This limitation was due mainly to the kinds of emerging environmental problems seen in industrialized regions. In fact, ideas of "pollution prevention" were not explicitly introduced into the Mexican Constitution until 1971, when the Federal Law for Pollution Prevention and Control was enacted.[60] In this law a statute was promulgated giving an existing agency, the *Consejo de Salud*, Federal Health Council, the power to outline legal procedures for addressing pollution. However, the fact that the Health Council was the governmental agency in charge of environmental protection showed that the new law still had a strong bias solely towards the protection of human health.
During the next decade and a half, additional efforts were made by the government to deal with environmental problems in a more systematic, institutionalized way. The 1983 reform of Articles 4, 25, and 27 incorporated new ideas. Article 4 established the right of every person to "health protection". Article 25 established for the first time the conditions of economic support to public and private sectors for "conservation of natural resources and the environment".[61] Article 27, on the other hand, explicitly incorporated the idea of the "overall protection of the environment".
In these new constitutional provisions the term "protection of the environment" has three different meanings: (1) the conservation of natural resources vulnerable to appropriation; (2) prevention and control of pollution in areas affecting human health; and (3) preservation of the environment, in the more general sense, from the irresponsible use of resources by the private and public sectors.
In 1987, Articles 27 and 73 of the Constitution were further modified to incorporate the concept of "preservation and restoration of ecological equilibrium" and with this modification, the principle that it is the duty of the State to

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[56] *Plan Nacional de Desarrollo*, National Development Plan, 1995-2000.
[57] Published in the *Diario Oficial de la Federación* on 5 February 1917.
[58] According to article 133 of Mexico's 1917 Constitution echoing article 126 of the previous Mexican Constitution of 1857. The latter had been modeled after the United States Constitution of 1787, the relevant clause (article VI, section 2a) of which states that, "this Constitution… shall be the Law of the Land".
[59] *Diario Oficial de la Federación*, 6 January 1992.
[60] Published in the *Diario Oficial de la Federación* on 6 July 1971.
[61] Article 25 established that by the criteria of social equity and productivity, support will be given to publicly-owned and private companies, subject to the dictates of the public interest and to the use, for the benefit of all, of the productive resources, conserving them and also the environment. This article was modified during 1982 and published in the *Diario Oficial de la Federación* on 3 February 1983. Article 25 together with Articles 26, 27, and 28 constitutes in practical terms the constitutional support of Mexican economic law.

protect the environment thus became part of the Constitution.[62] The concept of "environment" thereby came to be understood in a more comprehensive way.

3. The General Law of Ecological Equilibrium and Environmental Protection

An important part of the process of progressive improvement that started in 1987 with the modification of Articles 27 and 73 of the Constitution was the enactment of the *Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA),* General Law of Ecological Equilibrium and Environmental Protection[63] (also known as The General Ecology Law), in January 1988. This law, in fact, replaced the Federal Law on Environmental Protection (*FLEP*), which had been in force since 1982. Mexico's General Ecology Law is comprehensive in scope and covers all media — air, water, and solid waste handling and disposal — and considers natural resource conservation, ecological zoning, and all pollution problems in general.

The General Ecology Law, currently under review for possible modification, has 194 permanent dispositions organized in six main titles and five regulations which cover the following areas: environmental impact assessment, air pollution at the national level, air pollution in Mexico City, and hazardous wastes. Dispositions for water pollution prevention and control are treated separately in the National Water Law.[64]

Only 47 of the 194 articles of the General Ecology Law deal directly with pollution issues. The rest are focused on policies, instruments, and duties (43 articles); protection of natural resources (66 articles); and social participation, inspections, and sanctions (38 articles). The 47 pollution-related articles of the General Ecology Law refer to air, water, and soil pollution prevention and control; hazardous materials and hazardous wastes; radioactive materials; as well as noise, vibrations, odours, visual, thermal, and luminic energy emissions.

In most of these articles the term "pollution prevention" appears in the Law as "pollution prevention and control", indicating the strong influence lingering in Mexico towards the use of abatement technology, such as emissions control equipment, wastewater treatment plants, and treatment and final disposal of solid wastes, rather than the implementation of pollution "prevention" programs in the restricted sense that was mentioned above. The wider interpretation of pollution prevention, which includes control, is present throughout the General Ecology Law and its regulations, as well as in the corresponding 31 state environmental regulations. In fact, the word "control" appears in the General Ecology Law twice as frequently as the word "prevention".[65] The General Law also covers issues related to pollution of surface, ground, and marine waters and aquatic ecosystems, as well as water pollution control.[66]

Regulations

To implement the General Law, there are several regulations and standards. To regulate air quality at the national level, one of the regulations addresses issues such as stationary and mobile source controls, a national air-quality monitoring system, and enforcement mechanisms.[67] A second regulation covers only the air in and around Mexico City, dealing with traffic regulation, motor vehicle emissions, and inspections.[68] Most air *NOMs (Normas Oficiales Mexicanas)* address specific stationary source and mobile source requirements, and set standards for permits, test methods, and inspection equipment.

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[62] Published in *Diario Oficial de la Federación* on 10 August 10 1987.

[63] *Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA)*, the General Law of Ecological Equilibrium and Environmental Protection, published in the *Diario Oficial de la Federación* on 28 January 1988.

[64] *Diario Oficial de la Federación*, 1 December 1992.

[65] In the General Law of Ecological Equilibrium and Environmental Protection the word "control" appears 52 times, versus 21 times for the word "prevention".

[66] "Reglamento para la prevención y control de la contaminación de aguas", 30 pp., published in the *Diario Oficial de la Federación* on 29 March 1973; and "Reglamento para prevenir y controlar la contaminación del mar por vertimiento de desechos y otras materias", 15 pp., published in the *Diario Oficial de la Federación* on 23 January 1979.

[67] "Reglamento de la *Ley General del Equilibrio Ecológico y la Protección al Ambiente* en materia de prevención y control de la contaminación atmosférica", 24 pp., published in the *Diario Oficial de la Federación* on 25 November 1988.

[68] "Reglamento de la *Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA)* para la prevención y control de la contaminación generada por los vehículos automotores que circulan por el Distrito Federal y los municipios de su zona conurbada", 24 pp., published in the *Diario Oficial de la Federación* on 25 November 1988.

Mexican law also contains a regulation requiring an environmental impact statement (EIS) for any planned public or private works that may cause an ecological imbalance or that are subject to existing environmental laws.[69] These activities include federal public works, hydraulic works, oil and gas pipelines, mining, petrochemical activities, tourism, etc. With certain kinds of activities, especially "high risk" activities, a risk analysis must be conducted and submitted along with the environmental impact review. Mexican law also has a regulation requiring an analysis of a proposed project's potential environmental impacts, possible mitigation measures, and compliance status.

4. Other Laws and Regulations

Mexico does not currently have a law that is comparable to the US Emergency Planning and Right-to-Know Act (EPCRA), meaning that there are no required toxic chemicals inventory reporting and community right-to-know programs.[70] However, Mexico does subscribe to the UN Awareness and Preparedness for Emergencies at the Local Level (APELL) Program.[71] The NAFTA side agreements, moreover, make provisions for public participation and public dissemination of information with regard to environmental matters.[72] As part of an international treaty, these side agreements are as binding as any law of the country, according to normal constitutional principles. Thus, it would seem that the general principle of the public's right-to-know should now have a legal basis in environmental matters. Probably there remains, however, the need for more specific legislation in this area, especially as the Supreme Court of Mexico has not heard any cases regarding it. There does not seem to be a broadly based administrative stand on the issue, so the public's right-to-know currently tends to be effected by means of private or public discovery, denouncements, or flagrant evidence in the public domain or media. Except in certain instances, there does not seem to be an active movement to promote the public's right-to-know. Thus, these are all issues that require reinforcement.

An organized system for emergency response and contingency planning is found in the National System for Civil Protection, promulgated in 1986.[73] This decree designates the *Secretaría de Gobernación*, Secretariat of the Interior, as the federal agency responsible for this system.

The General Directorate for Civil Protection serves as the coordinator between federal contingency planning and emergency response units, and the state and local councils for civil protection. The local council is often headed by the local fire chief who may or may not currently have adequate means, procedures, training, funding, staff, and support. This system authorizes Mexican communities to develop their own contingency plans within the parameters established at the national level.

Dispositions for water pollution prevention and control are found in the National Water Law.[74] This Law gives the *Comisión Nacional del Agua*, National Water Commission, the authority to promote, execute, and operate federal infrastructure and services required for the preservation, conservation, and improvement of water quality in the different hydrological basins and aquifers of the country. The Water Commission is also responsible for formulating integral protection programs for hydrological resources and aquifers, and considers the existing relationship between land use and the quantity and quality of water.

Standards and Criteria

Regulations are implemented through technical standards, *Normas Oficiales Mexicanas (NOMs)*. The regulations provide qualitative criteria and policy guidance, while the *NOMs* provide quantitative criteria that serve as standards.

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[69] "Reglamento de la Ley General del Equilibrio Ecológico y la Protección al Ambiente (*LGEEPA)* en materia de impacto ambiental", published in the *Diario Oficial de la Federación* on 7 June 1988.

[70] The EPCRA is also known as Title III SARA (the Superfund Amendments and Reauthorization Act of 1986). Section 313 of this Act pertains to release reporting. The basic requirements of that Act are as follows: facilities that have on their premises chemicals designated under the Act as "extremely hazardous substances" must cooperate with state and local planning officials in preparing comprehensive emergency plans (Sections 302 and 303); facilities must report accidental releases of "extremely hazardous substances" to state and local response officials (Section 304); and facilities must make Material Safety Data Sheets (MSDSs) available to local and state officials, and inventories of chemicals on their premises for which MSDSs exist (Sections 311 and 312).

[71] APELL, 71 page document published by UNEP in 1989, ISBN 9280711857-00900P.

[72] Article 10:6(a), Article 21, Article 39, North American Agreement on Environmental Cooperation, Final Draft, 13 September 1993.

[73] *Diario Oficial de la Federación*, 6 May 1986.

[74] *Diario Oficial de la Federación*, 1 December 1992.

For example, regarding air quality, the General Law of 1988 and its regulations and standards set the air emissions and ambient standards, and the standards for test methodologies and air quality monitoring systems which required the installation of pollution control equipment, motor vehicle emissions standards, and vehicle inspection systems.[75] The Hazardous Waste Program, also set forth by the General Law of 1988, covers the generation, storage, treatment, transportation, and final disposal of hazardous wastes. The criteria for determining what materials are considered hazardous wastes are set by a technical standard, which lists about 144 types of industrial hazardous wastes.[76]

5. Enforcement

As was explained above, Mexico's environmental policy has typically relied more on enforcement and sanctions than in promotion of pollution-prevention activities and measures. But even enforcement is a complex task in Mexico, mainly because of the lack of a consistent and uniform set of enforcement standards, the lack of information and long-term planning, as well as the problem of corruption. Law enforcement in Mexico is administrative in nature, with the predominance of non-judicial forms of law enforcement. Administrative agencies, rather than courts, have considerable authority for determining whether laws are violated and, if so, the remedies that should be imposed.

Institutional Support for Promotion of Pollution Prevention Mechanisms

1. Fiscal Instruments

The *Secretaría de Hacienda y Crédito Público (SHCP)*, Mexican Treasury and Public Credit Secretariat, determines the criteria and total amounts of fiscal incentives. A Federal Decree that establishes the fiscal incentives to promote pollution-prevention activities was enacted in 1981.[77] Its objective was to stimulate the manufacture and acquisition of environmental equipment. To accomplish this, the decree provides for fiscal incentives, consisting of a credit against federal taxes, that were given to companies in the form of special fiscal certificates. Activities related to the preservation and restoration of ecological equilibrium, as well as those related to the protection of the environment, can be considered eligible for these fiscal incentives.

Decisions about which projects and activities will in fact receive such fiscal incentives are, however, left to the *authorization, judgment and/or initiative* of the pertinent environmental authorities. They are thus not automatically given, instead, companies must count on official approval and authorization, and if this is not granted, then no benefit accrues to the company that made the investment or incurred the expense. Obviously, this uncertainty affects the economic viability of environmental investments, distorting the decision-making process and increasing up-front risks and costs. It is a very undesirable combination for a business person.

These incentives are also restricted by the General Law of Ecology and Environmental Protection which provides for granting them only in cases of:

- the acquisition, installation, and operation of air pollutant emissions control equipment;
- the manufacture, installation, and maintenance of filters, combustion control, and general equipment for the treatment of emissions; and
- research on retrofit technology that will reduce the emission of contaminants to the atmosphere.[78]

The law does not provide for fiscal incentives for other areas, such as water and soil contamination, solid and hazardous wastes, radioactive wastes, as well as noise, vibrations, odors, visual, thermal, and luminic energy emissions. The law also does not mention any fiscal incentives for pollution-prevention activities in general.

The granting of these incentives is also conditional on the Federal Income Tax Law which authorizes the *Secretaría de Hacienda y Crédito Público (SHCP)* to grant the various kinds of incentives and subsidies. In fact, a recent modification to this law has eliminated the empowerment that *SHCP* formerly possessed to grant this type of

[75] "Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA)" published in the *Diario Oficial de la Federación* on 28 January 1988.

[76] *Norma Oficial Mexicana*, NOM-052-ECOL/93, published in the *Diario Oficial de la Federación* on 22 October 1993.

[77] *Diario Oficial de la Federación*, 23 March 1981, with erratum in 11 January 1982.

[78] "Ley General del Equilibrio Ecológico y la Protección Ambiental (LGEEPA)," Chapter I, Article 116, published in the *Diario Oficial de la Federación* on 28 January 1988.

incentive for the environmental area, and in general has restricted the application of all types of incentives and subsidies, leaving open only a few areas, such as agriculture.[79]

2. Financial Mechanisms

In the case of financial mechanisms, such as loans, grants, and credits, the Organic Law of the Federal Administration empowers the recently established *Secretaría del Medio Ambiente, Recursos Naturales y Pesca (Semarnap)*, Secretariat of Environment, Natural Resources and Fisheries, to promote and support financial mechanisms for the protection of the environment.[80] There are also special legal dispositions, establishing official measures of a financial nature to protect the environment, such as the institution of special funds for specific purposes.

The most important of these funds is the *Fondo Nacional para la Prevención de la Contaminación Ambiental*, National Pollution Prevention Fund, created in 1981 and administered by *Nacional Financiera (Nafin)*, Mexico's National Development Bank, and better known as the *Nafin* Environmental Improvement Program.[81] This fund mainly supports the execution of studies, technical assistance programs, training, equipment acquisition, construction of wastewater treatment plants, and incorporation of processes to improve energy efficiency and lower water consumption. The maximum term for repayment is 20 years. Interest rates are 8 percent above the Libor rate for small- and medium-sized enterprises (SMEs) and higher for larger companies.[82] *Nafin* does not give these credits directly to companies, but rather makes them available through private banks, credit unions, and other lending institutions. These institutions may or may not always be in a position to assist the borrower and may establish additional requirements for the financing. The borrower may or may not be in a position to fulfill these requirements, particularly under the present conditions of economic crisis in the country. Thus, there may be a certain gap between the official programs and the everyday reality of those seeking assistance.

Other funds available include the *Programa de Calidad Integral y Modernización Integral (CIMO)*, Quality and Modernization Program, a small fund operated by the Labor Secretariat with support from the World Bank. This fund is targeted for small- and medium-sized enterprises (SMEs) and gives support for training, consulting, and technical assistance. It may award 70 percent economic support (financing) for consulting and technical assistance programs and 35 percent for training. It supports a maximum of 100 hours of consultant time with a total budget not exceeding approximately US $3,500 per company.

The *Comisión Federal de Electricidad (CFE)*, Federal Electricity Board, created a fund called *Fideicomiso de Apoyo al Programa de Ahorro de Energía del Sector Eléctrico (FIDE)*, Energy Saving Program Support Fund, whose purpose is to inform workers and citizens in general about how to save energy when using electric appliances.

The private banking system in Mexico also provides funding for pollution prevention and control activities. However, it has concentrated its funding exclusively on the acquisition of environmental control equipment or other type(s) of capital goods or equipment. In these cases, funding is granted under the guarantee of international Export Credit Agencies, better known as Eximbanks. Credits can be granted in US dollars and repaid in Mexican pesos, subject to currency fluctuations.

In spite of the economic problems Mexico has faced during the last two decades, environmental markets are expected to grow due to the considerable backlog of environmental needs in the country (see Table 1). In this respect the creation of the Border Environmental Cooperation Commission (BECC), in combination with the NADBank, will facilitate the financing, construction, operation, and maintenance of environmental infrastructure projects in the Mexico-US border region, and particularly for the 16 sister cities located along the border.

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[79] *Diario Oficial de la Federación*, 20 December 1991.

[80] This is a new Secretariat established in 1994. *Diario Oficial de la Federación*, 28 December 1994.

[81] *Diario Oficial de la Federación*, 15 June 1981.

[82] *Nafin* interest rates are currently at around 34 percent and are subject to fluctuations that are difficult to predict which produces uncertainty in viability studies.

Table 1: Projected Performance of Mexican Environmental Markets

	1994	1995	1996
Water pollution control	841	1,085	1,288
Solid and hazardous waste	261	324	402
Energy efficiency	270	323	386
Renewable energy	149	657	699
Fixed-source air pollution control	360	400	456
Environmental consulting	18	20	23
Remediation	21	24	29
Total	**1,919**	**2,833**	**3,283**

Source: US Agency for International Development, March 1995

The type of projects supported by the BECC and NADBank will be mainly in such areas as water pollution, wastewater treatment, and municipal solid waste. Projects submitted to the BECC will be evaluated according to several sustainable development criteria.

In 1991, the World Bank and the United Nations set up an international financing mechanism known as the Global Environment Facility (GEF). It was funded by donor states from industrialized countries to provide less developed countries with financial incentive to tackle such global environmental problems as climate change. GEF was designed to finance the incremental cost of projects in the developing world that specifically addressed the following global environmental problems: global warming, pollution of international waters, destruction of biodiversity, and depletion of stratospheric ozone. GEF was designed to generate benefits to the international community rather than economic or environmental benefits to a specific nation.

The first stage of GEF had access to funds of around US $1.2 billion in September 1993, with contributions made by 28 countries, including Mexico.[83] The funds were allocated to 112 projects, 40 percent of which related to global warming, 43 percent to biodiversity, 16 percent to international waters and 1 percent to stratospheric ozone projects. In its second stage, in March 1994, the GEF had access to US $2 billion from its participant countries. Mexican or foreign companies making new investments can have access to financing from the GEF to pay for the incremental cost of equipment or pollution-prevention activities, particularly those that will incur desirable changes to the Earth's atmosphere and climate or have a positive impact on local transformations to the Earth's surface related to desertification, deforestation, and groundwater pollution.

3. State and Municipal Participation

In Mexico, the trend is towards giving state and local governments greater responsibility in areas of environmental policy-making and enforcement. Currently, the 31 states have environmental legislation and statutes, but the bulk of policy-making is still carried out at the federal level. Typically, environmental concerns such as risk assessments, environmental emergencies, and hazardous materials and wastes fall under federal jurisdiction, while states oversee such activities as regulating water pollution, vehicle emissions, the monitoring of air emissions, solid waste disposal, municipal sewage systems, state wildlife reserves, and insuring compliance with water pollution regulations.

Environmental policies and actions are conducted under a strategy of decentralization for environmental and natural resources management. The objective is the strengthening of the capacity of local management, especially at the municipal level, and the broadening of social participation. A key component of the decentralization programs is the induction of regional planning in the use of resources, oriented through local knowledge and recognition of the specific characteristics of such resources.

In addition to present state environmental duties, each federal agency and each specific environmentally critical zone is invited to establish an ecological zoning of the territory under its purview with the legal directive to enforce

[83] Mexico's contribution was US $5.65 million.

environmental laws. It is the responsibility of both state and municipal governments to carry out actions required for pollution prevention and control, including the installation of control equipment for generators. States and the municipalities are also responsible for carrying out inventories.[84]

4. Private and Social Mechanisms

The two main industrial associations in Mexico are *Cámara Nacional de la Industria de Transformación (Canacintra)*, National Chamber of the Manufacturing Industry,[85] and *Cámara de la Industria de Transformación de Nuevo León (CAINTRA)*, Association of the Manufacturing Industry of Nuevo León, which have thousands of affiliated companies, mainly SMEs. They are also part of the *Confederación de Cámaras Industriales (Concamin)*, Confederation of Industrial Associations. The three associations, *Concamin*, *Canacintra* and *CAINTRA*, promote pollution-prevention activities within their affiliates. In general terms, their primary contribution is the diffusion of these activities and programs by means of workshops, courses, and seminars. However, the emphasis of such seminars has been more on legal requirements and abatement technology, although there is a gradual trend to include more pollution-prevention topics within them.

Canacintra, in conjunction with the *Secretaría de Comercio y Fomento Industrial (SECOFI)*, Mexican Secretariat of Commerce and Industrial Development, and the company, IBM-México, created a Technology Transfer Unit in 1993 for the purpose of offering technology management services to SMEs, starting with a diagnosis of their needs and ending with negotiation and contracting of technology. *Concamin* has created a network of Regional Environmental Information Centres, starting with the cities of Monterrey, Guadalajara, and Mexico City. *Concamin* has also created the Mexican Foundation for Innovation and Technology Transfer (*FUNTEC*) for small- and medium-sized enterprises. *FUNTEC* particularly supports SMEs in areas related to international trade. In 1992, *CAINTRA* created an *Instituto de Protección Ambiental (IPA)*, Institute for Environmental Protection, with the purpose of giving advice and technical support to *CAINTRA's* member companies.

Since October 1991, the *Asociación Nacional de la Industria Química (ANIQ)*, National Association of the Chemical Industry, has adopted the *Responsabilidad Integral*, Responsible Care Initiative.[86] *ANIQ´s* membership is approximately 248 companies — about 35 large companies, 135 medium-sized companies, and 77 small companies. *ANIQ* members have more than 3,500 facilities in Mexico.

All of these companies have signed the protocol affirming the guiding principles, which are similar to the analogous programs administered by industrial associations in the US, Canada, and Europe. The key aspects of the program are constituted by a Code of Administrative Practices. The three first steps of the Code include community protection, pollution prevention, and process safety. These are followed by four further steps: transportation and distribution, employee health and safety, research and development, and product stewardship. *ANIQ* has organized a public advisory panel which began meeting in 1993. However, Mexico's economic crisis and the problems of compliance with the regulations may account for the limited progress in getting *Responsabilidad Integral* into action. In fact, many of the companies in the chemical industry are still not familiar with the program.

Professional associations, such as the *Instituto Mexicano de Ingenieros Químicos (IMIQ)*, Mexican Institute of Chemical Engineers, are starting to promote pollution prevention with their membership and in general within the chemical industry. Part of *IMIQ*'s responsibility is the development of a directory of professionals capable of conducting environmental audits. There were 27 authorized environmental professionals in this directory as of January 1995.

The number and importance of NGOs is growing every day in Mexico. There are 2,799 NGOs officially registered with the *Instituto Nacional de Ecología (INE)*, National Institute of Ecology. Of these, 461 are environmental groups without any specific area of specialization, 231 are consulting organizations, 19 consist of representatives from international NGOs, 75 are academic institutions with formal environmental programs, and 11 are NGOs promoted by private business and corporations.

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[84] Chapter I, Title IV, page 53, "Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA)," published in the *Diario Oficial de la Federación* on 28 January 1988; and also NOM-039-ECOL/1993 to NOM-085-ECOL/1994, published in the *Diario Oficial de la Federación* between 22 October 1993 and 2 December 1994.

[85] *Canacintra* has thousands of companies affiliated in Mexico, mainly from SMEs.

[86] *ANIQ* has as members approximately 95 percent of all companies in the chemical sector in Mexico. Communication with Ing. Miguel Benedeto, Director, *Medio Ambiente, Seguridad e Higiene* of *ANIQ* on 6 November 1995.

The academic institutions that are more directly involved in pollution-prevention activities include the *Universidad Nacional Autónoma de México (UNAM),* National Autonomous University; the *Instituto Politécnico Nacional (IPN),* National Polytechnic Institute; the *Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM),* Monterrey Technological and Higher Education Institute, with its 26 campuses throughout the country; the Secretaría de Educación Pública-Consejo Nacional de Ciencia y Tecnología *(SEP-CONACYT),* Technological Centres of the Secretary of Education, system throughout the country; and the Sistema Nacional de Educación Tecnológica *(SNET),* National System of Technological Education, with 19 centres distributed throughout 12 states.

Apart from the academic institutions, very few NGOs have pollution-prevention programs.[87] Several work to develop and promote programs for the conservation of natural resources. A large number of them are still perceived by the public as environmental watchdogs, presenting accusations and reports to the media on diverse environmental issues.

The Environmental Education and Training Institute of North America (EETINA) is the first trinational NGO of the NAFTA region. It was established in September 1994 with 25 associated NGOs from the US, Canada, and Mexico, and is based in Mexico City. EETINA has the opportunity to take a very important role in promoting pollution-prevention activities and training within the NAFTA region.

Present Situation and Trends

In Mexico there is an ongoing trend towards decentralization of environmental authority from federal to state and local governments. The General Law of 1988 is the basis for this distribution of authority between federal and state levels.[88]

A problem facing many Mexican industries is that the government is forcing compliance with environmental regulations when an adequate environmental infrastructure is still lacking. On the other hand, the level of enforcement is criticized by many as being insufficient. These circumstances have attracted many environmental companies and consulting firms to Mexico.

Even when several large companies are investing to modernize their facilities in order to improve their environmental performance, many SMEs cannot afford to invest in environmental technology because of the cost of financing versus their current level of production or their economic situation. Technical assistance has also become too expensive for these small companies, which thus fail to comply with the regulations. There are not enough financial aid packages and fiscal incentives available to promote pollution prevention with SMEs.

The internationalization of capital markets and investment flows increases business sensitivity to differences in environmental policies. While there are limits to short-term business mobility, many companies outside Mexico do in fact threaten to take their production into Mexico if they are faced with environmental compliance costs significantly greater than those faced by their competition in other Latin American or Asian countries. In this case a nation is relying on another's apparent ecological surplus. The problem with this, however, is the general perception, or misperception, that many of the undeveloped countries can exceed their carrying capacities and grow economically at the same time, by building factories to expand their production of manufactured and industrial goods at the expense of their "natural resource capital". These countries obviously cannot continue to do this indefinitely, and some may even be limited at the outset by inherent environmental factors; for example, water or energy may already be a limited or overexploited resource.

Most governmental agencies (GA) that deal with different environmental areas were recently integrated (in December 1994) into the Secretariat of Environment, Natural Resources and Fisheries.[89] These include:

- the Instituto Nacional de Ecología *(INE),* National Institute of Ecology;
- the *Comisión Nacional del Agua (CNA),* National Water Commission;
- the *Secretaría de Pesca,* Fisheries Secretariat, which now becomes an undersecretariat;
- the *Instituto Nacional de Pesca,* Fisheries Institute;
- the *Instituto Nacional Forestal,* National Forestry Institute;

[87] An example of an NGO that has a pollution prevention program is *"Fomento a la Cultura Ecológica" (FOMCEC),* which has developed a set of training materials for SMEs and schools.

[88] Chapter II, *"Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA)"* published in the *Diario Oficial de la Federación* on 28 January 1988.

[89] *Diario Oficial de la Federación,* 28 December 1994.

- the *Comisión Nacional para la Biodiversidad (CONABIO)*, National Commission on Biodiversity; and
- the *Procuraduría Federal de Protección Ambiental (Profepa)*, Environmental Enforcement Agency.

Most activities related to natural resources are now integrated into the new *Subsecretaría de Recursos Naturales*, Natural Resources Undersecretariat. The new undersecretariat also has two administrative arms, an Undersecretariat for Planning and Budgeting, and an arm to coordinate the state delegations.

Most of these government agencies have pollution-prevention programs, or promote them to some extent. However, the general perception in industry and among many environmental consultants seems to be that the GAs have not yet taken an active enough role in promoting them. The main priority of most GAs tends to be achieving compliance with existing regulations through pollution control strategies rather than through pollution-prevention programs.

Perhaps one of the more notable efforts to promote pollution prevention comes from the *Comisión Nacional de Ahorro de Energía (CONAE)*, National Commission to Save Energy, created in 1990. The main objectives of *CONAE* are to promote the efficient and rational use of energy among the energy users in Mexico and reduce energy consumption per unit of production. *CONAE* is funded by the Mexican government, but also receives funds from international organizations.

The former *Secretaría de Desarrollo Social (SEDESOL)*, Secretariat of Social Development, with the support of the World Bank, established a program called *Programa Ambiental de México (PAM)*, Mexico's Environmental Program.[90] The main purpose of the program is to strengthen, modernize, and decentralize the environmental management capacity of federal, state, and municipal governments. *PAM's* budget for 1991-1995 was in the order of US $88 million. The main components of the program were focused on the monitoring and controlling of industrial and municipal activities, the strengthening of management capacity, and the development of programs to protect natural resources and biodiversity. The program, however, did not have a pollution-prevention element.

According to a telephone survey involving interviews with more than 40 persons from different organizations, including companies, industrial associations, government agencies, and environmental consultants in 14 cities scattered over 11 different states, between 10 and 25 percent of all companies have established pollution-prevention programs.[91] However, the interviewers also mentioned that these companies do not very clearly differentiate between "pollution prevention" and the term "pollution control".

Most of the companies that have established pollution-prevention programs are big companies, mainly subsidiaries of international corporations, and have based their programs on the principles and administrative practices of their corporations.

SMEs have hardly begun to establish pollution-prevention programs and are in general more concerned with pollution control and the compliance with environmental regulations than with pollution prevention. SMEs in general seem to perceive that pollution prevention is costly.

The telephone interviews showed a clear need to develop ways of promoting and disseminating pollution-prevention concepts.

A survey was carried out on "pollution-prevention" newspaper articles in Mexico, which covered 14 of the most important national newspapers in the country and two from the United States.[92] Before 1988 there were practically no pollution-prevention features. Between 1988 and 1992 only sporadic articles on pollution prevention were found, mainly mentioning training needs in this area. In fact, during 1992, several articles mentioned the importance of training government environmental officials in pollution prevention. That same year, newspapers also featured the role of industrial and professional associations and NGOs in the diffusion of pollution-prevention concepts.

However, during 1993, the focus of the newspapers shifted from awareness to such areas as enforcing environmental standards and regulations, and to compliance, sanctions, and temporary and permanent closings of industries. Mexico was visualized, mainly in the US, as a country with a low degree of compliance where pollution

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[90] *SEDESOL* no longer handles environmental areas. These are now the concern of the *Secretaría del Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP)*, Secretariat of Environment, Natural Resources, and Fisheries.

[91] See the list of persons interviewed by telephone in the appendix to this document.

[92] *El Norte, Excelsior, La Jornada, El Financiero, El Universal, El Economista, Reforma, El Porvenir, El Sol de México, El Día, Novedades de México, América Economía, Siglo XXI, Expansión*, but also in *The Financial Times*, and *The Wall Street Journal*

prevention was practically non-existent. NGOs were perceived as denouncing and pressuring industry and environmental authorities. Several NGOs also took a radical position against the NAFTA.[93]
During 1994, press coverage focused on the participation of industrial associations. They exhorted their member companies not only to comply with the standards and regulations, but also to support the solution of environmental problems and aid in the transfer and adaptation of technology. *Nafin's* environmental financial programs for SMEs were mentioned in several occasions.
In 1995, newspaper attention to general environmental issues decreased considerably. Features concentrated mainly on enforcement, compliance, and sanctions, and practically never on preventing pollution.

Summary

Environmental activities in Mexico have seen continuous evolution during the last 30 years. However, most of the efforts have been in environmental regulations oriented towards control and command mechanisms. The pollution-prevention approach to solve environmental problems began to gain acceptance during the last decade.
In fact, "pollution prevention" as a concept has evolved from an anthropocentric interpretation of the environment, to priorities emphasizing environmental remediation in the 1970s, towards a more systemic interpretation of the environment, giving priority to prevention and control measures in the 1980s. Finally, during the last few years, it has gone from command and control mechanisms to a strategy based on economic instruments.
That said, little support yet exists in Mexico to promote pollution prevention within industry. In general, only a few organizations promote this concept and most of their initiatives are still developing. Institutions supporting pollution prevention in Mexico include the following: industrial and trade associations; universities; federal, state, and municipal agencies; professional associations; non-governmental organizations; and certain individuals who are often an institution in their own right.
Until recently, there has been relatively little experience in Mexico in applying economic instruments to the prevention of pollution. Historically, Mexico has tended to focus on legal liability for deterring potential polluters, as well as on direct regulation. More recently it has focused on subsidies such as accelerated depreciation, tax credits, and other fiscal benefits. Little has been done, on the other hand, to put in place instruments for environmental protection such as emission allowances and tradeable permits.
An important element in the evolution of Mexican environmental strategy has been the increase in the priority given to prevention activities over control or remediation methods. Indeed, the conflicting requirements of pollution control, remediation, and emergency response not only compete with the requirements for pollution prevention in the process of establishing priorities and budgets, but have influenced regulatory programs in Mexico. Environmental matters must also compete for public attention and priority with other social, political, and economic concerns. This situation is perhaps more evident and critical in Mexico than in Canada or the US.
The experiences of the individual states and municipalities in integrating pollution prevention into environmental policy varies widely. In Mexico, the trend is towards giving state and local governments greater responsibility in regard to environmental policy-making and enforcement. Currently, the 31 states have environmental legislation and statutes and most state and municipal governments promote pollution-prevention programs to some extent, but the bulk of policy-making is still carried out at the federal level. However, the general perception in industry seems to be that governmental agencies have not yet taken a very active role in this field.
While many companies in the NAFTA region have adopted pollution-prevention programs, much still needs to be done. Most of the companies that have established pollution-prevention programs in Mexico are big companies, mainly subsidiaries of international corporations, and have modeled their programs after those of their parent corporations. Even as these large companies are investing to modernize their facilities to improve their environmental performance, many SMEs have hardly begun to establish pollution-prevention programs, being in general more concerned with pollution control and compliance with environmental regulations than with prevention. In general, SMEs seem to believe that pollution prevention is costly. Although there is a growing awareness within industry in Mexico about the importance of pollution prevention, its economic benefits are still not well understood.

[93] "*Movimiento Ecologista Mexicano, Sociedad Ecologista de México*", "*Unión de Grupos Ambientalistas*", and "*Partido Verde*".

Mexico does not yet have toxic release reporting requirements like those established in the US (Toxic Release Inventory) and in Canada (National Pollutant Release Inventory). However, Mexico is in the process of reviewing most of the existing reporting systems in the world in order to develop its own.

In Mexico there is a clear need to develop mechanisms to promote and disseminate pollution-prevention concepts as well as to design more attractive financial packages for encouraging technical assistance and training programs, equipment acquisition, and process improvement in general.

The three participant countries in the NAFTA differ greatly in the size and composition of their overall economies and of course not all economic sectors or all regions of the three countries will prosper equally or simultaneously. A similar situation occurs in environmental protection.[94] The three countries need to work together at pollution prevention to ensure the protection of the environment and of all life-forms dependent upon it. For this reason, the NAFTA parallel agreement presents great challenges that organizations from the three nations need to discuss. They should propose innovative ways of collaborating in order to address comprehensively the environmental priorities of the NAFTA, and study ways of sharing costs equitably. Particularly since the NAFTA agreements were signed, Mexico has undergone a severe economic crisis that may compromise all of its programs, including the environmental investments, unless ways are found to ameliorate the near-term situation.[95]

[94] See for reference A. Bustani and P. Mackay, "NAFTA: Reflections on environmental issues during the first year", to be published during the fall of 1995 in the *Arizona Journal of International and Comparative Law*, Vol. 12, No. 2, 1995.

[95] The gravity of the current crisis is indicated in the tabulation of economic indicators published every week by *The Economist*, for example, see the issue of 11-17 November 1995, pp. 106-108.

V. Pollution Prevention in the United States

Introduction — The Context for Pollution Prevention in the United States

Over the last several decades, the United States has made substantial investments in programs and policies pertaining to environmental protection. The foundation for US environmental protection efforts consists of several pieces of major environmental legislation, such as the Clean Air Act, Clean Water Act, and Resource Conservation and Recovery Act. The US Environmental Protection Agency (EPA) is the administrative agency responsible for the implementation of these laws. State and local regulatory agencies are also granted authority for enforcing the laws. As a result, the US features a complex network of state and federal programs based on an extensive system of environmental standards, permitting, and enforcement procedures.

Over time, significant environmental progress and marked improvements have been achieved on many environmental issues of concern:

- Over the last 25 years, US air-quality programs have focused on the emission of six pollutants, referred to as criteria pollutants: sulphur dioxide, nitrogen oxides, ozone, carbon monoxide, particulate matter, and lead. Emissions of all criteria pollutants, except nitrogen oxides, have decreased. For example, emissions of sulphur dioxide in the US decreased from 28.4 billion metric tonnes in 1970 to 21.1 billion metric tonnes in 1985,[96] and emissions of volatile organic compounds (VOCs), which impact air quality because of potential toxic effects and ozone formation problems, decreased from about 27 million tonnes in 1970 to approximately 20 million tonnes in 1986.[97]
- For surface waters, most pollution controls have been aimed at limiting common pollutants from municipal and industrial sources, such as suspended solids, oil, and grease. Major improvements have been achieved. Between 1972 and 1988, people served by sewage treatment plants with secondary treatment or better increased from 85 million to 144 million. And, from 1972 to 1982, municipal loads of biochemical oxygen-demanding substances decreased by 46 percent, while industrial loads decreased by 71 percent. The United States has also achieved virtual elimination of pathogenic contamination of drinking water supplies.[98]
- The US has invested aggressively in stricter regulation and control of these materials. Over the last two decades strict standards have been set for the construction and operation of hazardous waste landfills. Regulations prohibiting land disposal of certain types of hazardous wastes have been promulgated. As of 1992, state and federal hazardous waste programs regulated the generation of hazardous waste of more than 15,400 large quantity generators and more than 210,000 small quantity generators that generated more than 240 million tonnes of hazardous waste.[99]
- However, in the last 25 years, the United States has also gained a far better understanding of the nature and scope of its environmental problems. Advances in the nascent sciences such as toxicology and atmospheric chemistry have provided insights into relationships never before understood. New issues continue to arise while difficulties in implementing and enforcing environmental policies keep old issues on the national agenda. Current attention is being focused on a wide variety of topics.
- Health risks from high ozone levels in heavily populated areas and damage to crops are continuing problems. Toxic air pollutants, not originally regulated by the Clean Air Act, pose environmental and human health concerns. Nearly 200 toxic chemicals are regulated by the 1990 Clear Air Act Amendments, the implementation of which is posing many problems for state agencies that are administering these programs at the state level. Indoor air quality, atmospheric deposition of persistent toxic chemicals into surface waters, and emissions of greenhouse gases are other issues of US concern.

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[96] Organization for Economic Cooperation and Development, *Environmental Indicators*, OECD Publications, 1991.

[97] Council on Environmental Quality, *Environmental Trends*, 1989.

[98] Council on Environmental Quality, *United States of America National Report: UNCED*, 1992.

[99] Ibid.

- Although adequate wastewater treatment is now the norm in this country, one-third of the nation's assessed river kilometres fail to meet state water quality standards.[100] The greatest challenge now for water quality improvement is the deposition of sediment, nutrients, and toxic chemicals from urban and agricultural runoff, commonly referred to as non-point source pollution. In fact, this problem of how to deal with a large amount of pollutants from ubiquitous small sources is a major barrier to improvement in each of the environmental media.
- As the regulation of hazardous waste and toxic substances has grown, the generation of these wastes and the production of toxic chemicals has also continued to grow. Many industrial chemicals commonly used in the US entered the market before environmental protection laws came into effect and many others have never been tested. While better management of these substances has greatly reduced some of the acute exposure problems faced by workers and communities, the current regulatory approach has also shown its limited ability to reduce the overall use and generation of these substances and their attendant risks to environmental and human health. Frequently, these substances are merely transferred from one environmental medium to another, e.g., from air to water or from water to land, or one community to another, rather than actually being reduced or eliminated.

As the amount of environmental improvement gained per dollar expended decreases, tensions have increased between economic and environmental interest groups. Like other countries, the United States is faced with the challenge of allocating limited resources toward an increasing litany of environmental issues in a way that best serves the goal of environmental protection.

1. The Future of US Environmental Protection Efforts

Several efforts have been made to prioritize the most pressing environmental problems and identify the strategies needed to overcome them. One of the more notable attempts to rank environmental problems was conducted by the EPA's Science Advisory Board (SAB) in 1992. In its 1992 report, *"Reducing Risk: Setting Priorities and Strategies for Environmental Protection"*, the SAB attempted to rank the varying risks that environmental problems pose to environmental and human health. Environmental health risks were ranked high, medium, and low as follows:

Relatively High-Risk Problems

- habitat alteration and destruction;
- species extinction and overall loss of biological diversity;
- stratospheric ozone depletion; and
- global climate change.

Relatively Medium-Risk Problems

- herbicides/pesticides;
- toxics, nutrients, biochemical oxygen demand, and surface water turbidity;
- acid deposition; and
- airborne toxics.

Relatively Low-Risk Problems

- oil spills;
- groundwater pollution;
- radio-nuclides;
- acid runoff to surface waters; and
- thermal pollution.

Environmental problems that represent major types of human exposure known to be associated with significant human health impacts were identified as:

- ambient air pollutants;
- worker exposure to chemicals in industry and agriculture;
- indoor air pollution; and
- pollutants in drinking water.

[100] Ibid.

The strategies offered in several studies for addressing these issues are remarkably consistent and provide an insight into US environmental protection strategy and philosophy in the coming decades[101]:

a) **Move towards a composite approach to environmental management** In recent years, it has become apparent that attempting to control pollutants on the basis of individual environmental media is insufficient and is counter to ecological reality.
b) **Shift attention to the large number of small pollution sources** Ubiquitous small sources of pollution are difficult to address with the current permitting system that was designed for large pollution sources. However, some of the greatest remaining potential for environmental improvement lies precisely with these small sources, especially as the current permitting approach is rapidly reaching the point of diminishing returns with the large sources.
c) **Invest in risk-based planning and management** Setting priorities based on the environmental and human health risks associated with various problems has gained substantial support. However, inherent problems associated with this approach, e.g., lack of data, problems of data quality and consistency, and the limits of scientific specialties on which it depends, must be addressed.
d) **Explore market-oriented approaches** Market incentives are gaining support in order to supplement traditional regulatory approaches with tools that yield environmental protection at lower costs. Tradeable emissions, tax credits, and government-subsidized loans are a few of the tools being considered.
e) **Integrate environmental considerations into all aspects of the economy, policy, and society** Experience has shown that attempting to protect the environment in a disjointed, piecemeal fashion is a disingenuous effort since all sectors of society are interconnected and impact one another. There is a growing realization in the United States that the economy and environment are inextricably intertwined and that policy and budget decisions across all policy arenas can impact environmental quality, e.g., through the implementation of tax, energy, agricultural, and international policy.

2. The Role of Pollution Prevention

There is a natural fit between this next generation of US environmental-protection strategies and pollution prevention. Pollution prevention is implicitly a composite, multimedia subject with a prevention approach, risks are not shifted from one medium to another. It is one of the more practical ways to address large numbers of small pollution sources. It is the most effective risk reduction strategy since prevention reduces or eliminates the risk exposure. It can have a strong market-oriented theme by providing firms the opportunity and flexibility to reduce costs in meeting environmental requirements. And, to do prevention well, demands taking into consideration environmental effects in all aspects of business decision-making. As a result, in a relatively short time, pollution prevention has matured from an operational concept employed by a few manufacturers to a philosophical foundation of US environmental-protection policy.

US Legislative and Policy Framework for Pollution Prevention

The decades of the 60s, 70s, and 80s witnessed an explosive growth in environmental regulation in the United States — much of it technology-forcing and based on treatment and control approaches. During the last two decades, pollution prevention began to gain national recognition and acceptance through the efforts of companies and their pollution-prevention programs. State efforts began shortly thereafter under titles like “waste minimization” and “waste reduction”. It was not until the passage of the US Pollution Prevention Act of 1990 that a formal effort was made to build the concept of prevention into US environmental-protection strategy as a national priority.

The 1990 Act was significant in two primary ways. First, it established a national waste management hierarchy in which prevention at the source is identified as the nation’s preferred environmental-management strategy. Second, the Act also established a national infrastructure to promote pollution prevention in businesses. This infrastructure includes an independent office at EPA headquarters for pollution prevention, a national grant program for state efforts in pollution prevention, and a national pollution-prevention information clearinghouse. However, with regards to the functioning of the regulatory system, the Act accomplished little beyond making pollution prevention a statement of national priority and intent.

[101] See *The State of the Environment*, OECD Publications, 1991, and Council on Environmental Quality, *United States of America National Report: UNCED*, 1992.

Specific regulations and environmental protection requirements have been the primary motivation for pollution-prevention implementation. While these laws may not specifically encourage pollution prevention (and in fact may discourage it by favoring pollution control), they may cause companies to re-examine operations and identify ways to reduce releases more efficiently and cost effectively.

Three specific policy initiatives have been especially potent drivers for pollution-prevention implementation. Toxic release reporting requirements established in 1986 marked a major milestone. For the first time, data on actual emissions and releases were readily available for public examination. With large release volumes on paper and under public scrutiny, companies found that simply being in compliance was no longer sufficient. Materials "sunsetting" efforts, such as the Montreal Protocol for ozone-depleting substances, have forced product substitutions and process changes in a wide variety of service and manufacturing industries. Finally, the Clean Air Act Amendments of 1990 overhauled the US air toxics system and caused large numbers of facilities, and even entire industries, to be captured for the first time under national air protection laws. While these amendments did not directly advance pollution prevention, the tighter emission standards and permitting requirements forced companies to re-examine and re-evaluate their processes leading to a large amount of pollution-prevention action.

To increase the frequency of using pollution-prevention strategies to meet environmental protection requirements, many efforts are now underway to build pollution prevention into US environmental-protection policy. These efforts can be grouped into three primary strategies— pollution integration into existing media protection programs, pollution-prevention planning mandates (laws), and voluntary initiatives.

1. Pollution Prevention Integration into Media Protection Programs

The United States has an immense body of legislation and regulation pertaining to the protection of its air, water, and land resources. The relatively recent advent of pollution prevention presents a complex and difficult ta~~sk~~ integrating a new paradigm into an established regulatory framework. The historical approach has created *de facto* bias toward pollution control, and regulatory programs have struggled with the challenge of fitting the values and approaches of prevention within a system entrenched in the logic of control. Examples of the types of barriers and sources of conflict include the following:

- Regulatory functions are highly divided across media lines, but pollution prevention requires a cross media perspective.
- Regulatory enforcement is based on a consistency in compliance, yet prevention-based approaches require higher levels of flexibility and time to put pollution-prevention strategies in place.
- By shifting the focus from end-of-pipe controls to the industrial process itself, the roles and goals of agency interactions with facilities are transformed and may not be accepted by industry.
- Pollution prevention may require a number of infrastructure changes, such as realignment of jurisdictional authorities, reallocation of funding, and changing the behavior and knowledge base of agency personnel.

The degree of change required and lack of fit has often resulted in confusion, resistance, and occasional hostility within agencies toward prevention-based regulatory approaches.

Seeking ways to make pollution prevention a result of the existing regulatory process is currently receiving strong emphasis at the federal and state levels. There is growing evidence in many states that results can occur through the existing policy framework, but few efforts have been made to investigate how the system can yield pollution-prevention results more optimally. Such a strategy has its own requirement~~s~~ – most notably financial support and a reporting system at the federal level that accommodates greater flexibility and a sense of entrepreneurship and creativity within state agencies.

The role of the EPA has been to provide the necessary conditions and support for states to adopt pollution prevention-based regulatory approaches to meet the requirements of national environmental laws. Several programs are currently being sponsored by the US EPA under the theme of "pollution-prevention enhancement" of existing media programs:[102]

- The Source Reduction Review Project is a pilot effort to advance the consideration of pollution-prevention strategies in the rule-making process for 17 target industries.
- The Industry Sector Initiative is a sector-based program designed to streamline and coordinate regulatory development across all media. Pollution-prevention considerations and strategies are currently being introduced into this new environmental protection approach.

[102]Program materials from the U.S. EPA Office of Pollution Prevention.

- The Pollution Prevention Integration Initiative serves as internal support for the EPA to assist various offices in efforts to incorporate pollution-prevention thinking into their respective areas of responsibility.
- The "Guidance and Grants Project" of the Pollution Prevention in Media Program promotes pollution prevention in state inspection and compliance programs and attempts to integrate it into the federal grants process as well.
- EPA regional offices are involved in building pollution prevention into regional operating programs and fund technical assistance/training efforts that target state and local regulatory agencies.

Several other initiatives provide support and resources for more long-range pollution prevention-based regulatory changes. Future plans include a revamping of Federal grants in the form of "performance partnerships". This would allow states to combine multiple grants into one block of federal money to address environmental problems. Such an approach— implicitly multi-media by its nature— would greatly favor results from pollution-prevention strategies.

Under the US concept of "federal standards, state implementation", much of the implementation and enforcement authority of US environmental law is delegated to the states. States, in turn, may subsequently delegate to local or regional government authorities to encourage greater responsiveness to the unique needs of particular areas, such as large urban centres. The experiences of individual states and these regional authorities when integrating pollution prevention into regulatory activities varies widely. Some states have undertaken ambitious efforts while others have done very little. Pilot efforts in permitting, inspection, and enforcement activities which incorporate pollution-prevention strategies exist around the country. Many states have established pollution-prevention programs with their regulatory agencies serving as information sources and providers of guidance for regulatory integration. These state programs expand efforts to integrate pollution prevention by working with authorities of local governments, such as cities, counties, regional air districts, fire inspectors, emergency response commissions, and publicly-owned treatment works.

Sharing innovative regulatory integration approaches has become a priority issue. To facilitate this type of communication and networking, the EPA helped establish the National Pollution Prevention Roundtable the largest organization in the United States dedicated solely to pollution prevention. Voting membership of the Roundtable is drawn from state and local governmental pollution-prevention programs from around the country, while affiliate members come from federal agencies, non-profit groups and the private sector. Although the Roundtable also concerns itself with many other pollution-prevention topics, regulatory integration is a primary area of interest.

Lack of incentives at the state and local level to reward the extra time and effort needed to integrate pollution prevention fully remains a significant problem. For state agencies and local authorities as well as for the EPA, which oversees state enforcement of environmental laws the old approaches are easier, simpler, and entail less organizational risk. While interest and investment in pilot initiatives continue to grow, integrating pollution prevention into the US environmental policy will undoubtedly be a slow evolutionary process.

2. Pollution Prevention Planning Laws

In addition to building a prevention component into specific environmental media protection programs, another policy strategy employed in the United States involves facility planning requirements. Although their contents differ from state to state, these laws generally require facilities to prepare and submit plans highlighting facility pollution-prevention objectives and strategies. Actual performance under these plans is not enforceable, but the laws typically require companies to establish pollution-prevention goals and re-examine their manufacturing operations.

Planning mandates have become a popular pollution-prevention policy tool and are now found in over two dozen states. Most states with planning requirements focus on hazardous wastes as defined under the US Resource Conservation and Recovery Act (RCRA). Other states have extended planning requirements to include releases of chemicals listed under Title III of the Emergency Planning and Community Right to Know Act. By extending the reach of the planning requirements beyond RCRA generators to include toxic release inventory reports, states are bringing more facilities and typically larger emitters of waste into pollution-prevention planning.

3. Voluntary Initiatives

A third policy approach being employed in the United States is the voluntary program. Perhaps the most famous effort is the EPA "33/50" program in which companies agreed to voluntarily reduce the emissions of 17 target

chemicals by 33 percent by 1992 and 50 percent by the end of 1995. Individual states have also used the voluntary approach to target specific materials and issues of concern.
A new dimension in voluntary programs with pollution-prevention implications is the emergence of the set of ISO 14000 standards. While they are not a policy initiative, state and federal agencies are showing interest in supporting the publication and adoption of these standards by industry to further pollution-prevention objectives. Many agencies are currently examining the potential for creating an incentive regulatory package which would attract more companies to adopt standards with embedded pollution-prevention requirements.

Institutional Support and Promotion Mechanisms

Concurrent with efforts in the policy area, a significant support network has been built in the United States to promote pollution prevention within business and manufacturing. In addition to organizations which are oriented specifically around pollution prevention, the US features a wide diversity of other organizations and outreach efforts with direct or indirect implications for pollution prevention. Outreach campaigns and programs have been designed from almost every imaginable angle, strongly emphasizing awareness building and information transfer, and have evolved to address multiple sectors concurrently.

1. Overview of US Organizations Involved in Pollution Prevention

The 1994 US Pollution Prevention "Yellow Pages", published by the National Pollution Prevention Roundtable, identified 162 pollution-prevention programs in the United States and its territories with a total budget of $74 million. However, the programs identified in this resource document are only a small portion of the US pollution-prevention infrastructure. Furthermore, the figures actually represent only a fraction of the total number of organizations involved in promoting pollution prevention in some way and the total dollar investments being made nationally in pollution-prevention outreach, education, and assistance.
Following are descriptions of a few of the more notable categories of organizations involved in pollution-prevention activities.

State and Local Technical Assistance Programs

Currently, there are an estimated 52 state- and locally-sponsored pollution-prevention technical assistance organizations in the United States, providing a variety of services to business, including pollution-prevention assessments, technical-information transfer, and technical advice. Many of these programs are organized outside state agencies in order to separate the assistance and outreach effort from state regulatory and enforcement efforts. Program evaluations suggest that successful technical-assistance programs share several characteristics – most notably staff retention and strong industrial competence– both of which helps overcome credibility and trust issues with industry. Technical assistance programs are also becoming more creative in building cooperative efforts with such organizations as suppliers and trade associations which provide trusted sources of information for manufacturers. Concerns, however, have been expressed about the focus of these programs. A 1994 US General Accounting Office study found that many of these programs were heavily involved with recycling, treatment, and disposal activities rather than with pollution prevention.

Industrial Extension Programs

A new and potentially powerful ally in pollution prevention is the growing industrial extension network being coordinated through the US National Institute of Standards and Technology (NIST) under the US Department of Commerce. The 58 technology and outreach centres around the country and their affiliated regional offices together comprise the NIST Manufacturing Extension Partnership. These organizations provide a wide range of assistance and modernization services to small manufacturing enterprises. A new multi-million dollar environmental initiative has recently been launched with a strong pollution-prevention focus. The program includes tool development and training activities for extension professionals across the nation, and efforts to build pollution prevention into existing modernization services already sought by manufacturers.

Foundations/Non-Profit Organizations

Pollution prevention is a program emphasis for many non-profit organizations in the United States and has become a program focus for a small group of private foundations. NGO program involvement in pollution prevention is extremely diverse and includes policy advocacy, policy analysis, technical research and development, education and training, grassroots organizing, and information dissemination. Non-profit organization involvement in pollution prevention ranges from the efforts of national environmental advocacy organizations targeting multiple

industry sectors, to regional and local initiatives targeting a specific community, watershed, or even an individual business.

The support structure also includes a handful of private and public foundations which have been active contributors to pollution prevention-related activities around the country. Some foundations, such as the Great Lakes Protection Fund, the Joyce Foundation, and the C.S. Mott Foundation, have established pollution-prevention grant-making programs. Others emphasize pollution prevention as a critical component or theme in their environmental grant-making strategies.

Universities and Academia

Universities are the institutional home for a wide variety of technical assistance and technical research programs pertaining to pollution prevention. Curriculum development programs for professional schools of business and engineering emphasizing pollution prevention have emerged around the country. A National Pollution Prevention Research Center has been established at the University of Michigan, emphasizing training and curriculum development. Universities are also the home of an emerging area of pollution-prevention research that pertains to the relationship between managerial systems, organizational change, and pollution-prevention practice. This "non-technological" dimension to pollution-prevention implementation has long been recognized but underserved in outreach programs. Now, however, interest in this aspect of pollution prevention and the number of research efforts exploring it continue to grow.

Trade Associations

Many industrial trade associations in the United States have demonstrated an interest and involvement in pollution-prevention issues. Metal finishing, printing, electronics, automotive, petroleum, aerospace, and chemical manufacturing trade associations are some of the more notable US examples of active involvement in pollution-prevention promotion and information transfer. As credible sources of information for their members, they have proven to be valuable program allies.

In other such associations, however, pollution prevention has not received much attention. Often pollution prevention is subordinated to issues of advocacy as the primary means to protect the interests of member companies pertaining to the environment.

Other Organizations

Pollution prevention has penetrated into the programs and outreach efforts of a number of other types of organizations. Small business assistance programs created under the Clean Air Act Amendments provide regulatory compliance advice for small business– with a pollution-prevention emphasis. Other federal agencies such as the Department of Energy and the Department of Defense sponsor major technology research, development, and dissemination programs with a strong emphasis on pollution-prevention, demonstration, and transfer. Research collaborations, such as the National Center for Manufacturing Sciences, offer groups of companies the opportunity to combine resources and solve shared environmental problems through pollution prevention. Some small business development centres sponsored under the Department of Commerce have made pollution-prevention assistance one of their service offerings. State and local departments of health, fire departments, and agricultural extension programs have also become brokers of pollution-prevention information and support.

Environmental management consultants have made tentative steps into pollution prevention and have had mixed success in marketing pollution prevention to clients. Part of the challenge is internal. In many cases, the skill base of environmental consultants centres on engineering services pertaining to control, treatment, and remediation. The shift to prevention-based services demands new expertise. Firms which have made this investment and have attempted to market prevention in the United States have had mixed results. Consultant firms report that clients are primarily interested in purchasing regulatory solutions and answers. If a prevention-based approach can be used to solve an environmental problem, it may be adopted, but marketing pollution prevention independently has proven to be a challenging task.

Finally, it is also worthwhile to note the myriad of organizations in the United States which would not be categorized as pollution-prevention providers, but have made ongoing efforts with implications for pollution prevention. Examples of these would include professional interest groups in such areas as quality management, such as the Association for Manufacturing Excellence, or professional associations such as the Society of Manufacturing Engineers. Some of these organizations simply promote manufacturing improvement methods which have pollution-prevention "fallout". Others have launched interest groups and seminars specifically focusing on improving the environmental performance of manufacturing operations. Again, while the specific words

"pollution prevention" may not be used, the concepts and ideas being promoted are very relevant to pollution-prevention principles and practices.

2. Types of Outreach Efforts

Categorizing the types of pollution prevention outreach activities in the United States is an equally challenging effort. In a recent study conducted for the Great Lakes Protection Fund (GLPF) on the status of pollution prevention in the Great Lakes basin, a program inventory was conducted in which similar types of pollution-prevention initiatives and program models were grouped together, suggesting trends in the types of activities being pursued.[103] The result was a classification of pollution-prevention outreach activities into three categories:

- **Mature initiatives**— pollution-prevention outreach efforts with an extensive history and track record;
- **Growing initiatives**— a second wave of programs building on the experiences gained through mature initiatives; and
- **Emerging initiatives**— a third wave featuring a new conceptual approach to pollution-prevention "marketing".

1. Mature Initiatives

Mature initiatives are those types of outreach efforts that have served as the principal strategies among organizations with a vested interest in pollution-prevention awareness building and promotion. They are:

- technical assistance/pollution-prevention assessments;
- information transfer— conferences, resource documents, training, guidance manuals, etc.; and
- compliance assistance with pollution prevention (P2) emphasis.

These initiatives can be considered the backbone of pollution-prevention outreach efforts in the United States they have the longest demonstrated history and continue to be the mainstay for many pollution-prevention organizations. State and local technical assistance programs and small business assistance programs are now well established throughout the US The number of pollution-prevention conferences, training programs, and symposia is extensive, and there is no dearth of available resources on pollution-prevention techniques and technologies pertaining to specific industries or for processes such as cleaning which are shared by industries.

Current information-related investments are attempting to link together disparate sources of information and regional information clearinghouses into a more coordinated pollution-prevention information network. Currently, the United States features a number of regional and national information databases, on-line libraries, and electronic communication services oriented around pollution-prevention research, techniques, technologies and vendor listings. In addition to coordinating the current information services, these data-sharing and distribution efforts are now being expanded to include other nations as well.[104]

The amount of investments made in documenting pollution-prevention techniques and technologies and in providing assistance services are such that any manufacturer in the United States wanting pollution-prevention information or assistance should be able to find it.

2. Growing Initiatives

Growing initiatives in the United States include a variety of pollution-prevention campaigns which are not directly oriented around the theme of technical assistance or information transfer. These initiatives generally are broader in scope, attempt to link and coordinate the interests of many organizations together (often through a voluntary and consensus-building process), and have a stronger strategic element embedded in them. The inventory yielded the following types and examples of "growing" initiatives:

- *Geographically-based P2 projects*— A number of efforts are underway in the United States to orient pollution-prevention strategies around specific geographical areas or political boundaries (e.g., watershed protection strategies, Lake Superior Project regional/county cooperatives and networks, Great Lakes Remedial Action Plans).

[103] *Pollution Prevention in the Great Lakes Basin: Current Status and Future Trends*, GLPF, 1995.

[104] "The North American Pollution Prevention Information Network". Paper presented at European Clean Technologies Conference, Rotterdam, Netherlands, Liebl, 1995.

- *Materials-based P2 projects*— Many pollution-prevention programs are being built around specific materials of concern on both the output side (e.g., mercury in Lake Superior, Great Lakes persistent toxics) and the input side (research on biochemical substitution for petroleum feedstocks).
- *Management system-based P2 projects*— A number of pollution-prevention efforts are based on a growing recognition that the company management systems are as potentially influential on actual adoption as the availability of a technique or technology itself. Such programs include a large number of environmental cost-accounting projects designed to improve the quality and accuracy of the cost information used to evaluate pollution-prevention investment decisions. Another group of efforts is oriented around environmental management system development as a way of advancing the adoption of pollution-prevention approaches. Examples would include "Total Quality Environmental Management" protocol adoption and dissemination, ISO 14000 Environmental Management System demonstration projects, and environmental management system training programs.
- *Industry cluster-based P2 projects*— These initiatives attempt to link pollution prevention to broader manufacturing networks rather than to individual companies. Momentum and consensus for P2 is built into entire sectors through "pollution prevention-biased" regulatory reform, public/private partnerships, information sharing, and involvement of customers and suppliers. Several high-profile industry-based collaborations are underway in the United States, including the Great Printers Project , the Automotive Pollution Prevention Project, the Pulp and Paper Project, and other pilot efforts for industries targeted under the EPA Common Sense Initiative.
- *Citizen-based P2 projects*— Many initiatives are seeking to create public awareness, interest, and involvement resulting in grassroots pressure for adoption of pollution prevention. Investments are being made in improving public access to reported information on uses and releases, and on using this information in working with local facilities to promote pollution-prevention practices.

Not surprisingly, there is substantial overlap between these different types of initiatives. For example, the mercury reduction program for Lake Superior has strong citizen support, a cluster of industries behind it, and favorable geography as well.

3. Emerging Initiatives

If a frontier still exists for pollution prevention in the United States, it is in "emerging initiatives", many of which are still largely in the research and development stage. The Great Lakes inventory yielded the following "emerging" initiatives:

- *Manufacturing excellence-based pollution-prevention projects*– New projects are examining ways to integrate pollution-prevention strategy within mainstream manufacturing improvement concepts and service deliveries. Current programs include the efforts of the NIST Manufacturing Extension Partnership to integrate pollution prevention into existing modernization services provided to manufacturers, as well as some emerging programs which are attempting to direct industrial supply-chain relationships so as to provide pollution-prevention benefits for both the customer and the supplier.
- *Finance and lending-based pollution-prevention projects*– Several emerging initiatives around the country are attempting to incorporate pollution prevention into financing and lending protocols. Integration into risk financing via insurance policies is another area seen as holding potential for pollution-prevention adoption and is currently being explored in several pilot projects.

The shared theme of these initiatives is the attempt to incorporate pollution prevention into activities which already influence business decision-making. Rather than attempting to "sell" a concept like pollution prevention, these efforts attempt to make pollution prevention a part of what is already credible and needed by businesses. These initiatives place a premium on investing in "non-environmental" partners and programs to achieve P2 results.

Summary

The United States features a wealth of education, information, and assistance programs oriented around pollution prevention. Although the quality may vary, the infrastructure is such that nearly any business desiring pollution-prevention information or guidance should be able to find it with a minimal amount of effort. Most of this infrastructure involves P2 information transfer and promotion; investments are currently being made to network these resources into more powerful and productive ways.

A remaining challenge facing pollution-prevention support organizations is that US efforts have historically demonstrated minimal direction (such as one-on-one technical assistance) and primarily speak only to companies

that are predisposed to listen to a pollution-prevention message. Given the sheer number of businesses in the total population, program direction and the ability to reach out to companies not already convinced are becoming increasingly important themes in outreach efforts.

Status and Trends

1. US Progress in Pollution Prevention

Measuring pollution-prevention progress has become a significant issue in the United State~~s~~ both for environmental agencies and for groups involved in pollution-prevention education and information transfer. However, as many organizations have noted, documenting the current extent of source reduction by US industry is an exceptionally challenging task. Measuring actual implementation rates is fraught with the following complexities:

- the challenges of determining what percentage of reductions can be "credited" to pollution prevention, as opposed to other management and control options;
- the amount of reduction that occurs as a fallout of manufacturing, modernization, and improvement, but has not been labeled "pollution prevention"; and
- the difficulty of normalizing reduction measures to account for decreases or increases in production volumes and allow for some type of data aggregation.

In essence, measuring progress in pollution prevention is quantifying harm or pollution that does not happ~~en~~ a conceptually challenging task to accomplish.

A number of research studies, program evaluations, and discussion roundtables have been conducted on pollution-prevention progress, providing a useful base of information. When combined with the vast amount of anecdotal information from company experiences and from those who work with companies, it is possible to achieve a good understanding of the degree of penetration pollution prevention has made in US environmental managerial practice. Specifically, several conclusions about progress in the US can be made:

The concept of pollution prevention is fairly well recognized among US businesses although it is interpreted in many ways.

Several research studies suggest a high degree of name recognition within business for the concept of "pollution prevention". In a 1995 survey of 450 national corporations conducted by Carnegie Mellon University, 100 percent of the responding corporations indicated pollution prevention was an important element in their overall corporate environmental strategy and 72.8 percent of respondents believed that pollution prevention was "important or very important to corporate performance". Likewise, in a survey of small and medium-sized manufacturers by the state of Colorado, 78 percent of the respondents recognized the term "pollution prevention". A 1995 focus group of industrial extension experts from the eight Great Lakes states and the province of Ontario estimated that 80 percent of Great Lakes Basin manufacturers had heard of the concept.

The research also suggests, however, that it is interpreted in many ways. The Carnegie Mellon study noted that 50.6 percent of respondents identified "treatment" and 21 percent identified "pollution control" as a main element of pollution-prevention strategy. The Colorado survey noted that only 60 percent of those familiar with the concept defined it "accurately" (reduction at the source). But perhaps most telling is the on-going squabble of definition still plaguing pollution-prevention discussions in the United States. Many manufacturers are adamant about including recycling and finding productive uses for generated wastes into their working concept of pollution prevention. Pollution-prevention "purists" remain equally adamant about limiting the concept to reduction at the source. While the US EPA has a pure definition, they have demonstrated compromise in implementing programs such as the use of P2 funds for information and promotion of recycling activities. As a result, measuring pollution-prevention awareness and activity means measuring a constantly moving target.

Most pollution-prevention implementation and progress has occurred in areas featuring strong regulatory pressure.

It is evident that some of the greatest pollution-prevention activity has resulted from tough regulations such as pertain to phasing out certain materials and mandatory reductions in permissible releases and emissions. Solvents, subject to several bodies of regulations, such as hazardous air pollutants, ozone-depleting substances and/or smog precursors, have been the focus for a significant amount of pollution-prevention investigation. Not surprisingly, several industrial surveys and toxic release inventories show that these chemicals had priority for reductions and eliminations by manufacturers. The idea, reinforced by surveys, that regulations are a primary motivating force for

companies to investigate and implement pollution prevention,[105] also applies to product and technological innovation.[106]

While regulatory drivers encourage pollution prevention, the United States experience suggests these pressures far from guarantee pollution-prevention results. Toxics Release Inventory data from 1992 noted that only 25.3 percent of the reporting companies employed source reduction as the means to achieve their emissions reductions. In addition, to comply with regulatory requirements, many US companies have engaged in an environmental "shell game" by simply switching from a targeted material to another which still possessed substantial risks (e.g., halogenated solvents to flammable solvents) or by shifting the environmental burden from one medium to another.

Institutionalized pollution-prevention programs are well established among many companies but these progressive companies comprise a comparatively small subset of US business.

Pollution prevention is now an ongoing part of corporate practice and management philosophy for many US companies. A 1995 survey of *Pollution Prevention Review* readership found that 73 percent of respondents featured a formal pollution-prevention plan and 47 percent had specific quantitative pollution-prevention goals. Many companies have incorporated pollution-prevention analysis into their total quality management activities. Institutionalization of pollution-prevention planning and practice comes in many forms.

Facility planning laws have in essence helped institutionalize pollution prevention by requiring companies to establish pollution-prevention policies and programs. These mandates have captured the largest facilities, emitters, and waste generators. However, they also typically apply only to a minority of a state's industrial installations. Moreover, there is ongoing debate as to the quality and completeness of these self-directed efforts, and about the progress that results.

There is growing evidence, however, that high quality, self-directed pollution prevention is found mostly within a small subset of the total population of US companies. Recent research suggests that businesses that adopt pollution-prevention programs are more likely to be predisposed to innovation and risk taking or which feature visionary and committed management. This set of businesses may be only be 10 to 30 percent of the possible "market" for pollution prevention.[107] However, the United States may be rapidly reaching the point where those companies interested in voluntarily institutionalizing pollution prevention in their operating practices have now already done so, leaving a strategic void for dealing with the remaining population of businesses and manufacturers.

Institutionalized pollution-prevention programs have not yielded exhaustive returns.

The 1995 Great Lakes Protection Fund study reports that pollution-prevention experts have consistently found rich opportunities for further application even among companies featuring well-established pollution-prevention programs, Malcolm Baldridge awards, and ISO 9000 certification. The rationale suggested by assessment experts for this amount of ongoing opportunity was twofold: 1) pollution-prevention initiatives are project-based, problem solving efforts rather than being built into the logic of the manufacturing system; and 2) individuals directing manufacturing operations and business units remain too insulated from the opportunities and savings that prevention can provide because of the close association of pollution prevention with environmental management and thus with the leadership of environmental managers.[108] As a result, opportunities for pollution prevention can go unnoticed, lacking a cost, quality, or regulatory need which reveals them.

There is a notable gap between promotion of pollution prevention and actual implementation.

Evidence continues to mount in the United States that there is still ample opportunity for pollution-prevention progress:

- The Great Lakes Protection Fund study concluded that "no industrial sectors have achieved anything close to pollution-prevention saturation or have in any way exhausted the opportunities available". Industrial sectors which had been the target of past pollution-prevention campaigns still demonstrated large amounts of pollution-prevention potential.

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[105] *Pollution Prevention Review*, Spring 1995.

[106] Michael Porter, "Green and Competitive: Ending the Stalemate", *Harvard Business Review*, September 1995.

[107] Thomas Bierma, *Overcoming Barriers to Pollution Prevention in Small Business*, Illinois HWRIC Reports, May 1995.

[108] Questions about the discrepancy between opportunity for and the success of existing programs was asked of several leading pollution prevention consultants in conjunction with the development of GLPF report.

- A 1993 US Office of Technology Assessment Study found that "significant source reduction opportunities still appear to exist, particularly those arising from industrial process modifications and the adoption of new technologies".[109]
- A 1995 study of the Illinois metal parts fabrication industry determined that adoption of pollution prevention was occurring very slowly and that efforts had only "scratched the surface" as far as potential was concerned.

Technical assistance providers and pollution-prevention professionals from around the country are reaching a similar conclusion: pollution prevention is being adopted by the business community at a far slower rate than would be expected given its merits as sound manufacturing practice; its benefits in cost control and environmental protection; and the significant efforts of federal, state, and local P2 programs. The lack of implementation seems to be especially prevalent among small business enterprises. The US experience suggests that information, resources, and promotional activities are necessary, but not in themselves sufficient to produce implementation.

2. Obstacles in Moving the Concept Forward in the United States

Many organizations and pollution-prevention experts in the United States have examined the reasons for the discrepancy between promotion and implementation, and explored the types of programs needed to move the concept forward. Many of the barriers identified pertain to lack of information, lack of technology, and lack of money. These of course are ever-present hurdles in the response to any type of change in technology or operating practice. However, the US experience suggests pollution prevention embodies two unique obstacles which limit its implementation and help explain why information, financial resources, and promotion are not enough.

Perceptions of pollution prevention inhibit implementation.

A study on integrating pollution prevention into industrial extension services noted that pollution prevention is closely identified with environmental management. As a result, it is often difficult for firms to perceive pollution prevention as an opportunity for business improvement.[110] Another study has concluded changes are needed in the language of pollution prevention to avoid terms such as "pollution", "environment", and "waste".[111]

Pollution prevention marketing efforts have suffered from these perceptual problems. US pollution-prevention program campaigns have generally attempted to create a demand for something called "pollution prevention" as well as to satisfy it. Creating a demand for something that is linked so closely to the high cost and administrative burden of environmental compliance and that affects the most sacred of areas – the manufacturing process— has proven to be an exceptionally challenging task.

Pollution prevention has not been integrated into issues, relationships, and organizations that influence business decision-making and are already causing businesses to change.

As noted earlier, consultants, industrial extension experts, and pollution-prevention technical assistance providers all report that promoting pollution prevention as a practice generally works among a minority of businesses. The majority of companies will adopt such measures only as a fallout of more conventional business issues such as regulatory, customer, and competitive pressures.

The US is becoming far more creative and aggressive in shaping one of these forces – the regulatory system— to achieve pollution-prevention results. However, relationships related to customers, competition, and business, which strongly influence decision-making have received comparatively little attention. Pollution-prevention campaigns in the United States have focused largely on companies and whole industrial sectors rather than on the organizations, relationships, and issues that influence the decision-making process of these companies.

It has been noted that this lack of attention has created two problems. First, credible and influential opportunities for delivering pollution-prevention content and fostering implementation are lost. But perhaps more significantly, transformation of business and industrial relationships is happening in the United States at an accelerating pace. Failing to understand how pollution-prevention relates to these transformations and how it can be built into them may mean that it will be left behind while companies pursue "lean" manufacturing approaches, reduced cycle times, and other high-performance manufacturing ideas.[112]

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[109] *Industry, Technology, and the Environment*, U.S. Office of Technology Assessment, May 1993.

[110] *Merging Pollution Prevention with 21st Century Manufacturing Practices*, report to the Great Lakes Protection Fund, University of Minnesota Strategic Management Research Center, August 1994.

[111] Bierma, op. cit.

[112] Terrence Foecke, "Combining Industrial Transformation and Environmental Excellence", presentation to the Environmental Grantmakers Association, October 1995.

3. Lessons from the US Experience

Pollution prevention now has a rich history in the United States and a fairly substantial infrastructure of agencies, programs, and organizations supporting it in various ways. The history and the experiences of the US effort suggest some lessons for future initiatives:

High-quality information and promotional programs will not by themselves yield optimal implementation.

It is increasingly evident that efforts to improve the quality of information and technical support are important and necessary, but alone, not sufficient. Part of the challenge is that third-party organizations are often not trusted as valued information sources for firms. But even when credibility exists and the assistance and information is of the highest quality, outreach and implementation can still be limited.

Governments are good at mandating, but not at encouraging.

Federal and state governments have proven very successful in telling companies **what** to do as far as environmental protection is concerned— through regulations, permits, emission standards, etc. But because it involves changes in manufacturing processes and operations, pollution prevention presents a totally new challenge for state and federal agencies— encouraging companies in **how** they manage their operations— a challenge the agencies have met with far less success.

Part of the problem resides in the 25-year history of environmental protection in the United States. As noted earlier, it has proven to be a significant challenge to take a system built on pollution control approaches and change it so that it not only accommodates, but prefers, prevention-based approaches. But prevention also requires new skills and an understanding which is much closer to manufacturing process and business management something which governments typically lack.

Making general business conditions and the business climate supportive of pollution-prevention adoption is as important as creating a supply of information and assistance.

Changing the business context has proven itself to be the key to implementation. U.S. regulatory agencies and environmental protection laws are currently being re-engineered to create this supportive context. This, however, is only part of the answer since businesses act, react, and change for reasons that have nothing to do with environmental management. The US experience suggests that more aggressive efforts need to be made to direct the activities and programs of the "non-environmental" organizations that affect business decision-making so that they support the adoption of pollution-prevention practices.

4. Future of Pollution Prevention— Emerging Strategies

In addition to efforts to improve the supply and quality of information, financial, and other resources encouraging pollution prevention, the United States is concurrently beginning to emphasize programs which encourage the demand for pollution-prevention practices. It is likely that these "demand-side" programs will continue to gain momentum over time. The shared theme of these emerging strategies is integrating pollution prevention into issues and relationships already causing businesses to adopt new practices.

Supply-Chain Programs

Research on the adoption of new technologies in the United States has demonstrated that customer relationships strongly influence:

- how firms manage their production operations;
- the degree of risk they are willing to undertake; and
- the flexibility they have to adopt new manufacturing strategies, techniques, and technologies.[113]

Efforts are now being made to weave pollution-prevention strategies into these relationships to increase the likelihood of implementation. This strategy is especially critical for reaching small and medium-size firms.

The Automotive Project under the US EPA Common Sense Initiative is an example of a collaborative attempt to reduce the generation and release of persistent toxins in the Great Lakes Basin, in part, by engaging firms supplying the automotive industry. Part of the challenge for the US in the future will be to integrate pollution prevention into the logic of supply-chain management practices as optimally as possible on all levels.

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[113] Maryellen Kelley and Harvey Brooks, "External Learning Opportunities and the Diffusion of Process Innovations into Small Firms: The Case of Programmable Automation", *Journal of Technological Forecasting and Social Change,* Vol. 39 (1991), *passim.*

Manufacturing Modernization

A number of initiatives are underway to make pollution prevention part of the existing efforts by companies to adopt "high performance" manufacturing practices— practices which improve quality, reduce manufacturing times, and save costs. In many cases, manufacturing modernization is often a **precondition** for pollution prevention, since the adoption of more sophisticated techniques and technologies first requires upgrades in human resources, information systems, and manufacturing management practices for the firm. Studies have shown that there are high correlations between pollution-prevention results and the adoption of high performance manufacturing methods.[114]

Current efforts to build pollution prevention into industrial extension efforts in the United States are doubly important. Not only do the industrial extension programs increase the technical assistance and outreach capacity, but their traditional modernization services can be highly credible vehicles for pollution-prevention adoption. In a recent survey of industrial extension professionals, several types of modernization improvements were identified as having a high opportunity for pollution-prevention integration, including quality assurance system design, use of process simulation techniques, specification and standards development, and plant layout and design.

Other Business Relationships

Less mature, but no less influential, are emerging US efforts to integrate pollution-prevention logic into other types of business relationships such as insurance, lending, tax policy, and economic development. All of these organizations help create a business climate that can either support or deter pollution-prevention practices in a company. Moreover, such efforts hold opportunities to reach multiple firms and industries at once something that "one-on-one" programs like technical assistance can not begin to do.

All of these emerging initiatives share a common theme— a shift from environmental management networks towards building a pollution-prevention capacity within non-environmental areas. Many of the traditional outreach campaigns have professionalized pollution prevention and unwittingly erected barriers to making this integration happen. The US experience suggests that specialized campaigns and programs built up around pollution prevention may have prevented the principles from penetrating into other systems and networks.

All of these emerging initiatives also share a common requirement— an up-front investment in understanding the networks, programs, methods, and vocabulary used by professionals in these other sectors. Instead of forcing insurance or financial underwriters to become environmental experts, the onus is increasingly on those who understand pollution prevention to communicate these ideas using appropriate language and professional skills.

Conclusions

Pollution prevention is a maturing concept in the United States, although there remains substantial debate about what it is and what it is not. Significant investments have been made over the course of many years at the federal, state, and local levels to build awareness and make it a part of business practice. Many companies have adopted the concept and have made great economic and environmental progress.

An ample amount of information exists on pollution-prevention techniques and technologies, and efforts are being made to transfer this information more efficiently and effectively. This support infrastructure helps overcome several barriers to pollution prevention, but US experience suggests that implementation realities are preventing the concept from reaching its full potential— especially within companies. As with other types of organizational change within companies, pollution prevention requires creativity, internal motivation, an appreciation of the value added, and a willingness to take risks— attributes which are not well addressed by information transfer and assistance programs.

As a result, pragmatic direction is needed to guide changes affecting industry and their underlying causes. Elements of the regulatory system are receiving the most attention; however, a number of other initiatives pertaining to buyer-supplier relationships, manufacturing modernization needs, and economic development programs are demonstrating potential. These types of integration initiatives are likely to hold the future for pollution prevention in the United States.

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