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REPORT ON THE ECONOMIC PROFILE OF THE HAZARDOUS WASTE MANAGEMENT SERVICE SUBSECTOR IN CANADA

FINAL REPORT

Canada

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REPORT ON THE ECONOMIC PROFILE OF THE HAZARDOUS WASTE MANAGEMENT SERVICE SUBSECTOR IN CANADA

By
Fenco Newfoundland Lavalin

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Any comments concerning its content should be directed to:

Jacques Brisson
Socio-Economic Analysis Division
Management and Emergencies Branch
EPD, C&P
Environment Canada
Ottawa, Ontario
K1A 0H3

Tom Foote
Waste Management Division
Industrial Programs Branch
EPD, C&P
Environment Canada
Ottawa, Ontario
K1A 0H3

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PURPOSE AND SCOPE

This study has been undertaken to assess the potential for the growth of the Canadian hazardous waste management service industry and to identify a strategy and associated actions that Environment Canada may adopt to encourage the development of the industry. Specifically, the objectives of this study are:

- to establish the profile of the hazardous waste management service industry in Canada by identifying the need for and current magnitude of the industry based on available waste volumes, waste types requiring on- and offsite management and availability and distribution of waste management services;

- to identify the potential of this industry in domestic and foreign markets by presenting barriers to promotion of the industry, mechanisms for overcoming barriers, and by soliciting the views of selected generators, the commercial waste management industry, industry associations, government entities and other interest groups (including consultants); and,

- to identify mechanisms to promote growth and productivity to the hazardous waste management industry.

HAZARDOUS WASTE QUANTITIES

The quantity of hazardous wastes generated in Canada has been estimated for 1986, and projected to 1992. These estimates and projections have been based on data generated and compiled by the Ontario Waste Management Corporation (OWMC) in 1988 and Proctor and Redfern et al. in 1984. These data sources represent the most up-to-date, standardized, and publicly-available sources of hazardous waste generation in Canada.

It has been estimated that approximately 6.1 million tonnes of hazardous wastes were generated in Canada in 1986, and that this quantity will increase to at least 6.5 million tonnes by 1992. Of these quantities, 38 percent (approximately 2.3 million tonnes) has been estimated to have required offsite management in 1986, while 41 percent (approximately 2.7 million tonnes) of the projected quantities generated is estimated to require offsite management in 1992.

GOVERNMENT INITIATIVES

Jurisdiction for most aspects of hazardous waste management in Canada rests with the Provinces. There is wide variation in hazardous waste regulatory activity between provinces. However, Ontario has adopted a similar hazardous waste regulatory framework to the federal U.S. model and it is widely expected that other provinces will also adopt frameworks similar to the U.S. and Ontario approaches.

The overall effect of the U.S. and Ontario approaches to regulatory hazardous waste management has been to channel waste that was being inappropriately disposed of into hazardous waste management disposal facilities. Although the effect of the regulations has been to broadly increase industrial costs associated with waste management, it appears that these price increases have not been sufficient to stimulate increased waste reduction/recycling activity either on- or offsite.

Additionally, major public sector hazardous waste management initiatives in Canada have been regulatory in nature. This contrasts with approaches taken by jurisdictions in the U.S. and in Western Europe, where technical and financial assistance is provided to companies in the hazardous waste management field to complement regulatory initiatives.

CANADIAN HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY

Although information on the hazardous waste management service industry in Canada is very limited, generalizations can be made to indicate its potential magnitude.

The industry is concentrated in Ontario and, to a lesser extent, Quebec largely due to the pre-eminence of central Canada in the generation of hazardous waste. Availability of offsite hazardous waste treatment/disposal services only appears to be adequate in Alberta.

It is estimated that the hazardous waste management service industry in Canada in 1983 may have been in the order of $80 million per year and may be approaching a $100 million per year industry. Over 80 percent of the services purchased from the industry by hazardous waste generators fall into the category of operating expenditures, indicating heavy reliance of hazardous waste generators on offsite facilities for managing in-house wastes. The industry appears to employ some 4,000 - 5,000 people providing services in consulting, engineering and chemical analysis, in addition to the operation and maintenance of hazardous waste management facilities.

VIEWS OF THE HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY

Industry representatives identified the following key points in considering how the industry may develop and the types of assistance that would be beneficial to its growth:

- The industry is driven by the application of regulatory requirements. Poor enforcement of these requirements continues to impede the growth of the industry.

- Appropriate waste management technology and services in most cases are, or can be made available, in Canada. However, hazardous waste generators are not sufficiently informed of these technologies or services.

- Research and development in hazardous waste management is lacking in Canada, particularly in comparison to U.S. and European research and development.

- The industry is fragmented and is not always capable of providing turnkey hazardous waste management services to large clients. However, a number of companies are competing internationally, although usually in a narrow market area.

- Waste minimization and onsite treatment activities are increasing.

- Training programs and workshops for hazardous waste regulatory officials, firms and generators are needed to improve the understanding of the roles, functions and abilities of and to encourage interaction of government and private sector representatives in the hazardous waste management field.

FACTORS INFLUENCING THE FUTURE OF HAZARDOUS WASTE MANAGEMENT IN CANADA

It is apparent from the study that the key factors influencing the future of hazardous waste management in Canada are:

- public policy goals in assuring that hazardous wastes are safely managed and that the quantities of wastes requiring offsite management be an absolute minimum;

- federal and provincial/territorial regulatory jurisdiction and the interpretation and enforcement of legislation;

- corporate policy - executive level decisions take into account not only financial return on investment but also considerations such as long-term position, corporate image, community relations and capital investments;

- technology availability - technology that is available may not be adopted because of prohibitive costs and concerns about technology reliability, lack of track record or difficulty of maintenance and/or operation; and,

- lack of available information - a pro-active "information marketing" approach rather than the passive, clearing-house model of information provision.

RECOMMENDATIONS

A federally led strategy is required to: encourage the establishment of additional offsite hazardous waste management treatment/disposal facilities; enhance hazardous waste minimization, reclamation and recycling activities; and, undertake a lead role in supporting hazardous waste technology development and commercialization. The four recommended strategies and associated goals are highlighted below:

(i) Strategy Item 1: Identify and support initiatives to site additional offsite hazardous waste treatment/disposal facilities.

Goal: Ensure all provinces/regions provide treatment/disposal facilities for locally-generated wastes.

(ii) Strategy Item 2: Identify and support opportunities for hazardous waste minimization, reduction and recycling.

Goal: To ensure that the quantities of wastes requiring offsite treatment/disposal are kept to a minimum.

(iii) Strategy Item 3: Support the development of an industry association to represent the Canadian hazardous waste management service industry.

Goal: To participate in the creation of a national hazardous waste management industry association that represents the interests of all sectors of the industry and is able to coordinate with government agencies and others in the identification and resolution of issues relevant to the growth and development of the industry.

(iv) Strategy Item 4: Create a "National Hazardous Waste Management Program" to provide a comprehensive framework for developing the Canadian hazardous waste management industry.

Goal: To place Canada and the Canadian hazardous waste management service industry at the forefront of the Canadian waste management field domestically and internationally.

1.0 INTRODUCTION

1.1 BACKGROUND

Hazardous wastes (or special wastes) are being recognized as one of the major environmental and societal problems of the 1980s and 1990s. Global concerns for greater environmental protection surfaced in the early 1970s as a result of increased awareness of the potential human toxicity of chemicals and the persistence of these chemicals in the environment. The growing public awareness of hazardous waste issues and associated environmental concerns resulted in the need for appropriate management and control of these wastes. By the end of the 1970s, hazardous waste issues were receiving international attention and general statuatory guidance for waste management were developed.

In the 1980s, legislative mandates and international agreements are continuing to become more specific. Instead of the general statuatory guidance typical of the 1970s, hazardous waste management legislation is being developed and implemented. In Canada, the United States, Europe and other countries regulations and guidelines governing hazardous waste management have been developed and enforced to varying degrees. As a result of this legislation, hazardous waste generators must provide appropriate waste management through the utilization of treatment, disposal and recycling technologies. Some companies have initiated onsite waste management activities or made process alterations, while other companies unable to undertake onsite activities seek offsite waste management services.

The need for offsite services has resulted in the growth of the commercial hazardous waste management industry. Ultimately, this industry has developed through public awareness of the hazards of various chemicals and wastes currently or previously utilized and generated throughout the world. With increasing awareness and subsequently increased legislation, as well as the tonnes of hazardous wastes being generated daily, the demand for commercial services will likely increase. The extent to which the commercial hazardous waste management industry must grow to meet this demand depends upon many factors such as public pressures, legislative enforcement, and onsite waste minimization activities. In Canada, the United States and other countries the demand for commercial services and facilities exists and cannot readily be satisfied by currently available services.

In Canada, the limited availability of services for hazardous waste treatment, disposal, recycling/recovery and collection and transportation is recognized and efforts are currently ongoing to assist in industry growth. Some provinces have organized corporations, associations and waste exchanges to promote and assist in industry development. Additionally, recent federal and provincial regulations and guidelines are generating accrued growth and business opportunities for the commercial hazardous waste management industry.

Waste management ultimately enables economic benefits with environmental protection in mind.

1.2 Purpose and Scope

In order to assist the industry in its growth and improve its productivity and competitiveness on domestic and foreign markets, it was decided that a study of this industrial sector be undertaken. Environment Canada contracted the services of Fenco Newfoundland Limited to conduct this study. The objectives of this study are presented below:

- Establish the profile of the hazardous waste management service industry in Canada by identifying the need for and current magnitude of the industry based on available waste volumes, waste types requiring on- and offsite management and availability and distribution of waste management services.

- Identify the potential of this industry in domestic and foreign markets by presenting barriers to promotion of the industry, mechanisms for overcoming barriers, and by soliciting the views of selected generators, the commercial waste management industry, industry associations, government entitites and other interest groups (including consultants).

- Identify mechanisms to promote growth and productivity to the hazardous waste management industry.

With an appropriate waste management and marketing strategy beneficial results may be achieved in the Canadian economy. Employment opportunities can be generated through construction, operation and maintenance of waste management facilities; waste transport; identification, testing and clean-up

of unsatisfactory waste sites; and recycling, recovery, reduction and reuse (the 4Rs) of waste products. Additionally, with continuing waste generation, the removal of chemicals such as PCB's out of service, and new concerns over the potentially hazardous nature of septic sludges business opportunities for hazardous waste management firms are apparent.

1.3 REPORT FORMAT

The extent to which hazardous waste management activities are ongoing on a provincial and federal level varies. The definition of a hazardous waste or special waste, as it is often referred, is not standardized within Canada or in foreign sectors. As a result, discrepancies exist in waste inventories conducted for the same areas, regulatory interpretation is at times difficult and industry and public perception of what constitutes a hazardous waste varies. For the purposes of this report, 'hazardous wastes' are those wastes which, due to their nature and quantity, are potentially harmful to human health and/or the environment and which require special disposal techniques to eliminate or reduce the hazard. This report does not, however, address radioactive wastes or septic sludge wastes.

The following report is comprised of eight sections:

- Section 1.0 - Introduction (presented above);
- Section 2.0 - Current and Future Hazardous Waste Generation;
- Section 3.0 - Overview of Governmental Initiatives in Hazardous Waste Management;

- Section 4.0 - Profile of the Hazardous Waste Management Service Industry in Canada;

- Section 5.0 - The Future of Hazardous Waste Management in Canada;

- Section 6.0 - Conclusions and Recommendations; and,

- Section 7.0 - Recommended Strategy to Develop the Canadian Hazardous Waste Management Service Industry; and,

- Section 8.0 - References.

Section 2.0 estimates hazardous waste volumes requiring appropriate management in 1986 and 1992. It also identifies waste import and export activities in Canada. Section 3.0 presents municipal, provincial/state, and federal governmental initiatives in waste management for Canada, the United States and several other countries including waste management status, programs and activities, marketing and waste management planning studies and legislation governing hazardous waste management. Additionally, an overview of the commercial hazardous waste management industry and a marketing study is presented for the United States. Section 4.0 presents a profile of the commercial hazardous waste management industry in Canada through identification of available services and technologies, views on the hazardous waste management industry in Canada as solicited from select waste generators, commercial waste management firms and industry associations, government entities and other interest groups and the economics of this industry in Canada. Section 5.0 addresses initiatives

and strategies for hazardous waste management in the future. Section 6.0 presents the conclusions of the study. Section 7.0 presents recommended strategies for development of the hazardous waste management service industry nationally. References for the study are presented in Section 8.0.

2.0 CURRENT AND FUTURE HAZARDOUS WASTE GENERATION

The purpose of this section is to provide estimates of industrial generation of hazardous waste with an emphasis on the waste volumes that currently and in the future will require offsite management. The estimates are made on a province-by-province basis and for each waste class (according to the University of California at Davis (UCD) 14 category waste classification). The estimates are calculated for the total amount of hazardous waste generated as well as the volume of wastes identified as requiring offsite management in 1986 and projected to 1992. This section also identifies national waste import and export activities.

Appendix A identifies the 14 UCD waste categories, corresponding waste types, and technologies capable of providing appropriate management of these wastes.

2.1 ESTIMATED HAZARDOUS WASTE GENERATION

The following two major sources of information were utilized in estimating the generation of hazardous wastes:

- Ontario Waste Management Corporation , 1988. Environmental Assessment, Volume I: The OWMC Undertaking.

- Proctor and Redfern et. al., 1984. Data on Hazardous Wastes, Rubber Wastes and Oil Wastes in Canada - 1983.

In February 1988, the Ontario Waste Management Corporation (OWMC) published a draft document entitled "The OWMC Undertaking", and is the first of six volumes of OWMC's Environmental Assessment. Chapter 4 of the document examines the quantity and characteristics of waste currently generated in Ontario. Chapter 6 of the document presents estimates of Ontario's generated waste quantities potentially seeking offsite treatment and disposal in 1992 and 1997. Ontario currently generates over 50 percent of the total volume of hazardous wastes in Canada and, as a result, influences the magnitude of the industrial and waste management capacity nationally.

As discussed in the OWMC document, there are three major sources of information on the generation of hazardous wastes in Ontario:

- the Ministry of the Environment's (OMOE) generator registration database, which has been compiled from generator registration records submitted to the Ministry in accordance with Regulation 309;

- the OMOE manifest database which includes records of all of the subject wastes transported in Ontario in compliance with the manifesting provisions of Regulation 309; and,

- surveys of waste generation in the province commissioned by the OWMC.

Despite some limitations, the OMOE generator registration database and the manifest database are the most comprehensive sources of waste quantity estimates in the

province. The OWMC utilized both databases in its quantities evaluation. The generator registration database is the only source of detailed information on waste characteristics and on wastes treated and disposed of onsite.

Waste inventories presented in the Proctor and Redfern study consolidated and standardized the information from several provincial hazardous waste inventory studies undertaken from 1979 to 1982 into a consistent database of industry categories and waste classifications. The two-digit United States Standard Industrial Classification (SIC) was used to standardize sources of waste generation, while the University of California at Davis (UCD) 14 category waste classification was utilized. For each province, in most instances, hazardous wastes inventoried varied with each study. This discrepancy is thought to be primarily the result of variations in the definition of a hazardous waste, in industry and waste classifications, methods by which the inventory was conducted and the detail of the study. Recent provincial waste inventories also differ from that standardized in the Proctor and Redfern report. Nevertheless, to evaluate the potential hazardous waste industry in Canada, a standardized database must be utilized; the inventory presented in the Proctor and Redfern study is the most current standardized database for Canada.

Since the recent waste inventory data available from the OWMC document can be considered as the best up-to-date figures on hazardous waste generation in Ontario, the hazardous waste quantities presented in the OWMC document were used as the basis for Ontario waste generation

estimates. For the other provinces, except Ontario, the provincial hazardous waste volumes presented in the "Data on Hazardous Wastes, Rubber Wastes and Oil Wastes in Canada - 1983" (Proctor and Redfern et. al., 1984) document were utilized to provide the basis for identifying the potential magnitude of hazardous wastes requiring treatment or disposal.

Table 2.1 presents the estimated 1986 total hazardous waste generation by province and waste category. For Ontario, the figures were extracted from "The OWMC Undertaking" document data. For the other provinces, the standardized 1982 provincial waste inventory presented in the "Data on Hazardous Wastes, Rubber Wastes and Oil Waste in Canada - 1983" has been extrapolated to 1986 figures by using as an index the Gross Domestic Product (GDP) of each province for each year (figures only available to 1986), adjusted for price increases based on a Canada-wide average. These extrapolations are based on the following assumptions:

- the 1982 figures are representative;
- hazardous waste generation increased in direct proportion to manufacturing activity; and,
- price increases in each province are congruent with the global price increases across Canada.

It is, however, recognized that there are inherent problems with these assumptions that should be addressed as outlined below:

- considerable waste volume discrepancies with the initial database should be addressed to enable uniform

TABLE 2.1 ESTIMATED 1986 TOTAL WASTE QUANTITIES (TONNES)

WASTE CLASS	ALBERTA	B.C.	MANITOBA	N.B.	NFLD	N.S.	ONTARIO	P.E.I.	QUEBEC	SASK.	TOTAL (by waste class)
ORGANIC SLUDGES	870	550	240	630	940	2,970	50,700	10	27,210	330	84,450
SOLVENTS & ORG SOLU	6,470	4,520	3,540	9,850	6,160	13,200	185,900	100	204,350	3,570	437,660
OILS & GREASES	19,610	23,160	12,450	23,480	820	18,000	41,500	130	134,600	15,840	289,590
OIL/WATER MIXTURES	1,640	1,540	850	130	30	2,720	21,600	10	20,710	1,000	50,230
ORG & OILY RESIDUALS	1,250	1,210	730	60	50	120	219,200	0	4,400	440	227,460
HEAVY METAL SOLU & RESID	30,530	24,710	3,230	15,400	13,630	68,230	2,336,700	190	572,610	14,940	3,080,170
MISC CHEM & PRODUCTS	8,890	4,080	360	1,010	1,650	5,500	70,100	30	51,240	660	143,580
PAINT & ORG RESIDUALS	670	440	240	440	590	1,940	500	10	19,120	220	24,170
AQUEOUS SOLU WITH ORGANICS	7,630	6,170	13,670	7,580	10	10,090	521,300	0	26,840	4,680	597,970
ANION COMPLEXES	470	220	410	190	10	60	3,200	10	6,990	110	11,670
SLUDGES & INORG RESID	3,380	3,190	2,680	250	410	14,370	122,700	10	91,450	4,900	243,340
PESTICIDE & HERBICIDE WAS	190	90	0	130	150	380	400	10	3,300	110	4,760
PCB WASTES	10	10	10	0	0	0	0	0	0	0	30
CLEAN-UP RESIDUALS	2,890	3,190	2,190	60	20	580	8,200	0	4,040	220	21,390
TOTAL (by province)	84,500	73,080	40,600	59,210	24,470	138,220	3,582,000	510	1,166,860	47,020	5,216,470

NOTES:

1. Figures for Ontario are OWMC data based on the MOE Generator Registration Database.
2. For all other provinces, the 1982 data presented in the 1983 Proctor and Redfern report was extrapolated to 1986 figures by using as an index the Gross Domestic Product (GDP) of each province for each year, adjusted for price increases based on a Canada wide average. The GDP is at factor's cost.

assessment of the Canadian hazardous waste management industry;

- fluctuations with provincial population and waste generation rates are considered uniform in the extrapolation;

- the influences of new regulatory policy or any other factors affecting hazardous waste volumes such as onsite treatment, waste minimization, and recycling and recovery are not addressed; and,

- discrepancies in waste inventories in terms of currently stored versus annual production of wastes is not addressed.

From Table 2.1, the relative portion of the total waste generated in Canada for each province was calculated:

B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	Nfld.
1.39%	1.61%	0.90%	0.77%	68.12%	22.19%	1.13%	2.63%	0.01%	0.47%

Waste generated in the territories has been included in the total waste generated for British Columbia.

The relative weight of each province in the total Canada GDP value for the manufacturing sector for year 1987 was also identified:

B.C.	Alta.	Man.	Sask.	Ont.	Que.	N.B.	N.S.	P.E.I.	Nfld.
9.42%	5.71%	9.26%	1.19%	52.44%	24.48%	1.13%	2.25%	0.01%	1.13%

By comparison, it can be seen that for provinces other than Ontario, the total waste generated tends to be under-estimated in relation to the province's participation in the total Canada GDP for the manufacturing sector.

To adjust for this under-estimation, a correction factor has been applied to the waste inventory data presented in Table 2.1 for all of the provinces, except Ontario. This correction factor is defined as the relative part in total Canadian GDP relative to the manufacturing sector divided by the relative part of total waste generated. The correction factors are calculated as follows:

B.C.	Alta.	Sask.	Man.	Que.	N.B.	N.S.	P.E.I.	Nfld.
6.77	3.55	1.33	2.92	1.10	1.00	0.86	1.00	2.41

The results of the corrected 1986 total waste generation are shown on Table 2.2. Ontario quantities were not adjusted.

Additionally, for each province, the total generated waste quantities in the year 1992 were estimated and presented in Table 2.3. Economic forecasts obtained from the Canadian Regional Services, DRI Data Resources of Canada, as presented in Table 2.4, were used to project waste quantity growth to 1992. Economic growth was forecasted in gross domestic product (GDP) rates for the manufacturing sector for each province. The 1986 waste quantities were extrapolated to 1992 by applying directly in real terms the economic growth rates of the GDP index for the manufacturing sector on a province-by-province basis, with similar to the OWMC study, the projected GDP growth rates

TABLE 2.2 ESTIMATED 1986 TOTAL WASTE QUANTITIES (TONNES) - corrected on the basis of each province's participation in the total Canadian Gross Domestic Product

WASTE CLASS	ALBERTA	B.C.	MANITOBA	N.B.	NFLD	N.S.	ONTARIO	P.E.I.	QUEBEC	SASK.	TOTAL (by waste class)
ORGANIC SLUDGES	3,090	3,740	710	630	2,280	2,560	50,700	10	29,940	450	94,110
SOLVENTS & ORG SOLU	22,980	30,630	10,340	9,650	14,850	11,360	185,900	100	224,790	4,750	515,550
OILS & GREASES	69,040	156,850	36,360	23,480	2,000	15,480	41,500	130	148,060	21,070	514,570
OIL/WATER MIXTURES	5,830	10,460	2,500	130	90	2,340	21,600	10	22,790	1,340	67,090
ORG & OILY RESIDUALS	4,460	8,220	2,140	60	140	110	219,200	0	4,850	590	239,770
HEAVY METAL SOLU & RESID	108,400	167,310	9,450	15,400	32,850	58,680	2,336,700	190	629,880	19,880	3,378,740
MISC CHEM & PRODUCTS	31,560	27,640	1,070	1,010	4,000	4,790	70,100	30	56,370	890	197,460
PAINT & ORG RESIDUALS	2,400	2,990	710	440	1,430	1,670	500	10	21,040	300	31,490
AQUEOUS SOLU WITH ORGANICS	27,100	41,830	39,930	7,580	30	8,680	521,300	0	29,530	6,230	682,210
AMION COMPLEXES	1,680	1,500	1,210	190	30	60	3,200	10	7,690	150	15,720
SLUDGES & INORG RESID	12,000	21,660	7,840	250	1,000	12,360	122,700	10	100,600	6,530	284,950
PESTICIDE & HERBICIDE WAS	690	670	0	130	370	330	400	10	3,640	150	6,390
PCB WASTES	40	80	40	0	0	0	0	0	0	0	160
CLEAN-UP RESIDUALS	10,290	21,660	6,420	60	60	500	8,200	0	4,450	300	51,940
TOTAL (by province)	300,160	495,240	118,720	59,210	59,130	118,920	3,582,000	510	1,283,630	62,630	6,080,150

NOTES:

1. The correction factor applied is defined as the relative part in the total Canadian Gross Domestic Product for the manufacturing sector divided by the relative part of total waste quantity generated.
2. The Ontario quantities were not corrected.

TABLE 2.3 PROJECTED 1992 TOTAL WASTE QUANTITIES (TONNES)

WASTE CLASS	ALBERTA	B.C.	MANITOBA	N.B.	NFLD	N.S.	ONTARIO	P.E.I.	QUEBEC	SASK.	TOTAL (by waste class)
ORGANIC SLUDGES	3,350	4,050	770	660	2,470	2,770	53,920	10	32,130	490	100,640
SOLVENTS & ORG SOLU	24,920	33,200	11,150	10,660	16,070	12,290	197,700	110	241,200	5,160	552,460
OILS & GREASES	75,520	170,030	39,210	25,400	2,160	16,750	44,140	140	158,870	22,900	555,120
OIL/WATER MIXTURES	6,320	11,340	2,700	140	100	2,530	22,970	10	24,450	1,460	72,020
ORG & OILY RESIDUALS	4,840	8,910	2,310	70	150	120	233,120	0	5,200	640	255,360
HEAVY METAL SOLU & RESID	117,560	181,360	10,190	16,660	35,540	63,490	2,485,080	210	675,860	21,610	3,607,560
MISC CHEM & PRODUCTS	34,230	29,960	1,150	1,090	4,330	5,180	74,550	30	60,490	970	211,980
PAINT & ORG RESIDUALS	2,600	3,240	770	480	1,550	1,810	530	10	22,580	330	33,900
AQUEOUS SOLU WITH ORGANICS	29,390	45,340	43,060	8,200	30	9,390	554,400	0	31,690	6,770	728,270
ANION COMPLEXES	1,820	1,630	1,300	200	30	70	3,400	10	8,250	160	16,870
SLUDGES & INORG RESID	13,010	23,480	8,460	270	1,080	13,370	130,490	10	107,940	7,100	305,210
PESTICIDE & HERBICIDE WAS	750	730	0	140	400	360	430	10	3,910	160	6,890
PCB WASTES	40	90	40	0	0	0	0	0	0	0	170
CLEAN-UP RESIDUALS	11,160	23,480	6,920	70	70	540	8,720	0	4,780	330	56,070
TOTAL (by province)	325,510	536,840	128,030	64,060	63,980	128,670	3,809,450	550	1,377,350	68,080	6,502,520

NOTES:

1. The 1986 total waste quantities were extrapolated up to 1992 on the basis of the Gross Domestic Product Index for the manufacturing sector reduced by 50% to consider the potential impacts of the process change associated with future economic growth.

TABLE 2.4

REAL GROWTH RATE FORECASTED FOR THE GDP INDEX FOR THE MANUFACTURING SECTOR BY PROVINCE FOR THE PERIOD 1986 to 1992

(in %)

Period	Alberta	B.-C.	Manitoba	Atlantic Provinces	Ontario	Québec	Sask.	Canada
1986-87	2,2	1,6	3,5	2,9	2,4	2,8	3,3	2,5
1987-88	2,9	2,9	2,6	3,0	2,4	2,6	3,4	2,6
1988-89	2,2	2,0	1,7	1,7	0,6	1,6	2,2	1,2
1989-90	2,8	3,2	2,6	2,8	2,5	2,4	3,0	2,6
1990-91	3,3	3,7	2,7	2,9	2,5	2,6	2,8	2,7
1991-92	3,5	3,4	2,6	3,1	2,3	2,6	2,7	2,6
1986-92	16,9	16,8	15,7	16,4	12,7	14,6	17,4	14,2

Source: Canadian Regional Services
DRI Data Resources of Canada

cut in half to consider the potential impacts of the process change associated with future economic growth. That is, the waste quantity growth rate for any province is equal to 50 percent of the forecasted rate for GDP growth of that province. This approach assumes that hazardous waste generation increased in direct proportion to manufacturing activity. Since direct extrapolation of data was involved, the reliability of the figures projected for 1992 is directly related to the 1986 data.

To provide an estimate of the 1986 and 1992 waste quantities requiring offsite management, it was assumed that the provinces would adopt similar programs and initiatives to those of Ontario, therefore a similar impact is assumed to occur. The findings of the OWMC study provided the basis for estimating the 1986 and 1992 offsite waste quantities.

For the provinces, excluding Ontario, the portion of the estimated 1986 hazardous waste quantity that was handled offsite could be assessed, for each waste class, on the basis of the OWMC (Ontario) data by directly applying an Ontario ratio factor. This ratio factor per waste class was generated by dividing the offsite waste quantity for each class identified in the OWMC study for Ontario by the total 1986 waste quantity requiring offsite management in Ontario as presented in the OWMC study. These ratios were applied directly to the provincial waste quantities presented in Table 2.2. Ontario quantities are those presented in the OWMC study. The results of the estimated 1986 waste quantities requiring offsite management are presented in Table 2.5.

TABLE 2.5 ESTIMATED 1986 OFF-SITE WASTE QUANTITIES (TONNES)

WASTE CLASS	ALBERTA	B.C.	MANITOBA	N.B.	NFLD	N.S.	ONTARIO	P.E.I.	QUEBEC	SASK.	TOTAL (by waste class)
ORGANIC SLUDGES	2,190	2,660	500	450	1,620	1,820	36,000	10	21,260	320	66,830
SOLVENTS & ORG SOLU	12,410	16,540	5,580	5,320	8,020	6,150	99,600	50	121,390	2,570	277,610
OILS & GREASES	59,890	134,890	31,270	20,190	1,720	13,310	35,800	110	127,330	18,120	442,630
OIL/WATER MIXTURES	4,780	8,580	2,050	110	70	1,920	17,800	10	18,690	1,100	55,110
ORG & OILY RESIDUALS	3,260	6,000	1,560	40	100	80	161,000	0	3,540	430	176,010
HEAVY METAL SOLU & RESID	8,670	13,380	760	1,230	2,630	4,690	183,000	20	50,390	1,590	266,360
MISC CHEM & PRODUCTS	24,300	21,280	820	780	3,080	3,690	53,900	20	43,400	690	151,960
PAINT & ORG RESIDUALS	2,400	2,990	710	440	1,430	1,670	500	10	21,040	300	31,490
AQUEOUS SOLU WITH ORGANICS	23,300	35,970	34,340	6,520	30	7,460	446,100	0	25,400	5,360	584,480
ANION COMPLEXES	270	240	190	30	10	10	500	0	1,230	20	2,500
SLUDGES & INORG RESID	7,440	13,430	4,860	160	620	7,660	76,100	10	62,370	4,050	176,700
PESTICIDE & HERBICIDE WAS	690	670	0	130	370	330	400	10	3,640	150	6,390
PCB WASTES	0	0	0	0	0	0	0	0	0	0	0
CLEAN-UP RESIDUALS	5,150	10,830	3,210	30	30	250	4,100	0	2,230	150	25,980
TOTAL (by province)	154,750	267,460	85,850	35,430	19,730	49,020	1,114,800	250	501,910	34,850	2,264,050

NOTES:

1. Figures for Ontario are OWMC data using the MOE Generator Registration Database.
2. For all other provinces, the 1986 off-site waste quantities were estimated, for each waste class, on the basis of the Ontario data, by applying a ratio factor which is defined as the relative part of the off-site waste to the total waste quantity generated in Ontario.

Offsite hazardous waste quantities, as presented in Table 2.6, were projected to 1992 on the basis of the estimated 1986 offsite waste quantities presented in Table 2.5 and by directly applying a growth rate. The growth rate over the period 1986 to 1992 was estimated by the OWMC study to be approximately 1.18. This growth rate addresses the impact of additional wastes resulting from the Municipal/Industrial Strategy for Abatement (MISA) program, household, site cleanup and site decommissioning wastes, and PCB's in use and in storage that require appropriate management in Ontario. The OWMC study estimates that for Ontario in 1992 an additional 48,000 to 299,000 tonnes of wastes may require offsite treatment/disposal when considering these factors.

Additionally, if the provinces adopt an 'enhanced regulation' scenario, as discussed for Ontario in the OWMC study, the quantity of waste requiring offsite management in 1992 will again increase. Enhanced regulation considers dust suppression wastes and wastes requiring offsite treatment/disposal as a result of a land disposal ban in addition to the impacts of MISA, etc. The OWMC study indicates that for Ontario an additional 223,000 to 474,000 tonnes of wastes will require offsite management under the enhanced regulation scenario. When considering that Ontario generates over 50 percent of the quantity of hazardous wastes in Canada, if other provinces adopted similar initiatives to enhanced regulation then the above additional waste quantity estimates requiring treatment/disposal could be double.

In addition to the wastes included in the above inventory, contaminated used oils and biomedical wastes that are designated as hazardous should also be addressed. A study

TABLE 2.6 PROJECTED 1992 OFF-SITE WASTE QUANTITIES (TONNES)

WASTE CLASS	ALBERTA	B.C.	MANITOBA	N.B.	NFLD	N.S.	ONTARIO	P.E.I.	QUEBEC	SASK.	TOTAL (by waste class)
ORGANIC SLUDGES	2,580	3,140	590	530	1,910	2,150	42,460	10	25,080	380	78,830
SOLVENTS & ORG SOLU	14,640	19,510	6,580	6,270	9,460	7,230	117,480	60	143,180	3,030	327,440
OILS & GREASES	70,040	159,100	30,660	23,810	2,030	15,700	42,230	130	150,190	21,370	522,080
OIL/WATER MIXTURES	5,040	10,120	2,420	130	80	2,260	21,000	10	22,040	1,300	65,000
ORG & OILY RESIDUALS	3,850	7,080	1,840	50	120	90	189,900	0	4,180	510	207,620
HEAVY METAL SOLU & RESID	10,230	15,780	900	1,450	3,100	5,530	215,850	20	59,440	1,880	314,180
MISC CHEM & PRODUCTS	28,060	25,100	970	920	3,630	4,350	63,580	20	51,190	810	179,230
PAINT & ORG RESIDUALS	2,830	3,530	840	520	1,690	1,970	590	10	24,820	350	37,150
AQUEOUS SOLU WITH ORGANICS	27,480	42,430	40,500	7,690	40	8,800	526,170	0	29,960	6,320	689,390
ANION COMPLEXES	320	280	220	40	10	10	590	0	1,450	20	2,940
SLUDGES & INORG RESID	8,780	15,840	5,730	190	730	9,030	89,760	10	73,570	4,780	208,420
PESTICIDE & HERBICIDE WAS	810	790	0	150	440	390	470	10	4,290	180	7,530
PCB WASTES	0	0	0	0	0	0	0	0	0	0	0
CLEAN-UP RESIDUALS	6,070	12,770	3,790	35	40	290	4,840	0	2,630	180	30,645
TOTAL (by province)	182,530	315,470	101,260	41,785	23,280	57,800	1,314,920	280	592,020	41,110	2,670,455

NOTES:

1. The 1992 off-site waste quantity projections have been done on the basis of the estimated 1986 off-site waste quantities and by applying the growth rate forecasted in the OWMC document. The growth rate, for the wastes potentially seeking off-site treatment and disposal, over the period 1986 to 1992 is assessed by OWMC to be 1.1795.

entitled "Used Oil Management in Canada" (Monenco, 1988) estimates that approximately 967 million litres of lubricating and other oils were sold in Canada during 1986. Of this volume it was estimated that 425 million litres of used oil were generated and only about 30 percent re-refined or burned in a controlled fashion as supplementary fuel. The remaining portion was identified as being utilized or disposed of in a environmentally unacceptable manner. A study entitled "State-of-the-Art Report on the Management of Biomedical (Type A) Wastes in Canada" (Environment Canada, 1987a) estimates that 8,300 to 31,300 tonnes of hazardous biomedical wastes are generated in Canada annually. The types and volumes of contaminated used oil and biomedical wastes that require treatment, disposal or recycling may also have a bearing on the hazardous waste market in Canada.

2.2 PROVINCIAL/TERRITORIAL WASTE IMPORT AND EXPORT ACTIVITIES

Table 2.7 summarizes provincial waste import and export activities for a one year period. Wastes are transported interprovincially and internationally. Table 2.8 identifies Ontario waste types transported to the United States (U.S.) for handling. Table 2.9 identifies the type and quantity of waste transported to the U.S. for the specified period by the province of Ontario. The information for Tables 2.7 through Table 2.9 was compiled from manifest data from the Federal Transportation of Dangerous Goods Act (TDGA). Several assumptions were made to enable compilation of this waste movement data as presented below (Environment Canada, 1988a):

- receiving province data was utilized in the event of a conflict data; and,

TABLE 2.7 INTERPROVINCIAL/TRANSBORDER/INTERNATIONAL MOVEMENTS OF HAZARDOUS WASTES (TONNES/NO. OF SHIPMENTS)*

DESTINATION

ORIGIN	B.C.	ALTA.	SASK.	MAN.	ONT.	QUE.	N. B.	N. S.	P.E.I.	NFLD.	N.W.T.	YUKON	U.S.A.	OTHERS	TOTAL
B.C.					14/17								287/36		301/53
ALTA.	64/4				460.7/29										524.7/33
SASK.				9.9/1	54/28										63.9/29
MAN.					220.5/71										220.5/71
ONT.						10360/607							33982.8 /1250**		44342.8 /1857**
QUE.					46126.9 /1197**			20/1		320/16			2820/244		49286.9 /1454**
N.B.					59.19/15	146.9/12							31.9/2	0.41/1 England	238.4/30
N.S.					19.8/16	25/1							10/2		54.8/19
P.E.I.								2.88/12							2.88/22
NFLD.															
N.W.T.															
Yukon															
U.S.A.					79787.9 /2164**	54375 /3102									134162.9 /5266**
Others															
Total	64/4			9.9/1	126742.99 /3533**	64906.9 /3722		22.88/13		320/16			37131.7 /1534**	0.41/1	229198.78 /8824**

* Based on TDGA manifest data for 4th quarter 1986 and 1st through 3rd quarter of 1987.

** Number of shipments incomplete.

TABLE 2.8 INTERNATIONAL WASTE MOVEMENT FOR ONTARIO*

OUT OF PROVINCE RECEIVERS	WASTE TYPE
U.S.	Waste oil and lubricants
	Acid waste - other metals
	Neutralized waste - heavy metals
	Paint/pigment/coating residue
	Aliphatic solvents
	Transfer station oil wastes
	Alkaline waste - heavy metals
	Spent pickle liquor
	Acid waste - heavy metals
	Brines, chlor-alkali wastes
	Oil skimmings and sludges
	Emulsified oils
	Other specified organics
	Aromatic solvents
	Latex wastes
	Polymeric resins
	Halogenated solvents
	Non-halogenated rich organics
	Neutralized waste - other metals
	Petroleum distillates
	Pharmaceuticals
	Organic laboratory chemicals
	Photoprocessing wastes
	Inorganic laboratory chemicals
	Pathological wastes
	Other polymeric wastes
	Other specified inorganics
	Alkaline phosphates
	Light fuels

*Based on TDGA Manifests for the 1st and 2nd Quarters of 1987.

TABLE 2.9 INTERNATIONAL WASTE MOVEMENT FOR ONTARIO[1]

PERIOD	OUT-OF-CANADA RECEIVER	WASTE VOLUME EXPORTED (TONNES)	% OF TOTAL FOR THE PERIOD[2]	PERCENT PER PRIMARY UCD WASTE CATEGORIES	COMMENTS
1st Quarter for 1987 (January - April)	U.S.A.	7116.5	73.8%	7.0%-Oils and Greases 9.5%-Oil/Water Mixtures 8.2%-Organic and Oily Residuals (oil component only) 12.7%-Sludges and Inorganic Residuals 31.3%-Heavy Metal Solutions and Residuals 19.0%-Solvents and Organic Solutions	24.7% - oily wastes
2nd Quarter for 1987 (April - June)	U.S.A.	7859.1	84.4%	2.9%-Oils and Greases 13.4%-Oil/Water Mixtures 3.2%-Organic and Oily Residuals (oil component only) 34.3%-Heavy Metal Solutions and Residuals 23.6%-Solvents and Organic Solutions 7.1%-Sludges and Inorganic Residuals 11.4%-Paint and Organic Residuals	19.5% - oily wastes

[1] Compiled from TDGA manifest database for Ontario.
[2] Percentage of the total waste for Ontario requiring offsite treatment, disposal or recycling for the cited period.

- in several instances data received from Quebec was ratioed (i.e., interpolated).

It is evident from Tables 2.7 and 2.9 that an extensive list and considerable quantity of wastes are shipped to the U.S. for handling due to insufficient capacity or inadequate technology in Canada for management of these wastes. Data presented in Table 2.7 indicates that of the estimated 95,000 tonnes of hazardous wastes in Canada manifested for the one year period, approximately 39 percent of these wastes were shipped to the U.S. for handling. However, it should also be noted that an estimated 1.4 times the Canadian waste total for the period was imported from the U.S. for handling.

2.3 SUMMARY OF FINDINGS

This section identifies hazardous waste quantities generated in Canada in 1986 and projected to 1992. These figures can be used as a basis for identifying the potential future demand for commercial hazardous waste management services in Canada. Significant assumptions were made in the generation of the waste quantity data that subsequently limit the use of this data. Although this data may provide an indication of potential trends, service needs, and orders of magnitude of the industry careful use and interpretation is imperative.

Highlights of the findings of this section are presented below:

i) The total estimated existing (1986) and future (1992) hazardous wastes requiring treatment/disposal in Canada are as follows:

Estimated 1986 total waste quantities	6,080,000 tonnes
Projected 1992 total waste quantities	6,503,000 tonnes
Estimated 1986 offsite waste quantities	2,264,000 tonnes
Projected 1992 offsite waste quantities	2,670,000 tonnes

(1992 offsite quantities include impact of MISA, household, site cleanup and decommissioning wastes, and PCB wastes)

ii) A review of the data suggests that approximately 50 percent of the total waste generated is of the "heavy metal solutions and residuals" class, about 3.38 million tonnes in 1986. Of this volume, it was estimated that only about ten percent was handled offsite.

iii) The three waste classes "solvents and organic solutions", "oils and greases", and "aqueous solutions with organics" each constituted about ten percent of the total hazardous wastes generated in Canada in 1986.

iv) For 1986, the estimate of Ontario's total hazardous waste quantity, 3.58 million tonnes, is about 60 percent of the total waste generated in Canada. The estimate for Quebec, 1.28 million tonnes, comprises another 20 percent of the total waste quantity in Canada.

v) For 1986, Canada generated over 2.26 million tonnes of hazardous wastes requiring offsite treatment and/or disposal, an estimated 37 percent of the total waste quantity generated in Canada.

vi) It was estimated that from 1986 Canada will have an overall increase in annual total hazardous waste generation of seven percent, about 6.5 million tonnes by 1992.

vii) Annual demand for offsite treatment/disposal may be increased by 18 percent, to about 2.7 million tonnes, by the year 1992 with consideration of programs such as MISA, and offsite handling of household wastes, site cleanup and site decommissioning wastes, and PCB's in use and in storage.

A range of 48,000 to 299,000 tonnes of additional wastes requiring offsite treatment and/or disposal may be generated in Ontario under this scenario as indicated by the OWMC study. With enhanced regulation in Ontario, the OWMC study estimates that an additional 223,000 to 474,000 tonnes of wastes will require offsite treatment/disposal in 1992 due to land disposal banning and inclusion of dust suppression wastes (includes impacts of MISA, etc.) This additional volume of waste could have an important bearing on future waste management practices. Additionally, if such initiatives are adopted nationally than increased impacts on future waste management practicies and commercial markets will likely be recognized.

viii) Review of waste import/export activities in Canada indicate that several provinces do not have sufficient capacity and/or adequate technology for appropriate management of all provincial wastes. Import/export activities also indicate that an extensive

list and considerable quantity of wastes are shipped to the U.S. for handling due to insufficient capacity or inadequate technology in Canada for the management of these wastes. Of the 95,000 tonnes of hazardous waste manifested for interprovincial shipment within Canada or international shipment from Canada (for a one-year period) approximately 39 percent was shipped to the U.S. for treatment or disposal. It should also be noted, however, that an estimated 1.4 times the Canadian waste total for the same period was imported from the U.S. for handling.

ix) Inclusion of used oils and biomedical wastes in the hazardous waste inventory may have a bearing on future waste management practices and the commercial market.

3.0 OVERVIEW OF GOVERNMENTAL INITIATIVES IN HAZARDOUS WASTE MANAGEMENT

The growth of the hazardous waste management industry has resulted primarily from increased awareness of the hazards of various chemicals and wastes currently or previous utilized and generated in Canada and throughout the world. The heightened awareness of environmental and public health and safety concerns associated with these hazardous or special wastes has resulted in the conduct of hazardous waste inventory studies, increased and improved regulation of waste management, and expanding technological development for the appropriate management of hazardous wastes. Waste management corporations, waste materials exchanges, and recycling councils have been established. Task forces and special advisory committees have also been commissioned to study the industry and recommend appropriate methodologies for waste management.

The following section presents an overview of hazardous waste management initiatives in Canada, the United States and in several other countries.

3.1 CANADIAN INITIATIVES

An overview of municipal, provincial/territorial and federal waste management activities, initiatives, organizations, inventories and legislation in Canada are presented in this section. Appendix B discusses these Canadian initiatives in detail.

3.1.1 Municipal Initiatives

Municipalities in Canada do not have direct mandates for hazardous waste management activity at the regulatory or policy level beyond the need to ensure that municipally generated hazardous wastes are managed according to applicable requirements. Increasingly, however, municipalities are undertaking regulatory and non-regulatory initiatives that directly and indirectly impact private sector hazardous waste management practices. In some cases, these initiatives expressly target private sector hazardous waste management practices; in other cases, private sector hazardous waste management practices are impacted indirectly, but significantly, as a result of municipal initiatives primarily designed for other purposes.

In this subsection, emphasis is placed on municipal activity in Ontario because municipalities in that province have moved further in impacting hazardous waste management than have municipalities in other parts of Canada.

3.1.1.1 Municipal Initiatives in Ontario

As is the case elsewhere in Canada, urban municipalities in Ontario are responsible for the provision of sewage treatment and non-hazardous, solid waste collection and disposal services. Generally in Ontario, these responsibilities give rise to municipal ownership and operation of sewage treatment facilities and associated infrastructure, and to municipal ownership of non-hazardous, solid waste landfill sites. Over the last decade, increasing concern over the environmental impacts of both types of facilities has led

to increased municipal efforts to assure environmental protection from these facilities.

In 1982, the Region of Waterloo agreed to host a demonstration program funded largely by Environment Canada to determine and refine appropriate municipal initiatives to encourage improved industrial and hazardous waste management. The municipality's objective in this work was to develop ways of ensuring and, if necessary, assisting industry in keeping its hazardous wastes out of the Region's sewage treatment and landfill facilities, both of which could potentially be seriously impacted by hazardous wastes.

The demonstration program was preceded by an in-depth survey of 50 companies in Southern Ontario. This established the kinds of municipal initiatives that hazardous waste generators would respond to and how, from the generator perspective, municipal hazardous waste management initiatives should be designed and delivered so as to elicit the greatest response (from the generators). For the purposes of the present study, the following findings are relevant:

i) For many companies, and particularly for medium- and smaller-sized companies and plants (250 employees or less), the municipality is the single most important waste management regulator. This is because for most companies hazardous waste management activity revolves around the range and concentration of wastes capable of being discharged to sanitary sewers.

ii) When companies become aware that in-house waste disposal practices may be contributing to environmental or public health problems, these companies are frequently willing to consider and implement alternative practices even though these may be more costly than established practices.

iii) While economics are the single most important factor in determining which of a range of hazardous waste management options should be undertaken, other factors, such as public image, availability of information and corporate policy, can also play key roles in hazardous waste management decision-making.

The demonstration industrial and hazardous waste management program in the Region of Waterloo, which was publicly endorsed by the local Chamber of Commerce, comprised several key activities. These were:

- creation of a local waste exchange serving industry in the municipality and linked to the Canadian Waste Materials Exchange (CWME);

- establishment of an industrial and hazardous waste management information centre;

- creation of an industrial and hazardous waste management manual on an industry-specific level, supported by in-plant waste audit activity;

- preparation and distribution of a quarterly newsletter featuring articles on the regulatory, technical and economic aspects of industrial and hazardous waste management;

- seminars and workshops on improved waste management practices in industry; and,

- implementation of Canada's first household hazardous waste collection program.

The demonstration program operated between 1983 to 1985, at which time a preliminary evaluation of the program was conducted. This indicated that the waste exchange had resulted in the reuse or recycling of listed wastes at a level equal to or comparable to the levels achieved by the CWME on a relative basis. The waste management manual and newsletter received a positive response and favourable feedback. The household hazardous waste collections led to the creation of a provincial household hazardous waste collection program.

Since 1985, the Region of Waterloo has maintained the program. Additionally, programs with similar components have been initiated in the Region of Peel, Region of Halton, the Essex-Windsor area and other jurisdictions in the province.

3.1.2 Provincial/Territorial Initiatives

Hazardous waste management activities have been undertaken in each of the provinces and territories to varying degrees, with Ontario and Alberta leading the development of the commercial waste management industry largely through the development of the Ontario Waste Management Corporation and the Alberta Special Waste Management Corporation, respectively. Several hazardous waste inventory studies have been undertaken on national, provincial/territorial and regional levels. The methodology for conducting these studies and the resultant waste inventories generated, in

some cases, varied considerably. Nevertheless, these inventories identified a need for commercial hazardous waste management services, although the magnitude of this demand could not readily be ascertained.

Many provinces/territories have developed legislation or are utilizing existing legislation to address appropriate management of hazardous wastes. Only British Columbia and Ontario have legislation addressing appropriate management of biomedical wastes. Ontario and Quebec are the only provinces with legislation governing used oils. Most provinces/territories have adopted in full or in part the federal Transportation of Dangerous Goods Act and Regulations for inter- and intra-provincial hazardous waste movement.

Several provinces have initiated waste management programs including provincial marketing and waste management planning studies to assess the need for, market potential of, and mechanism for development of appropriate waste management strategies for that province. These initiatives have not, however, focussed on the development of the hazardous waste management service industry. Programs that have been undertaken by the provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick and Nova Scotia, are highlighted below:

- British Columbia. A Special Waste Advisory Committee was commissioned to review waste management in the province. The B.C. Special Waste Services, Inc. has recently been established to develop a waste management system including a treatment and disposal facility in the province.

- Alberta. A cooperative effort has been undertaken between government and industry in the creation of the Alberta Special Waste Management System, a three-part program. The first step of the program was the construction of a treatment and disposal facility for handling the provinces hazardous wastes. The facility located at Swan Hills, Alberta opened on September 17, 1987. The Alberta Special Waste Management System's second step is the creation of transfer stations in major cities for special waste identification and sorting. The third stage involves strategic placement of smaller collection stations for consumer drop-off in subsidiary areas. Steps two and three are currently ongoing.

- Saskatchewan. A study was undertaken to establish the framework for development of a waste minimization program for the province including a waste exchange.

- Manitoba. A three-phase process for development of a comprehensive hazardous and special waste management plan to accommodate all of the hazardous waste generated in the province is currently underway. A series of public hearings are ongoing as part of the process of determining the nature and location of facilities required by the province. A crown agency entitled the Manitoba Hazardous Waste Management Corporation has been established to own and operate facilities in the province.

- Ontario. Waste management planning in Ontario continues to be guided by the provincial "Blueprint for Waste Management", published in 1987 and includes an active approach by the provincial government to establish the

Ontario Waste Management Corporation (OWMC) for construction and operation of facilities to address the problem of inadequate capacity for treating and disposing of hazardous and liquid industrial wastes in the province. The OWMC conducted an environmental assessment to identify the need for waste management in the province and the role that it could play in satisfying these needs. The OWMC's philosophy is to fill the gap in the provincial supply-demand scenario for provision of commercial hazardous waste management services. A draft document entitled "The OWMC Undertaking" (OWMC, 1988) addresses these needs. A key piece of legislation in the province is Regulation 309 which requires "cradle-to-grave" manifesting and tracking of solid hazardous wastes and liquid industrial wastes.

- Quebec. A special task force, le groupe d'étude et de restauration des lieux d'elimination des déchets dangereux (GERLED), was established to assess the dangers posed by active and abandoned disposal sites and the development and amendment of provincial regulations to specifically address appropriate hazardous waste management. GERLED is now a component of the provincial government. A market study of dangerous organic wastes was also undertaken in the province.

- New Brunswick. A comprehensive waste management plan is being developed for the province. As part of plan development public meetings are being held to discuss the hazardous waste problem in the province and its appropriate management.

- Nova Scotia. A Task Force on Hazardous Waste Management established to examine the hazardous waste management problem in the province recommended that a comprehensive strategy be developed for managing these wastes including public consultation. A study was also undertaken to inventory sources, types and methods of handling special wastes in the Halifax-Dartmouth Metropolitan area to provide a basis for development of the special waste management strategy.

Other provincial programs established to address or provide appropriate hazardous waste management include, but are not limited to, the following:

- Alberta - Help End Landfill Pollution (HELP) Program
  - Program for collection of used agricultural containers

- Saskatchewan - Pesticide Container Disposal Program
  - Annual collection of derelict vehicles

- Manitoba - Provincial "Wasteline" as part of the Manitoba Waste Exchange
  - Household Hazardous Waste Days
  - Several municipalities have programs to collect chemical pesticide containers

- Ontario - OWMC Waste Reduction Program
  - Household Hazardous Waste Collection Program
  - Municipal/Industrial Strategy for Abatement Program
  - Ministry of the Environment Industrial Waste Reduction Program

In addition to the above provincial initiatives, waste management corporations, councils and exchanges have been established in in several provinces. Waste materials exchanges have been established in British Columbia (one year pilot project), Alberta, Manitoba and Ontario. Three waste management crown corporations exist, these are; the Alberta Special Waste Management Corporation, the Manitoba Hazardous Waste Management Corporation, and the Ontario Waste Management Corporation. Recycling councils have been established in British Columbia, Alberta, Manitoba and Ontario. Other provincial waste management organizations include; Alberta Environment Centre, Biomass Energy Institute in Manitoba, Manitoba Environmental Council, Manitoba Clean Environment Commission, Ontario Research Foundation, and the New Brunswick Environmental Council.

Aside from governmental initiatives, industry has established a waste management association in Ontario and efforts are currently ongoing to establish such an association in Alberta and in other provinces. Additionally, privately developed and managed programs such as the "ONSITE" program in Ontario have operated in Quebec and Nova Scotia. A similar program is expected to startup in British Columbia.

3.1.3 Federal Initiatives

The Federal government has been actively involved in hazardous waste management initiatives and programs for several years with the development of regulations and guidelines addressing appropriate waste management, hazardous waste reduction and recycling programs, abandoned waste site studies and waste inventories, and the publication of

many documents addressing various aspects of waste management. Much of the federal legislation addressing hazardous wastes has been adopted from other jurisdictions, particularly the United States. The new Canadian Environmental Protection Act (CEPA) (currently in its third reading) will promote a "cradle-to-grave" approach to waste management. The Transportation of Dangerous Goods Act and Regulations have played a key role in appropriate management of hazardous wastes through control and manifesting of international and interprovincial dangerous goods and hazardous wastes transport. Presently, waste management in the provinces is solely a provincial jurisdiction with the exception of hazardous wastes generated by federal activities or on federal lands. In the territories, however, federal assistance is currently provided for appropriate waste management.

The Federal government has been involved in various recycling and reduction activities through programs such as the Development and Demonstration of Resource and Energy Conservation Technology (DRECT), the Canadian Waste Materials Exchange and the Accelerated Capital Cost Allowance (ACCA) Program. Other funding and technical assistance opportunities such as the Industrial Research Assistance Program (IRAP), the Industrial Regional Development Program (IRDP), the Industry Energy Research and Development (IERD) program, the Unsolicated Proposal (UP) fund, and the Technology Inflow Program are available. Although few of the above programs are designed specifically for pollution control efforts, these programs can be tapped to assist in minimizing pollution by enhancing processing and energy efficiency.

Additionally, the Federal government has chaired or initiated several working groups to assess hazardous waste management in Canada, including the Hazardous Waste Definition Task Force, the Federal/Provincial/Territorial Committee on Hazardous Wastes, and the Canadian Council of Resource and Environment Ministers (CCREM). Recently, a plan to manage hazardous waste in Canada was initiated by CCREM. The Action Plan contains detailed proposals for the harmonization of legislation, policies and programs dealing with hazardous waste and the harmonization of rules and manifest systems for the shipment of wastes across provincial and international borders. Although the Action Plan does not propose initiatives explicity focussed on the development of the hazardous waste management service industry, the industry will benefit from many initiatives proposed by the Plan.

In recent years, federal budget cuts have imposed strict contraints on funds directed towards environmental protection. As a result, Environment Canada's committment to a wide range of environmental and research activities has been limited. The Federal government's mandate, with respect to hazardous waste management, has five major components that will likely continue to be prime areas of federal involvement in the future, as presented below:

- the control of international and interprovincial hazardous waste movement;

- the management of hazardous wastes generated by federal activities and the disposal of wastes on federal lands;

- the control of materials dumping in the ocean (including incineration at sea);

- the protection of federally managed resources (i.e. fish, migratory birds) from the impacts of improper hazardous waste management practices by non-federal government activities; and,

- the management of radioactive wastes.

A detailed discussion of federal initiatives and programs in hazardous waste management is presented in Appendix B.

3.2 UNITED STATES INITIATIVES

In the United States (U.S.), the hazardous waste management industry has rapidly progressed largely due to the U.S. regulatory program and its early mitgation. Comprehensive legislation has been developed to address hazardous, solid and municipal waste disposal problems at existing or proposed facilities and abandoned facilities. Regulation of the industry has forced hazardous, solid and municipal waste generators to appropriately manage these wastes. Regulation has also resulted in the development of innovative technologies for waste management and the siting of commercial treatment, storage and disposal facilities.

The following section presents a brief overview of municipal, state and federal initiatives in hazardous waste management in the United States. Detailed discussions of U.S. legislation and programs for waste management is presented in Appendix C.

3.2.1 Municipal Initiatives

Several significant municipal programs in the U.S. are highlighted below.

3.2.1.1 North Carolina Pollution Prevention Pays Program

Started in 1985, this program focusses specifically on industrial waste minimization. The program has three major activities: provision of information regarding improved waste management, particularly waste minimization; the funding of research and development for waste minimization technology; and a matching grant program for the application of waste minimization technology. Specific industry sectors targeted by the program include the textiles and the food and beverage industry. A budget of $300,000 has been allocated for the 1987/88 budget year.

An evaluation of the impact of the program has not been undertaken, although case-studies have been prepared and anecdotal information conveyed by staff suggests that the program has triggered waste management improvements in at least several dozen companies. However, the extent to which program activities, as opposed to other influences, have triggered changes is not clear.

The North Carolina Pollution Prevention Pays Program was one of the first non-regulatory state programs to focus on improved industrial and hazardous waste management. As such, it continues to serve as a model for the creation and development of a number of similar programs in other states, including Pennsylvania, Georgia, Massachusetts, Oregon, New York and Minnesota.

3.2.1.2 Tacoma-Pierce County, Washington State

Starting in 1983, the Tacoma-Pierce County area of Washington State began an initiative to encourage 150

target companies to comply with hazardous waste management regulations and improve hazardous waste management practices. Problems associated with poor waste management practices were defined and strategies were developed to work co-operatively with industry to improve or change traditional practices.

Many approaches taken by this program are similar to those taken in the Region of Waterloo and other Ontario municipal programs. The design and implementation of the program involved local business people as well as the relevant regulatory agencies. Although the scope of the program included the broad range of industrial and hazardous waste in the area, individual initiatives were targeted on an industry-specific basis. A strong emphasis was placed on education and information transfer activity to target industries. In-plant activity was a major focus to ensure relevance of information provided by the municipal officials.

The initial impact of the program was evaluated in 1984. As a result of the program, companies known to be out of compliance with hazardous waste regulations dropped by 40 percent and municipal officials claim that the quantity of mishandled waste dropped by 2,400 U.S. gallons in the initial 12 month period. The program has since been expanded to include Seattle King County, Snohomish County (including the City of Everett) and Thurston County (including Olympia).

3.2.1.3 Eire County, New York State

In 1984, Eire County in New York State, which includes the greater Buffalo area, established a program to work with some 3,000 businesses and public agencies in the County in

in order to achieve improved compliance with hazardous waste regulations. Specific industry sectors targeted by the program include the printing, furniture refinishing, and dry cleaning sectors and automotive body shops. The range of program activity includes hazardous waste management planning, sampling and analysis of waste streams and information on technology applications for waste management. By mid-1986, municipal officials believed hazardous waste management improvements may have occurred in up to 200 companies, although the magnitude of these improvements was not clear.

Interestingly, the Eire County program is viewed by the municipality as an economic development program as well as an environmental protection program. The County has, therefore, adopted its strategy as a way of marketing itself and its services to industry that may be interested in locating in the Country as well as a means of enhancing compliance with environmental regulations.

3.2.2. State Initiatives

Similar to the U.S. Environmental Protection Agency (EPA), several states have developed legislation and initiated programs for appropriate hazardous waste management. Some state legislation is more stringent that federal legislation. For example, in California, the Katz bill on hazardous waste disposal goes beyond the federal Compresive Environmental Response, Compensation and Liability Act (CERCLA) and imposes control on waste disposal in cases where the state determines a particular waste is hazardous. In addition to strict technical requirements to prevent water pollution including double lined ponds, unsaturated

zone monitoring, complex sampling and analytical procedures, the California Water Quality Control Board imposed requirements on wastes.

Several states have initiated waste management programs. Some key programs are highlighted below:

- Minnesota. The Minnesota Technical Assistance Program (MNTAP) was created in 1984 to provide confidential assistance, free of charge, to industries with waste management problems. MNTAP is funded 100% by a grant from the Minnesota Waste Management Board to the University of Minnesota. The grant is for a one year term and is subject to renewal each year. The objective of MNTAP is to reduce hazardous waste generation and identify cost effective alternatives to land disposal by providing small quantity waste generators with technical assistance.

- Illinois. The Industrial Waste Elimination Research Center focusses on waste reduction through process control and modification. Another major thrust of this research body is to develop innovative uses for industrial wastes as resource inputs or as end products.

- California. The California Department of Health is engaged in a waste recycling program that actively locates industrial waste streams whose components might be recycled. The purpose of the free consulting service to industry is to conserve energy and material resources by re-using materials which would normally be disposed, and to reduce the volume of materials going into disposal sites. Additionally, the California Office of

Appropriate Technology is active in promoting industrial waste reduction and recovery through policy recommendations and technology assessments (Campbell et al., 1982).

In addition to the above programs, several states have established waste materials exchanges, these include:

- Great Lakes Regional Waste Exchange-Grand Rapids, Michigan
- Industrial Material Exchange Service-Springfield, Illinois
- Northeast Industrial Waste Exchange-Syracuse, New York
- Southeast Waste Exchange-Charlotte, North Carolina
- Southern Waste Information Exchange-Tallahassee, Florida
- Western Waste Exchange - Tempe, Arizona
- California Waste Exchange - Sacremento, California
- Indiana Waste Exchange - Indianapolis, Indiana
- Montana Industrial Waste Exchange - Helena, Montana
- Industrial Waste Information Exchange - Newark, New Jersey
- Tennessee Manufacturers and Taxpayers Association - Nashville, Tennessee

3.2.3 Federal Initiatives

3.2.3.1 Legislation and Programs

In the United States, hazardous waste management is regulated on a national level with some states developing additional or more stringent criteria to ensure environmental protection. In order to adequately address the

issue of appropriate waste management federal legislation has been developed and a variety of federal programs have been undertaken.

Legislation governing hazardous waste management in the U.S. has been developed by the Environmental Protection Agency (EPA) since 1976 and continues to be developed and amended with the growing public awareness of this industry. The focus of the legislation is to provide 'cradle to grave' management of hazardous wastes, progressive banning of land disposal of untreated wastes, clean-up for past waste mismanagement and use of a corporate guarantee to satisfy liability coverage requirements. Much of the U.S. legislation has been adopted in other jurisdictions. One of the key federal initiatives in hazardous waste management are the statuatory mandates initiated by the U.S. Congress in 1984 to reduce the amount of waste generated and to reuse and recycle waste constituents, to the extent possible. Legislation was promulgated to require waste minimization programs to be initiated at all manufacturing plants, regardless of the size. Every shipment of hazardous wastes moving from a generator to treatment or disposal facilities require certification that a waste minimization program is in effect. Additionally, the U.S. Congress required that the EPA evaluate the extent of waste minimization being implemented nationally. The mandate was to evaluate the range of state programs that exist, the barriers that may exist for more comprehensive waste minimization in medium to small manufacturing companies, and give recommendations to Congress about mechanisms that would encourage greater corporate efforts to minimize waste generation (Piragis, 1987).

Several other programs exist to promote the appropriate management of hazardous wastes. Two such programs are the SITE Program and a telephone hotline. The Superfund Innovative Technology Evaluation (SITE) Program began in late 1985 to allow selected innovative waste remediation technologies to be demonstrated on a commercial scale. The program has been allotted $ 20 million U.S. dollars a year to identify, conduct demonstration testing and encourage the use of technologies that handle hazardous waste by methods other than land disposal. The EPA covers permit requirements and funds the cost of analytical support for the demonstration. A RCRA Hotline provides a national service specifically for interpretation of the Resource Conservation and Recovery Act and its 1984 Hazardous and Solid Waste Amendments. The Hotline also addresses other waste management related inquiries.

3.2.3.2 U.S. Marketing Study

In addition to federal initiatives in legislative development and waste management programs, studies of the commercial hazardous waste management industry in the United States have been undertaken. These studies indicate that perhaps the most important driving force of the U.S. commercial waste management industry is the public. Public awareness of the health risks from hazardous waste contamination has led to stricter legislation regarding hazardous waste management and abandoned dump sites. New regulations are forcing onsite treatment of waste, or hazardous waste transport to commercial waste management facilities. Currently, the largest commercial waste management market in the U.S. is the remediation of problems existing at old disposal sites as a result of past waste disposal

practices. This rapidly growing market is driven by Superfund. Another market focusses on the treatment, storage and disposal of presently generated industrial wastewater and other hazardous wastes. This market is driven by other legislation.

A study entitled "Analysis of the Market for Commercial Hazardous Waste Management Services" (Industrial Economics Inc., 1988) has recently been undertaken in the U.S. The purpose of the study was to supplement ongoing EPA activities in assessing the market for commercial waste management services in the U.S. and where EPA should concentrate its future analytical efforts in this industry. The study estimated that 550 companies provide hazardous waste transportation services in the U.S. Of these firms, 78 percent offer only transportation services while the remaining 22 percent offer transportation along with treatment, storage, disposal and recycling and/or spill response and clean-up services.

Approximately 330 companies with operations at more than 500 locations were identified as offering commercial treatment, storage, disposal or recycling services. In general, the total number of facilities with treatment, storage or recycling operations is large relative to the number providing incineration and land disposal services. Nationwide there are only 19 commercial facilities that incinerate hazardous wastes (excluding cement kilns) and only 13 of these burn solids and sludges.

In the market for commercial land disposal, 47 facilities provide the service, and only 29 of these have hazardous waste landfills. However, a 1985 EPA survey of commercial

waste management firms indicated that landfilling activities accounted for almost 50 percent of the waste accepted at commercial firms. The landfilled quantity was approximately 10 times the quantity incinerated (5 percent of all waste). Chemical treatment of waste accounted for most of the remaining volume (25 percent) (Industrial Economics, Inc., 1988).

The study also suggested potential "problem" areas with the greatest likelihood that capacity is or will not be expanding rapidly enough. One potential problem area was cited as inadequate capacity of existing treatment and disposal technologies, specifically, the incineration of solids and sludges and inadequate landfill capacity.

An overview of the factors influencing the growth of the commercial waste management industry in the United States as evidenced in the study, is briefly presented below:

- A generator's decision to treat wastes on-or offsite and the type of technology implemented depends on the cost of onsite versus offsite waste management; the effectiveness of on-versus offsite treatment and disposal technologies for reducing the hazard posed by the waste; and, the ability to obtain a permit for an onsite treatment process.

- Large profitable firms select waste management services that provide the greatest degree of destruction or permanent immobilization of the waste and the supplier with the "deepest pockets" on the premise that these firms are more likely to provide sufficient liability protection.

- Regional imbalances in the distribution of commercial hazardous waste management facilities has resulted in the need for generators to ship wastes long distances for treatment or disposal, thereby increasing waste management costs.

- There is a limited availability of transportation services for less-than-full truckloads of waste thereby making waste pick-up difficult and resulting in high transportation costs.

- The uncertainty about what wastes will be regulated and how stringently the regulations will be enforced is influencing the supply of commercial waste management services.

- The difficulty of obtaining siting permits for facilities at new locations and permitting expansions or new technologies at existing waste management facilities is influencing the supply of commercial services.

- Obtaining environmental liability insurance for commercial hazardous waste facilities is very difficult.

- A perceived decision that regulatory officials are encouraging waste management at only a small number of commercial facilities and requesting large generators to withdraw RCRA Part B permit applications (for onsite treatment) is increasing the demand for commercial waste management services.

- Implementation of the RCRA corrective action program requiring a clean-up plan for all solid waste management units is serving as a disincentive to firms considering applications for onsite treatment thereby increasing the demand for offsite services

- The demand for offsite services is increasing due to the great difficulty in obtaining EPA approval for delisting a waste or treatment residue.

- Permitting is a primary constraint to expansion of commercial waste services due to lack of resources and personnel at both the state and federal level for processing permits, problems caused by differences and inconsistencies between federal and state regulatory standards, and limited incentives for permit writers to issue permits that can actually be implemented by the applicant.

- The Superfund program provides federal funding for remediation of abandoned and inactive hazardous waste sites and as such provides funding for technological development and demonstration testing. This program encourages development of the commercial industry.

- The RCRA Hotline assists industry in interpretation of the legislation governing hazardous waste management, thereby encouraging appropriate waste management.

A detailed discussion of the hazardous waste market in the U.S. and the findings of the above study is presented in Appendix C.

3.3 INITIATIVES IN OTHER COUNTRIES

Other countries have developed aggressive programs to encourage the adoption of pollution control equipment generally, including hazardous waste management technology. In Western Europe these programs have been developed at the European Economic Community (EEC) level, and at the national level. At the EEC level, programs are of a policy, technical and financial nature, but not regulatory. At the national level, regulatory programs and related technical and financial programs exist.

An overview of initiatives in other countries that are considered to be most significant and have most relevance for the Canadian situation are presented below.

3.3.1 European Community

In contrast to the prevalent North American attitude, the EEC's environmental policies and programs are explicitly viewed as significant stimuli of economic growth. While precise information on the contribution of the pollution control equipment sector generally, and the hazardous waste industry specifically, is unavailable, the EEC estimates that between 1.5 and 2.0 million people are employed in the "pollution control equipment and related services" industry. This is expected to double by the year 2000. In total, the EEC estimates that 9,000 companies in member countries earned in excess of $15 billion in 1985 from the export of pollution control equipment. Major export markets were in North American, U.S.S.R., Scandinavia and Japan. The total value of the EEC pollution control industry in terms of sales is estimated at over $30 billion worldwide.

Recognizing the importance of the industry, the EEC has initiated a series of activities and policies specifically intended to enhance the industry through the business development and market potential perspective. These policies and activities are being undertaken separately from the development of activities and policies intended to protect the environment, but as a complement to environmental protection policies.

The EEC has undertaken specific initiatives to promote the long-term viability of the EEC pollution control industry as highlighted below:

- The EEC is assisting in the development of Polmark, a database containing information on markets for pollution control and waste management technology. Polmark will provide a comprehensive inventory of available pollution control and waste management technology, and is seen as an "invaluable tool" for identifying markets over the next decade.

- A research, development and demonstration program to support "clean" and "low-waste" technology has been established to provide up to 50 percent funding of research, development and demonstration for eligible technologies.

- A computerized Network for Technology Transfer (NETT) is being developed as a tool to provide independent advice on pollution control and hazardous waste management technology to potential users of the technology. NETT will also provide comprehensive information on government programs, research and development initiatives and financial and technical assistance.

- A training program has been initiated to increase the number of pollution control and hazardous waste management specialists in the EEC. It has been estimated that Italy will require 25,000 toxic waste specialists to service the toxic waste management industry in that country alone.

- On a more general level, the EEC has highlighted the high level of economic activity that its member countries have with the developing world. It has emphasized the advantages that this activity and historical European ties with the developing world give the EEC in terms of marketing pollution control and hazardous waste management equipment to these countries. The increasing integration of development aid efforts with environmental protection is viewed by the EEC as providing major impetus for exports by domestic companies of pollution control and hazardous waste management technology. Specific steps to increase exports to the developing world and elsewhere include support of trade missions and trade exhibitions.

3.3.2 France

The hazardous waste management regulatory framework in France is complex, with five major governmental agencies responsible for implementing various aspects of hazardous waste management programs. However, there has been reluctance on the part of the French government to undertake enhanced hazardous waste management initiatives because of the perceived encouragement to generators to dispose of wastes illegally that may result from any increase in hazardous waste management costs. Emphasis has

therefore been placed on assisting industry to meet current hazardous waste management requirements and on encouraging hazardous waste generation avoidance.

Programs aimed at developing and implementing "clean technology", that do not result in hazardous waste generation, have therefore been initiated for retrofitting existing plants and for inclusion in the design of new plants. Financial assistance is available for the research, development and implementation of "clean technology". The fragmentation of agencies administering this assistance makes it difficult to precisely state the value of the assistance, but it appears to have been in the $7-10 million range in 1985.

3.3.3 West Germany

The Waste Avoidance and Disposal Act (1986) has established waste minimization as a national policy and allows the drafting of regulations to support and implement the policy. In addition, 1985 amendments to the Emission Control Law requires that facilities avoid or recycle all waste residues unless this is not technically feasible or is not considered economically achievable. Consistent with this emphasis on waste minimization, a catalogue of alternative technologies for managing specific waste streams has been developed. This provides a technical basis for determining levels of waste minimization necessary to comply with the waste minimization requirements of the law and the related need for offsite hazardous waste management.

Financial and technical assistance programs complement these policy directions. In 1985, over $85 million was

approved by the West German government for the research, development and implementation of new technologies capable of exceeding regulatory pollution control requirements, including those associated with hazardous waste management. Technical assistance programs are notable for the roles industrial associations and Chambers of Commerce play in providing information and related services to companies regarding pollution control and hazardous waste management.

3.3.4 Activity in Other Countries

Although not imposing similarly stringent legislation, other countries have begun to focus attention on waste minimization activities. For example, Denmark and Sweden are developing legislation that requires substitution of dangerous substances found in specific products. These two countries have targeted compounds such as cadmium, plasticizers and mercury as first efforts for minimization through substitution. Japan has also launched efforts to reduce mercury and cadmium use in batteries. In Australia, legislative demands require that new industrial ventures must employ "low-waste" technologies, to the extent possible (Piragis, 1987).

Additionally, in Western Europe, although the majority of the waste is still landfilled, there is increasing movement toward incineration and physical/chemical treatment. This trend exists in the Eastern European countries also, where 90% of all hazardous waste has been placed into land disposal. Japan pretreats nearly 68% of hazardous wastes prior to land disposal. Although Hong Kong still uses ocean dilution and dispersal principles as a major management option, there is emerging concern for the need to have

specialized treatment and disposal facilities. The United Kingdom is also attempting to reduce dependence on land disposal. Some wastes are prohibited from specific landfills. In addition, incineration and treatment is encouraged, but not yet legislatively mandated (Piragis, 1987).

Other actitivies include: in Switzerland, the development of legislation to control the quantity and disposal of inorganic residues from incineration processes; review in Denmark of the need to allocate additional funds for cleanup operations at sites contaminated with chemical wastes; assessment of the future direction of hazardous waste management in Norway; the banning of organochlorine pesticides for agricultural uses in Australia; development of a landfill modelling program in France in 1988-89 to predict the quantity and characteristics of leachates; and the development of legislation to address hazardous wastes in Spain.

3.4 CONCLUSIONS

A number of general conclusions are presented below regarding current hazardous waste management regulations and future regulatory direction. These conclusions have important implications for the hazardous waste management service industry and the future actions Environment Canada may take to assist in developing market opportunities for the industry.

i) There is significant variation in the extent to which provinces have developed and implemented hazardous waste management regulations. The trend, however, is clearly towards more rigorous definition of what

constitutes a hazardous waste and towards greater regulation of hazardous waste management activities. A number of initiatives are already underway at the federal level to standardize hazardous waste management practices, particularly through CCREM and the implementation of the Transportation of Dangerous Goods Act.

ii) Some provinces, and notably Ontario, are reviewing requirements for financial assurance and technical standards for hazardous waste management facilities. To the extent that higher financial assurance and technical standards may be required by regulatory agencies, the costs of establishing, operating and closing these facilities will rise. This is likely to have two effects.

First, greater capital resources will be required to satisfy regulatory requirements and will tend to force companies with an inadequate capital base out of the hazardous waste management field. The result will be fewer, but larger, companies providing treatment, or disposal services.

Second, the cost of hazardous waste management services to waste generators will rise as those companies remaining to provide such services charge higher prices to cover higher capital costs.

iii) There has been broad consensus at the federal and provincial levels that hazardous waste minimization is a highly desirable objective. In the U.S., legislation requires that waste minimization programs be

initiated at all manufacturing plants, regardless of size. Europe is also placing increased emphasis on waste minimization. Ontario's waste management regulations provide significant impetus for onsite treatment by classifying many hazardous wastes in terms of waste characteristics. If a waste can be treated to reduce the hazardous nature of the waste below the relevant characteristic, it is no longer considered hazardous and may be disposed of, at much reduced cost, as a non-hazardous waste. To the extent that this activity occurs, quantities of hazardous waste requiring offsite management will decrease, with an attendant loss of market opportunities for the commercial (offsite) hazardous waste management industry.

iv) It appears that technical and financial assistance programs may have a significant effect on the quantity of hazardous waste generated. It is difficult, if not impossible, to determine the actual impact of assistance programs on hazardous waste management decision-making. Nevertheless, it is true that for regulations to be effective regulatory compliance is a must and, as the limited data on these activities indicate, assistance programs may play a major role in facilitating regulatory compliance. To this extent, assistance programs can be viewed as important components of regulatory programs in that compliance can be achieved through the adoption of hazardous waste management technology and services. In addition, such programs may alleviate what would otherwise be an onerous burden on enforcement personnel and may facilitate communication on a wide range of issues between

the regulated community and the regulators that could not otherwise exist.

Technical and financial assistance programs are relatively undeveloped in Canada as compared to efforts in Europe and parts of the U.S. Outside Ontario, there is virtually no attention explicitly given to these activities. In Ontario, assistance programs offered by provincial agencies and municipalities are often unco-ordinated and may not focus on hazardous waste. Models focussing on hazardous waste management do, however, exist in Europe, the U.S. and Ontario that could be used for substantial expansion of this activity across Canada.

v) The explicit support of the hazardous waste industry by government agencies as a vehicle of economic growth has not been seriously undertaken, and is not part of the CCREM agenda. By contrast, the European Economic Community (EEC) has developed explicit policies for developing the industry in recognition of its already major contribution to the EEC economy and its future growth potential. EEC objectives with these policies are two fold: to maintain and enhance the competitiveness in Europe of the domestic industry in the face of increasing competition from, particularly, the U.S. and Japan; and to ensure that the domestic industry is well placed to both build upon its already large exports to industrialized countries and to take advantage of significant export opportunities in aiding developing countries.

In contrast, the pollution control industry and the hazardous waste management service industry, in Canada

is not generally recognized by government agencies as a potentially major contributor to economic growth. A major opportunity exists for both environmental protection and industrial development agencies to develop policies and initiate activities supportive of the industry in recognition of its potential and actual contribution to the economy.

4.0 PROFILE OF THE HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY IN CANADA

Commercial hazardous waste management is a relatively new industry in Canada. This industry has grown largely due to the development and enforcement of legislation resulting from increased public awareness of the hazardous nature of many wastes. The magnitude of the hazardous waste service industry in Canada can be identified through a review of services, technologies and waste transport activities nationally and the economics associated with this industry. The views of the commercial industry, hazardous waste generators and waste management organizations on the current status and future potential of this service industry are also important considerations. These factors enable establishment of the profile of the hazardous waste management industry in Canada, as discussed in the following section.

4.1 OVERVIEW OF PROVINCIAL/TERRITORIAL SERVICES AND TECHNOLOGIES

Commercial waste management services have been categorized in the "Directory of Hazardous Waste Services" (Corpus Information Services, 1987) as consulting/engineering, disposal, equipment manufacturing/sales, laboratory/analysis, material recycling/recovery, site rehabilitation, spill cleanup, transport and treatment chemical/sales. Many companies provide one or more of the above services. Other directories also categorize provincial waste management services. For the purposes of this study, however, treatment, disposal, transportation and recycling services in Canada will receive primary emphasis.

To identify the number of companies providing commercial services, and the types of services and technologies available within each province, hazardous waste service directories were reviewed and provincial environment officials were contacted. Several variations were evidenced between these information sources, most notably in the number of firms providing commercial waste management services. This variation has been attributed to the following:

- number of facilities and type of technology not identified in the directories;
- whether a firm's prime business is hazardous waste management was not identified;
- a firm may be located in a particular province but could be providing services to other provinces;
- in the directories, a firm may be identified in several service categories (i.e., treatment, disposal, transport and recycling) and not actually provide these services. For example, a consulting firm may be identified as providing disposal and treatment services when in fact this firm has expertise in disposal/treatment technologies or can identify a commercial facility suitable for waste disposal/treatment but does not actually undertake disposal/treatment activities;
- waste management industry changes so rapidly that directories may be out-of-date;
- directories may not specify provision of onsite or offsite services;

- a firm's anticipated but not yet available services may be identified; and,

- provincial environment officials may not be aware of all provincial service companies for several reasons, for example, other department divisions may be responsible for specific waste management aspects.

Although several variations in the data sources were identified, it was deemed reasonable to utilize information provided by provincial officials over the directory information because this information is most current and was available in greater detail in terms of the number of service companies located in the province and corresponding services and technologies provided.

Discussions with provincial environment officials indicated the provincial availability of commercial hazardous waste services (i.e., treatment, disposal, recycling and transport). Tables 4.1 and 4.2 identify provincially available services and technologies.

Several factors have been cited as influencing a generator's decision to utilize onsite treatment facilities or acquire offsite services as briefly presented below:

- economics and the nature and enforcement of the regulations;

- information on the range of options available - lack of information has been cited as a major barrier to onsite waste management activities; and,

TABLE 4.1 COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES AVAILABLE PROVINCIALLY*

Province	Disposal		Physical/Chemical Treatment		Thermal Destruction		Recycling/Recovery		Transportation
	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities
British Columbia	-	-	1	Solidification	1	Incineration	3	Used oil recycling	8
			1	Neutralization			5	Solvent recycling	
Total			2		1		8		8
Alberta	1	Secure landfill	4	Neutralization	1	Incineration (rocking kiln)	4	Used oil recycling	12
	2	Deep well injection	1	Solidification			1	Crude oil recovery	
			1	Biological Treatment			1	Used oil for road oiling or fuel in asphalt plants	
			1	Oil Separation			2	Catalyst reclamation	
							1	Solvent recycling	

TABLE 4.1 COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES AVAILABLE PROVINCIALLY* (Cont'd)

Province	Disposal		Physical/Chemical Treatment		Thermal Destruction		Recycling/Recovery		Transportation
	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities
Alberta (Cont'd)							2	Recycling/ recovery of film scrap and photo- graphic chemicals	
							2	Metal recycling	
							1	Recycling of inor- ganic chemicals & mineral by-pro- ducts	
Total	3		7		1		14		12
Saskatchewan	-	-	1	Sodium dechlorin- ation	-	-	1	Used oil recycling	11
							2	Solvent recycling	
Total	-		1		-		3		11
Manitoba	-	-	-	-	-	-	2	Solvent recycling	5

TABLE 4.1 COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES AVAILABLE PROVINCIALLY* (Cont'd)

Province	Disposal		Physical/Chemical Treatment		Thermal Destruction		Recycling/Recovery		Transportation
	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities
Ontario**	1	Landfill	1	Solidification	2	Incineration (liquid injection)	6	Used oil recycling	32
			1	Emulsion			9	Solvent recycling	
			1	Dewatering			3	Acid and/or alkaline waste reclamation	
							2	Used oil and acid and alkaline waste reclamation	
							2	Used oil and solvent recycling	
							1	Pickle liquor reclamation	
Total	1		3		2		23		32

TABLE 4.1 COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES AVAILABLE PROVINCIALLY* (Cont'd)

Province	Disposal		Physical/Chemical Treatment		Thermal Destruction		Recycling/Recovery		Transportation
	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities
Quebec	1	Landfill	1	Solidification	1	Incineration (liquid injection)	1	Solvent recycling	17
			1	Neutralization/ precipitation					
Total	1		2		1		1		17
New Brunswick	-	-	-	-	-	-	1	Solvent recycling	2
							1	Used oil recycling	
Total	-		-		-		2		2
Nova Scotia	-	-	-	-	-	-	2	Solvent recycling	7
							2	Used oil recycling	
Total	-		-		-		4		
Prince Edward Island	-	-	-	-	-	-	1	Used oil recycling	1

TABLE 4.1 COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES AVAILABLE PROVINCIALLY* (Cont'd)

Province	Disposal		Physical/Chemical Treatment		Thermal Destruction		Recycling/Recovery		Transportation
	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities	Type of Technology	No. of Facilities
Newfoundland	-	-	-	-	-	-	-	-	2
Northwest Territories	-	-	-	-	-	-	-	-	-
Yukon	-	-	-	-	-	-	-	-	-

*Based on discussions with provincial/territorial environment officials.
**Based on findings of "The OWMC Undertaking" (OWMC, 1988).

TABLE 4.2 COMPANIES PROVIDING COMMERCIAL SERVICES (BY PROVINCE)*

PROVINCE	NUMBER OF COMPANIES	PRIVATE/CROWN	WASTE MANAGEMENT CATEGORY/SERVICE	NUMBER OF FACILITIES	TYPE OF TECHNOLOGY
British Columbia	1	Private	Physical/Chemical Treatment	1	Solidification
				1	Neutralization
			Transportation	1	
	1	Crown (U.B.C.)	Thermal Destruction	1	Incineration
	1	Private	Recycling/Recovery	3	Solvent recycling
			Transportation	3	
	1	Private	Recycling/Recovery	1	Solvent recycling
	1	Private	Recycling/Recovery	1	Solvent recycling
				1	Used oil recycling
			Transportation	1	
	1	Private	Recycling/Recovery	1	Used oil recycling
	1	Private	Recycling/Recovery	1	Used oil recycling
			Transportation	1	
	2	Private	Transportation	2	
Total	9			19	
Alberta	1	Crown	Disposal	1	Secure landfill
				1	Deep well injection
			Physical/Chemical Treatment	1	Solidification

TABLE 4.2 COMPANIES PROVIDING COMMERCIAL SERVICES (BY PROVINCE)* (Cont'd)

PROVINCE	NUMBER OF COMPANIES	PRIVATE/CROWN	WASTE MANAGEMENT CATEGORY/SERVICE	NUMBER OF FACILITIES	TYPE OF TECHNOLOGY
Alberta (Cont'd)				2	Neutralization
			Thermal Destruction	1	Incineration (rocking kiln)
	1	Private	Disposal	1	Deep well injection
			Physical/Chemical Treatment	1	Oil separation
			Transportation	1	
	1	Private	Physical/Chemical Treatment	1	Biological treatment
	1	Private	Physical/Chemical Treatment	2	Neutralization
	1	Private	Recycling/Recovery	1	Solvent recycling
	2	Private	Recycling/Recovery	2	Catalyst reclamation
	2	Private	Recycling/Recovery	2	Recycling/recovery of film scrap and photo-graphic chemicals
	2	Private	Recycling/Recovery	2	Metal recycling
	1	Private	Recycling/Recovery	1	Recycling of inorganic chemicals and mineral by-products
	1	Private	Recycling/Recovery	1	Crude oil recovery

TABLE 4.2 COMPANIES PROVIDING COMMERCIAL SERVICES (BY PROVINCE)* (Cont'd)

PROVINCE	NUMBER OF COMPANIES	PRIVATE/CROWN	WASTE MANAGEMENT CATEGORY/SERVICE	NUMBER OF FACILITIES	TYPE OF TECHNOLOGY
Alberta (Cont'd)	1	Private	Recycling/Recovery	1	Used oil for road oiling or fuel in asphalt plants
			Transportation	1	
	1	Private	Recycling/Recovery	1	Used oil recycling
			Transportation	1	
	3	Private	Recycling/Recovery	3	Used oil recycling
	8	Private	Transportation	9	
Total	26			37	
Saskatchewan	1	Private	Physical/Chemical Treatment	1	Sodium dechlorination
			Transportation	1	
	1	Private	Recycling/Recovery	1	Used oil recycling
			Transportation	1	
	2	Private	Recycling/Recovery	2	Solvent recycling
			Transportation	2	
	7	Private	Transportation	7	
Total	11			15	

TABLE 4.2 COMPANIES PROVIDING COMMERCIAL SERVICES (BY PROVINCE)* (Cont'd)

PROVINCE	NUMBER OF COMPANIES	PRIVATE/CROWN	WASTE MANAGEMENT CATEGORY/SERVICE	NUMBER OF FACILITIES	TYPE OF TECHNOLOGY
Manitoba	2	Private	Recycling/Recovery	2	Solvent recycling
	5	Private	Transportation	5	
Total	7			7	
Ontario**	1	Private	Disposal	1	Landfill
			Physical/Chemical Treatment	1	Emulsion
				1	Dewatering
				1	Solidification
			Thermal Destruction	1	Incineration (liquid injection)
			Recycling/Recovery	1	Solvent recycling
	1	Private	Thermal Destruction	1	Incineration
			Transportation	1	
	2	Private	Recycling/Recovery	2	Solvent recycling
			Transportation	2	
	27	Private	Transportation	27	
	1	Private	Recycling/Recovery	1	Used oil recycling
			Transportation	1	
	1	Private	Recycling/Recovery	1	Used oils and acids and alkaline wastes reclamation

TABLE 4.2 COMPANIES PROVIDING COMMERCIAL SERVICES (BY PROVINCE)* (Cont'd)

PROVINCE	NUMBER OF COMPANIES	PRIVATE/CROWN	WASTE MANAGEMENT CATEGORY/SERVICE	NUMBER OF FACILITIES	TYPE OF TECHNOLOGY
Ontario** (Cont'd)			Transportation	1	
	1	Private	Recycling/Recovery	1	Used oils and acid and alkaline wastes reclamation
	2	Private	Recycling/Recovery	2	Used oils and solvent recycling
	5	Private	Recycling/Recovery	5	Used oil recycling
	6	Private	Recycling/Recovery	6	Solvent recycling
	3	Private	Recycling/Recovery	3	Acid and alkaline waste reclamation
	1	Private	Recycling/Recovery	1	Pickle liquor reclamation
Total	51			61	
Quebec	1	Private	Disposal	1	Secure landfill
			Physical/Chemical Treatment	1	Solidification
				1	Neutralization/ Precipitation
			Transportation	1	
	1	Private	Thermal Destruction	1	Incineration (liquid injection)
			Transportation	1	
	1	Private	Recycling/Recovery	1	Solvent recycling
			Transportation	1	
	14	Private	Transportation	14	
Total	17			22	

TABLE 4.2 COMPANIES PROVIDING COMMERCIAL SERVICES (BY PROVINCE)* (Cont'd)

PROVINCE	NUMBER OF COMPANIES	PRIVATE/CROWN	WASTE MANAGEMENT CATEGORY/SERVICE	NUMBER OF FACILITIES	TYPE OF TECHNOLOGY
New Brunswick	1	Private	Recycling/Recovery	1	Solvent recycling
			Transportation	1	
	1	Private	Recycling/Recovery	1	Used oil recycling
			Transportation	1	
Total	2			4	
Nova Scotia	2	Private	Recycling/Recovery	2	Used oil recycling
			Transportation	2	
	1	Private	Recycling/Recovery	1	Solvent recycling
			Transportation	1	
	1	Private	Recycling/Recovery	1	Solvent recycling
	4	Private	Transportation	4	
Total	8			11	
Prince Edward Island	1	Private	Recycling/Recovery	1	Used oil recycling
			Transportation	1	
Total	1			2	
Newfoundland	2	Private	Transportation	2	
Northwest Territories	-	-	-	-	-
Yukon	-	-	-	-	-

* Based on discussions with provincial environment officials.

** Based on the findings of "The OWMC Undertaking" (OWMC, 1988).

- the firm's perception as to whether the available treatment technology corresponds with the corporate image.

In addition to hazardous waste management services and technologies involving treatment, disposal, recycling and transport, appropriately trained professionals are required. A study entitled "Study of Professional Needs in Solid and Hazardous Waste Management" (Jones et al., 1984) was undertaken to assess the current and future professional manpower needs in solid and hazardous waste management in Canada. The study surveyed consultants, federal, provincial, and municipal government agencies, industry and generators involved in solid and hazardous waste management. Highlights of this study are presented below:

- approximately 250 and (likely several times more) additional professionals are expected to be needed in the not too distant future;

- an increase of 40% to 100% in the need for professionals for the management of industrial wastes by the year 2000 with greatest demands in the areas of waste treatment, incineration, and materials recycling is expected;

- in-house staff are being inadequately prepared to deal with future work in solid and hazardous waste management thereby requiring professional upgrading;

- "on the job" training and professional development are the most useful educational vehicles for appropriate waste management;

- consultant capabilities are weakest in waste treatment and materials recycling/recovery; and,

- in excess of 80 percent in all responding groups would participate in the activities of a Centre providing short courses and special courses for specific industries in waste management and conduct of applied research by sending staff to the Centre for professional upgrading.

4.2 ECONOMIC PROFILE

Quality information is not currently available concerning the economic aspects of the Canadian hazardous waste management service industry. Studies focussing on these aspects of the industry have not, in general, been undertaken, although Ontario is undertaking such a study. Some studies have been conducted on the pollution control industry generally in Canada, but it is not possible to identify the components of the total industry that relate specifically or in part to hazardous waste management.

An alternative approach to generating an economic profile of the industry would be to review and collate corporate statistics on the companies in the industry. Few companies in this industry are publically traded, however, and this approach was therefore not adopted.

The economic profile that is provided below is therefore based on extrapolations from available U.S. and Canadian data sources. While this approach cannot provide a precise economic profile of the hazardous waste management service industry, it does provide an initial framework for under-

standing the essential economic components of the industry and is, therefore, considered useful for the purpose of this study. More precise data will require the generation of primary data by, for example, a survey questionnaire administered to the industry.

4.2.1 Market Size

Direct information on the size of the hazardous waste management market in Canada, such as sales figures, is not readily available. Information on pollution control expenditures by manufacturing industry is, however, available for Canada and the U.S. From this information it is possible to estimate the approximate size of the Canadian hazardous waste management market.

4.2.1.1 Capital Expenditures

The methodology for estimating Canadian manufacturing sector hazardous waste management capital expenditures assumes the following:

1) The Canadian manufacturing sector is approximately 10 percent the size of the U.S. manufacturing sector and generates similar quantities of hazardous waste on a unit basis.

2) The manufacturing sector represents essentially the entire market for the hazardous waste management service industry.

3) The overall relationship of manufacturing sector water and air pollution control expenditures between the U.S.

and Canada can be used as a guide for the approximate relationship of hazardous waste management manufacturing expenditures.

Table 4.3 presents available data on hazardous waste management, water and air pollution capital investments by the manufacturing sector in Canada and the U.S. Hazardous waste management capital expenditures are unavailable for Canada, but may be estimated on the basis of the remaining information in the Table.

As Table 4.3 indicates, water pollution control capital expenditures by the manufacturing sector in Canada in the 1978-84 period averaged 5.7 percent of the equivalent U.S. expenditures. For air pollution control, the corresponding figure was 2.5 percent. When annual Canadian expenditures in both areas are expressed as a percentage of corresponding U.S. expenditures on an annual basis, there is variation either side of the mean, as expected, but the amount of variation is small. For both air and water pollution control capital expenditures, the 1978-84 mean figure therefore provides a useful descriptive indicator of the relationship of expenditures in these areas between the two countries. Further, both sets of data indicate that pollution control capital expenditures in Canada are lower than would be anticipated solely on the basis of the relative size of the two economies. On this basis, capital expenditures in Canada would be anticipated at approximately 10 percent of the level of expenditure in the U.S.

The relatively lower capital expenditures in Canada in comparison to the U.S. can be explained in terms of differences in the legislative frameworks between the two

TABLE 4.3 CAPITAL EXPENDITURES FOR POLLUTION CONTROL IN CANADA AND THE UNITED STATES 1978 - 1984 (millions of dollars)

	HAZARDOUS WASTE MANAGEMENT								WATER POLLUTION CONTROL								AIR POLLUTION CONTROL							
	1978	1979	1980	1981	1982	1983	1984	MEAN 1978-84	1978	1979	1980	1981	1982	1983	1984	MEAN 1978-84	1978	1979	1980	1981	1982	1983	1984	MEAN 1978-84
CANADA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	42	80	89	59	66	33	66	62	36	46	117	56	28	22	19	46
U.S.	179	247	251	263	218	197	N/A	226	1246	1246	1147	1028	977	819	N/A	1077	1854	2072	2105	2194	1828	1029	N/A	1847
CANADIAN EXPENDITURES AS $ OF U.S. EXPENDITURE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.4	6.4	7.8	5.7	6.7	4.0	N/A	5.7	1.9	2.2	5.5	2.5	1.5	2.1	N/A	2.5

Interpolated mean annual Canadian manufacturing sector hazardous waste management capital expenditures assuming expenditures at: 2.0% of mean U.S. hazardous waste capital expenditures - $ 4.5 million; 2.5% of mean U.S. hazardous waste capital expenditures - $ 5.6 million; 5.7% of mean U.S. hazardous waste capital expenditures - $12.9 million; 10.0% of mean U.S. hazardous waste capital expenditures - $22.6 million.

Notes:

1. U.S. data for hazardous wastes are reported under the term "Solid Waste", which includes solid and liquid hazardous and non-hazardous waste. Non-hazardous liquid and solid waste management capital expenditures comprise a minor proportion of total industrial waste management capital expenditures, however, and for the purposes of this study, the full "Solid Waste" data can be considered representative of hazardous waste management capital expenditures.

2. Canadian data based on Accelerated Capital Cost Allowances reported in: Statistics Canada, Corporation Taxation Statistics, 1977-1984, Catalogue No. 61-208.

3. U.S. data based on U.S. Bureau of the Census survey as compiled and reported in: Simulation of the Economic Impact of Pollution Abatement and Control Investments: Methodology, Data Base and Detailed Estimates, Management Information Services Inc., Washington, D.C., 1986.

N/A - Not available

countries. In both the air and water pollution control areas, more stringent legislation has existed in the U.S. than in Canada since the early 1970's. The effect of this legislation has been to require the manufacturing industry to invest in equipment to remove environmental contaminants from atmospheric emissions and wastewater effluents prior to discharge. The findings in Table 4.3 that Canadian manufacturing sector capital investments in water and air pollution control technology have been disproportionately low compared to U.S. investment levels is consistent with the regulatory climate governing environmental investments in the two countries.

The application of air and water pollution control technology to remove contaminants from atmospheric and wastewater discharges may result in increased generation of hazardous waste. In addition, the hazardous waste regulatory climate in the U.S. has resulted in both increased hazardous waste generation as compared to Canada, and higher hazardous waste disposal costs as a result of the increased environmental protection from hazardous wastes mandated by RCRA. It can, therefore, be expected that hazardous waste management capital expenditures by the manufacturing sector would also be higher, on a relative basis, in the U.S., than those in Canada. The relative hazardous waste management expenditures in the U.S. over Canada cannot be ascertained from readily available data. However, to the extent that this overall pattern is consistent with capital investments in the air and water pollution control sectors, these sectors may provide an indication of the relationship of hazardous waste management investments in Canada to those in the U.S.

Based on this methodology, it is possible to estimate a probable mean range of hazardous waste management capital expenditures by the Canadian manufacturing sector in the 1978-84 period. As a reference point, the relative size of the Canadian economy as compared to the U.S. would suggest hazardous waste management capital expenditures by the Canadian manufacturing sector at approximately 10 percent of U.S. levels; this implies Canadian capital expenditures of approximately $22.6 million annually during the period.

However, in light of the factors considered above, it is highly probable that Canadian capital expenditures were somewhat less than the 10 percent scenario based solely on relative size of the U.S. and Canadian economies. If Canadian manufacturing sector capital expenditure in hazardous waste management relates to U.S. expenditures similar to water pollution control capital expenditures between the two countries, then Canadian hazardous waste management capital expenditures by the manufacturing sector would have averaged 5.7 percent of the level of U.S. expenditures, an estimated $12.9 million annually over the 1978-84 period.

If manufacturing sector capital expenditure in hazardous waste management between the two countries more closely resembled the relationship of air pollution control capital expenditures, then Canadian capital expenditures would have been 2.5 percent of the level of U.S. expenditures, or $5.6 million annually during the 1978-84 period.

As a reference point for a low estimate of Canadian manufacturing sector hazardous waste management capital expenditures during the period, mean annual expenditure

levels at 2 percent of U.S. levels can be assumed. This suggests annual capital expenditures of $4.5 million in hazardous waste management by the Canadian manufacturing sector during the 1978-84 period.

Based on this analysis, it appears that Canadian manufacturing industry capital expenditures in hazardous waste management may have averaged in the order of $10 million annually during the late 1970's to mid 1980's period. Data could not be obtained to estimate capital expenditures since that time. However, significant changes to Ontario's hazardous waste management regulations introduced in 1986 have had a significant impact on increasing the quantities of waste requiring disposal as "hazardous" waste. This fact, and overall inflationary pressures, may have increased hazardous waste management capital investment by the Canadian manufacturing sector to the $15 million range annually since 1984.

This does not take into account, however, capital investment decisions since 1984 that may have been driven by factors other than simple regulatory and economic pressures. These additional factors are discussed further in Section 5.0, and may result in high levels of investment related to hazardous waste management by the manufacturing sector. In spite of the uncertainties inherent in this analysis, however, it seems clear that capital expenditure levels by Canadian manufacturers in the hazardous waste management area are low and, as discussed in the following section, hazardous waste generators appear to favour managing hazardous waste through operating expenditures.

4.2.2 Operating Expenditures

In a hazardous waste management context, manufacturing sector operating expenditures for hazardous waste management are associated with the maintenance and operation of onsite facilities and the management of wastes offsite.

Data on hazardous waste management operating expenditures for the Canadian manufacturing sector are not readily available. However, it is possible to interpolate the general size of these expenditures on the basis of available U.S. data.

Table 4.4 provides data on U.S. manufacturing sector operating costs for hazardous waste management. The Table also provides capital cost data for U.S. manufacturing sector hazardous waste management that have been previously presented in Table 4.3. The methodology for estimating Canadian manufacturing sector hazardous waste management operating costs is based on the relationship between capital and operating hazardous waste management expenditures by the U.S. manufacturing sector. The methodology assumes that the relationship is broadly similar to that which exists in Canada.

This approach is reasonable for the purposes of this study. In general, similar hazardous waste management technologies and practices exist in both countries with considerable emphasis on offsite management of hazardous wastes. Two considerations regarding this methodology are presented below:

TABLE 4.4 TOTAL MANUFACTURING SECTOR CAPITAL AND OPERATING EXPENDITURES FOR HAZARDOUS WASTE MANAGEMENT IN U.S. 1978-83 (millions of dollars)

	1978	1979	1980	1981	1982	1983	MEAN 1978-82	MEAN 1978-83
Capital Expenditures	179	247	251	263	218	197	232	226
Operating Expenditures	1218	1322	1651	1856	1620	2175	1533	1640
Ratio of Capital to Operating Expenditures	1:6.8	1:5.3	1:6.6	1:7.1	1:7.4	1:11.0	1:6.6	1:7.3

Interpolated mean annual Canadian manufacturing sector hazardous waste management operating expenditures assuming $10 million mean annual capital expenditure and a ratio of capital to operating expenditures of 1:7.3 = $70 million.

Notes:

1) U.S. data for hazardous waste are reported under the term "Solid Waste", which includes solid and liquid hazardous and non-hazardous waste. Non-hazardous waste management operating expenditures are generally a small proportion of total industrial waste management operating expenditures and, for the purposes of this study, the full "Solid Waste" data can be considered representative of hazardous waste management operating expenditures.

2) Data based on U.S. Bureau of the Census survey as compiled and reported in: Simulation of the Economic Impact of Pollution Abatement and Control Investments: Methodology, Data Base and Detailed Estimates, Management Information Services Inc., Washington, D.C., 1986.

1) The U.S. data includes non-hazardous waste management operating expenditures. While this is not believed to impact significantly on the analysis, these expenditures may be more significant than in consideration of capital expenditure data since virtually all non-hazardous waste management costs are related to offsite disposal and, therefore, included in operating costs.

2) The enhanced waste management regulatory environment in the U.S. during the 1978-83 period likely resulted in more hazardous wastes being managed appropriately in the U.S. than in Canada, where a relative lack of regulations may have allowed wastes that would have been managed as hazardous in the U.S. to be lost to the environment in Canada. Thus, Canadian operating expenditures may be lower than those in the U.S. on a relative basis and the ratios calculated from the U.S. data and applied to Canadian capital expenditures may over-estimate the Canadian situation.

While both of these considerations may affect the calculation of precise hazardous waste management operating expenditures for the Canadian manufacturing sector, neither factor is sufficiently significant to detract from the purpose of this analysis to broadly characterize these expenditures. Thus, the limitations of the data should be recognized, as should the value of the analysis for the purpose of this study.

The data in Table 4.4 suggests that for the 1978-83 period, the ratio of manufacturing sector hazardous waste management capital expenditures to operating expenditures averaged 1:7.3 over the period. Assuming an average annual

Canadian manufacturing sector capital expenditure of $10 million, the application of this ratio to Canada implies mean hazardous waste management operating expenditures by the Canadian manufacturing sector of $73 million over the period.

The data in Table 4.4 also indicates that for the period 1978-82 the ratio of capital to operating expenditures was relatively constant. The ratio value for 1983 however, is higher than these values. The reason for this is not clear. However, if the data for 1983 is considered anomalous for the purpose of this analysis and omitted, the ratio for the period 1978-82 can be considered. This ratio is 1:6.6 and implies mean annual hazardous waste management operating expenditures by the Canadian manufacturing sector of $66 million, assuming $10 million annual hazardous waste management capital expenditures by the sector.

For the purposes of this analysis, these estimates are only marginally different and suggest that annual operating expenditures by the Canadian manufacturing sector related to hazardous waste management were in the order of $70 million up to the mid 1980's.

Data on the growth of manufacturing sector hazardous waste management operating expenditures since 1983 are not readily available. As discussed in the previous section, however, substantial change in the Ontario regulatory environment governing hazardous waste management and inflationary pressures are likely to have resulted in increased expenditure requirements by industry. In addition, the data presented in Section 2.0 projects increasing quantities of waste requiring offsite manage-

ment. These factors suggest that annual manufacturing sector operating expenditures for hazardous waste management in Canada may be considered, for the purposes of this study, to be approaching the $100 million range.

In summary, the absence of Canadian data concerning the size of the hazardous waste management service industry requires that its size be estimated on the basis of environmental expenditures by the manufacturing sector in both Canada and the U.S. This approach is indirect and subject to three primary limitations:

1) In both the U.S. and Canada, other sectors of the economy generate hazardous wastes and the expenditures necessary to provide for the management of these wastes are not considered in the analysis. However, the quantities of hazardous waste generated by these additional sectors in Canada is a minor proportion of the total quantity generated and would not substantially alter the expenditure estimates presented.

2) It is assumed that economic aspects of U.S. hazardous waste management are appropriate as a base from which to characterize the economic aspects of the Canadian industry. The broad relative similarities of the manufacturing sector and the structure of hazardous waste management systems suggests that this is a reasonable assumption for the purposes of this study. The generation of primary economic information concerning hazardous waste management in Canada will be required if more precise economic characterization of the industry is to be accomplished.

3) The U.S. and Canadian data which provided the basis for the estimates presented in this section have inherent limitations. Canadian data reflects only those expenditures qualifying for the ACCA provisions of the Tax Code and do not consider other expenditures which may contribute to pollution control. U.S. data is generated by survey methods and is assumed to be representative of industry generally. These data sources are the most appropriate for the present study and are considered adequate for the broad characterization made.

In spite of these limitations it is possible to estimate the approximate economic size of the hazardous waste management service industry in Canada, for the purposes of this study, by estimating expenditures by the manufacturing sector on hazardous waste management.

It appears that total expenditures by the manufacturing sector for hazardous waste management amounted to an average of approximately $80 million annually in the 1978-83 period. This amount, may have risen to as much as $100 million in 1988 as a result of inflationary pressure and increased regulatory activity, especially in Ontario. These estimates should be considered preliminary and useful only for estimating the apparent size of the industry.

4.2.3 Significance of Expenditures by Manufacturers in Hazardous Waste Management

Table 4.5 presents estimates prepared by the U.S. Congressional Budget Office on the anticipated costs to various sectors of industry for managing hazardous wastes

in 1990. These costs are expressed as a percentage of sales by the sectors given. The table indicates that hazardous waste management costs for the U.S. industry are generally forecasted to amount to less than two percent of sales. For some sectors, however, costs to industry are expected to be more significant. For example, hazardous waste management costs are projected to amount to 4.1 percent of wood preserving industry sales.

Hazardous waste management costs as a percentage of sales can be expected to be somewhat lower in Canada than in the U.S. Again, this results primarily from the more stringent regulatory framework in the U.S. as compared to Canada thereby resulting in higher costs for hazardous waste generators. However, even at the levels projected for U.S. hazardous waste management costs in 1990, it is clear that the hazardous waste management service industry exists on the basis of expenditures that are minor for the manufacturing sector generally, and trivial for many of its sub-sectors.

Table 4.5 also indicates reasons for why the effect of hazardous waste regulations have typically been to simply alter how hazardous waste is disposed of, rather than to stimulate widespread re-evaluation of hazardous waste generation and waste minimization in manufacturing facilities. When hazardous waste management costs are only a few percentage points or less of sales, there is not a pressing economic need for industry to devote capital and other resources to major investments to reduce hazardous waste management costs.

TABLE 4.5 PROJECTED 1990 HAZARDOUS WASTE EXPENDITURES BY INDUSTRY AS PERCENT OF SALES

MAJOR INDUSTRY	Percentage
Chemicals and Allied Products	1.8
Primary Metals	1.0
Fabricated Metal Products	2.3
Rubber and Plastic Products	1.4
Miscellaneous Manufacturing	0.9
Non-electrical Machinery	0.3
Motor Freight Transportation	N/A
Transportation Equipment	0.1
Electrical and Electronic Machinery	0.3
Petroleum and Coal Products	0.1
Wood Perserving	4.1
AVERAGE COST AS A PERCENTAGE OF SALES	1.3%

SOURCE: Congressional Budget Office; as reported in 1987 Update - Hazardous Waste Control Industry Outlook, William T. Lorenz and Company, Concord, New Hampshire, 1987.

4.2.4 Other Economic Aspects

Other key economic aspects of the hazardous waste management service industry can also be considered for a full understanding of the industry in Canada. These aspects include consideration of the extent to which dollars spent by hazardous waste generators remain in Canada, and the number of jobs created by hazardous waste management expenditures.

4.2.4.1 Flow of Hazardous Waste Management Expenditures in the Economy

The Transportation of Dangerous Goods Act requires the tracking of hazardous waste movement across Provincial and National borders. This data indicates that only approximately 1.6 percent of hazardous waste managed in offsite facilities in the 1986-87 period was exported to the U.S. or other countries. To the extent that hazardous waste managed in offsite facilities remains within Canada, the dollars expended by Canadian hazardous waste generators to manage these wastes remains in the Canadian economy.

Imports of hazardous waste into Canada can also have a beneficial effect on the Canadian economy as a result of the dollars spent in this country for hazardous waste management purposes. This does not necessarily imply that Canada is, or should, become a "dumping ground" for the hazardous wastes generated by others. However, potential exists to encourage the environmentally sound management in Canada of hazardous wastes generated outside the country. In Ontario, for example, approximately 55 percent of hazardous wastes imported to the Province from the U.S. is destined for recycling/reclamation activity.

4.2.4.2 Employment Creation as a Result of Hazardous Waste Management Expenditures

A variety of approaches may be taken to estimate the number of jobs created as a result of expenditures in the economy. These may include surveys to generate primary information of employment and hiring patterns within the industry, or estimates developed using models based on economic theory. It was not possible in this study to develop primary information and projections of employment resulting from hazardous waste management expenditure. As in other aspects of this economic profile, it is therefore necessary to develop estimates indirectly from available information.

The most relevant information available on employment resulting from hazardous waste management expenditures in Canada has been presented in "Jobs and the Environment: Some Preliminary Number Crunching" (Glenn, 1987). A survey of 800 firms who had been identified in 1985 as conducting some business in the hazardous waste management or liquid industrial waste field indicated total employment in these firms of some 8,000 people.

Only a percentage of these jobs, however, result from expenditures strictly in the hazardous waste management field. Of the companies active in the hazardous waste management service industry, it is not clear what proportion of the business, and therefore employment, is related strictly to hazardous waste management; however, it is certainly less than the total business. The inclusion of "liquid industrial waste" services, as distinct from "hazardous waste" services, in the survey also complicates interpretation of the data, for the purposes of this

report; the removal of "liquid" industrial waste services would also reduce the employment statistics given. For these reasons, it is unlikely that more than the equivalent of 5,000 person years of employment was created by hazardous waste management expenditures in Canada in 1985. The distribution of hazardous waste generators and the hazardous waste management service industry in Canada suggests that at least two-thirds of these jobs are located in Southern Ontario and Southern Quebec. This is consistent with the views of the Ontario Pollution Control Equipment Association, who have anecdotally suggested that the pollution control industry generally is heavily located in these regions of the country.

To provide perspective to these figures, "Jobs and the Environment: Some Preliminary Number Crunching" also estimates that the total environmental protection industry provides between 72,500 and 97,000 private sector jobs in Canada.

4.3 SUMMARY OF VIEWS ON THE COMMERCIAL HAZARDOUS WASTE MANAGEMENT INDUSTRY IN CANADA

To assist in identifying and assessing the magnitude of the waste management industry in Canada, barriers to growth of the industry, market potential and mechanisms whereby the federal government can assist in industry development, the views of select generators, commercial waste management firms, industry associations and corporations, government entities and other interest groups were solicited on specific points of interest. This section presents an overview of the responses of generators, commercial waste management firms, and waste management organizations to the solicited points of interest. The term "waste management

organizations" includes industry associations and corporations, government entities and other interest groups (including consultants). Appendix D identifies the points of interest of the waste management industry upon which views were solicited and discusses in detail the responses of generators, commercial waste management organizations to these points of interest.

Of the eleven companies solicited for views on the Canadian hazardous waste management industry, five responded. Seven out of twelve of the waste management organizations contacted responded. All companies and waste management organizations contacted were supportive of the study and indicated a willingness to participate but due to the time constraints of the study and previous internal commitments and constraints were unable to participate. Of the ten generators solicited for views, four responded. Generators or potential generators of hazardous wastes were more restrictive in their responses due to legal concerns and liabilities. Principal types of commercial waste management services provided by waste management firms are not addressed in this section because only a select number of firms were contacted in the study and may not be all encompassing of the range of services available in Canada. An overview of technologies and services available provincially was presented previously in Section 3.1.

In general, the views solicited from commercial waste management firms, generators and waste management organizations on the hazardous waste management industry in Canada focussed on these general themes:

- applicable legislation, intrepretation and enforcement;

- availability of services, capacity and need for research and development;
- services in domestic and foreign markets and potential expansion;
- growth markets or markets in decline;
- barriers to growth of the industry;
- need for information transfer and training programs; and,
- suggestions for industry growth.

4.3.1 Applicable Legislation, Intrepretation and Enforcement

Legislation was cited as the primary mechanism driving the waste management market. Legislation is deemed to be insufficiently enforced thereby placing reliance on corporate conscience for ensuring environmental protection by the utilization of available waste management services. The extent of provincial and federal legislation governing the industry varies and is at times conflicting. Additionally, the impact of future regulations governing the industry is a moving target, making long-term planning by industry as well as regulatory officials difficult. The development of onsite waste treatment systems has been cited as economically prohibitive, with several regulatory constraints tending to discourage the implementation of these systems. However, it was also noted that focus on waste minimization is a likely future trend.

4.3.2 Availability of Services, Capacity and Need for Research and Development

In general, industry indicated that services or technologies are available within Canada or can be made available to Canada for waste management. Biotechnology was identified by industry as a technology that needs to be developed particularly with respect to insitu biodegradation of contaminants in soils. Technology development was also cited by generators as being lacking for PCB wastes, and for sludges with a flash point below 70°C. Fifty percent of generators are not sufficiently informed of the availability and location of these services or appropriate technologies to handle in-house wastes. A lack of available waste management capacity in Canada was cited because commercial waste management firms respond to the needs of industry (i.e., business opportunities). If regulations are not in place and enforced, then new technologies will not be developed nor will capacity be expanded. One commercial waste management firm indicated increased growth of waste volume handled for over a decade with an anticipated increase in 1988 of 20 percent. This company also indicated that of the 40 million gallons of liquid wastes that they handled worldwide in 1987, only 2.5 million gallons represented Canadian wastes. Another commercial firm indicated that they have a permit to handle 100,000 tonnes/yr. of hazardous wastes but currently operate at 75,000 tonnes/yr. with 70 percent of these wastes imported from the United States. Delays in waste pick-up and increased costs for commercial services are also indicative of a lack of available capacity. It was stated by generators that for some waste types the cost for commercial waste management has increased 50 percent from last year.

Research and development is considered to be lacking in Canada, particularly in recycling and waste minimization. One commercial firm stated that the cost of R & D in Canada is close to being prohibitive given the high costs involved in going through political steps with government agencies. This firm identified the situation in the United States as being different because the size of the market and the greater incentives towards clean-up efforts create a situation favourable to technology development without the need for government involvement. The SITE Program under CERCLA in the United States was cited as a useful approach for implementation in Canada. This Program utilizes some Superfund money and conducts demonstration testing of onsite remedial technologies. [The SITE Program is discussed in Appendix B.] Additionally, it was stated that technologies for handling PCB wastes and sludges with a flash point below 70°C are inadequate. The development of biotechnology for in-situ biodegradation of contaminants in soil is progressing slowly in Canada.

4.3.3 Services in Domestic and Foreign Markets and Potential Expansion

Three of the five Canadian commercial firms solicited indicated that services are being provided in both foreign and domestic markets. Two firms indicated that over 70 percent of business is supported by foreign markets. As well, Canadian generators are using domestic services but in some instances must resort to foreign capabilities.

Each commercial firm is expanding to meet technological and capacity needs of the waste management industry. Two firms indicated that they had recently bought out other Canadian

hazardous waste management companies. Another firm recently purchased a transfer facility in the United States.

4.3.4 Growth Markets or Markets in Decline

The recycling and waste minimization industry was cited as growing, including equipment supply for on-site treatment. The need for treatment and disposal facilities may grow due to increased regulation of the industry. However, waste minimization will likely be inherent in company processes in the near future. Some generators are currently incorporating waste minimization and reduction technologies and mechanisms to reduce toxicity at the product development stage.

A lack of federal funding addressing waste management and recycling programs was noted. Specifically the need for financial support for companies that are experiencing difficulties in identifying markets for recycled oil due to the current low prices of virgin (i.e., crude) oil was cited. A need for clean-up capabilities through site remediation and decommissioning was also cited by waste management organizations.

4.3.5 Barriers to Growth of the Industry

A lack of regulatory enforcement received primary emphasis in being a barrier to industry growth. Without regulatory enforcement the management of hazardous wastes relies largely on corporate conscience in ensuring environmental protection. Considerable time for obtaining permits, the NIMBY syndrome and a lack of uniform policies, regulations and educational programs were also cited as deterrents.

4.3.6 Need for Information Transfer and Training Programs

Training programs and workshops for waste management firms, generators and regulatory officials received considerable emphasis. These training programs and workshops would provide industry and the regulatory body with a mechanism to become knowledgeable of industry and regulatory representatives, the waste management industry and the companies involved, and applicable regulations and requirements. It was stated that training programs and workshops should be directed at specific industries and problems.

4.3.7 Suggestions for Industry Growth

Again the most prevalent comment was directed towards uniform legislation and its enforcement. Regulatory enforcement is deemed to drive the market by requiring hazardous wastes to be appropriately managed and industry will response to meet this demand. In order to assess the potential magnitude of this demand, a comprehensive inventory of wastes throughout Canada is deemed necessary. Incentives such as financial assistance or tax breaks were suggested to encourage research and development, waste minimization and provision of services to communities that are not readily accessible, do not have a large industrial base and require management of small waste volumes. Funding and increased awareness of waste minimization and the 4Rs received considerable emphasis for assessing the future of the commercial hazardous waste management industry in Canada.

4.3.8 Conclusions

It should be noted that the views presented in this section are preliminary in nature and are based on the responses of select generators, commercial waste management firms, and waste management organizations. Definitive conclusions would require more detailed investigation and expansion of solicited industry groups. Additionally, views should be solicited on the issue of liability and how liability is influencing business decisions in the waste management industry.

However, it is clear from both the discussions held with these selected interest groups and from the level of information available from published sources that the Canadian hazardous waste management service industry is fragmented and poorly organized on a national basis. Some sectors of the industry are represented in some provinces in industry associations whose major focus is solid, non-hazardous waste management. Other sectors of the industry are represented by industry associations whose major focus is pollution control equipment supply generally and whose knowledge and expertise in hazardous waste management issues specifically is poor. Yet other sectors of the hazardous waste management service industry may not be represented by industry associations at all. As a result of this fragmentation, the industry itself is at a disadvantage in developing strategies for growth.

5.0 THE FUTURE OF HAZARDOUS WASTE MANAGEMENT IN CANADA

This section integrates the information and analyses presented in the previous sections. A framework is developed for conceptualizing the future of hazardous waste management in Canada that is most desirable from a public policy perspective. The ability of the hazardous waste management industry to achieve this future goal and the factors that are important in understanding how, why, and when hazardous waste management decisions are made is discussed. An analysis of the strategies Environment Canada could undertake to support the hazardous waste management industry in achieving intermediate and ultimate goals is also presented.

5.1 PUBLIC POLICY GOALS AND FACTORS IN PROGRAM DESIGN

From an environmental perspective, the ultimate objectives of public policy in the hazardous waste management field are commonly: 1) the assurance that hazardous waste is safely managed; and, 2) the quantities of wastes requiring offsite management be an absolute minimum. These goals have commonly been endorsed by jurisdictions across North America, including Canada, and Western Europe as well as elsewhere. Clearly, the realization of these goals will minimize the potential for environmental and human health problems associated with hazardous wastes.

These goals may appear self-evident and idealistic. In Ontario, however, the OWMC estimates that some 40 percent of the Province's "special waste", as defined by OWMC, does not receive adequate treatment prior to disposal and that over one million tonnes must be managed offsite. Clearly,

the realization of goals to minimize hazardous waste quantities requiring disposal and to maximize environmental protection from hazardous wastes that require disposal are far from being realized, in spite of progress in recent years.

The realization of these goals should consider both the types of initiatives that are required to meet public policy goals and the initiatives that are appropriate for Environment Canada to undertake, as presented below:

i) Hazardous waste management is primarily a provincial/territorial jurisdiction. The siting, and operation of hazardous waste management facilities and systems is governed primarily by provincial/territorial governments. Environment Canada's activity in hazardous waste management will only be with provincial/territorial consent through, for example, adoption of the TGDA manifest form by many provinces/territories. While some inequities in hazardous waste management will likely occur between provinces/territories as a result of differing priorities, other recent initiatives such as the CCREM Hazardous Waste Action Plan and the soon to be passed Canadian Environmental Protection Act are designed to keep such occurrences to a minimum.

ii) Environment Canada's regulatory jurisdiction in hazardous waste management will continue in interprovincial and international matters. Environment Canada will continue to exercise its influence in aspects of hazardous waste management falling in provincial/territorial jurisdiction through CCREM and related bodies, and through research and technical support of provincial/territorial activities.

iii) There is general agreement that further steps are needed to protect the environment from contaminants currently released in wastewater discharges and atmospheric emissions. These actions will lead to the capture of contaminants from these sources and will result in an increase in hazardous waste quantities generated. Other policy initiatives, such as site decommissioning, site cleanup and household hazardous waste collection programs have broad support at all government levels and will also result in increased quantities of hazardous waste requiring management.

iv) There is broad support for onsite 4Rs (recycling, recovery, reduction, reuse) and pretreatment approaches to hazardous waste management in order to minimize the amount of hazardous waste requiring offsite treatment or disposal. At the current rate of adoption, however, these approaches will result in only moderate decreases (perhaps 5%-10% of annual quantities generated) in the amount of hazardous waste requiring offsite management.

v) Additional offsite treatment/disposal capacity is required in all provinces/territories to ensure that hazardous wastes currently generated can be properly disposed of and that additional hazardous wastes that require offsite treatment/disposal as a result of regulatory activity can be properly managed.

Significant policy activity is underway at the provincial/territorial and federal levels to work towards the twin goals of waste reduction and improved management of hazardous wastes. To date, however, much greater emphasis has

been on the latter of these objectives and action taken to improve management of wastes generated has been, principally, of two kinds: 1) the development of regulations and regulatory policies to govern hazardous waste treatment/disposal; and, 2) a focus on the establishment of offsite hazardous waste treatment/disposal facilities necessary to manage the hazardous wastes that are defined in regulations.

Notably, the growth of the hazardous waste management service industry in Canada has occurred as a direct result of regulatory activity regarding hazardous waste treatment and disposal. The industry has not benefitted from regulatory activity focussing on the need to reduce hazardous waste generation, nor has it benefitted from economics-based strategies that encourage hazardous waste generators to manage in-house wastes in ways that go beyond the minimum requirements of regulations to further progress towards the public policy goals identified. Thus, the regulatory focus on hazardous waste treatment/disposal has encouraged the development of hazardous waste management service industries engaged primarily in the treatment/disposal of hazardous waste without also stimulating the industry towards the ultimately more desirable policy goal of hazardous waste reduction/recycling.

The Canadian situation contrasts with that of the U.S. and, more notably, Western Europe. In the U.S., an initial waste minimization program has been undertaken at the federal level, and a number of states are devoting significant resources to the development of economic policies for both hazardous waste reduction activities and improved treatment/disposal activities. In Europe, regulatory

agencies have gone further. In addition to similar U.S. activities, Europe is pro-actively assisting hazardous waste generators in adopting waste reduction/recycling approaches while developing strategies aimed at the economic development of the hazardous waste service industry. Consequently, new industrial attitudes are developing in Europe with regard to hazardous waste generation and new technologies and public and private strategies are being developed to take advantage of the resulting business opportunities both domestically and abroad.

The net result of this situation is that the hazardous waste management service industry has developed a momentum and a self-interest in favour of hazardous waste treatment and disposal. The lack of regulatory policy focussing on waste reduction/recycling in Canada has retarded the development of these sectors of the industry, and the lack of economic policies specifically targeted at encouraging improved hazardous waste management practices has retarded the equipment supply sector of the industry.

The emphasis placed on regulating offsite waste treatment and disposal had also sent a signal to hazardous waste generators that it is acceptable to generate hazardous waste so long as compliance with hazardous waste regulations is maintained. To a degree, of course, this is indeed acceptable. However, it ignores the fact that hazardous waste regulations merely state the minimum courses of action and behaviour required. In the absence of government policy to encourage action and behaviour that exceeds regulatory requirements in support of more distant goals, the minimum regulatory requirements become operating standards. This has contributed to industrial attitudes,

discussed further in the next section, that favour disposal of waste rather than the re-evaluation of whether it is necessary to generate the waste in the first place. It is only when this industrial re-evaluation occurs that substantial progress can be made towards the ultimate goal of minimizing wastes requiring disposal.

The roles that Environment Canada can play to enhance the hazardous waste management service industry must be sensitive to the issues raised in this analysis. In order to provide further perspective to these, however, it is first necessary to review the decision-making process in industry as it relates to hazardous waste management. This will ensure that initiatives that may be adopted by Environment Canada will be effective in the context of "real-world" industrial decision-making.

5.2 THE ROLE OF ECONOMICS AND OTHER FACTORS IN THE DEVELOPMENT OF THE HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY

In a regulated hazardous waste management environment, hazardous waste management decisions most obviously are triggered by regulatory requirements. Once a company has decided to take action with regard to its hazardous wastes, the precise course of action taken will theoretically be based on the economics of the various courses of action available within the regulatory framework. Thus, a regulatory initiative that defines a waste as "hazardous" closes some avenues that would otherwise have been open to the generator for the management of the waste, but leaves a range of other options open. If the designation of the waste as "hazardous" requires the generator to manage the waste in a different fashion, the generator may consider

a number of potential options, depending on the precise nature of the waste. These options may include:

- process modification to eliminate or reduce the waste;
- re-use of the waste in-house;
- recovery of the waste for recycling or use as a fuel supplement in the generator's or some other facility;
- treatment of the waste to render it non-hazardous, either on- or offsite; and,
- disposal of the waste as hazardous, either on- or offsite.

While regulations may force generators to manage hazardous wastes in ways that would not otherwise be chosen, and while economic considerations generally will be a key consideration in the selection of alternative waste management approaches, other factors may also be significant.

In the face of regulatory requirements, a waste generator may elect to transfer disposal of hazardous waste from a non-hazardous to a hazardous waste facility. Such an approach may be the easiest and the most convenient, but not necessarily the cheapest. In Hamilton, Ontario, for example, recent work has indicated the economic viability of solvent recovery from auto-body shops; the solvents are currently disposed of as hazardous wastes. Similar situations exist with regard to a range of other wastes, including used oils and oil/water mixtures, a range of electroplating sludges, and a range of acids (Ontario Research Foundation, 1982; RIS, et. al., 1984).

A view of hazardous waste management decision-making as a simple interaction between regulations and economics is therefore over-simplified. A more accurate understanding of the hazardous waste generator's decision-making process is necessary to provide a clearer understanding of why generators elect to dispose of hazardous waste without considering alternatives that may be economically viable.

Three factors can be identified in addition to regulatory and economic factors that may impact on hazardous waste management decision-making: corporate policy, availability of technology, and availability of information.

5.2.1 Corporate Policy

Hazardous waste management is often considered a maintenance and operation function within a company, as suggested by the data in Section 4.2.2, demonstrating the high ratio of operating to capital expenditures for hazardous waste management. As such, hazardous waste management tends to be a responsibility delegated to the plant management or even process control level, where decision-making must typically be in accordance with direction and policy established by the executive. In companies where hazardous waste management is viewed as simply an operational/maintenance function, it is likely to receive only low priority among the total range of items requiring attention by plant management.

In these situations there is typically an absence of dedicated resources for reviewing and improving hazardous waste management practices. Traditional practices tend to persist until change is initiated by an external stimulus (RIS, et.al., 1984). Frequently, the external stimulus is

the actual or likely enforcement of existing or new regulations. The stimulus may also be in the form of new information of which a company becomes aware (see Section 5.2.3). In either case, however, improved hazardous waste management is likely to only be considered in the context of the specific item(s) required for regulatory compliance or the specific improvements suggested by the new information.

By contrast, hazardous waste management decision-making that is elevated to the executive level is generally broad and more strategic in scope than it is at the plant level. Executive-level decisions take into account not only financial return-on-investment considerations, but also considerations such as long-term position, corporate image, community relations and capital investment. Priorities at the plant level may change rapidly in light of executive level decisions. A corporate policy endorsed by corporate senior management supportive of improved hazardous waste management may therefore permit changes in hazardous waste management practices that would not otherwise occur.

The importance of considerations such as market position, corporate image and community relations in corporate decision-making should not be underestimated. While it may be difficult to assign a dollar value to any of these items, all can be important in a company's marketing strategy. This has been clearly documented in the solid waste management area with regard to the recycling of soft drink beverage containers: the image of causing highly visible litter and solid waste problems is inconsistent with the image the consumer-oriented soft drink companies wish to present to the public. Consequently, these companies have assumed lead roles in funding and supporting the recycling of soft drink containers and, in some cases, materials.

The impact of public image, community relations and related factors has not been so clearly documented in the hazardous waste management field in Canada. However, sensitivity has been shown by some corporations concerning the impact of hazardous waste management on corporate image. Recently, for instance, the pulp and paper industry has taken significant action with respect to the discovery of dioxins in some wastewaters, even though the concentration of dioxins has not been linked to significant environmental damage. The cosmetics industry has long been concerned about the potential for poor public images associated with its waste materials.

International aspects of corporate hazardous waste management policy are also important for many Canadian companies. In many corporations, policies endorsed at the executive level are adopted by all corporate facilities, irrespective of geographic location. Multi-national corporations operating in Canada may therefore adopt hazardous waste management practices consistent with a corporate policy that was initially stimulated by hazardous waste management considerations in another country. This may lead to a greater emphasis on hazardous waste management than the local regulatory or economic situation would otherwise justify. The Canada Chemical Producers Association attribute the improved environmental performance of the chemical industry over the last several years in large part to the environmental policies issued by U.S. parent companies in response to U.S. conditions, but which nonetheless apply in Canada (RIS et. al., 1984).

Theoretically, this could also work in reverse. If a parent company does not face an environmental regulatory climate as stringent as Canada's, it may not allocate the

resources to the Canadian facilities to adequately comply with Canadian regulations. This situation has not, however been documented.

5.2.2 Technology Availability

Hazardous waste management technology may not exist or may not be economical to adopt. Technology that is available may not be adopted because of concerns about its reliability, lack of track record or difficulty of maintenance and/or operation. In some cases, these concerns may be perceptual in nature rather than supported by quantified fact, but such perceptions may nonetheless preclude adoption of a hazardous waste management technology that is otherwise economically attractive. In other cases, technologies that are available on a generic basis may be prohibitively expensive to adapt to the specific requirements of a production process, for example, batch processes or processes generating variable waste streams. From a management perspective, these issues can be resolved through improved commercialization of existing technology.

Alternatively, some hazardous waste management options may not develop beyond the conceptual stage because technology has not been developed to address the option. The development of new hazardous waste management technology is not an item that most hazardous waste generators have the time or resources to address, preferring instead to purchase necessary equipment from pollution control equipment suppliers.

5.2.3 Availability of Information

It is clear from a wide range of work done to date (RIS et. al, 1984; ORF, 1982) that potentially significant hazardous waste management improvements could be resolved through the wider adoption of technology already in existence.

The importance of providing timely information concerning hazardous waste management to the individual(s) who need it has been established. A key to the effective provision of information has been pro-active "information marketing" of the type adopted by North Carolina and Minnesota in Technical Assistance Programs. These approaches bring hazardous waste management information to decision-makers at both the plant and executive levels and as a result may bring to the attention of decision-makers hazardous waste management information that cannot be ignored.

This contrasts with the passive, clearing-house model of information provision which requires hazardous waste generators to initiate an information search. The initiation of an information search pre-supposes a level of knowledge of hazardous waste management options and where this exists a passive storehouse of information that can be tapped may be adequate. However, a major goal of information provision programs in the hazardous waste management field is to stimulate an appreciation that options for improving a hazardous waste management system exist, and pro-active information programs are better able to accomplish this than clearing-house programs.

5.3 CORPORATE PROFILE OF HAZARDOUS WASTE MANAGEMENT DECISION-MAKING

The following profiles of hazardous waste management decision-making illustrate the practical applications of the concepts discussed in Section 5.2.

5.3.1 Dow Chemical Canada

Dow Chemical Canada is the Canadian subsidiary of U.S. based Dow Chemical. Canadian operations include major chemical manufacturing facilities at Sarnia, Ontario, Fort Saskatchewan, Alberta, and smaller facilities in Varennes, Quebec. The company also owns a variety of smaller operations.

Over approximately the past decade, Dow Chemical Canada has undertaken a multi-media environmental protection program that has seen, for example, the amount of organic waste-water contaminants reduced by over 80 percent. The centre-piece of this environmental protection program is a corporate policy emphasizing the need for environmental concern in the corporation's manufacturing activities. The policy is periodically revised and updated as necessary; for Dow Chemical Canada, the most recent policy update occurred in 1987. Dow Chemical's Environmental Policy is contained in Appendix E.

Dow Chemical Canada personnel are emphatic that the stimulus for the policy, and the enhanced environmental protection it has stimulated, was not a need to comply with regulatory requirements. The company suggests that mere compliance with environmental regulations would be much less costly than the existing environmental protection

program. Rather, the impetus for the program has been corporate image and community relations in terms of environmental protection and protection of public health. The value of these intangibles to the company cannot be readily estimated. However, a capital budget of $10 million was spent on an environmental program in 1987 and $14 million will be spent in 1988, exclusive of process-oriented capital investments that may also reduce waste generation.

As one arm of a large multi-national corporation, Dow Chemical Canada has access to a wide range of technical services provided by the U.S. parent. Chief among these are the U.S. based Technical Centres that serve as a technical resource to each of the manufacturing processes used by Dow worldwide. Consistent with policy on environmental protection, the Technical Centres provide expertise on pollution control as well as production-oriented issues.

The pro-active environmental protection policy at Dow Chemical Canada provides an internal corporate context for improved hazardous waste management that exceeds the regulatory environment in which the company operates.

5.3.2 3M Corporation

In 1975, 3M Corporation adopted an environmental policy that stressed the need to conserve resources and take the initiative to solve its in-house pollution problems. The policy applies to all 3M facilities worldwide. In order to enact this policy, the company created its Pollution Prevention Pays program or, as its known in the company, the 3P program.

The focus of the 3P program is to minimize pollution generating activities, including hazardous waste management, at the source in order to reduce end-of-pipe pollution control and offsite management of pollutants to the maximum extent possible. Consequently, emphasis is placed on process change, product reformulation and waste recycling/recovery as the prime means of preventing pollution and minimizing hazardous waste generation.

The program is directed at the technical and operational levels of the company. Individuals and teams are encouraged to introduce pollution prevention initiatives into the manufacturing process. In order to win recognition under the 3P program, the initiatives must be approved by a technical co-ordinating committee according to criteria that included documentation of pollution prevented, energy and resources conserved , and cost-savings to the company. Individuals responsible for initiatives recognized under the 3P program receive a certificate formally presented in front of fellow employees by senior management and a reward such as a private dinner.

In total, over 2200 3P projects have been undertaken by 3M companies in 21 countries worldwide since the program was initiated in 1975. These projects are reported to result in eliminating annually the discharge of more than 120,000 tonnes of air pollutants, 14,000 tonnes of water pollutants, 300,000 tonnes of sludge, and 7 billion litres of wastewater. Net cost savings to the company since 1975 exceeds $ 500 million (Benforado, 1988).

This program was not introduced as a result of regulatory pressure, although some activities undertaken through the program have been driven by this pressure. Rather, the primary motivating force for the program is a belief that improved hazardous waste management and environmental control can have significant financial advantages for the company. The peer recognition, support and reward aspects of the program are effective incentives for employee participation in the program. Currently, the company is reviewing how waste minimization can be designed into new products.

5.4 STRATEGIC CONSIDERATIONS IN DEVELOPING THE HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY IN CANADA

Hazardous waste management in Canada is a complex business and one which is poorly understood. Economic data on even the most basic aspects of the industry is unavailable for most regions of the country and economic indicators of the industry must therefore be developed indirectly on the basis of other sectors of the pollution control industry and information from the U.S. Interpretation of the indicators must be undertaken with caution and within the boundaries of imprecision that accompany development of these indicators.

In spite of this uncertainty, however, a broad generalization of the hazardous waste service industry in Canada, and its potential for future development may be made. The successful development of this industry in directions that are compatible with public policy objectives is a vital ingredient of environmental protection in Canada, as well as being a significant economic development opportunity with the attendant potential for economic benefits that this implies. Given that it is possible to make broad generalizations about the industry and the certainty that the industry will play a major role in future environmental

protection programs, it is possible to develop strategies for the development of the industry that maximize its economic development potential within the framework of stated hazardous waste management public policy objectives.

The generation of strategies to develop the hazardous waste management industry must take account of a variety of perspectives that have not always been clearly understood in the past. It is clear that the industry is a product of regulatory activity restricting the range of options available to the hazardous waste generator for the management of hazardous wastes. Yet the assumption that hazardous waste management decision-making by the generator is necessarily predicated on the economics of remaining management options is overly-simplistic. Equally, the clear distinction made at regulatory levels between hazardous waste management and air and water pollution control is to a significant degree inappropriate from the point of view of the hazardous waste generator. From this perspective "waste" may require management in gaseous, liquid or solid forms and it is often the case that "hazardous waste management" for the generator must include consideration of "wastewater management" and "atmospheric emission management". Thus, the development of the hazardous waste management service industry must recognize the close integration of this industry with other sectors of the pollution control industry.

A single perspective development strategy cannot maximize the growth potential of the hazardous waste management industry. Further, it may result in an industry that is incapable of providing the range of services required to fulfill established public policy objectives or, at a later stage of development, it may result in an industry whose

own self-interest is contrary to the interest of public policy objectives such as hazardous waste minimization.

These considerations require that a strategy for developing the Canadian hazardous waste management service industry be multi-faceted in order to maximize the economic development of all sectors of the industry and to ensure the capability of the industry to provide the range of services necessary to achieve a broad range of public policy goals. The development and presentation of such a strategy requires that the separate aspects and goals of the strategy be identified and that further research needs and action items be identified to accomplish these goals.

6.0 CONCLUSIONS

The conclusions of this study are summarized below and presented under section headings. Recommendations are presented in Section 7.0 in the format of a strategy that Environment Canada should adopt to promote the hazardous waste management service industry together with the action items Environment Canada should adopt to guide the implementation of the recommended strategy.

6.1 CURRENT AND FUTURE HAZARDOUS WASTE GENERATION

i) Approximately half of the hazardous waste in Canada in 1986 requiring offsite management was generated in Ontario. Over two-thirds of the hazardous wastes in Canada requiring offsite management were generated in Ontario and Quebec;

ii) Some 2.25 million tonnes of hazardous waste requiring offsite management is estimated to have been generated nationally in 1986. This amount is projected to grow by over 400,000 tonnes (18 percent) by 1992 as a result of the growth of existing activity. New regulatory and policy initiatives at the federal and provincial levels, however, will result in increased hazardous waste generation. The scale of these increases is unclear, because the impact of the new regulatory directions in hazardous waste management is uncertain.

An additional 48,000 - 474,000 tonnes of hazardous waste requiring offsite management in 1992 has been forecast for Ontario as a result of new regulatory activity. If similar regulatory and policy activity is duplicated across Canada, the amount of hazardous waste requiring offsite management may increase up to 50 percent above estimated 1992 levels. The actual amount of this increase occuring by 1992 would be dependent on federal and provincial regulatory timetables.

iii) Of the total quantity of hazardous waste generated in Canada in 1986 and projected for 1992, over half (53 percent) may be classified in waste classes that have high reclamation/recycling potential. If the Ontario situation is typical of the country, less than one-fifth (18 percent) of the hazardous waste generated in Canada requiring offsite management is currently being reclaimed/recycled. There may, therefore, be a major opportunity to increase hazardous waste reclamation/recycling activity in Canada.

iv) The majority of hazardous wastes generated in Canada (an estimated 65 percent in 1986, and a projected 59 percent in 1992) are managed onsite.

6.2 GOVERNMENTAL INITIATIVES IN HAZARDOUS WASTE MANAGEMENT

i) Jurisdiction for most aspects of hazardous waste management in Canada rests with the provinces. There is wide variation in hazardous waste regulatory activity between the provinces. However, Ontario has adopted a similar hazardous waste regulatory framework to the federal U.S. model, and it is widely

expected that other provinces will also adopt frameworks similar to the U.S. and Ontario approaches.

ii) The overall effect of the U.S. and Ontario approaches to regulatory hazardous waste management has been to channel waste that was being inappropriately disposed of into hazardous waste management disposal facilities. Although the effect of the regulations has been to broadly increase industrial costs associated with waste management, it appears that these price increases have not been sufficient to stimulate increased waste reduction/recycling activity either on- or offsite.

iii) Major public sector hazardous waste management initiatives in Canada have been regulatory in nature. This contrasts with approaches taken by jurisdictions in the U.S. and in Western Europe, who provide technical and financial assistance to companies in the hazardous waste management field to complement regulatory initiatives. Examples of this type of activity in Canada include the federal DRECT Program, the ONSITE Program, and provincial and municipal initiatives in Ontario that encourage industry towards improved waste management practices. These efforts are generally small in both scale and scope, and suffer from a lack of regulatory support, poor co-ordination and, in some cases, duplication of efforts.

iv) Regulatory agencies in Canada have tended to view the hazardous waste management service industry simply as part of the regulated community. These agencies have not considered in any detail the economic development

impact of hazardous waste management regulatory activity, nor have policies or programs been formulated to assist in the development of the industry in any way except as a product of regulatory activity. Nor has the opportunity to take on this role been adopted by public agencies whose first priority is to promote the economic development of potential growth industries.

This situation contrasts with that of the European Economic Community (EEC), where explicit, non-regulatory programs are being undertaken to provide support and develop the hazardous waste management service industry in order to ensure its competitiveness in the domestic European and overseas markets. Notable features of the European initiative are; emphasis on information and technology transfer, training, and the future growth in the industry that is foreseen through relating hazardous waste management to economic aid to the developing world.

6.3 HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY IN CANADA

Information on the hazardous waste management industry in Canada is extremely limited. Studies on the industry have not been undertaken, although profiles have been prepared on the environmental protection industry more broadly. A study on the Ontario industry, to be released later this year, was unavailable for this study. More detailed information on the industry nationally will require extensive survey work to generate a level of primary information that does not currently exist. With these points in mind, the following conclusions can be drawn:

i) A survey of government environmental officials across Canada indicated the concentration of the industry in Ontario and, to a lesser extent, Quebec. This is expected in light of the pre-eminence of central Canada in the generation of hazardous waste. However, hazardous waste treatment/disposal capacity only appears to be adequate in Alberta, and to a lesser extent in Ontario and Quebec. Current initiatives to establish increased hazardous waste disposal capacity in Ontario and British Columbia may result in an improved situation in these provinces. It is not yet clear whether initiatives to site facilities in Saskatchewan and Manitoba will result in increased hazardous waste disposal capacity. Currently, however, these provinces, the territories and Atlantic Canada do not have any facilities for treating/disposing of the 225,000 tonnes of hazardous waste requiring offsite management that was estimated to have been generated in these areas in 1986.

ii) Information does not readily exist on the size of the hazardous waste management service industry in Canada since accessible and reliable information on revenues, profits and other economic data concerning the industry is not obtained by any agency. Estimates on the size of the hazardous waste management service market in Canada could be made, however, on the basis of industry expenditures in other areas of pollution control and on the basis of available U.S. data. Using this approach, it is estimated that the hazardous waste management service industry in Canada may have amounted to an approximate $80 million per year industry in 1983 and may now be approaching a $100

million per year industry. It was estimated that over 80 percent of the services purchased from the industry by hazardous waste generators fall into the category of operating expenditures. This indicates the heavy reliance of hazardous waste generators on offsite facilities for managing hazardous wastes. The industry probably employs some 4,000 - 5,000 people providing services in consulting, engineering and chemical analysis in addition to the operation and maintenance of hazardous waste management facilities.

iii) The industry identified a number of points in considering how the industry may develop and the types of assistance that would be beneficial to this growth. The following are considered to be key observations:

- The industry is driven by the application of regulatory requirements. Poor enforcement of these requirements continues to hamper the growth of the industry.

- Appropriate waste management technology and services in most cases are, or can be made available, in Canada. However, hazardous waste generators are not sufficiently informed of these technologies or services.

- Research and development in hazardous waste management is lacking in Canada, particularly in comparison to U.S. and European research and development.

- The industry is fragmented and is not always capable of providing turnkey hazardous waste management services to large clients. However, a number of companies are competing internationally, although usually in a narrow market area.

- Growth in waste minimization and onsite treatment was noted.

- Training programs and workshops for hazardous waste regulatory officials, firms and generators are needed to improve the understanding of the roles, functions and abilities of and to encourage interaction of government and private sector representatives in the hazardous waste management field.

It is clear from discussions with the industry and others that a major barrier to the future development of the industry is its fragmented structure. Representation of the industry through associations that can speak on behalf of the industry is incomplete for the industry sectors involved and their geographic location.

6.4 THE FUTURE OF HAZARDOUS WASTE MANAGEMENT IN CANADA

i) There is broad consensus that public policy goals in the hazardous waste management field must incorporate both the safe treatment/disposal of hazardous wastes and the maximization of waste reduction/recycling. In Ontario, the Province with the most advanced regulatory framework, the OWMC estimates that some 40 percent of the province's "special waste" does not receive adequate treatment prior to disposal. In addition, little support has been given to hazardous waste minimization.

ii) A regulatory focus has been placed on establishing new hazardous waste treatment/disposal facilities and developing the regulatory framework to channel wastes to these facilities. The hazardous waste management service industry has developed in response to this activity and is itself primarily focussing on the offsite treatment/disposal of hazardous wastes. Potentially significant growth of the industry could occur in the onsite treatment of hazardous wastes and the hazardous waste minimizaton/recycling areas with suitable regulatory support. Currently, however, the industry is poorly structured to meet these established public policy goals.

iii) Hazardous waste management from the waste generator's perspective is not necessarily a simple function of the inter-play of regulatory and economic factors. Although widely interpreted in this light, hazardous waste management is such a minor component of costs (less than 1 percent of sales for most companies) that many generators choose the most convenient of available management alternatives - generally a waste disposal option - and channel corporate resources into the more profitable areas of corporate operations.

Consequently, while an appropriate regulatory and economic climate are essential prerequisites for encouraging hazardous waste generators to adopt waste minimization and onsite treatment, these factors are not, alone, sufficient to lead to the changed behaviour that waste minimization, recycling and pretreatment imply. In order to accomplish these objectives, improved technology availability, pro-

active information exchange and explicit corporate policy endorsing waste minimization and waste pretreatment are required. As 3M Corporation and Dow Chemical Canada have demonstrated, a corporate commitment to the goals of hazardous waste minimization and onsite treatment can have far reaching impacts on the amount of waste requiring disposal. It is not necessarily the case, however, that these and other corporate commitments in the hazardous waste management area are driven by either regulatory or direct economic considerations. Factors such as public image and community relations can be significant in the development and implementation of corporate committments and policies regarding hazardous waste management.

7.0 RECOMMENDED STRATEGY TO DEVELOP THE CANADIAN HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY

7.1 INTRODUCTION

The following recommendations are presented in the form of a strategy that Environment Canada may choose to adopt to enhance the development of the hazardous waste management service industry in Canada. Action items are identified to accomplish the goals of the strategy. This strategy is a product of the information and analyses presented in this report and is consistent with both the environmental protection mandate of the Agency and the directions taken by the CCREM Action Plan for the Management of Hazardous Wastes. Two premises/assumptions have guided the development of this strategy:

1) Environment Canada is not the prime regulator of hazardous waste management in Canada except in areas of interprovincial or international concern. The overall role of the agency must therefore be related to supporting public policy goals for environmental protection and economic development and to playing a lead role in defining what these goals shall be.

2) While this study focusses on those sectors of the hazardous waste management service industry engaged in offsite management of wastes, the industry includes the provision of services for the onsite management of hazardous wastes. The close integration of the industry with other sectors of the pollution control industry requires that the development of the hazardous waste management service industry be sensitive to these other sectors.

7.2 A STRATEGY TO DEVELOP THE HAZARDOUS WASTE MANAGEMENT SERVICE INDUSTRY IN CANADA

The strategy presented has four major items, as presented below:

1) To identify the need for, and support initiatives to site, additional facilities for the offsite treatment/ disposal of hazardous wastes in Canada.

2) To identify and support opportunities for hazardous waste minimization and hazardous waste reclamation/ recycling activities in Canada.

3) To support the development of an industry association to represent the hazardous waste management service industry nationally.

4) To undertake a lead role in research, development and demonstration of new hazardous waste management technology in Canada, technology transfer and information exchange and the development of export markets and opportunities.

The development of the Canadian hazardous waste management service industry is inherently an undertaking conducive to improved environmental protection nationally. However, the successful implementation and delivery of a national strategy to develop the industry will depend on the continuation of the co-operative working relationship between Environment Canada and the Provinces/Territories that is exemplified by CCREM. This is particularly the case with respect to Strategy Item 4 above. This item

implies a range of new and expanded activities in areas that can most appropriately be pursued at the federal level (in order to avoid duplication of efforts between provinces/territories or because they fall outside direct provincial jurisdiction) but which will depend to a significant extent on provincial/territorial acceptance and/or participation for success.

Environment Canada should, therefore, consult with the Provinces/Territories to secure acceptance that the strategy represents a logical and desirable positioning by the federal agency in the hazardous waste management field. This acceptance should be forthcoming, given that the strategy defines expanded and concrete roles for Environment Canada to develop the hazardous waste management industry to the benefit of all provinces/territories without requiring duplication of existing provincial initiatives and without threatening provincial jurisdiction. Environment Canada should then adopt lead roles in implementing the specific activities required to meet the goals of the strategy. In some cases this will require working on a multilateral basis with other federal agencies, provincial agencies, hazardous waste generators and/or the existing hazardous waste management service industry. In other cases, it will be more appropriate to work bilaterally with one or more of these actors. The successful implementation and delivery of the strategy, therefore, implies the need for a cooperative and consultative partnership between Environment Canada and other actors in the hazardous waste management field. However, the partnership should be such that Environment Canada adopts a lead role in the identification, co-ordination and timing, and funding, as necessary, of the actions required to achieve the goals of the strategy.

7.2.1 Strategy Item 1: Identify and Support Initiatives to Site Additional Offsite Hazardous Waste Treatment/Disposal Facilities

- Goal: To ensure that all provinces/territories/regions provide treatment/disposal facilities for locally-generated hazardous wastes.

Most provinces/territories in Canada rely on treatment/disposal facilities in other jurisdictions for the management of large quantities of hazardous wastes. This is inherently insecure because there is no assurance that existing facilities will continue to accept out-of-province hazardous wastes. Environment Canada should, therefore, support and assist in efforts to increase hazardous waste treatment/disposal capacity across Canada.

The precise configuration of the additional hazardous waste management facilities necessary to manage the quantities and types of waste generated in Canada will vary according to the requirements of each province/region. There is a wide variety of technology available and a wide variety of possible facility configurations ranging from large, centralized facilities to smaller, regional facilities and mobile facilities. The precise technologies and configurations selected will be a provincial/territorial decision based on circumstances in each province/region and the establishment of precise hazardous waste quantity data for each province/region.

- Action: With regard to the siting of new hazardous waste treatment/disposal facilities, Environment Canada's role should include the following:

  1) Communicate the need for additional offsite treatment/ disposal facilities to the provinces/territories and the public on the basis of the information presented in this report.

  2) Undertake research in those jurisdictions where additional capacity may be required, but which are at either an early stage of planning for facilities or which have not yet begun to plan for facilities. Research would focus on the advantages and disadvantages of different technologies and facility configurations for each province/region and the associated economic and environmental benefits of the optimum facilities.

  3) Provide guidance to all jurisdictions across Canada regarding approaches to overcome the "Not-In-My-Backyard" (NIMBY) syndrome.

  4) Undertake enhanced public education activity regarding hazardous waste management to develop public understanding on hazardous waste management issues and alternatives, consistent with the direction outlined in the CCREM Action Plan for the Management of Hazardous Waste.

Each of these activities should be undertaken in consultation with the hazardous waste management service industry in order to ensure that private sector roles in the offsite treatment/disposal of hazardous wastes can be properly

identified within each province/region of the country and to further define federal initiatives to encourage additional private sector activity in this field.

7.2.2 Strategy Item 2: Identify and Support Opportunities for Hazardous Waste Minimization and Hazardous Waste Reduction/Recycling

- Goal: To ensure that the national quantities of hazardous wastes requiring offsite treatment/disposal are kept to a minimum by encouraging waste minimization and recycling/recovery.

- Action: Environment Canada should develop a national policy on hazardous waste minimization and reduction/recycling. This is likely to result from an existing action item under the CCREM Action Plan for the Management of Hazardous Wastes.

Additional activities that may be undertaken by Environment Canada in support of increased hazardous waste minimization, reduction and recycling include the following:

1) Identify classes of waste with high potential for recycling/reuse, determine the generators of the waste, the proportions currently reclaimed/recycled and the chemical characterization and variation of the waste. This study suggests that this information should initially be generated for those waste classes containing solvents, oils and heavy metals.

2) Based on the detailed information gathered, initiate with the commercial hazardous waste management service industry and the provincial/territorial governments an improved transportation and transfer facility network

for collecting and transporting recyclable hazardous wastes. Initially, the expanded transfer facility network would expand the service area of existing reclamation/recycling facilities. Depending upon the increased quantities of materials recovered, the establishment of new recycling/recovery facilities may be justified. This initiative should be initially undertaken on a demonstration basis with regard to specific types of wastes from specific types of industry, for example, solvents generated from auto-body shops. The program should be expanded as lessons are learned on the operational aspects of the program and as experience is gained in the handling and management of a greater range of wastes from a greater variety of industry.

3) Promote with the commercial hazardous waste management service industry the concept of waste auditing in industry. A manual on waste auditing is currently in use in Ontario through the OWMC, but the concept should be promoted nationally. Environment Canada should work with the hazardous waste management service industry to explore ways in which the industry should deliver such a program as one of a range of hazardous waste management services it offers its clients.

   In order to test the operational feasibility of this concept, Environment Canada should extend the federally-funded ONSITE Program to include the placement of personnel within companies in the hazardous waste management service industry. The specific task of these individuals would be the undertaking of waste audits for hazardous waste generators that may result in increased

business opportunities for the hazardous waste management service industry through improvements to the generators' hazardous waste management program. The success of this approach would result in a business-oriented, pro-active initiative by the hazardous waste management service industry to participate in corporate waste management planning with the attendant environmental and economic benefits this would create.

7.2.3 Strategy Item 3: Support of the Development of an Industry Association to Represent the Canadian Hazardous Waste Management Service Industry

- Goal: To participate in the creation of a national hazardous waste management industry association that represents the interests of all sectors of the industry and is able to deal with government agencies and others in the identification and resolution of issues relevant to the growth and development of the industry.

  The current fragmentation of the industry is a significant barrier to efforts to develop concensus within the industry of future development directions. The industry is complex and is comprised of subsectors whose goals may conflict or require resolution, for example, between interests representing 4Rs approaches and those representing disposal approaches. A national industry association will lead to improved communication of issues affecting the industry, and provide a forum for discussion to resolve issues affecting the industry and improved planning concerning the development of the industry.

- Action: Environment Canada should support the creation of a national hazardous waste management industry association by:

  1) Identifying the potential range of interests and activities that would be represented in such an industry association.

  2) Conducting a survey of key individuals within the identified range of interests and activities to be represented by an industry association in order to determine the level of interest there may be in establishing such an association, and the views of these individuals regarding how such an association should be structured.

  3) Hold a workshop to discuss the results of the survey and the desirability/feasibility of establishing an association. All participants in the survey, plus additional individuals, as appropriate, would be invited to the workshop. The goals of the workshop would be to identify specifically how a national hazardous waste management industry association should be established, the tasks required to achieve this goal, a division of responsibilities to ensure the tasks are completed and a set of milestones and deadlines to achieve establishment of the association.

  From the workshop, Environment Canada could identify the support roles it could perform. Although these will require definition in light of the survey results

and the directions identified at the workshop, roles could include the co-ordination of tasks, scheduling of meetings and provision of information and issues upon which such an association could respond. Subject to other considerations, Environment Canada should consider keeping the option open as to whether or not financial support would be provided to establish such an association and under what circumstances and at what levels such financing could be made available.

7.2.4. Strategy Item 4: Create a "National Hazardous Waste Management Program" to provide a comprehensive framework for developing the Canadian hazardous waste management industry

- Goal: To place Canada and the Canadian hazardous waste management service industry at the forefront of the Canadian waste management field domestically and internationally.

- Action: There are four major areas where Environment Canada can provide infrastructural tools essential for the future development and competitiveness of the Canadian hazardous waste management service industry. These relate to:

  - technology research, development and demonstration;

  - information transfer;

  - training; and,

  - development of exports.

Co-ordinated Environment Canada initiatives in these areas will create a base of support for the commercial hazardous waste management service industry that the industry can draw upon to develop and exploit business opportunities in Canada and abroad. The program would stimulate all sectors of the industry and would be the centrepiece of developing an internationally prominent Canadian industry.

- Action 1: Technology research, development and demonstration

Substantially expanded activity in the development and commercialization of hazardous waste management technology is necessary to better meet current hazardous waste management needs (on- and offsite) and development needs, such as site cleanup and remediation. The following activities should be undertaken by Environment Canada:

(i) Develop a funding program to assist in financing the research, development and demonstration of new hazardous waste management technology. This fund should finance both approved unsolicited proposals and proposals submitted in response to specifications identified by Environment Canada. In addition to new technology development and commercialization, this program would conduct research into technologies currently in existence but whose range of applications are not fully understood. Examples of these kinds of technology would include landfarming and stabilization/solidification technologies.

The fund itself would represent an evolution of the DRECT program. The fund should be established to include a venture capital component to permit Environment Canada to finance and recover the high costs associated with unsolicited proposals for the successful development of technology. Work solicited by Environment Canada, however, would not be funded on a venture capital basis, but on a research and development basis as is currently done for scientific contracts arranged by Supply and Services Canada.

(ii) Create a visually prominent symbol to be awarded to hazardous waste management technologies that are independently verified to perform at required specifications in specific applications. This symbol would be used by the company marketing the technology as an independently verified "seal of excellence". This could become a major quality assurance promotion and marketing tool for the hazardous waste management service industry domestically and internationally and would be a major factor in raising the profile of both the commercial hazardous waste management service industry and Environment Canada.

- Action 2: Information Transfer

The findings of this and previous studies have identified that substantially greater adoption of hazardous waste management technology by Canadian industry would result from improved information availability of technologies and services available. The small budget assigned by most companies to hazardous waste management in terms of

proportion of sales indicates that many companies are unlikely to consider hazardous waste management a priority item. Information transfer should, therefore, be pro-active in order to impact on corporate hazardous waste management decision-making. Environment Canada should undertake the following:

(i) Develop a comprehensive electronic data base on the state-of-the-art of hazardous waste management research, technology, suppliers, technology applications and associated factors. The data base should be constructed so as to provide a complete profile of hazardous waste management technology, availability, and application in Canada.

(ii) The preparation of sector-specific handbooks on hazardous waste management practices and options, including discussion of the environmental and public health impacts that may result from improper management of hazardous wastes.

(iii) The delivery of this information by means of an outreach program designed in conjunction with the hazardous waste management service industry. The delivery of this information could be undertaken by both municipalities and the hazardous waste management service industry based on models established at the municipal and other levels in Ontario, the U.S. and Western Europe.

(iv) Develop its dialogue with senior corporate executives regarding hazardous waste management. Corporate policies focussing on improved hazardous waste management can be encouraged by this activity.

- Action 3: Training

As new technologies are developed and hazardous waste management assumes a higher profile in corporate affairs, demand for more highly trained hazardous waste management staff will grow in both the private and public sectors. Few hazardous waste management technical training programs are currently available. Environment Canada should:

(i) Review the scope of existing hazardous waste management training programs in Canada and identify on a regional basis the need for expanded course offerings in the hazardous waste management field. Emphasis should be on "hands-on" technology operation and control and should ensure the availability in each region of courses covering the range of technology applications.

(ii) Work with colleges of applied technology to create and deliver expanded hazardous waste management courses, as necessary.

(iii) Investigate the potential for developing a national hazardous waste management accreditation certificate to be awarded on the completion of a requisite number of courses offered through this expansion of hazardous waste management training activity.

- Action 4: Development of Export Markets

Although precise data are not readily available, there are clearly major overseas hazardous waste management markets that offer potential export opportunities for the Canadian hazardous waste management service industry. Major markets exist in Europe, the Middle East and the Far East. Additional markets exist in the developing world where the role of environmental protection in industrial development is being widely re-evaluated and upgraded. There is currently no co-ordinated activity to market Canadian hazardous waste management services and expertise abroad. Federal support for the Canadian hazardous waste management service industry could result in significant export success in these markets.

The following roles should be undertaken by Environment Canada to develop the export potential of the Canadian hazardous waste management service industry in foreign markets:

(i) sponsor overseas business development tours to assist Canadian companies;

(ii) develop a handbook on federal sources of funding and financing related to developing export markets;

(iii) encourage the development of joint ventures between Canadian companies in order to provide turnkey hazardous waste management services;

(iv) sponsor overseas trade fairs that showcase Canadian hazardous waste management expertise;

(v) develop promotional literature for overseas markets on the Canadian hazardous waste management industry, together with a directory of Canadian firms active in the field;

(vi) develop a directory of international aid organizations and contacts to be used by the Canadian hazardous waste management service industry as a point of entry for exploring business opportunities with these organizations; and,

(vii) explore with the Canadian International Development Agency specific opportunities tied to Canadian aid programs for overseas activity by the Canadian hazardous waste management service industry.

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