THE POLLUTION PREVENTION RESOURCE BIBLIOGRAPHY:

A Reference Manual to Support Pollution Prevention Activities in the Great Lakes Basin

By

Burkhard Mausberg

with the assistance of

Jan Rabantek

The Canadian Institute for Environmental Law and Policy

October 1993

TABLE OF CONTENTS

How to Use This Bibliography

The purpose of this bibliography is to provide a reference manual to support pollution prevention activities in the Great Lakes basin. To do so, the bibliography:

- provides an overview of pollution prevention policies and programs in the Great Lakes basin;
- provides information on how to get financial or technical help from government agencies;
- presents case studies of companies who have successfully implemented pollution prevention;
- provides a range of information sources such as databases, libraries and bibliographies; and
- summarizes a range of additional information that encourages the adoption of the pollution prevention concept.

The listings in this bibliography are summarized to provide overviews of each topic. More information is available from the originator of the listing, or from the Great Lakes Pollution Prevention Centre in Sarnia, Ontario. The address and phone number of the publisher or originator can be found in Appendix 1 under the given Code number.

The books, reports, manuals and articles are organized alphabetically by title, with Canadian entries first, followed by U.S. entries.

This bibliography is the initial step in producing a database on pollution prevention activities, programs, and written materials. The Great Lakes Pollution Prevention Centre in Sarnia will operate the database and update it regularly. To include new documents, programs or activities in the database please contact:

Great Lakes Pollution Prevention Centre
265 North Front Street, Suite 112
Sarnia, Ontario
N7T 7X1
(519) 337-3423
1-800-667-9790

Acknowledgements

The author would like to thank George Crawford, Stewart Forbes, Sonja Gutschi-Santavy, Ray Rivers, Yasmin Tarmohamed, Mark Winfield, and Jody Pilbeam for their guidance and help.

Section 1: UNDERSTANDING POLLUTION PREVENTION

Table of Contents

1. INTRODUCTION

1.1. Origins of the Pollution Prevention Concept

Environmental concerns have led to the development of new approaches to managing our resources. Since the early 1980's, it has become increasingly clear that efforts to reduce pollution were not entirely successful. While there have been certain successes, such as the clean-up of Lake Erie in the 1970's, the overall level of pollution has continued to increase. Thus, new approaches for dealing with environmental pollution have been sought. One such new approach is *pollution prevention*, which is slowly replacing pollution control as the main approach to protecting our environment.

Pollution Prevention Success:

Essex Specialty Products, London

This adhesives manufacturing company received the 1992 *Outstanding Waste Reduction Performance Award* from the Ontario Waste Management Corporation (OWMC). Since 1988, the company has cut its hazardous waste by 95 per cent. Savings in material and disposal costs for 1991 are expected to exceed $160,000. Essex reduced its waste by re-using samples, recycling materials in filters, and replacing organic solvents.

See Appendix 3 for more details.

1.2. What is Pollution Prevention?

With the traditional pollution control approach, companies try to trap contaminants and wastes after they have been produced. This is where the limitations of the pollution control approach begin. First, not all pollutants can be captured completely. Second, even those that are partly captured need to be destroyed. Unfortunately, this is often impossible, and consequently, the collected pollutants need to be stored or dumped. Third, the pollution prevention approach sometimes transfers certain pollutants from one medium (eg. water), into another medium (eg. air). However, the pollutant is still present and able to do damage.

The pollution prevention approach does not suffer from these limitations. By preventing the creation of pollutants in the first place, the problems with capturing, transporting, disposing, or transferring pollutants and wastes do not occur. Quite the opposite, the pollution prevention approach has a number of significant advantages, which include:

- reducing energy and resource use;
- minimizing waste disposal costs;
- reducing the need for pollution control equipment;
- increasing productivity;
- complying with regulations more easily;
- reducing liability regarding environmental problems;
- reducing liability for worker's health and safety;
- improving the company's image in the community; and
- improving competitiveness through increased efficiency.

1.3. Terminology

There are a number of terms used in place of pollution prevention that sound similar: toxics-use-reduction, source reduction, waste reduction, waste minimization, and sunsetting. There are important differences in translating these terms into environmental action, and we have briefly summarized each one.[1]

Pollution Prevention - refers to a combination of various methods, many of them described below, to eliminate the generation or use of harmful substances and other wastes. The ultimate aim of pollution prevention is not to emit less waste, but to eliminate it entirely.

Toxics-Use-Reduction - reduces the amount of toxic chemicals *entering* the plant. Toxics-use-reduction reduces the use of toxics and the need to use toxics. Thus, toxics-use-reduction fundamentally changes the way companies think about toxic chemicals by questioning their need in the first place.

Source Reduction - implies the reduction of waste at the source - the manufacturing process. Source reduction focuses on reducing the amount of harmful substances that *leave* a facility, but not on the toxics that *enter* a facility.

Pollution Prevention Success:

Algoods, Toronto

Algoods was in the top 300 generators of liquid industrial and hazardous waste Ontario. The company was so surprised, it teamed up with the Ontario Waste Management Corporation. Together, they performed a waste reduction audit and consequently installed various 3R initiatives. This effort resulted in annual savings of over $36,000, and a reduction of 116 tonnes of liquid industrial and hazardous waste. As a result, Algoods is no longer in the top 300.

See Appendix 3 for more details.

Waste Reduction - is a variety of measures to reduce the amount of wastes entering the environment. Many waste reduction methods are not pollution prevention methods. Sometimes, the amount of waste is reduced, to minimize the volume and weight for dumping in a landfill, but its toxicity is increased.

Waste Minimization - is a term which can mean anything from waste reduction to toxics-use-reduction.

Sunsetting - is a step-by-step process to phase-out and ban the production and use of targeted chemicals, the processes that create toxic chemicals, and the end-products that contain toxic chemicals.

1.4. Pollution Prevention Definitions

On a policy level, the **Ontario Ministry of Environment and Energy** has defined pollution prevention as:

> "any action which reduces or eliminates the creation of pollutants or wastes at the source, achieved through activities which promote, encourage or require changes in the basic behaviourial patterns of industrial, commercial or institutional generators or individuals."

Pollution Prevention Success:

Northern Telecom

Through an extensive research program, Northern Telecom found substitutes for CFC cleaning agents and in December of 1991, was the first telecommunications company in the world to completely phase-out CFCs. As a result, Northern Telecom expects to save almost $50 million by the year 2000.

See Appendix 3 for more details.

The federal government has no official or legislated definition of pollution prevention. However, the **Departments of Environment and Industry and Science** propose the following definition of pollution prevention for discussion purposes:

> "The use of processes, practices, materials and energy that avoid or minimize the creation of pollutants and wastes."[2]

The **United States** has a legislated definition of source reduction which reads as follows:

> "any practice which
>
> reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and
>
> reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants."

Pollution Prevention Success:

Twinpack

In 1990, the Brantford company turned to the Ontario Waste Management Corporation for help in improving its production process. Following a thorough audit, Twinpack engineers and OWMC employees installed glue recycling facilities. This reduced waste disposal costs by $12,000 and allows the company to re-use some 35,000 kg of glue.

See Appendix 3 for more details.

1.5. Pollution Prevention Methods

Pollution prevention methods or techniques include:[3]

- **input substitution** - replacing a toxic substance used in a process with a non-toxic or less toxic substance, or using a raw material which does not lead to toxic products or other wastes;
- **product reformulation** - changing the formulation of the final product to reduce or eliminate the amount of waste formed during the process;
- **production process redesign** - modifying or redesigning the production process to reduce or eliminate the use and release of harmful substances and other wastes;
- **production process modernization** - replacing the existing production method or equipment with different methods, based on the same production process;

- **improved operation and maintenance** - improving housekeeping methods, system adjustments, and product and process inspections to reduce the use and generation of harmful substances and other wastes; and

- **in-process recycling** - re-using the wastes within closed-loop production processes.

1.6. What is not Pollution Prevention?

Certain techniques are generally excluded from the definition of pollution prevention, including:

- incineration;
- off-site recycling;
- out-of-process recycling; and
- "end-of-the-pipe" treatment methods.

These techniques are excluded from pollution prevention because they are responses to situations after the pollutants have been generated.

Pollution Prevention Success:

Metal Recovery Industry Inc.

Since more and more scrap metal is being recycled, Metal Recovery Industry Inc. (MRI) developed a promising process of de-zincing. During a demonstration project in Hamilton, the process removed 70-90 per cent of zinc from baled scrap and up to 98 per cent from the loose scrap.

See Appendix 3 for more details.

Section 2: POLICIES AND PROGRAMS

Table of Contents

2. POLICIES AND PROGRAMS

Governments at various levels have implemented pollution prevention policies and programs. While pollution prevention is not legislated or regulated in Canada or Ontario, businesses are persuaded to make pollution prevention a corporate policy when complying with environmental standards. This section reviews the policies and programs of the federal and Ontario governments dealing with pollution prevention.

1. Lake Superior Pollution Prevention Program. *Code 11.*

Originating from a recommendation by the International Joint Commission, this joint U.S.-Canada Program seeks to restore and protect Lake Superior. With pollution prevention as its basic conviction, the Lake Superior Progam has two components: the zero discharge demonstration program; and a broader restoration program. Partnerships with industry, government and community groups are encouraged.

2. Ontario's Municipal-Industrial Strategy for Abatement (MISA). *Code 28.*

Established in 1986, the Municipal-Industrial Strategy for Abatement (MISA) is the clean water program for Ontario. Nine major industrial sectors will have to meet new discharge standards, based on the "Best Available Technology" (BAT). Such BAT standards have been developed for the petroleum refining and pulp and paper sector, and BAT standards for other sectors are currently under development. In September of 1991, the Ontario Ministry of Environment and Energy announced that the standards developed under MISA must be based on pollution prevention methods.

A sewer use program is also being developed under MISA. Discharge standards based on pollution prevention will then apply to businesses who discharge pollutants into the municipal sewer systems.

3. Ontario's Sunset Chemical List. *Code 27.*

In April of 1992, the Ontario Ministry of the Environment released its "Candidate Substances Lists for Bans and Phase-outs." The Ministry employed a screening system, evaluating chemicals based on their persistence, bioaccumulation and toxicity. As a result, Ministry scientists identified 21 priority chemicals which should to be phased out and banned. Examples include arsenic, mercury, pentachlorophenol and benzo(a)pyrene. A secondary list of 46 chemicals is slated for phase-outs as well. Chemicals contained in the secondary list include lead, chloroform, uranium and

styrene. As of September 1993, no elimination plans had been released by the Ministry.

4. Ontario's Pollution Prevention Pledge Program (P^4). *Code 27.*

This voluntary program was launched in 1992 and consists of four phases:

- *Registration and Planning*: businesses indicate their intention to develop pollution prevention plans and register their reduction commitments with the Ministry of Environment and Energy (MOEE).
- *Reduction Commitment*: businesses make public commitments indicating specifically the reduction and elimination of pollutants, regardless of quantity.
- *Reduction Achievement*: businesses will receive certificates from the MOEE once their commitments are fulfilled.
- *Pollution Prevention Achievement*: when businesses have used pollution prevention methods, they reach the highest level of recognition from the MOEE under this program.

Through the Pollution Prevention Pledge Program, the Ministry has issued a challenge to business to reduce a selected number of priority chemicals by 50% in 1995 and by 90% in the year 2000.

5. Federal/Provincial Partnerships with Business/Industry/Municipalities

Over the last two years, the provincial and federal governments have been negotiating voluntary pollution prevention partnership programs with various business sectors. So far, sector-specific agreements have been signed with the "big three" automakers and metal finishers. Similar agreements are planned for the chemical sector, the pulp and paper sector, and auto parts manufacturers.

Accelerated Reduction and Elimination of Toxics (ARET), *Code 15.*

ARET is a collaborative consultation program to encourage voluntary action by industry to reduce or eliminate toxic substances. Initiated by Environment Canada in 1992, ARET will identify substances which are are toxic, persistent and bioaccumulative. Targets and schedules for reduction and elimination of releases will be set by 1994.

Automotive Manufacturing Pollution Prevention Project, *Code 33.*

The project's goal is to "produce a verifiable reduction of persistent toxic substances as well as other environmental contaminants of concern used, generated or released by the participating member companies." Initiated in May of 1992, the project covers GM, Ford and Chrysler. An initial list of 65 substances of concern has been developed for which pollution prevention plans will be established, implemented, monitored, and their successes publicized.

Metal Finishing Pollution Prevention Project, *Code 33.*

Signed in June of 1993, the agreement for this sector is similar to that of the Automotive Project. The participating agencies are: Environment Canada, Ontario Ministry of Environment and Energy, the Canadian Association of Metal Finishers, the American Electroplaters and Surface Finishers Society, the Automotive Parts Manufacturers' Association and the Metal Finishing Suppliers Association. The Project includes the following components: (1) the identification of a priority list of toxic substances; (2) the development and evaluation of a pollution prevention planning guide; (3) the preparation and implementation of pollution prevention plans; and (4) the promotion of pollution prevention in the metal finishing sector.

Municipal Pollution Prevention Projects, *Code 23.*

The Comprehensive Municipal Pollution Prevention Project

The purpose of this project is to implement pollution prvention in a comprehensive manner for the Hamilton-Wentworth Region. The Region will reduce pollution from its own activities, as well as reduce pollution from those over which it has regulatory authority. The project is a joint effort between the Region, the federal government and the provincial government. A template has been developed that can be used in other communities to promote pollution prevention planning.

The Bilateral Partnership In Municipal Pollution Prevention

The Regional Municipality of Hamilton-Wentworth, Ontario and Erie County, New York, with the support of the Environment Canada are developing a Memorandum of Understanding designed to formalize a Bilateral Partnership. This partnership will be based on the exchange of resources and information on sustainable development and pollution prevention to the mutual benefit of each municipal authority. Bilateral

activities will include joint training programs, roundtables and staff exchanges designed to exchange program information.

Municipal Success Stories Case Study Series

The objective of this educational initiative is to produce and distribute a series of Great Lakes-based examples of municipal pollution prevention. These case studies are designed to articulate the practical, "hands on" details of successful pollution prevention projects to encourage program replication in Great Lakes communities.

Municipal Pollution Prevention Training Series

This series of training seminars, facilitated by the Great Lakes Pollution Prevention Centre, builds on the "Municipal Pollution Prevention Case Studies" to provide an detailed training program for municipal officials. The first seminar took place in November of 1993 and will focus on the City of Waterloo's "*Plant Health Care Program*". This successful pollution prevention program has resulted in a reduction in the amount pesticides sprayed on turf from 72% in 1979 to 2% in 1993.

Multi-process Wet Cleaning Demonstration "The Green Clean Project"

This project is designed to help reduce *the use* of the chlorinated solvent, perchloroethylene, used by the dry cleaning industry. This pollution prevention demonstration project builds on the recent research done by the U.S. EPA's Design for The Environment Program. The EPA program has identified Multi-process Wet Cleaning as providing a significant opportunity to reduce chlorinated chemical use in dry cleaners. A number of on-site demonstration projects, designed to test the economically viability and the potential reductions of perchloroethylene, will be run in the Great Lakes basin this year. The project is being developed and delivered with the participation and support of several industry associations, ENGOs and the federal, provincial and several municipal governments.

McMaster University Micro Scale Experimentation Project

This is demonstration project designed to assess the viability of establishing a micro scale laboratory course for 500 second year organic chemistry students. The project has concluded that micro scale experimentation integrates responsible environmental chemistry practices into organic chemistry courses, achieves substantial reductions in chemicals used and disposed of, and reduces the generation and emission of airborne chemicals. In fact, the research found that with a thirty five thousand dollar initial investment in micro scale glassware the university could eliminate the need for over two hundred thousand dollars of fume hood technology, as well as realizing nine

thousand dollars a year in reduced chemical and disposal costs. The project staff has concluded that the results and benefits of this project could easily be realized by other universities and laboratories.

National Pollutant Release Inventory (NPRI), *Code 24.*

While not a pollution prevention program, the NPRI requires larger industries to report their annual releases of over 170 chemical to Environment Canada. The department will then develop and publish a national data base for hazardous pollutants.

Section 3: SUPPORT PROGRAMS

Table of Contents

3. SUPPORT PROGRAMS

Both the provincial and federal governments offer a variety of support programs for companies to advance their environmental initiatives. These programs have increased significantly since 1990. Governments now provide assistance for research and development programs, for the commercialization of new environmental technologies, for installing clean technologies and for a range of other environment-related activities. In addition, umbrella business associations provide technical assistance to their members.

This section lists and reviews these support programs. Not all of the programs are geared solely to pollution prevention projects. However, the chances are better for a company to receive assistance, if pollution prevention is the reason for seeking help.

3.1. Research and Development Support Programs

Federal Programs

1. **The Environmental Innovations Program**; *Code 35.*

   Environment Canada's **Environmental Innovations Program** funds innovative research and development projects for new environmental processes and services. Projects must be sponsored by a federal government department, and are judged by their uniqueness, scientific merit and technical feasibility. There must be funding from sources other than the **Environmental Innovations Program**, which has a total budget of $20 million over 6 years.

2. **Natural Sciences and Engineering Research Council of Canada**; *Code 37.*

   The Natural Sciences and Engineering Research Council of Canada (NSERC) funds a variety of R&D activities through a number of special programs. NSERC welcomes co-operation with small- and medium-sized businesses, especially through its *University-Industry Cooperative R & D Activities*. Under this initiative, three main research and development programs are offered:

   (a) **Collaborative Research and Development Grants**

   Funding is available to support well-defined research projects which are a collaborative effort between a company and a university. NSERC requires either a cash contribution or in-kind contribution by the

company. Any projects can receive support, as long as they involve research appropriate for a university to carry out.

(b) **Industrially Oriented Research Grants**

This program supports projects which involve more research than development. Again, a collaborative with a university must be established, and the company is expected to contribute half the project costs.

(c) **Shared Equipment and Facilities Grants**

This program helps universities acquire specialized equipment or facilities that will be shared with industrial partners. These grants make available facilities that neither partner could afford on its own. The equipment remains the property of the universities and the companies negotiate guaranteed access for their personnel.

Provincial Programs

3. **Environmental Research Program**; *Code 36.*

The **Environmental Research Program** supports research projects which are compatible with the needs and priorities of the Ontario Ministry of Environment and Energy. The program focuses on air and water quality, wastes, analytical methods, and multi-media contaminants. Each year, the Ministry's research priorities are summarized in a report which should be consulted before approaching the Ministry.

4. **EnerSearch**; *Code 38.*

With the **EnerSearch** program, the Ontario government funds activities which reduce energy demand through the application of innovative technologies. To be eligible, projects must involve some level of technical innovation and technical risk. **EnerSearch** will fund up to 50 per cent of the total project costs, to a maximum of $500,000.

3.2. Financial Support Programs

Federal Programs

1. Technology for Environmental Solutions. *Code 39.*

A six-year and $100 million program under the Green Plan, this direct financial assistance program by Industry and Science Canada facilitates the development and commercialization of leading-edge environmental technologies in the following areas:

- clean process technologies;
- waste reduction and recycling;
- air and water pollution prevention and control; and
- water conservation.

- The **Environmental Technology Commercialization Program** provides direct financial assistance to businesses for first-time demonstration projects of new environmental technologies. Over $80 million is available from the federal government over six years, specifically geared to small- and medium-sized companies. Up to 50 per cent of eligible costs will be awarded for projects that demonstrate for the first time the use of new environmental products and processes having reasonable prospects of commercialization. Projects and studies dealing with the formation of alliances, the preparation of business plans to implement projects, and the investigation of the feasibility of technical aspects of a project will be funded by up to 75 per cent (maximum of $50,000).

- The **Technology Transfer Program** provides $18 million of federal assistance to help Canadian firms locate, assess, transfer and promote environmental technologies. The following are examples of services which will be supported:

  - technical reviews;
  - regulatory and legal assistance;
  - advice on alternative funding sources; and
  - determination of the status of intellectual property.

2. Development and Demonstration of Resource and Energy Conservation Technology Program (D-RECT). *Code 41.*

D-RECT is geared primarily to prevent pollution through energy efficiency and recovery. With an annual budget of $1 million, the program funds projects which demonstrate the commercial viability of new methods, procedures and processes that conserve energy. **D-RECT** covers 50 per cent of the total costs for equipment, buildings, installation, engineering and consulting services. Eligible projects are those that demonstrate the commercial viability of new methods, procedures, processes or equipment. The main aim of the technology must be energy-savings - especially energy derived from non-renewable resources.

3. Great Lakes Clean-Up Fund; *Code 42.*

The **Great Lakes Clean-Up Fund** provides $55 million to assist in the development and demonstration of clean-up and pollution prevention technologies. To be eligible for funding, projects must involve innovative technologies which address: the assessment, removal and treatment of contaminated sediments; wastewater treatment technologies; habitat rehabilitation; or non-point sources of pollution.

4. Accelerated Capital Cost Allowance

The federal government provides an **Accelerated Capital Cost Allowance** for water and air pollution control equipment (class 24 and 27 in income tax regulations). Some energy conservation equipment also qualifies for the accelerated capital cost allowance (class 34).

Provincial Programs

5. Applied Pollution Prevention Program; *Code 40.*

The **Applied Pollution Prevention Program** funds initial demonstration projects for technologies that prevent or reduce pollution at source. The program has a budget of $30 million over five years and funds a variety of activities, including:

- research and development of innovative products and processes;
- equipment-prototype development and testing;

- pilot-scale equipment refinement and adaptation; and
- full-scale field-trials and demonstrations projects.

Preference is given to technologies which eliminate, prevent or reduce pollution at the source.

6. **Industrial Waste Diversion Program**; *Code 45.*

The **Industrial Waste Diversion Program** provides funding to companies to divert solid and hazardous waste from disposal based on the 3R's (reduce, reuse, recycle). With an annual budget of $7 million, the Program will support businesses, commercial operations and institutions who divert waste which was previously destined for disposal. The program includes up to 50 per cent for capital costs of eligible equipment and up to 100 per cent for research and demonstration projects. The technology or process should be innovative and demonstrate potential for commercial application.

7. **Industrial Process Equipment Demonstration Program**; *Code 46.*

The **Industrial Process Equipment Demonstration Program** shares the cost of demonstrations projects which will estimate the performance, energy impact, and other benefits of energy efficient technologies. The program will provide up to 30 per cent of eligible project costs.

8. **Industrial Retrofits Grants Program**; *Code 46.*

The **Industrial Retrofits Grants Program** provides grants to install engineered systems that will improve the energy efficiency of processes and equipment. In terms of funding, the program provides the lesser of the following: 30 per cent of the total project costs; or $300,000; or the amount required to reduce the simple payback period to 1.5 years.

9. **Innovation Ontario**; *Code 43.*

While not strictly an environmental program, **Innovation Ontario** is an Ontario crown corporation which invests in Ontario companies which cannot raise adequate start-up capital. To be eligible for an investment, Ontario firms must offer an innovative technology-based product or service. Investments by

Innovation Ontario are more flexible than those of traditional venture capitalists. The investments are divested once the firms can attract private sector investments.

10. Ontario Hydro Energy Management Programs; *Code 56.*

Ontario Hydro offers a variety of progams which offer businesses ways to reduce their energy consumption and thus prevent pollution. Hydro's services include energy audit plans, energy efficient lighting plans, high efficiency motor replacement plans and load shifting plans.

11. Ontario Technology Fund; *Code 44.*

Similar to Innovation Ontario, the **Ontario Technology Fund** is not solely oriented to environmental technologies. However, part of its $81 million fund will go to enhance collaboration and cooperation among business, government and universities to develop and share environmental technologies.

3.3. Technical Support Programs

Federal Programs

1. **Great Lakes Pollution Prevention Centre**; *Code 47.*

   The **Great Lakes Pollution Prevention Centre** in Sarnia was established in May 1992 to promote the development and implementation of pollution prevention activities in the Great Lakes Basin. The Centre provides customized training seminars, technical assistance to identify and implement pollution prevention activities, and access to technical information through a number of databases. In addition, the Centre organizes workshops and conferences and prepares summaries of pollution prevention success stories. Reports, technical documents, databases and other information sources are available through the Centre's resource library.

2. **ON-SITE**; *Code 25.*

   Energy Pathways Inc. operates the **ON-SITE** program which matches scientists, engineers and technicians with companies who need assistance with waste management and pollution prevention problems. Salaries for On-SITE workers are paid by Employment and Immigration Canada for up to six months. Over 600 companies have participated in ON-SITE. They have, among other activities, undertaken water and energy audits and initiated recycling programs.

3. **Industrial Energy Efficiency Initiative**; *Code 52.*

   The **Industrial Energy Efficiency Initiative** consists of industry-based task forces to design, develop, and implement cooperative energy efficiency initiatives. Technical assistance on the energy use of a particular process may be obtained through this initiative.

4. **The Industrial Research and Assistance Program (IRAP)**; *Code 34.*

   The National Research Council of Canada operates the **Industrial Research and Assistance Program (IRAP)** to provide small- and medium-sized firms with technical information, industrial engineering expertise, and access to Canadian and foreign technologies. **IRAP** also includes product and process

problem-solving services and the provision of access to new environmental technologies.

5. **Wastewater Technology Centre**; *Code 53.*

The **Wastewater Technology Centre** is primarily geared towards pollution control technologies, but also assists in technology research for source reduction activities. The Centre offers technology assessments, helps to commercialize innovative technologies and assists in other research and development activities. The Wastewater Technology Centre, which charges for its services, is conducting research for several federal/provincial pollution prevention programs.

6. **Environmental Technology Network**; *Code 48.*

The **Environmental Technology Network** is designed to increase awareness of the latest research and development efforts in environmental technology and to increase communication and cooperation among researchers. Federal, provincial and university centres of environmental technology are part of the Network.

Provincial Programs

7. **Ontario Waste Management Corporation (OWMC)**; *Code 26.*

The **Ontario Waste Management Corporation (OWMC)** is a provincial Crown agency specializing in hazardous waste reduction and treatment. The corporation offers several waste minimization programs to Ontario companies including:

- technical and advisory services designed to assist businesses in assessing their operations and recommending improved hazardous waste management practices;
- educational workshops illustrating waste minimization techniques and concepts; and
- annual awards which recognize achievements in hazardous waste reduction.

8. Environmental Business Development Unit; *Code 49.*

In late 1992, the Ontario Ministry of Environment and Energy established an **Environmental Business Development Unit** to facilitate the development of environmental industries and the greening of existing industries. To do so, the Unit assists in the transfer of technology, shares information on green technologies, facilitates financial assistance and fosters Ontario and international market development.

9. ORTECH International; *Code 50.*

ORTECH International is a non-profit research corporation that provides services in product and process design, energy, waste management and others. ORTECH also operates the **Canadian Waste Exchange** and the **Ontario Waste Exchange**. The latter diverted over 36,000 tonnes from disposal in 1992.

10. Industrial Energy Service Program; *Code 46.*

Free comprehensive energy audits of equipment and processes are provided under the **Industrial Energy Service Program** operated by the Ministry of Environment and Energy. Financial assistance to implement the recommendations of the audits are also available.

3.4. Programs by Other Organizations

1. Manufacturing Environmental Performance (MEP) Program; *Code 54.*

While not just strictly a pollution prevention program, the **MEP** project by the Canadian Manufacturing Association provides for a "systematic approach to understand and manage the major environmental issues impacting the manufacturing sector." The **MEP** program consists of various tools for the CEOs and Environmental Managers of small- and medium-sized businesses. Manufacturer's can receive a reference guide for the CEO, a legislative framework guide, and a resource handbook similar to this one.

2. **Canadian Environmental Industries Association (CEIA)**; *Code 99.*

CEIA provides member groups with up-to-date information on developments in the environmental business community. The Association also represents the interests of its members at various forums.

3. **Great Lakes Protection Fund**; *Code 58.*

This U.S. fund, set up by the 8 U.S. States bordering the Great Lakes, encourages pollution prevention. In the past, financial contributions have been made to Canadian groups have been made, however, they are becoming more difficult to obtain.

Section 4: INFORMATION RESOURCES

Table of Contents

4. INFORMATION RESOURCES

4.1. Resource Centres and Libraries

Canada

1. Great Lakes Pollution Prevention Centre
   265 North Front Street
   Suite 112
   Sarnia, Ontario
   N7T 7X1
   (519) 337-3423
   1-800-667-9790

2. National Office of Pollution Prevention
   Environment Canada
   351 St. Joseph Blvd.
   Hull, Quebec
   K1A 0H3
   (819) 953-7819

3. Pollution Prevention Branch
   Ontario Region
   Environment Canada
   25 St. Clair Ave. East, 9th Floor
   Toronto, Ontario
   M4T 1M2

Ontario

1. Environmental Information Service
   Business Environmental Support Team
   Hamilton Public Library
   P.O. Box 2700, Station A
   Hamilton, Ontario
   L8N 4E4
   (905) 546-3434

2. Library for the Environment and the Law
   c/o Canadian Environmental Law Association
   517 College Street
   Suite 401
   Toronto, Ontario
   M6G 4A2
   (416) 960-2284

3. The Ontario Waste Exchange
   c/o Ortech
   2395 Speakman Dr.
   Mississauga, Ontario
   L5K 1B3
   (905) 822-4111 ext. 656 or 354

4. Ontario Waste Management Corporation
   2 Bloor Street West
   11th Floor
   Toronto, Ontario
   M4W 3E2
   (416) 923-2918
   1-800-268-1179

5. Pollution Prevention Office
   Ontario Ministry of the Environment and Energy
   135 St. Clair Avenue West
   Toronto, Ontario
   M4V 1P5
   (416) 323-5072

United States

1. American Institute for Pollution Prevention
   Department of Civil and Environmental Engineering
   University of Cincinnati
   Cincinnati, Ohio
   45221-0071 U.S.A.
   (513) 556-3693

2. New York State Information Clearinghouse
   New York State Department of Environmental Conservation
   Division of Hazardous Substances Regulation
   50 Wolf Road
   Albany, New York
   12233-7253 U.S.A.
   1-800-462-6553

3. Pollution Prevention Information Clearinghouse (PPIC)
   U.S. Environmental Protection Agency
   401 M. Street, SW, PM-211A
   Washington, D.C.
   20460 U.S.A.
   (202) 260-1023

4.2. Bibliographies

1. **Bibliography of Hazardous Waste Reduction Publications**, 1991. *Code 79.*

   Developed by the State of Oregon, this bibliography lists articles, books and other publications dealing with hazardous waste reduction. It includes mostly sector-specific entries which deal with how individual industry sectors can reduce hazardous wastes. The listed industry sectors include: printing, chemicals, textiles, petroleum, metals, automotive, solvents, paints, and others.

2. **Municipal Water Pollution Prevention Bibliography**, 1992. *Code 80.*

   Prepared by the U.S. EPA, this bibliography provides listings of the most current literature available on pollution prevention as it relates to municipal wastewater. The entries in the bibliography are annotated and cover legal and policy issues, enforcement, land application of sludge, surface and ground water, and pre-treatment measures.

3. **Pollution Prevention Bibliography**, 1988. *Code 76.*

   This bibliography from the North Carolina Pollution Prevention Pays Program lists technical pollution prevention information for over 20 business categories, from primary metal industries to personal services. The bibliography features over 4000 entries and is compiled to provide business-specific information on ways to make pollution prevention pay. This bibliography is accessible through the Great Lakes Pollution Prevention Centre in Sarnia, Ontario.

4. **Reference Guide to Pollution Prevention Resources**, 1988. *Code 85.*

   Produced by the U.S. EPA, this Guide contains summaries of pollution prevention activities with regard to training opportunities, technical assistance, state and federal programs, and publications. The guide is a very good summary and snapshoot of pollution prevention activities in the U.S..

5. TechInfo. *Code 75.*

University of Wisconsin developed TechInfo which contains over 6000 entries comprising technical papers, pamphlets, books, audio and visual media dedicated to topics on pollution prevention. The entries are international in scope and are particularly useful to firms dealing with pollution prevention. TechInfo is accessible through the Great Lakes Pollution Prevention Centre in Sarnia, Ontario.

4.3. Databases

1. International Cleaner Production Information Clearinghouse. *Code 77.*

This Clearinghouse is a computer-based information exchange system established by the United Nations Environment Programme in conjunction with the U.S. Environmental Protection Agency. Among other information, the database holds:

(a) case studies of over 450 cleaner production initiatives and techniques;
(b) a list of cleaner production programs by country and company;
(c) a bibliography of cleaner production publications; and
(d) current and recent research abstracts.

Direct computer access to the database is free of charge, but an access number is necessary. The Clearinghouse will eventually be publicly available without the need for an access number.

2. Pollution Prevention Information Exchange System (PIES). *Code 85.*

Developed by the U.S. EPA, the PIES is an information resource and communication network that allows those who wish to establish pollution prevention programs to benefit from the experience, progress and knowledge of their peers. PIES contains bulletins, case studies, publications, directories and other features. It is becoming rapidly a global pollution prevention network, including entries from a range of international sources. PIES is accessible through a personal computer and modem, and a user guide for the system is available.

3. Pollution Prevention Research. *Code 77.*

Part of the U.S. EPA's Risk Reduction Engineering Laboratory, the Pollution Prevention Research Branch provides technical assistance to encourage the development of technologies, products and pollution prevention techniques. It has three main programs: the Clean Technology Projects, the Pollution Prevention Assessments, and the Clean Products Projects.

4. Stewardship Information Bureau (SIB). *Code 73.*

The Stewardship Information Bureau operates several databases dealing primarily with soil, water and agriculture. For example, the ENVIRO.DOC database lists some 11,000 international papers on soil and water conservation subjects. The databases are accessible free of charge.

5. The Waste Reduction Advisory System (WRAS). *Code 74.*

WRAS is a user-friendly computerized waste management tool developed in the U.S.. It provides waste generators with a wide range of options for reducing and recycling waste. The WRAS has two parts:

(1) the Waste Reduction Audit Checklist (WRAC) provides individualized waste reduction assistance via a series of questions presented in the Audit Checklist. The questions are designed to assess a facility's current waste reduction activities and then identify potential waste reduction techniques for each waste generating process.

(2) the Waste Reduction Information Bibliography (WRIB) provides the user with literature abstracts and case studies, some of which are not available elsewhere. The current version (2.3) contains over 300 abstracts and case studies.

In order to use the WRAS, an IBM or compatible computer is required with at least 640K memory and a hard disk.

A new up-dated version should be available in early 1994.

4.4. Manuals and Guidebooks

Manuals and guidebooks can be very useful tools to transform businesses into pollution prevention operations. A good manual will provide a step-by-step guide to identify and implement pollution prevention options. Many useful manuals have been produced and the ones by the OWMC and by the MOEE are the most applicable to Ontario businesses.

General Manuals for All Businesses

1. **Green Business Guides. Pollution Probe, 1993. (Toronto, Ontario: Pollution Probe Foundation), 4 volumes.** *Code 3.*

The four volumes cover some specific comments on how business can make pollution prevention part of their activities. Volume 1, Waste Minimization, deals primarily with solid waste; Volume 2, Getting off Toxics, shows how all sorts of businesses can reduce their toxic use; Volume 3, Hazardous Waste Management, provides an overview of issue and government laws; Volume 4, Greening the Business, shows step-by-step how any business can encourage pollution prevention.

2. **Facility Pollution Prevention Guide. Office of Solid Waste, U.S. Environmental Protection Agency, 1992. (Washington, D.C.: U.S. EPA), Report EPA/600/R-92/088.** *Code 85.*

This guide describes how to establish a company-wide pollution prevention program. It outlines procedures for conducting a preliminary assessment to identify opportunities for waste reduction or elimination.

3. **Industrial Waste Audit and Reduction Manual: A Practical Guide to Conducting an In-Plant Survey for Waste Reduction. OWMC, 1989. (Toronto: Ontario Waste Management Corporation), 91 pages.** *Code 26.*

The second edition of this popular manual is an exceptionally useful tool for business to implement source reduction technologies. Dividing the waste audit and reduction approach into 18 succinct steps, the first part of this manual covers four general aspects of a source reduction strategy:

- how to conduct a waste audit;
- how to identify source reduction alternatives;

- how to calculate a cost-benefit analysis; and
- how to implement an "Action Plan."

The second part of the manual outlines in detail three case studies, which follow the 18 steps of a waste audit. The final component of the manual lists source reduction funding programs and information sources. This publication is valuable for businesses interested in source reduction.

4. **Industrial Waste Prevention. Waste Advantage Inc., 1988. (Southfield, MI: Waste Advantage Inc.).** *Code 60.*

A practical guide which provides step-by-step instructions to develop an effective waste prevention program. It includes forms, worksheets and original waste prevention ideas and is designed for in-plant use. The following topics are covered:

- the environmental manager's role;
- waste prevention planning;
- formation of a waste prevention committee;
- waste prevention costs; and
- the development of waste prevention ideas.

5. **Minnesota Guide to Pollution Prevention Planning. Minnesota Office of Waste Management, 1992. (St. Paul, Minn.: Minnesota Pollution Control Agency; Minnesota Technical Assistance Program (MnTAP)).** *Code 82.*

This manual is designed to be used by those who wish to take advantage of the economic and environmental benefits which can come from pollution prevention planning and those who are required by the Minnesota Toxic Pollution Prevention Act to prepare a plan and progress reports. Minnesota's Office of Waste Management (OWM) led the manual project, in conjunction with the Minnesota Pollution Control Agency (MPCA) and the Minnesota Technical Assistance Program (MnTAP).

6. **Pollution Prevention for the Great Lakes: Tips for Small Quantity Hazardous Waste Generators. LURA Group, 1991.** *Code 22.*

This is a very simple guide to waste management for small Canadian businesses around the Great Lakes. It includes a brief guide to developing a hazardous waste management plan.

7. Pollution Prevention Planning Guidance Document and Workbook. MOEE, 1993. (Toronto: Ministry of Environment and Energy), 89 pages & appendices. *Code 27.*

This very useful manual covers a whole range of topics. It provides step-by-step instructions on how to design, implement and monitor multi-media pollution prevention programs in your business. Furthermore, the manual includes a description on how to analyze pollution prevention projects financially, and includes worksheets to guide you through a pollution prevention project. This is a detailed and informative document and a must-have for all businesses interested in beginning a pollution prevention program or project.

8. Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), 106 pages. See also the first edition which is more extensive. *Code 3.*

This book identifies the steps business can take to prevent pollution by outlining how to set up a waste reduction program. Many different types of businesses are examined, including dry cleaning, electroplating, pulp and paper, textiles and plastics. The technologies used in pollution prevention methods are discussed in detail, and several dozen case studies are presented.

9. Profiting from Waste Reduction in Your Small Business. David Wigglesworth, 1988. (Anchorage, Alaska: Alaska Health Project). *Code 83.*

This manual is geared towards assisting small business managers and their employees to identify and implement methods to reduce waste. It includes the following topics:

- how to organize a business to promote waste reduction;
- how to review business plans for waste reduction;
- how to conduct a waste audit; and
- how to evaluate a waste reduction program.

10. Waste Minimization Opportunity Assessment Manual. U.S. EPA, 1988. (Washington, D.C.: Hazardous Waste Engineering Research Laboratory, U.S. EPA), 106 pages. *Code 85.*

This is a document similar to OWMC's Industrial Waste Audit and Reduction Manual. It is written for businesses interested in applying waste minimization by describing step-by-step procedures to identify minimization opportunities. The manual covers initial assessment needs, technical and economic feasibility analyses and implementation methods.

Sector-Specific Manuals

The following manuals are geared towards specific business sectors. They indicate how pollution prevention principles can be directly applied to a given business sector. If your business is not listed below, contact the Great Lakes Pollution Prevention Centre in Sarnia, Ontario.

Automotive Industry (selected activities)

Hazardous Waste Reduction Checklist Automotive Repair Shops. (Sacramento, CA: California Department of Toxic Substances Control, 1988), Report WA004. *Code 55.*

Auto Repair Shops: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1991). *Code 77.*

Automotive Refinishing Industry: Guide to Pollution Prevention. (Washington, D.C.: U.S. EPA, 1991), Report EPA/625/7-90/016. *Code 81.*

Automotive Repair Shops: Hazardous Waste Reduction Assessment Handbook. (Sacramento, CA: California Department of Toxic Substances Control, 1988). *Code 55.*

Waste Audit Study: Automotive Paint Shops. (Sacramento, CA: California Department of Toxic Substances Control, 1987), Report WA001. *Code 55.*

Waste Audit Study: Automotive Repairs. (Sacramento, CA: California Department of Toxic Substances Control, 1987), Report WA002. *Code 55.*

Chemical Industry

Waste Minimization Assessment for a Manufacturer of Chemicals. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/600/S-92/004. *Code 77.*

Pollution Prevention Resource Manual. (Washington, D.C.: Chemical Manufacturers Association, 1990). *Code 65.*

Dry Cleaning Industry

Aqueous Cleaners as Substitutes for Organic Solvents. (Minneapolis, MN: WRITAR, 1991). *Code 30.*

Dry Cleaners: On-Site Consultation Audit Report. (Anchorage: Alaska Health Project, 1987). *Code 83.*

Electronics Industry

Printed Circuit Board Manufacturers: Hazardous Waste Reduction Checklist and Assessment Manual. (Sacramento, CA: California Department of Toxic Substances Control, 1991). *Code 55.*

Printed Circuit Board Manufacturing Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1990), Report EPA/625/7-90/007. *Code 77.*

Waste Minimization in the Electronics Products Industries. (Minneapolis, MN: WRITAR, 1991). *Code 30.*

Waste Reduction Strategies in the Printed Circuit Board Industry. (Sacramento, CA: California Department of Toxic Substances Control, 1987). *Code 55.*

Manufacturing Industry

Waste Minimization Assessment For a Manufacturer of Aluminum Cans. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/600/M-91/025. *Code 67.*

Waste Minimization: Manufacturers' Strategies for Success. (Washington, D.C: National Association of Manufacturers, 1989). *Code 66.*

Metals Industry

Electroplating Shop: On-Site Consultation Audit Report. (Anchorage: Alaska Health Project, 1988). *Code 83.*

Fabricated Metal Products Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1990), Report EPA/625/7-90/006. *Code 77.*

Fabricated Metal Products Industry - Waste Audit Study. (Sacramento, CA: California Department of Toxic Substances Control, 1989), Report WA017. *Code* 55.

Metal Finishing Industry: A Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/625/R-92/011. *Code 77.*

Metal Waste Management Alternatives Minimizing, Recycling, and Treating Hazardous Metal Wastes, (Sacramento, CA: California Department of Toxic Substances Control, 1989), Report WRO12. *Code 55.*

Precious Metal Reclamation: Gold, Silver, Platinum, and Other Precious Metal Product and Reclamation. (Sacramento, CA: California Department of Toxic Substances Control, 1990), Report WA018. *Code 55.*

Source Reduction Opportunities in the Metal Plating Industry. (Minneapolis, MN: WRITAR, 1991). *Code 30.*

Waste Minimization Assessment for a Manufacturer of Metal Parts Coating. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/600/M-91/005. *Code 77.*

Waste Minimization for the Metal Finishing Industry. (Sacramento, CA: California Department of Toxic Substances Control, 1991), Report WR024. *Code 55.*

Waste Reduction for Metal Finishers. (Sacramento, CA: California Department of Toxic Substances Control, 1991). *Code 55.*

Paint Manufacturing Industry

General Paints and Painting Supplies. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/600/S-92/054. *Code 77.*

Hazardous Waste Minimization Checklist and Assessment Manual for Paint Formulators. (Sacramento, CA: California Department of Toxic Substances Control, 1991), Report WA025. *Code 55.*

Manufacturer of Artists' Supply Paints. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/600/S-92/045. *Code 77.*

Manufacturer of Paints for Metal Finishing. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/600/S-92/040. *Code 77.*

Paint Manufacturing Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1990), Report EPA/625/7-90/005. *Code 77.*

Paint Manufacturing Industry - Waste Audit Study. (Sacramento, CA: California Department of Toxic Substances Control, 1987), Report WA008. *Code 55.*

Waste Minimization Assessment for a Paint Manufacturing Plant. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/600/M-91/023. *Code 77.*

Photoprocessing Industry

Photoprocessing Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/625/7-90/012. *Code 77.*

Photofinishing Shop: On-Site Consultation Audit Report. (Anchorage: Alaska Health Project, 1989). *Code 83.*

Printing Industry

Commercial Printing Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1990), Report EPA/625/7-90/008. *Code 77.*

Printing Company: On-Site Consultation Audit Report. (Anchorage: Alaska Health Project, 1989). *Code 83.*

Waste Minimization Assessment for a Manufacturer of Printed Labels. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/600/M-91/047. *Code 77.*

Waste Reduction for the Commercial Printing Industry. (Sacramento, CA: California Department of Toxic Substances Control, 1989), Report WA005. *Code 55.*

4.5. General Literature

The following articles, books and reports explore the pollution prevention concept further. Most of the materials are readily available and provide good overviews of the issues involved with pollution prevention.

Canadian Materials:

1. **A Pollution Prevention Strategic Framework for Canada; Draft Discussion Paper (Under Revision). Environment Canada, 1993. (Ottawa: Environment Canada and Industry and Science Canada).** *Code 1.*

   This document is a good introduction into the field of pollution prevention. In part I, it covers the basic questions of "why, what and how" pollution prevention is a better management strategy. The responses to pollution prevention by governments and business are summarized in part II, with a discussion of the various options that exist to further the pollution prevention approach in Canada. Finally, part III consists of a range of supporting information, including pollution prevention efforts in other jurisdictions.

2. **Barriers to Recycling of Hazardous Waste. Technology Resources Inc., 1988. (Toronto), prepared for the Canadian Council of Resource and Environment Ministers.** *Code 6.*

   This document identifies the various barriers to hazardous waste reduction. The authors conclude that the barriers are economic, technological, legislative, informational, attitudinal, and institutional. Each barrier is discussed in some detail, followed by recommendations on how to remove it. Furthermore, this publication reviews existing business waste reduction programs, and summarizes the available technologies for specific hazardous wastes such as phenols, heavy metals, corrosives, and others.

3. **Breaking the Barriers: A Study of Legislative and Economic Barriers to Industrial Waste Reduction and Recycling. V.F. Adamson, 1984. (Toronto: The Canadian Institute for Environmental Law and Policy and the Pollution Probe Foundation), 100 pages.** *Code 4.*

   This report identifies and explains the principal barriers that restrict waste

recycling or reduction activities by business. The barriers include:

- lack of financial incentives;
- waste disposal pricing;
- pollution control standards;
- lack of legislation; and
- lack of awareness and information.

Recommendations to remove each of the barriers are directed to federal and provincial governments, and to businesses.

4. **From Pollution Prevention to Waste Reduction: Toward a Comprehensive Hazardous Waste Strategy for Ontario. D. Macdonald and P. Pickfield, 1989. (Toronto: The Canadian Institute for Environmental Law and Policy), 63 pages.** *Code 4.*

Macdonald and Pickfield provide an overview of Ontario's hazardous waste management policies. Included in this overview is the role of the Ontario Waste Management Corporation (OWMC) and the 1983 Blueprint for Waste Management in Ontario. Following a critical analysis of these elements, MacDonald and Pickfield present proposals for a new integrated hazardous waste management approach. The authors recommend several direct actions for the Ontario Government. Among the recommendations is the enactment of a Waste Reduction Tax Act to provide the legislative authority to tax waste generation. Another recommendation sees the Ontario Government establishing a waste reduction commission with the mandate to (1) develop new source reduction technologies and processes, (2) provide technical assistance to business, and (3) act as a clearinghouse for information on waste reduction. This document further examines issues relating to standards, target dates, enforcement and household hazardous wastes.

5. **Hazardous Waste Reduction: An Overview and a Call for Action. Rick Lindgren, 1988. (Toronto: The Canadian Environmental Law Association).** *Code 29.*

This paper outlines the four barriers to source reduction: economics, regulations, technology and attitudes. Each barrier to employ source reduction is discussed in some detail. Lindgren suggests recommendations for reform

on a federal and provincial level, including:

- a substantial overhaul of the Canadian Environmental Protection Act which would recognize hazardous waste reduction as a explicit goal of the waste management hierarchy;
- reduction targets and timetables for action; and
- requiring periodic preparation of waste audits to identify opportunities for source reduction.

6. **Legislative Jurisdiction over Reduction, Recycling and Disposal of Hazardous Waste. John Tidball, 1988. (Toronto: the Canadian Institute), Conference Proceedings to "Hazardous Waste: Strategies for Efficient Waste Management and Liability Avoidance."** *Code 29.*

There are presently no legislative tools which mandate the reduction of hazardous wastes in Canada. Federal legislation to regulate waste management practices does not exist, although Parts I and II of the Canadian Environmental Protection Act (CEPA) may be used to establish regulatory requirements for hazardous waste management. The article proceeds to explain how these two parts may be applied in the area of hazardous waste reduction. The author also explains Ontario legislation, specifically the Ontario Environmental Protection Act (EPA) and Regulation 309, as well as the Ontario Waste Management Corporation's (OWMC) role and the Environmental Assessment Act (EAA).

7. **Ontario's New Pollution Prevention Program: How to Reap the Awards. T.P. Stopps, 1993. (Toronto: Ministry of Environment and Energy.)** *Code 27.*

This presentation to the 1993 Environmental Compliance Conference provides a brief overview of MOEE's approach to pollution prevention and its *Pollution Prevention Pledge Program (P^4)*. It is a good document to see what the *(P^4)* program is all about, describing each of its *P's*: Registration and Planning; Reduction Commitment, Reduction Achievement; and Pollution Prevention Achievement.

8. **Prescription for Healthy Great Lakes. CIELAP and NWF, 1991. (Toronto: The Canadian Institute for Environmental Law and Policy), 64 pages.** *Code 4.*

This report outlines how to achieve the virtual elimination of persistent toxic substances from the Great Lakes Ecosystem. The report presents two case studies showing how pulp and paper mills and petroleum refineries can implement pollution prevention technologies to achieve virtual elimination. CIELAP's main recommendations are:

- prevent an increase of toxic discharges into the Great Lakes (a "toxics freeze");
- implement toxic use reduction laws in all Great Lakes jurisdictions, with a goal of 50 per cent reduction by 1996 and a 75 per cent reduction by the year 2000; and
- phase-out and ban approximately 70 chemicals from the Great Lakes region.

9. **"The Best Way to Fight Pollution: Prevent It." C. Collins, Canadian Business, March 1991, pp. 52-56.** *Code 62.*

Using Canada's first zero-discharge pulp and paper mill as a backdrop, the article covers the business advantages of employing pollution prevention technologies. The emphasis is shifting more and more to what goes into the plant to prevent pollution. Indeed, one venture capitalists is quoted as saying that "Companies that understand it's not the back end of the pipe but the front - and even before the front - that's the issue [they need] to win. That means redesigning your product so that you don't even have to worry about how you rejig your manufacturing process."

10. **"Where is Industrial Waste Reduction Taking Us?" Glen Monroe, Probe Post, August 1986, pp. 14-18.** *Code 3.*

Although Glen Monroe presents valid arguments in favour of waste reduction, he also points to the fundamental problems associated with waste reduction technologies. He maintains that there is a danger in getting caught in the 'technological fix' situation, while the roots of environmental problems remain unchallenged. An interesting article which examines issues beyond the irrefutable advantages of waste reduction.

U.S. Materials:

1. **"A New Direction for Environmental Policy: Hazardous Waste Prevention, not Disposal." Joseph R. Bidden, Environmental Law Reporter, Vol. XVII, No. 10, 1987.** *Code 9.*

   Written by a candidate for the 1988 Democratic nomination for President, this paper argues that source reduction is a proven success by listing case studies by 3M, DuPont and several smaller corporations. Furthermore, this article criticizes the shortcomings of current laws on hazardous waste minimization, and outlines a specific federal program to encourage waste reduction.

2. **"Corporate Risk Communication: New Challenges for Makers and Users of Toxic Chemicals." M. Baram, 1993. Pollution Prevention Review, Spring 1993, pp. 167-175.** *Code 59.*

   This article provides a review of existing U.S. laws and regulations governing releases of toxins and prevention programs. The author comments on the laws for occupational health and safety, on the Superfund, and on the U.S. Clean Air Act and their achievements with regard to process safety, accident hazards and risk communication. These U.S. statutes require businesses to release information on toxic releases and products to federal, state or local agencies. The availability of this information will likely force firms to reconsider their production processes via pollution prevention methods and risk communication practices and, in effect, improve not only environmental quality, but also human health and safety and corporate image and credibility.

3. **From Pollution to Prevention: A Progress Report on Waste Reduction. U.S. Congress, Office of Technology Assessment, June 1987, Special Report OTA-ITE-347, Washington, D.C.** *Code 16.*

   This Progress Report recommends that a concerted national effort in the reduction of hazardous wastes is the next logical step in environmental protection. Although source reduction has unique and undisputed environmental and economic benefits, many source reduction opportunities remain unused. The application of source reduction proceeds slowly, not because of the lack of technology, but because it is inhibited by organizational and institutional barriers in business and government.

4. **"Going to the Source; The Real Solution to the Toxic Waste Crisis." David Sarokin, Greenpeace Magazine, Vol. 12, No. 1, 1987.** *Code 12.*

Sarokin argues that source reduction obstacles are neither of technological nor of economic nature. Instead, attitude is the major obstacle to applying source reduction, encouraged by a weak regulatory structure and the availability of cheap disposal options. Consequently, the debate among source reduction advocates "...is whether to use the carrot or the stick, or both." That is, should the principal force behind implementing source reduction strategies be extensive legislation or financial and technical assistance, or both? While not answering this important question directly, the author insists that governments must create incentives that will force corporations to consider source reduction as the primary toxic waste management option.

5. **"Let's Get Serious about Pollution Prevention." B. Commoner, EPA Journal, Vol. 15, No. 1, 1989, pp. 15 to 17.** *Code 61.*

Commoner argues that the reorientation of the EPA programs toward pollution prevention rather than pollution control is necessary in order to make a real improvement in environmental quality. Commoner maintains that once the *use* of certain pollutants (DDT, PCB, mercury, lead, etc) had been eliminated, environmental improvements have been achieved. According to Commoner, following the pollution prevention approach also means less bureaucracy, because once pollution is reduced or eliminated, risk assessments, standard setting, negotiations and litigation become increasingly irrelevant. An interesting article which challenges traditional approaches to environmental management.

6. **"Pollution Prevention: An Environmental Goal for the 1990's." W.K. Reilly, EPA Journal, Vol. 16, No. 1, 1990, pp. 4-7.** *Code 61.*

In this article, the former Administrator of EPA summarizes the evolution of the approach toward environmental protection, from pollution control to pollution prevention. With the pollution prevention approach, business has to consider not just how a given product will be used, but also how long it can last and what will happen to it when its useful life is over. The U.S. EPA is supporting state and local pollution prevention activities which encourage fundamental alterations in products. The article summarizes these efforts by the U.S. EPA to further the pollution prevention in the U.S..

7. **"Preventing Pollution in the Chemical Process Industries." R.L. Berglund and C.T. Lawson, Chemical Engineering, September 1991, pp. 120-127.** *Code 32.*

A review of practical requirements for successful pollution prevention programs at chemical-process-industries (CPI) is presented in this paper. Various functional aspects of the manufacturing processes are discussed. These include product design; process design; plant configuration; information and control systems; human resources, research and development; and supplier-customer rapport and organization. The role of each of these aspects is evaluated, and the importance of thinking about pollution prevention at every stage of the production process is stressed. In the final part of the article, the authors provide a list of suggested government actions that would make pollution prevention more attractive.

8. **Prosperity Without Pollution: The Prevention Strategy for Industry and Consumers. J.S. Hirschhorn and K.U. Oldenburg, 1991. (New York: Van Nostrand Reinhold), 386 pages.** *Code 13.*

The authors of this book strongly support the argument that pollution prevention is the best strategy for environmental protection. Pollution problems such as ozone depletion, pesticides, solid waste and household toxics are used as the examples to present opportunities and examine obstacles for pollution prevention. The authors conclude that the adoption of the prevention strategy would represent a major cultural change, and thus it is resisted by many agencies which already committed themselves to the conventional pollution control strategy. The authors argue that changes in human values and behaviour are slower than changes in technology.

9. **Serious Reduction of Hazardous Waste: Summary. Office of Technology Assessment (OTA), 1986. U.S. Congress, Report OTA-ITE-318, (Washington D.C.).** *Code 16.*

In its first major assessment of the source reduction potential, the OTA reached to several significant conclusions:

(1) Even though source reduction is critical to the prevention of future hazardous waste problems, over 99 percent of the U.S. Federal and State environmental spending is devoted to controlling pollution after it has been created.

(2) Source reduction is a practical way to complement the costly pollution control regulatory system.
(3) Establishing a comprehensive, multi-media approach to reducing wastes is essential.
(4) Businesses have not taken advantage of all effective source reduction opportunities that are available.
(5) Although U.S. Federal law says that source reduction is the preferred anti-pollution method, government actions often send different or ambiguous messages to waste generators.
(6) The U.S. federal government must show leadership by providing policy development, education and oversight, and by using a number of legislative tools to encourage the better collection and distribution of information on source reduction.

10. "The Case for Pollution Prevention", J.S. Hirschhorn, EPA Journal, Vol. 15, No. 2, 1989, pp. 50-52. *Code 61.*

Initially, the author ties pollution prevention into a global context; that is, pollution prevention must not only apply for hazardous and toxic waste but also for CFC's, greenhouse gases, household garbage etc.. Subsequently, the author discusses why there has been a limited interest in pollution prevention. He concludes the following:

- pollution prevention shows moral concern for others and concern for individual rights;
- pollution prevention is a threatening concept because it would require major cultural changes;
- the marketplace does not efficiently promote pollution prevention, that is, conventional pollution control shifts long-term environmental costs to the general public; and
- finally, Hirschhorn acknowledges that pollution prevention is not easy to implement.

11. Toxic Substances: Advantages of and Barriers to Reducing the Use of Toxic Chemicals. GAO, 1992. Report # GAO/RCED-92-212, (Washington, D.C.: U.S. General Accounting Office). *Code 5.*

This GAO report provides a quick summary on the environmental and economic benefits of toxics use reduction, barriers to toxics use reduction and

actions taken by U.S. states to encourage firms to reduce their use of toxic chemicals.

12. **U.S. Environmental Protection Agency Pollution Prevention Strategy. U.S. EPA, 1991. (Washington, D.C.: U.S. EPA, Office of Pollution Prevention), 45 pages.** *Code 85.*

This document presents EPA's blueprint for a comprehensive national pollution prevention strategy. It is designed to guide the incorporation of pollution prevention into EPA's existing regulatory and non-regulatory programs, and to set forth a program that will achieve specific objectives through pollution prevention activities within reasonable time frames.

13. **"Waste Reduction: A New Strategy to Avoid Pollution." K.U. Oldenburg and J.S. Hirschhorn, Environment, Vol. 29, No. 2, 1987, pp. 16-45.** *Code 10.*

Following an introduction to the overall concepts and misconceptions of pollution prevention, the article clarifies the definitions of waste reduction, source reduction, waste minimization, and waste reduction at the source, and how these are used by different organizations. The article also analyzes State governments' source reduction activities, concluding that the State governments have been ahead of the Federal government, mainly because the States have taken a non-regulatory approach to pollution prevention by focusing on educating business through information, technology transfer and offering research grants.

4.6. Periodicals and Newsletters

1. At The Source. Produced by the Great Lakes Pollution Prevention Centre, this quarterly newsletter highlights pollution prevention and provides up-to-date information on basin-wide activities. A mixture of pollution prevention success stories, program summaries, announcements and updates, At The Source is available free of charge from the Centre. *Code 47.*

2. Cleaner Production. A newsletter produced by the United Nations Environment Programme (UNEP), this periodical summarizes international activities related to cleaner production. Appearing twice a year, it includes information about government activities, business activities, and the UNEP cleaner production working groups. *Code 14.*

3. EPA Pollution Prevention News. A monthly publication which examines U.S. initiatives in the pollution prevention field. This periodical reviews current legislative efforts to increase source reduction practices, and includes conference listings and reviews on businesses employing source reduction. *Code 85.*

4. Everyone's Backyard. Published by the Citizens Clearinghouse Hazardous Wastes Inc. (CCHW), the Everyone's Backyard represents the "public action" vehicle for this grassroots organization. It calls for boycotting products, keeps the reader updated on hazardous waste issues in each U.S. state, lists conferences and conventions, and includes a catalogue of their 50+ publications, most of which focus on hazardous waste issues. *Code 72.*

5. Hazardous and Solid Waste Minimization & Recycling Report. Published by Government Institutes Inc., this monthly periodical features a wealth of practical ideas for business to implement waste minimization. Usually, several reports from the federal, state and international waste reduction efforts are included. Other features which make this newsletter exceptionally useful include: case studies (examining economic and environmental benefits resulting from source reduction), recycling news, waste minimization tips, technical notes and a calendar of events. *Code 21.*

6. Hazardous Materials Management Magazine. Billing itself as "the Canadian Publication of Pollution Prevention and Control," this bi-monthly journal covers a range of issues associated with pollution prevention and control. From legal analyses to the latest in pollution prevention technologies, Hazardous Materials Management may be good investment for any Canadian business having to manage waste materials. *Code 70.*

7. MnTAP Source Newsletter. Produced by the Minnesota Technical Assistance Program, this newsletter provides updates primarily on Minnesota pollution prevention activities with regard to technological changes. *Code 82.*

8. Pollution Prevention Alliance Newsletter. Published by the U.S. Environmental Defense Fund, the newsletter is an update on pollution prevention activities from the perspective of environmental groups. *Code 90.*

9. Pollution Prevention Review. This U.S. quarterly is a very useful publication covering regulatory developments, technology changes and business-specific case studies of pollution prevention activities. The Pollution Prevention Review usually includes very detailed articles. *Code 59.*

10. TURA Reports: News of the Massachusetts Toxics Use Reduction Act. Newsletter prepared by the Toxics Use Reduction Institute as a periodic reporting on the progress of the Toxics Use Reduction Program in MA. *Code 92.*

11. Waste Reduction Bulletin. Published by the Ontario Waste Management Corporation, the Waste Reduction Bulletin is a periodical promoting hazardous waste reduction. The publication profiles upcoming events, new production processes, waste exchange programs, public funding for waste reduction operations, and details on how to obtain information regarding waste reduction. The Bulletin appears three times a year and is free for anyone interested. *Code 26.*

12. Wastewater Technology Centre Newsletter. As a bilingual publication of Environment Canada's Wastewater Technology Centre, the Newsletter focuses on research in the areas of direct sources, water treatment facilities, chemical and physical pollution, and regulatory frameworks. Its articles assume a high degree of technical understanding. The Newsletter is published quarterly. *Code 71.*

4.7. Videos

Dow Chemical's Waste Minimization Program. Two videos describing Dow's waste minimization efforts. *Code 69.*

Dupont's Waste Minimization. A vidoes which outlines some of Dupont's efforts in waste minimization. *Code 69.*

Beyond Business as Usual: Meeting the Challenge of Hazardous Waste. Uses success stories from business and governments to explain the benefits of source reduction. *Code 61.*

In Partnership with the Earth: The Future of the Environment. A collaborative effort by business, environmental groups and the EPA, this video describes the emerging effort to change our emphasis from pollution control to pollution prevention. Includes several success stories from 3M, General Motors and others. *Code 61.*

Less is More: Pollution Prevention is Good Business. Produced by the U.S. Environmental Protection Agency, this video consists mostly of success stories of small and large corporations. *Code 61.*

Mission Impossible: Introduction to the Pollution Prevention Clearinghouse. Describes in detail the U.S. EPA's clearinghouse dedicated to promoting pollution prevention. The video includes an overview of the Clearinghouse components and a training session on how to access an use the Electronic Information Exchange system (48 min.), *Code 85.*

Money Down the Drain. Five manufacturers tell how they have used waste reduction as an industrial policy. Ontario Waste Management Corporation, 1991, 17 min. *Code 26.*

Negawatts - A Goldmine of Opportunity. Describes how corporations can apply energy-efficiency programs in their operations and save significant energy costs (20 mins). *Code 87.*

Pollution Prevention: The Bottom Line. Produced in association with the U.S. EPA, this video includes interviews with officials of major international corporations on how they have increased profits by applying pollution prevention. The video has received the endorsement of the United Nations Environment Programme (24 min). *Code 88.*

The Competitive Edge. This video explains the six steps in a waste audit and is an excellent tool to acquaint employees with the auditing process. Ontario Waste Management Corporation, 1991, 18 min. *Code 26.*

3M's Pollution Prevention Pays Program & Challenge to Innovation. Two videos describing 3M's achievements in pollution prevention (9 min. each). *Code 61.*

Waste Not: Reducing Hazardous Waste. In a series of profiles, this video examines activities and programs businesses have undertaken to reduce and eliminate hazardous waste (35 min). *Code 89.*

Section 5: SUCCESS STORIES

Table of Contents

5. SUCCESS STORIES

Many companies have recognized the economic and environmental potential of pollution prevention. Indeed, from the smallest to the biggest, there are many companies in Canada and the U.S. who have invested time and money to make pollution prevention part of their corporate agenda. This section summarizes several success-stories.

5.1. Inventories of Success Stories

The following books and reports contain many success stories of pollution prevention activities.

1. **Pollution Prevention Case Studies Compendium. J. Springer, 1992. Report EPA/600/R-92/046, (U.S. EPA: Office of Research and Development), 100 pages.** *Code 85.*

   This is an impressive collection of pollution prevention case studies and research projects which have been undertaken via government-business partnerships in the U.S.. Each case study or demonstration project is fully described, including technology or process changes, reductions in the generation of pollutants, savings in costs, contact names, addresses and further information sources. A broad array of facilities are included, from hospitals and school boards to chemical business and military bases.

2. **"Pollution Prevention: The Chevron Story." G. Karras, Environment, Vol. 31, No. 8, 1989, pp. 4-5.** *Code 10.*

   In an innovative settlement of a permit challenge by local citizens, Chevron USA used pollution prevention to cut metal discharges into San Francisco. This article summarizes the changes in Chevron's petroleum refinery which were undertaken.

3. **Proven Profits from Pollution Prevention; Case Studies in Resources Conservation and Waste Reduction. The Institute for Local Self-Reliance, 1989. (Washington, D.C.: The Institute for Local Self-Reliance), 316 pages.** *Code 20.*

The heart of this book summarizes case studies from over 18 U.S. industry sectors, giving at least one example of waste reduction for each sector. The waste reduction efforts specify annual savings, pay-back time of capital costs, implementation time and technical detail. In addition, each example describes "process dimensions", which entail product quality change, net benefits, and down time due to process changes. The publication concludes with recommendations to increase waste reduction utilization, and an inventory of the regulatory, economic and informational barriers which prevent extensive waste reduction applications in business and agriculture.

4. **"Waste Reduction: It's Working for These Four." Tracy Patterson, Water & Pollution Control, April 1989.** *Code 18.*

This article describes examples of how waste reduction has succeeded for four Ontario companies. The information about the production changes and resulting financial benefits is described in non-specific terms, but this part only serves to make the point that source reduction is a growing trend. Most importantly, the article tabulates 11 different sources of help that businesses can approach for financial and technical assistance programs, most of which are in Ontario.

5. **Waste Minimization Case Studies. Government Institutes, 1991. (Rockville, M.D.: Government Institutes), 290 pages.** *Code 21.*

This collection of 68 case studies show first-hand how small and large companies have established pollution prevention programs and systems. Part I contains both technical and strategic insights into waste reduction programs by Kodak, DuPont, Hewlett Packard, and others. Part 2 provides case studies on a sectoral basis, including paint manufacturing, fabricated metals, commercial printing, etc..

6. **"Waste Reduction Through Material and Process Substitutions: Progress and Problems Encountered in Industrial Implementation." L.C. Gardner and D. Huisingh, Hazardous Waste and Hazardous Materials, Vol. 4, No. 1, 1987.** *Code 19.*

The article presents eleven examples of successful material and process substitutions for chlorinated, caustic or acidic cleaners and degreasers; toxic metals; and organic-based inks, paints and solvents.

5.2. Examples of Success Stories

Chemical Industry

Ashland Chemicals, Mississauga

The Ontario chemicals company needed to look at waste reduction because an incinerator in its vicinity closed down. As a result, Ashland reduced water consumption, separated and reused material previously discharged, and recycled samples back into the production process. These actions resulted in a reducing Ashland's waste by over 30 tonnes per year, the company estimates that over $600,000 has been saved between 1985 and 1990 because of improved plant efficiency and reduced treatment costs. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), pp. 89-93.

Essex Specialty Products, London

This Ontario adhesives manufacturer received the 1992 *Outstanding Waste Reduction Performance Award* from the Ontario Waste Management Corporation (OWMC). Since 1988, the company has cut its hazardous waste by 95 per cent. Savings in material and disposal costs for 1991 are expected to exceed $160,000. Essex reduced waste by re-using samples, recycling materials in filters, and replacing organic solvents. See also Appendix 3 for more details. Reference: Staddon, C. "Adhesives Manufacturer wins 3Rs Award." Waste Reduction Bulletin, January 1992, pp.1-2.

3M, Worldwide

The 3M company has been a leader in pollution prevention since 1975. The combined total of almost 1,900 projects internationally has resulted in the annual elimination of almost 400,000 tonnes of pollutants! Between 1975 and 1989, the company reduced its pollution by 50% per unit of production and saved $500 million doing so. In an Ontario tape manufacturing plant, for example, 3M reduced their waste requiring disposal from 2,800 tonnes/year to 115 tonnes/year. Reference: D. Benforado, "Pollution Prevention as Corporate Policy: A Look at the 3M Experience." The Environmental Professional, Vol. 11, 1989, pp. 117-126.

Electronics Industry

Data General, North Carolina

In making circuit boards, Data General generated used solvents, plating baths and contaminated process water. By spending $50,000 on pollution prevention equipment, the company reduced its waste by about 400 tonnes a year. Moreover, the cost savings amounted to $80,000/year for waste disposal and $100,000/year for pollution control. Other benefits included 75 per cent less down time, and reduced costs for raw materials. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), p.17

Northern Telecom, Bramalea

Through an extensive research program, Northern Telecom found substitutes for CFC cleaning agents and in December of 1991, was the first telecommunications company in the world to completely phase-out CFCs. As a result, Northern Telecom expects to save almost $50 million by the year 2000. See also Appendix 3 for more details. Reference: "Northern Telecom Eliminates CFCs at Bramalea Plant." Waste Reduction Bulletin, OWMC, January 1992, p. 5.

Manufacturing Industry

Canadian Meter Co., Milton

Canadian Meter Co. replaced throw-away cardboard filters with reusable metal ones for its painting operation. Now Canadian Meter Co. and saves over $10,000 in disposal costs annually. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), p. 32.

Chrysler Canada, Windsor

In the last five years, Chrysler Canada minimized its use of solvents through process modernization and substituted some oil-based solvents with water-based ones. The company reduced its waste to such a degree that it won the Waste Reduction Award from the Ontario Waste Management Corporation in 1993. Reference: "OWMC

Honors Waste Reduction Achievements." Waste Reduction Bulletin, OWMC, December 1992, p.1.

Kinred Industries, Midland

This manufacturer of stain-less steel sinks installed a waste reduction process which reduced its sludge generation by 50 per cent at a cost of $8,000. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), p. 33.

Metal Plating and Finishing Industry

G.G. Buffing and Plating, Montreal

This plating company has installed several waste reduction systems, including a chemical recovery system and an acid purification system. The company now saved over $17,000/year in disposal and recovery costs, and its products have achieved a higher quality. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), pp. 86-89.

Sun Polishing and Plating, Toronto

This plating company installed an electrolytic recovery system, provided by BEWT Metal Recovery of Whitby, to recycle the nickel from its wastewater stream. The system recovers 18 kg of nickel each week and can recover silver, gold, copper and cadmium as well. The pay-back period for its investment is estimated to be five years. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), p. 66.

Western Forge Plating, Colorado

The Colorado Springs company manufactures high-quality hard tools and operates a nickel plating system. It installed an acid purification unit and reduced its nitric acid consumption by 60-70 per cent. The pay-back period is 2.5 years since the

equipment costs $14,000, but $6,000 are being saved annually on nitric acid costs. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), p. 75.

Printing Industry

Kitchener-Waterloo Record, Kitchener

Over the last two decades, the newspaper installed a range of waste reduction systems. From paper and aluminum recycling to silver and ink recovery systems, the Record has continuously set an example in its efforts to reduce waste. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), p. 93-95.

RBW Graphics, Owen Sound

This printing company installed recovery systems for paper, ink, silver and solvents at a cost of $100,000. As a result, each year over 35,000 kg of ink are diverted from hazardous waste landfill and the company saves $280,000. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), p. 35.

Toronto Star Newspaper, Toronto

Through its ink recycling program, the Toronto Star saved $15,000/year in disposal costs and $40,000/year in ink savings, while releasing fewer toxics into the environment. Reference: A Framework for Pollution Prevention. Environment Canada, 1993. (Ottawa: Supply and Services), Appendix 2.

Other Industries

Phillips Paint Products, Winnipeg

After being in business for 55 years, Phillips discontinued its use of toxic isocyanate by developing a superior, but more environmentally friendly alternative. Its research lasted for over 18 months, but the company now receives over one-quarter of its revenue from the new product. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), p. 26.

Thru Blu, Minnesota

This leather-making facility established an in-process recycling facility for chromium. With its old system, Thru Blu discharged nearly $1,200 worth of chromium per month down the drain. After investing $1.2 million to recover the chromium, wastes were reduced by 99 per cent, and annual savings amounted to $510,000. This resulted in a pay-back period of two years. Reference: Luppino, T. Guide to Pollution Prevention in Your Community. (Buffalo: Great Lakes United, 1992), p. 44.

Twinpack, Brantford

In 1990, Twinpack turned to the Ontario Waste Management Corporation for help in improving its production process. Following a thorough audit, Twinpack and OWMC employees installed glue recycling facilities. This reduced waste disposal costs by $12,000 and allowed the company to re-use some 35,000 kg of glue. See also Appendix 3 for more details. Reference: Michalowicz, R. "Audit shows packaging company best way to cut waste." Waste Reduction Bulletin, OWMC, July 1991, p. 8/9.

Winnipeg Photo Limited, Winnipeg

This family-owned film processing and printing business installed an electrolytic recovery system for silver, as well a recovery systems for developer and other chemicals. In doing so, the company has significantly decreased its costs while reducing chemical effluent by 70 per cent. Reference: Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). G. Munroe, W. Bradley, and F. Neuber, 1990. (Toronto: Pollution Probe Foundation), pp. 95-97.

6. TRAINING COURSES

1. Alaska Health Project. *Code 83.*

The "Industrial Waste Reduction" curriculum has been developed for environmental engineers, covering audits, technologies, regulations (U.S.) and worker health and safety. Divided into 15 sessions of 2 hours and 40 minutes each, the curriculum is designed for a three-credit college course.

2. Alternative Technology Division. *Code 55.*

The Alternative Technology Division of the California Department of Health Services has developed three pollution prevention training modules. Each module consists of a workbook and a supporting video:
Module 1: Introduction to waste minimization
Module 2: Waste Minimization Assessment Procedures
Module 3: Training on Waste Minimization for the Metal Finishing Sector.

3. Canadian Standards Association (CSA). *Code 78.*

The CSA offers training courses mainly related to environmental management. Its National Environment Workbook Series (NEWS) contains 8-12 page booklets which describe various aspects of the components of an environmental management system. The NEWS series in interactive and hands-on.

4. Centre for Industrial Services (CIS). *Code 91.*

This Nashvill, Tennessee Center sponsors an extensive waste reduction assessment training program which includes indepth waste reduction assessment courses. The purpose is to develop highly skilled waste reduction engineers and managers.

5. Great Lakes Pollution Prevention Centre. *Code 47.*

The Great Lakes Pollution Prevention Centre in Sarnia provides customized training seminars to show how to integrate pollution prevention planning into organizational strategies and everyday practices. One series of training seminars focuses on municipal pollution prevention.

6. The Ontario Waste Management Corporation. *Code 26.*

The OWMC offers training courses on various waste reduction activities, such as auditing and identifying opportunities. They are held in various locations throughout Ontario.

7. Northeast Waste Management Officials Association (NEWMOA). *Code 93.*

NEWMOA offers several pollution prevention training opportunities. In particular, its "Costing and Financial Analysis of Pollution Prevention Projects" provides a training packet to introduce the concepts and methods for conducting financial analyses of pollution prevention projects.

8. Toxics Use Reduction Institute. *Code 92.*

The Institute has developed a "Curriculum for Toxics Use Reduction Planners" to train officials in analysing toxics-use-reduction plans.

9. Pollution Prevention Training Opportunities in 1991. U.S. Environmental Protection Agency, Office of Research and Development, EPA/600/R-92/175, October 1992. *Code 85.*

Updated regularly, this guide contains information about publicly sponsored training opportunities and resources. It covers seminars and workshops, as well as hardcopy and video training materials, and provides contact information for state and federal pollution prevention programs.

10. Waste Reduction Institute. *Code 30.*

(1) Centre for Excellence in Pollution Prevention Training:

WRITAR has established a new national pollution prevention training center in Minneapolis, MN to meet the growing and diverse needs of professionals involved in promoting and implementing waste reduction practices.

The Centre will develop and deliver state-of-the-art training programs for industry, regulatory agency, consultant, and training audiences tailored to their specific needs. The Centre's training program areas are:

- building training capacity and materials -- "train the trainer"
- pollution prevention assessment and implementation
- technical content
- regulatory integration

(2) Community-Based Pollution Prevention Planning:

In conjunction with the Community-based Remedial Action Plan process, WRITAR will be working with two Great Lakes areas of concern in an innovative pilot program to plan and design community-wide pollution prevention strategies. WRITAR will assist local committees in these communities to identify industrial, residential, consumer, transportation and institutional pollution sources, develop long-term prevention strategies and help build the partnerships and resources needed to implement them.

(3) National Pollution Prevention Training Plan:

WRITAR has been commissioned by the US Environmental Protection Agency to develop a national strategy for future development and delivery efforts in pollution prevention training. Primary emphasis will be placed on identifying unmet training needs, ways to leverage existing investments in training, and strategies to tap the expertise and contributions of "unconventional" professional networks (such as logistics engineers, quality experts, and production and inventory control specialists) for purposes of promoting waste reduction excellence.

11. **Pollution Prevention: Homework & Design Problems for Engineering Curricula. D. Allen, N. Bakshani, and K. Rosselot, 1992. (New York: American Institute of Chemical Engineers), 155 pages.** *Code 94.*

12. **Incorporating Pollution Prevention Concepts in Higher Education Curricula: An Interactive Seminar for Faculty of All Disciplines. WRITAR, 1991.** *Code 30.*

13. **Pollution Prevention: Work Environment, Community, Physical Environment. A three hour worker education program., Canadian Labour Congress, 1993. (Ottawa: Canadian Labour Congress), 37 pages.** *Code 95.*

14. **Pollution Prevention and Higher Education Curricula - Seminar for Post-Secondary Educators of All Disciplines. Minnesota Office of Waste Management and WRITAR, 1991.** *Code 30.*

7. CONFERENCES

1. Canadian Standards Association (CSA). *Code 96.*

While not specifically geared towards pollution prevention, the CSA organizes conferences on environmental management for businesses. For example, during 1993 and 1994, the Canadian Standards Association offers a 3-day seminar through the country called "How to Successfully Respond to Environmental Concerns."

2. Great Lakes Pollution Prevention Centre. *Code 47.*

The Centre offers various types of conferences and workshops. The Centre provides customized training seminars, technical assistance to identify and implement pollution prevention activities, workshops with municipalities, and conferences on pollution prevention programs and activities in the Great Lakes Basin.

3. International Joint Commission (IJC). *Code 97.*

The IJC is a bi-national body which, among other ducties, oversees the implementation of the U.S.-Canada Great Lakes Water Quality Agreement. The Commission has promoted pollution prevention in the past and organizes a number of different conferences and workshops. Its largest event is its biennial meeting last held in Windsor in 1993. The biennial meeting brings together scientists, governments, industries and environmental groups for a lively debate on Great Lakes issues.

4. MidWest Roundtable on Pollution Prevention. *Code 47.*

Organized by Region V of the U.S. EPA and the Great Lakes States, the roundtable is accessible to Canadian participants. Its purpose is to assist government, industry and the public to implement pollution prevention strategies.

5. MOEE's Pollution Prevention Conference. *Code 27.*

Every spring, the Ontario Ministry of Environment and Energy holds its annual Pollution Prevention Conference. Topics range from an update of Ontario policies and programs, to recent technology developments and technology transfer.

6. MOEE's Technology Transfer Conference. *Code 51.*

Every fall, the Ontario Ministry of Environment and Energy holds its annual Technology Transfer Conference. The goal of the conference is to introduce the latest environmental technologies to Ontario businesses and to provide opportunities for businesses to establish and develop key alliances.

7. Office of Waste Reduction Services. *Code 98.*

The Michigan Department of Natural Resources (DNR) organizes frequent waste reduction seminars and and annual roundatable of pollution prevention.

Appendix 1:

CODES AND SOURCES

Below are the addresses and phone numbers for the materials listed in the above chapters.

83. Alaska Health Project
1818 West Northern Lights
Suite 103
Anchorage, Alaska
99517 U.S.A.
(907) 276-2864

94. American Institute of Chemical Engineers
Publications Department
345 East 47th Street
New York, New York
10017 U.S.A.
(212) 705-7407

15. ARET Secretariat
National Office of Pollution Prevention
Environment Canada
351 St. Joseph Blvd.
Hull, Quebec
K1A 0H3
(819) 953-7819

55. California Department of Toxic Substances Control
Alternative Technology Division
400 P Street, 4th Floor
P.O. Box 806
Sacramento, CA
95812-0806 U.S.A.
(916) 322-3670

62. Canadian Business
CB Media Ltd.
70 the Esplanade
2nd Floor
Toronto, Ontario
M5E 1R2
(416) 364-4266

6. The Canadian Council Ministers
of the Environment
326 Broadway, Suite 400
Winnipeg, MB
R3C 0S5
(204) 948-2090

99. Canadian Environmental Industries Association
401 Richmond Street West
Suite 139
Toronto, Ontario
M5S 1L6
(416) 598-7901

29. The Canadian Institute
1329 Bay Street, 3rd Floor
Toronto, Ontario
M5R 2C4
(416) 927-0718

4. The Canadian Institute
for Environmental Law and Policy
517 College Street, Suite 400
Toronto, Ontario
M6G 4A2
(416) 923-3529

95. Canadian Labour Congress
Department of Workplance Health,
Safety and Environment
2841 Riverside Dr.
Ottawa, Ontario
K1V 8X7
(613) 526-7418

8. Canadian Environmental Law Association
517 College Street, Suite 401
Toronto, Ontario
M6G 4A2
(416) 960-2284

78. Canadian Standards Association
178 Rexdale Blvd.
Toronto, Ontario
M9W 1R3
(416) 747-4155

96. Canadian Standards Association
178 Rexdale Blvd.
Toronto, Ontario
M9W 1R3
(416) 747-4235

67. Centre for Environmental Research Information
Environmental Protection Agency
Office of Research and Development
3235 Omni Drive
Cincinnati, Ohio
45245 U.S.A.
(513) 752-2950

91. Centre for Industrial Services
University of Tennessee
226 Capitol Boulevard Building
Suite 606
Nashville, Tennessee
37219 U.S.A.
(615) 242-2456

32. Chemical Engineering
1221 Ave. of the Americas
43rd Floor
New York, New York
10020 U.S.A.
(212) 512-2000

65. Chemical Manufacturers Association
2501 M Street, N.W.
Washington, D.C.
20037 U.S.A.

(202) 887-1100

72. Citizens Clearinghouse for Hazardous Wastes, Inc.
P.O Box 6806
Falls Church, Virginia
22040 U.S.A.
(703) 237-2249

88. Coastal Video
3083 Brickhouse Court
Virginia Beach, Virginia
23452 U.S.A.
(800) 767-7703

57. Division of University Studies
North Carolina State University
Raleigh, NC
27695-7107 U.S.A.
(919) 737-2470

41. D-RECT Program
Technology Development Branch
Environment Canada
351 St. Joseph Blvd.
Hull, Quebec
K1A 0H3
(819) 953-7827

25. Energy Pathways Inc.
251 Laurier Ave. West
Suite 500
Ottawa, Ontario
K1P 5J6
(613) 235-7976.

38. Energy Research and Development
Ministry of Environment and Energy
56 Wellesley St. West
Toronto, Ontario
M7A 2B7
(416) 327-1255

10. Environment
Heldref Pubs.
1319 18th Street, NW
Washington, D.C.
20036-1802 U.S.A.
(202) 296-6267

23. Environment Canada
Ontario Region
Pollution Prevention Branch
25 St. Clair Avenue East, 9th floor
Toronto, Ontario
M4T 1M2
(416) 973-1162

33. Environment Canada
Ontario Region
Pollution Prevention Branch

25 St. Clair Avenue East, 9th floor
Toronto, Ontario
M4T 1M2
(416) 973-3347

39. Environmental Affairs Branch
Industry and Science Canada
235 Queen Street
Ottawa, Ontario
K1A 0H5
(613) 954-3242

54. Environmental Affairs
Canadian Manufacturer's Association
130 Albert St., Suite 302
Ottawa, Ontario
K1P 5G4
(613) 233-8423

49. Environmental Business Development Unit
Policy and Intergovernmental Affairs
Ministry of Environment and Energy
135 St. Clair Ave. West, 4th Floor
Toronto, Ontario
M4V 1P5
(416) 323-4219

68. The Environmental Defense Fund
2606 Dwight Way
Berkeley, California
94704 U.S.A.
(415) 548-8906

90. Environmental Defense Fund
Pollution Prevention Alliance
1875 Connecticut Ave., Suite 1016
Washington, D.C.
20009 U.S.A.
(202) 387-3500

35. Environmental Innovations Program
Science and Professional Service Directorate
Supply and Service Canada
12C1, Phase III, Place du Portage
Hull, Quebec
K1A 0S5
(819) 956-1781

9. Environmental Law Reporter
The Environmental Law Institute
1616 P Street N.W., Suite 200
Washington, D.C.
U.S.A. 20036
(202) 328-5150

40. Environmental Technologies Section
Research and Technology Branch
Ministry of Environment and Energy
135 St. Clair Ave. West, 12th Floor
Toronto, Ontario

M4V 1P5
(416) 323-4476

59. Executive Enterprises Publications Co., Inc.
22 West 21st Street
New York, New York
10010-6990 U.S.A.
(212) 645-7880

51. Fiscal Planning and Information Management Branch
Ministry of Environment and Energy
135 St. Clair Ave. West
Toronto, Ontario
M4V 1P5
(416) 323-4649

21. Government Institutes Inc.
4 Research Place, Suite 200
Rockville, MD
20850 U.S.A.
(301) 921-2355

16. Government Printing Office
P.O. Box 371954
Pittsburgh, PA
15250-7954 U.S.A.
(202) 783-3288

42. Great Lakes Cleanup fund
Science and Integrated Programs Directorate
Environment Canada
867 Lakeshore Road
Burlington, Ontario
L7R 4A6
(905) 336-6276

47. Great Lakes Pollution Prevention Centre
265 North Front Street
Suite 112
Sarnia, Ontario
N7T 7X1
(519) 337-3423
1-800-667-9790

58. Great Lakes Protection Fund
35 East Wacker Dr.
Suite 1880
Chicago, Illinois
60601 U.S.A.
(312) 201-0660

12. Greenpeace
185 Spadina Avenue
Toronto, Ontario
M5T 2C5
(416) 345-8408

70. Hazardous Materials Management Magazine
401 Richmond Street West
Suite 139

Toronto, Ontario
M5V 1X3
(416) 348-9922

19. Hazardous Waste and Hazardous Materials
Mary Ann Liebert Inc.
1651 Third Avenue
New York, New York
10128 U.S.A.
(212) 289-2300

74. The Hazardous Waste Research and Information Center
#1 E. Hazelwood Drive
Champaign, IL
61820 U.S.A.
(217) 333-8940

45. Industrial 3R's Funding Unit
Waste Management Branch
Ministry of Environment and Energy
2 St. Clair Ave. West, 14th Floor
Toronto, Ontario
M4V 1L5
(416) 323-5182

17. INFORM Inc.
381 Park Avenue South
New York, New York
10016 U.S.A.
(212) 689-4040

43. Innovation Ontario
56 Wellesley St. West
7th Floor
Toronto, Ontario
M7A 2E7
(416) 326-1190

52. Innovators Program
Efficiency and Alternative Energy Branch
Energy, Mines and Resources
580 Booth St.
Ottawa, Ontario
K1A 0E4
(613) 995-6838

20. The Institute for Self-Reliance
2425 18th Street, NW
Washington, D.C.
20009 U.S.A
(202) 232-4108

97. International Joint Commission
100 Ouellette Ave.
Windsor, Ontario
N9A 6T3
(519) 256-7821

11. Lake Superior Pollution Prevention Program
1194 Dawson Rd.

RR. 12
Thunder Bay, Ontario
P7B 5E3
(807) 768-2102

69. The Local Government Commission
909 12th Street, Suite 203
Sacramento, California
95814 U.S.A.
(916) 448-1198

22. The LURA Group
3 Church Street
Suite 400
Toronto, Ontario
M5E 1M2
(416) 863-6777

46. Ministry of Environment and Energy
56 Wellesley St. West
14th Floor
Toronto, Ontario
M7A 2B7
(416) 327-1440

82. Minnesota Technical Assistance Program (MnTAP)
1313 5th Street, S.E.
Suite 207
Minneapolis, MN
55414 U.S.A.
(612) 627-4555

28. Municipal-Industrial Strategy for Abatement
Ministry of Environment and Energy
135 St. Clair Ave. West
Toronto, Ontario
M4V 1P5
(416) 323-4915

66. National Association of Manufacturers
1331 Pennsylvania Ave. N.W.
Washington, D.C.
20004-1790 U.S.A.
(202) 637-3000

31. National Environmental Law Center
29 Temple Place
Boston, MA
02111 U.S.A.
(617) 422-0880

1. National Office of Pollution Prevention
Environment Canada
351 St. Joseph Blvd.
Hull, Quebec
K1A 0H3
(819) 953-7819

24. National Pollutant Release Inventory
Environment Canada

351 St. Joseph Blvd.
Hull, Quebec
K1A 0H3
(819) 953-1654

34. National Research Council of Canada
Building M-55, Montreal Road
Ottawa, Ontario
K1A 0R6
(613) 993-1790

37. Natural Sciences and Engineering Research Council of Canada
200 Kent Street
Ottawa, Ontario
K1A 1H5
(613) 995-6295

2. New Solutions
P.O. Box 281200
Lakewood, Colorado
80228 U.S.A.
(303) 987-2229

93. Northeast Waste Management Officials Association (NEWMOA)
85 Merrimac Street
Boston, MA
02114 U.S.A.
(617) 367-8558

98. Office of Waste Reduction Services
Environmental Services Division
Michigan Department of Natural Resources
116 West Allegan Street
P.O. Box 30004
Lansing, Michigan
48909-7504 U.S.A.
(517) 335-1178

56. Ontario Hydro
700 University Ave.
Toronto, Ontario
M5G 1X6
1 (800) 263-9000

44. Ontario Technology Fund
Ministry of Economic Development and Trade
56 Wellesley St. West, 15th Floor
Toronto, Ontario
M7A 2E7
(416) 314- 8208

26. Ontario Waste Management Corporation
2 Bloor St. W., 11th Floor
Toronto, Ontario
M4W 3E2
(416) 923-2918 or 1 (800) 268-1178

50. ORTECH International
2395 Speakman Dr.
Mississauga, Ontario

L5K 1B3
(905) 822-4111 ext. 656 or 354

85. Pollution Prevention Information Clearinghouse (PPIC)
U.S. EPA
401 M. Street, SW, PM-211A
Washington, D.C.
20460 U.S.A.
(202) 260-1023

27. Pollution Prevention Office
Ministry of Environment and Energy
135 St. Clair Ave. West
Toronto, Ontario
M4V 1P5
(416) 323-5072

76. Pollution Prevention Pays Program
North Carolina Department of Environment
Health and Natural Resources
P.O. Box 27687
Raleigh, NC
27611-7687 U.S.A.
(919) 571-4100

77. Pollution Prevention Research Branch
Center for Environment Research Information
26 West Martin Luther King Drive
Cincinnati, Ohio
45268 U.S.A.
(513) 569-7562

3. The Pollution Probe Foundation
12 Madison Avenue
Toronto, Ontario
M5R 2S1
(416) 926-1907

80. Report EPA 832B-92-001
U.S. Environmental Protection Agency
Office of Water
401 M. Street S.W., WH-546
Washington, D.C.
20460 U.S.A.
(202) 260-7786

36. Research and Technology Branch
Ministry of Environment and Energy
135 St. Clair Ave. West, 5th Floor
Toronto, Ontario
M4V 1P5
(416) 323-4554

87. Rocky Mountain Institute
1739 Snowmass Creek Road
Snowmass, Colorado
81654-9199 U.S.A.
(303) 927-3851

75. Solid and Hazardous Waste Education Centre

University of Wisconsin
610 Langdon Street
Madison, WI
53703 U.S.A.
(608) 562-0385

73. Stewardship Information Bureau
University of Guelph
Research Park Centre
150 Research Lane, Suite 104
Guelph, Ontario
N1G 4T2
(519) 767-5020

48. Technology Transfer and Training Division
Technology Development Branch
Environment Canada
351 St. Joseph Blvd.
Hull, Quebec
K1A 0H3
(819) 953-9364

92. Toxics Use Reduction Institute
University of Lowell
One University Avenue
Lowell, MA,
01854 U.S.A.
(508) 934-3250

89. Umbrella Films
60 Blake Road
Brookline, MA
02146 U.S.A.
(617) 277-6639

14. UNEP Industry and Environment Office
Tour Mirabeau
39/43 qaui Andre Citroen
75739 Paris Cedex 15
France

81. U.S. Department of Commerce
National Technical Information Service
Springfield, VA
22161 U.S.A.
(703) 487-4650

7. U.S. Environmental Protection Agency
Public Information Center
Carborundum Centre
345 Third Street, Suite 530
Niagara Falls, N.Y.
14303 U.S.A.
(716) 285-8842

61. U.S. Environmental Protection Agency
Public Information Office
401 M. Street S.W. 3404
Washington, D.C.
20460 U.S.A.

(202) 260-2080

5. U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD
20877 U.S.A.
(202) 512-6000

13. Van Nostrand Reinhold
115 Fifth Avenue
New York, New York
10003 U.S.A.
(212) 254-3232

60. Waste Advantage Inc.
17117 West Nine Mile Road
Suite 902
Southfield, Michigan
48075 U.S.A.
(313) 569-8150

79. Waste Reduction Assistance Program
Oregon Department of Environmental Quality
Hazardous and Soild Waste Division
811 S.W. Sixth Avenue
Portland, Oregon
97204 U.S.A.
(503) 229-5696

53. Wastewater Technology Centre
RockCliffe Research Management Inc.
867 Lakeshore Road
P.O. Box 5068
Burlington, Ontario
L7R 4L7
(905) 336-4855

71. Wastewater Technology Centre Newsletter
Wastewater Technology Centre, P.O. Box 5068
867 Lakeshore Road
Burlington, Ontario
L7R 4L7
(905) 336-4588

18. Water and Pollution Control
190 Main Street
2nd Floor
Unionville, Ontario
L3R 2G9
(905) 887-4813

30. WRITAR
1313 5th Street SE
Minneapolis, MN
55414-4502 U.S.A.
(612) 379-5995

63.

64.

84.

86.

Appendix 2:

REFERENCES

Adamson, V.F. Breaking the Barriers: A Study of Legislative and Economic Barriers to Industrial Waste Reduction and Recycling. (Toronto: The Canadian Institute for Environmental Law and Policy and the Pollution Probe Foundation, 1984), 100 pages.

Alaska Health Project. Dry Cleaners: On-Site Consultation Audit Report. (Anchorage: Alaska Health Project, 1987).

Alaska Health Project. Electroplating Shop: On-Site Consultation Audit. (Anchorage: Alaska Health Project, 1988).

Alaska Health Project. Photofinishing Shop: On-Site Consultation Audit Report. (Anchorage: Alaska Health Project, 1989).

Alaska Health Project. Printing Company: On-Site Consultation Audit Report. (Anchorage: Alaska Health Project, 1989).

Baram, M. "Corporate Risk Communication: New Challenges for Makers and Users of Toxic Chemicals." Pollution Prevention Review, Spring 1993, pp. 167-175.

Benforado, D. "Pollution Prevention as Corporate Policy: A Look at the 3M Experience." The Environmental Professional, Vol. 11, 1989, pp. 117-126.

Berglund, R.L. and C.T. Lawson, "Preventing Pollution in the Chemical Process Industries." Chemical Engineering, September 1991, pp. 120-127.

Bidden, J.R. "A New Direction for Environmental Policy: Hazardous Waste Prevention, not Disposal." Environmental Law Reporter, Vol. XVII, No. 10, 1987.

California Department of Toxic Substances Control. Automotive Repair Shops: Hazardous Waste Reduction Assessment Handbook. (Sacramento, CA: California Department of Toxic Substances Control, 1988).

California Department of Toxic Substances Control. Fabricated Metal Products Industry - Waste Audit Study. (Sacramento, CA: California Department of Toxic Substances Control, 1989), Report WA017.

California Department of Toxic Substances Control. Hazardous Waste Minimization Checklist and Assessment Manual for Paint Formulators. (Sacramento, CA: California Department of Toxic Substances Control, 1991), Report WA025.

California Department of Toxic Substances Control. Hazardous Waste Reduction Checklist Automotive Repair Shops. (Sacramento, CA: California Department of Toxic Substances Control, 1988), Report WA004.

California Department of Toxic Substances Control. Metal Waste Management Alternatives Minimizing, Recycling, and Treating Hazardous Metal Wastes, (Sacramento, CA: California Department of Toxic Substances Control, 1989), Report WRO12.

California Department of Toxic Substances Control. Paint Manufacturing Industry - Waste Audit Study. (Sacramento, CA: California Department of Toxic Substances Control, 1987), Report WA008.

California Department of Toxic Substances Control. Precious Metal Reclamation: Gold, Silver, Platinum, and Other Precious Metal Product and Reclamation. (Sacramento, CA: California Department of Toxic Substances Control, 1990), Report WA018.

California Department of Toxic Substances Control. Printed Circuit Board Manufacturers: Hazardous Waste Reduction Checklist and Assessment Manual. (Sacramento, CA: California Department of Toxic Substances Control, 1991).

California Department of Toxic Substances Control. Waste Audit Study: Automotive Paint Shops. (Sacramento, CA: California Department of Toxic Substances Control, 1987), Report WA001.

California Department of Toxic Substances Control. Waste Audit Study: Automotive Repairs. (Sacramento, CA: California Department of Toxic Substances Control, 1987), Report WA002.

California Department of Toxic Substances Control. Waste Minimization for the Metal Finishing Industry. (Sacramento, CA: California Department of Toxic Substances Control, 1991), Report WR024.

California Department of Toxic Substances Control. Waste Reduction for the Commercial Printing Industry. (Sacramento, CA: California Department of Toxic Substances Control, 1989), Report WA005.

California Department of Toxic Substances Control. Waste Reduction for Metal Finishers. (Sacramento, CA: California Department of Toxic Substances Control, 1991).

California Department of Toxic Substances Control. Waste Reduction Strategies in the Printed Circuit Board Industry. (Sacramento, CA: California Department of Toxic Substances Control, 1987).

Canadian Institute for Environmental Law and Policy. Prescription for Healthy Great Lakes. (Toronto: CIELAP, 1991), 64 pages.

Chemical Manufacturers Association. Pollution Prevention Resource Manual. (Washington, D.C.: Chemical Manufacturers Association, 1990).

Collins, C. "The Best Way to Fight Pollution: Prevent It", Canadian Business, March 1991, pp. 52-56.

Commoner, B. "Let's Get Serious about Pollution Prevention." EPA Journal, Vol. 16, No. 1, 1989, pp. 15 to 17.

Environment Canada. Pollution Prevention Strategic Framework for Canada; Draft Discussion Paper (Under Revision). (Ottawa: Environment Canada and Industry and Science Canada, 1993).

Gardner, L.C. and D. Huisingh, "Waste Reduction Through Material and Process Substitutions: Progress and Problems Encountered in Industrial Implementation." Hazardous Waste and Hazardous Materials, Vol. 4, No. 1, 1987.

General Accounting Office. Toxic Substances: Advantages of and Barriers to Reducing the Use of Toxic Chemicals. Report # GAO/RCED-92-212, (Washington, D.C.: U.S. GAO, 1992).

Government Institutes INC. Waste Minimization Case Studies. (Rockville, M.D.: Government Institutes, 1991), 290 pages.

Hirschhorn, J.S. and K.U. Oldenburg. Prosperity Without Pollution: The Prevention Strategy for Industry and Consumers. (New York: Van Nostrand Reinhold, 1991).

Hirschhorn, J.S. "The Case for Pollution Prevention", EPA Journal, Vol. 15, No. 2, 1989, pp. 50-52.

Institute for Local Self-Reliance. Proven Profits from Pollution Prevention; Case Studies in Resources Conservation and Waste Reduction. (Washington, D.C.: The Institute for Local Self-Reliance, 1986), 316 pages.

Karras, G. "Pollution Prevention: The Chevron Story." Environment, Vol. 31, No. 8, 1989, pp. 4-5.

Lindgren, R. Hazardous Waste Reduction: An Overview and a Call for Action. (Toronto: The Canadian Environmental Law Association, 1988).

LURA Group. Pollution Prevention for the Great Lakes: Tips for Small Quantity Hazardous Waste Generators. (Toronto: Lura Group, 1991).

Macdonald, D. and P. Pickfield. From Pollution Prevention to Waste Reduction: Toward a Comprehensive Hazardous Waste Strategy for Ontario. (Toronto: The Canadian Institute for Environmental Law and Policy, 1989), 63 pages.

Ministry of Environment and Energy. Pollution Prevention Planning Guidance Document and Workbook. (Toronto: Ministry of Environment and Energy, 1993), 89 pages & appendices.

Minnesota Office of Waste Management. Minnesota Guide to Pollution Prevention Planning. (St. Paul, Minn.: Minnesota Pollution Control Agency; Minnesota Technical Assistance Program (MnTAP), 1992).

Munroe, G., W. Bradley, and F. Neuber. Profit from Pollution Prevention: A Guide to Industrial Waste Reduction and Recycling (2nd Edition). (Toronto: Pollution Probe Foundation, 1990), 106 pages.

Monroe, G. "Where is Industrial Waste Reduction Taking Us?" Probe Post, August 1986, pp. 14-18.

National Association of Manufacturers. Waste Minimization: Manufacturers' Strategies for Success. (Washington, D.C: National Association of Manufacturers, 1989).

Office of Technology Assessment. From Pollution to Prevention: A Progress Report on Waste Reduction. (Washington, D.C.: U.S. Congress, OTA, 1987), Special Report OTA-ITE-347.

Office of Technology Assessment. Serious Reduction of Hazardous Waste: Summary. (Washington D.C.: U.S. Congress, OTA, 1986), Report OTA-ITE-318.

Oldenburg, K.U. and J.S. Hirschhorn, "Waste Reduction: A New Strategy to Avoid Pollution." Environment, Vol. 19, No. 2, 1987, pp. 16-45.

Ontario Waste Management Corporation. Industrial Waste Audit and Reduction Manual: A Practical Guide to Conducting an In-Plant Survey for Waste Reduction. (Toronto: Ontario Waste Management Corporation, 1989), 91 pages.

Patterson, T. "Waste Reduction: It's Working for These Four." Water & Pollution Control, April 1989.

Pollution Probe. Green Business Guides - 4 Volumes. (Toronto, Ontario: Pollution Probe Foundation, 1993).

Reibstein, R. "Source Reduction; It's a Pollution Cure based on a new Philosophy." Industry, November 1988.

Reilly, W.K. "Pollution Prevention: An Environmental Goal for the 1990's." EPA Journal, Vol. 16, No. 1, 1990, pp. 4-7.

Sarokin, D. "Going to the Source; The Real Solution to the Toxic Waste Crisis." Greenpeace Magazine, Vol. 12, No. 1, 1987.

Springer, J. Pollution Prevention Case Studies Compendium. (Washington, D.C.: Office of Research and Development, U.S. EPA, 1992), 100 pages.

Stopps, T.P. Ontario's New Pollution Prevention Program: How to Reap the Awards (Toronto: Ministry of Environment and Energy, 1993).

Technology Resources Inc. Barriers to Recycling of Hazardous Waste. (Winnipeg: Canadian Council of Ministers of the Environment Ministers, 1988)

Tidball, J. Legislative Jurisdiction over Reduction, Recycling and Disposal of Hazardous Waste. (Toronto: the Canadian Institute, 1988), Conference Proceedings to "Hazardous Waste: Strategies for Efficient Waste Management and Liability Avoidance."

U.S. Environmental Protection Agency. Auto Repair Shops: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1991).

U.S. Environmental Protection Agency. Automotive Refinishing Industry: Guide to Pollution Prevention. (Washington, D.C.: U.S. EPA, 1991), Report EPA/625/7-90/016.

U.S. Environmental Protection Agency. Commercial Printing Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1990), Report EPA/625/7-90/008.

U.S. Environmental Protection Agency. Fabricated Metal Products Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1990), Report EPA/625/7-90/006.

U.S. Environmental Protection Agency. Facility Pollution Prevention Guide. (Washington, D.C.: U.S. EPA, 1992), Report EPA/600/R-92/088.

U.S. Environmental Protection Agency. General Paints and Painting Supplies. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/600/S-92/054.

U.S. Environmental Protection Agency. Manufacturer of Artists' Supply Paints. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/600/S-92/045.

U.S. Environmental Protection Agency. Manufacturer of Paints for Metal Finishing. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/600/S-92/040.

U.S. Environmental Protection Agency. Metal Finishing Industry: A Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/625/R-92/011.

U.S. Environmental Protection Agency. Paint Manufacturing Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1990), Report EPA/625/7-90/005.

U.S. Environmental Protection Agency. Photoprocessing Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/625/7-90/012.

U.S. Environmental Protection Agency. Printed Circuit Board Manufacturing Industry: Guide to Pollution Prevention. (Cincinnati, OH: U.S. EPA, 1990), Report EPA/625/7-90/007.

U.S. Environmental Protection Agency. Pollution Prevention Training Opportunities in 1991. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/600/R-92/175.

U.S. Environmental Protection Agency. U.S. Environmental Protection Agency Pollution Prevention Strategy. (Washington, D.C.: U.S. EPA, Office of Pollution Prevention, 1991), 45 pages.

U.S. Environmental Protection Agency. Waste Minimization Assessment For a Manufacturer of Aluminum Cans. (Cincinnati, OH: U.S. EPA, 1991).

U.S. Environmental Protection Agency. Waste Minimization Assessment for a Manufacturer of Chemicals. (Cincinnati, OH: U.S. EPA, 1992), Report EPA/6-00/S-92/004.

U.S. Environmental Protection Agency. Waste Minimization Assessment for a Manufacturer of Metal Parts Coating. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/600/M-91/005.

U.S. Environmental Protection Agency. Waste Minimization Assessment for a Paint Manufacturing Plant. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/600/M-91/023.

U.S. Environmental Protection Agency. Waste Minimization Assessment for a Manufacturer of Printed Labels. (Cincinnati, OH: U.S. EPA, 1991), Report EPA/600/M-91/047.

U.S. Environmental Protection Agency. Waste Minimization Opportunity Assessment Manual. (Washington, D.C.: Hazardous Waste Engineering Research Laboratory, U.S. EPA, 1988), 106 pages.

Waste Advantage Inc. Industrial Waste Prevention. (Southfield, MI: Waste Advantage Inc., 1988).

Wigglesworth, D. Profiting from Waste Reduction in Your Small Business. (Anchorage, Alaska: Alaska Health Project, 1988), 87 pages.

WRITAR. Aqueous Cleaners as Substitutes for Organic Solvents. (Minneapolis, MN: WRITAR, 1991).

WRITAR. Source Reduction Opportunities in the Metal Plating Industry. (Minneapolis, MN: WRITAR, 1991).

WRITAR. Waste Minimization in the Electronics Products Industries. (Minneapolis, MN: WRITAR, 1991).

Appendix 3:

DETAILED SUCCESS STORIES OF ONTARIO COMPANIES

SUCCESS STORY 1: Algoods, Toronto

Algoods is a Toronto-based division of Alcan Aluminum Ltd. Its products include extrusion blanks used for manufacturing of cans and heat exchangers for refrigerators. Before undertaking a waste reduction audit and applying waste reduction measures, the company was among the top 300 generators of the industrial and hazardous waste in Ontario.

The waste reduction audit was undertaken with the support of the Ontario Waste Management Corporation. The audit identified at what production stage waste reduction measures could be applied. Consequently, it was to Algoods' advantage to already have detailed data on hazardous waste generation.

Every month 9,000 litres of the coolant used for hot-rolling of cast aluminum were disposed because of the build-up of oils from leaking equipment. These oils were causing degradation of the metalworking fluid. Through skimming and coalescence, free floating and dispersed oils are now removed and the life of the coolant is prolonged by up to five months. For the total investment of $6,000 the company is expected to save $21,000 each year for the waste disposal costs and the costs of the raw material.

Additional improvements were made in the paint line pre-treatment stages. Here, chromium in the rinsewaters was reduced to trivalent chromium, and then flocculated and settled. This produced a slurry which needed to be disposed. Following the waste reduction audit, a filterpress was installed which increased the solid levels and decreased the volume of the waste to be disposed by 90 per cent. This measure saved Algoods $13,824 a year.

As a result of the implemented waste reduction measures, Algoods not only achieved substantial financial savings, and the company is also no longer among the top 300 hazardous waste generators in Ontario.

Source: Wolnik, C. "Waste Audit pays dividends for Algoods." Waste Reduction Bulletin, OWMC, April 1993.

CASE STUDY 2: Northern Telecom, Bramalea

After securing a leading position in the telecommunications equipment industry, Northern Telecom is now becoming a leader in eliminating chlorofluorocarbons (CFCs), which are infamous for their ozone-depleting properties.

In its Bramalea plant, solvent containing CFC had been used for cleaning circuit boards after electronic parts were soldered on. Total elimination of the CFCs was possible because of the introduction of new soldering processes which do not require circuit board cleaning. New fluxes were developed that contain 98 per cent of isopropanol and 2 per cent of other chemicals. Used with an Electrovert 2000 soldering machine, spent flux does not have to be cleaned of the board. Similarly, another soldering machine, Seho Nitrogenous, eliminates the need for circuit board cleaning altogether. In this case the soldering is done in the inert gas atmosphere of the nitrogen.

In addition to the modification of the manufacturing process to eliminate CFCs, Northern Telecom removed halon fire extinguishers, replacing them with the water and dry sprays.

Source: "Northern Telecom Eliminates CFCs at Bramlea Plant." Waste Reduction Bulletin, OWMC, January 1992.

CASE STUDY 3: Essex Specialty Products, London

A subsidiary of the Dow Chemical Company, Essex Specialty Products makes urethane adhesives that are used, for example, to attach car windows to the frame. Its waste reduction program started in 1988 and by 1991, the company has cut its hazardous waste by 95 per cent. This successful program originated from the ideas of the all five production employees, each of whom was familiar with every aspect of operations.

One initiative was aimed at re-directing material from the waste stream back into the production process. Reusing material from sample lines was the first step. The idea was to detach lines quickly after taking the samples for viscosity testing and re-direct the material back to the mixer. Earlier, material from the sample lines was removed and incinerated. This simple step reduced the waste by 11,300 litres and saved the company in excess of $40,000 a year.

A similar idea was employed in the recycling of the material from the strainers, which are changed every two batches. What was previously disposed of is now re-directed back to the batch, saving the company over $29,000 a year without any investment.

Further waste reduction was achieved through the modification of the mixer which eliminated the need for periodical cleanouts. As a result, excessive amounts of the highly flammable organic solvents are no longer used, waste is reduced, safety and working conditions are improved, and the company is saving financially. And the savings in this case are very impressive. For a mere $2,800 invested in the mixer modification, the company is saving over $54,000 this year.

Solid waste disposal is another area that the Essex employees are trying to reduce waste. By putting a plastic liner in the drums that are used for shipping its products, Essex' customers can sell the drums to reconditioners instead of disposing them into a hazardous waste disposal site.

Source: Staddon, C. "Adhesives Manufacturer wins 3Rs Award." Waste Reduction Bulletin, January 1992.

CASE STUDY 4: Twinpack INC., Brantford

Twinpack Inc. produces multi-wall paper bags and plastic film packaging materials. It is connected to the local sanitary sewer system and has to comply with the local by-law limits for suspended solids, chemical oxygen demand (COD) and biological oxygen demand (BOD). In the past, these limits were sometimes exceeded. In order to achieve permanent compliance, Twinpack and the Ontario Waste Management Corporation (OWMC) formed a partnership in June of 1990 to conduct a waste audit of the company's plant.

The designated group of employees from both companies conducted a detailed data collection and sampling program which showed that most of the total BOD and COD was created at the tubers. Unused glue, that was primarily made of starch, was washed from the tuber holding posts into the sewer at the end of every shift. It represented 25 per cent of the BOD and COD of the wastewater discharges from the tubers. Change of this practice and recycling of the unused glue saved the company approximately $10,000 a year. In addition, Twinpack now complies with the regulations.

Source: Michalowicz, R. "Audit shows packaging company best way to cut waste." Waste Reduction Bulletin, OWMC, July 1991.

CASE STUDY 5: Metal Recovery Industries, Inc., Hamilton

Zinc-coated high quality steel is widely used in the car industry because of its great resistance to corrosion. The presence of zinc becomes a problem when the metal of a finished car goes to the blast furnace. Oxidized zinc creates a dust that is hazardous to the worker's health and expensive to remove.

Since more and more scrap metal is being recycled, Metal Recovery Industry Inc. (MRI) developed a promising process of de-zincing. This process is a reversed process of electroplating. Galvanized scrap metal is placed in a electrolyte (water solution of the sodium hydroxide) and connected to the anode. When the electric current is applied zinc is stripped and deposited on the metal cathode and subsequently removed and recovered.

Following a demonstration project in Hamilton, MRI has received a $120,000 grant from the Ontario Ministry of Environment and Energy to develop an elctrowinning process for zinc. If successful on a large scale, then much of the 700,000 kilograms of waste zinc generated in Canada could be recovered and reused.

At a cost of $30-$50 per tonne of zinc recovered, the MRI's degalvanizing process is considered to be the least expensive of the de-zincing processes. During the demonstration, the process removed 70-90 per cent of zinc from baled scrap and up to 98 per cent from the loose scrap.

Source: Staddon, C. "De-zincing process promises environmental benefits for steel industry." Waste Reduction Bulletin, August 1992.

Endnotes

1. The definition of the terms are based on: Luppino. T. Guide to Pollution Prevention in Your Community, (Buffalo, New York: Great Lakes United, 1992), p. 7.

2. At present there is no official or legislated definition of pollution prevention accepted in Canada. A consensus amongst all stakeholders on the definition of pollution prevention has been elusive because there are a number of divergent views of what should be included in the definition. For discussion purposes, Environment Canada and Industry and Science Canada have offered the aforementioned definition.

3. Taken from T. Luppino, Guide to Pollution Prevention in Your Community, (Buffalo, New York: Great Lakes United, 1992), p. 9.