



IPEC & RECYC-QUÉBEC

Key Factors for a Sustainable Approach to Plastics Recovery

Final Report

September 2001

This report was prepared by Frédéric Lesueur, MBA Economist, and approved by Frédéric Faustin, MBA, Project Manager at DESSAU-SOPRIN. DESSAU-SOPRIN had been mandated by Recyc-Quebec, jointly with the Environment and Plastics Industry Council (EPIC), to carry out a survey to better understand the key factors affecting the reclamation of waste plastics in Quebec. RECYC-QUÉBEC and EPIC have reviewed this report and modified the content of the original report made by Dessau-Soprin.

Environment and Plastics Industry Council

5925 Airport Road, Suite 500
Mississauga, Ontario L4V 1W1
Tel (905) 678-7405
Fax (905) 678-0774

A Council of the Canadian Plastics Industry Association

RECYC-QUÉBEC

Head office

675 Saint-Amable st.
Suite 300
Québec (Québec) G1R 2G5
Telephone: (418) 643-0394
Fax : (418) 643-6507

Montréal

7171 Jean-Talon East
Suite 500
Anjou (Québec) H1M 3N2
Telephone : (514) 352-5002
Fax : (514) 873-6542

Dessau-Soprin inc.

1441 René-Lévesque West blvd., Suite 500
Montréal (Québec) Canada H3G 1T7
Telephone : (514) 281-1010
Fax : (514) 875-2666
E-mail : enviro@dessausoprin.com
Web Site : www.dessausoprin.com

EXECUTIVE SUMMARY

THE PLASTICS INDUSTRY IN QUEBEC

The Quebec plastics industry, with nearly 650 companies, generated 23,800 direct jobs in 1998, 3.7% of all manufacturing jobs in Quebec. Shipments by this industry are estimated at nearly \$3 billion, a third of which is exported. The province of Quebec has 27% of Canada's plastic processing establishments.

WASTE PLASTICS GENERATED IN QUEBEC

The volume of waste plastics generated at the municipal level in 2000 can be estimated at 224,000 metric tonnes, more than 30 kg per person per year. Of the 224,000t of plastics in the Quebec residential waste stream, 83% or 186,000t were derived from packaging. 119,000t of the packaging waste are considered to be capable of being recycled by conventional means if they could be recovered from the waste stream and markets were available for them. The remaining 67,000t are comprised largely of film contaminated with food residues and/or used as receptacles for garbage. This material cannot readily be recycled mechanically.

The volume of waste plastics generated annually by the ICI sector can be estimated at 176,919 tonnes. However, in the absence of a characterization study of waste from the ICI sector, any attempt at an estimate is uncertain.

In the agricultural industry, the volume of plastic film used in Quebec is assessed by the industry at 1,400 tonnes (LDPE) for 1999. It is estimated that in greenhouse production, some 450 tonnes of plastic sheeting is replaced every year and therefore available for recycling. Pesticide containers represent a volume of 37.5 tonnes (HDPE).

RECOVERY for RECYCLING

In 1998, 50,500 tonnes of plastics were recovered in Quebec, 7,800 tonnes came from the Blue Box program, 9,500 from the return of non-reusable soft-drink containers (NRC), and 33,200 from the ICI sector.

The three main resins recovered in Quebec were PET (15,140 tonnes), LDPE (14,250 tonnes) and HDPE (6,461 tonnes). These alone represented 72.2% of all the different types of plastics recovered in 1998.

Recent data for the year 2000, received from RECYC-QUEBEC, indicate a recovery of 14,600 tonnes of plastic through the Blue Box program. In addition the deposit system contributed 9118 tonnes to recovery. The ICI sector recovered 37,955 tonnes bringing the total plastics recovered in 2000 to 61,673 tonnes. PET, LDPE and HDPE made up 82% of the material recovered.

Since June 1990, RECYC-QUÉBEC has been managing returns of non-reusable containers (NRC). The soft drink market has experienced strong growth over the past fifteen years since sales of containers have more than doubled, from 422 million units in 1985 to 1.3 billion in 1999. The sales of PET containers which are part of the deposit system in Québec for the year 2000 was 276 610 149 containers and the take back 200 968 139 containers for a return rate of 72.65 %.

RECYCLING

In 1998, more than 64,000 tonnes of plastics were recycled in Quebec. Plastics from Quebec represented only 44.7% of all the plastics reprocessed in the Province. Some plastics are imported into the Province for reprocessing while some plastics collected in Quebec are exported.

The recycled resins with the largest volumes in Quebec are PET (28.9%), HDPE (20.8%), PP (20.1%) and LDPE (15.4%). These four resins alone represented 85.3% of all the various types of plastics recycled in 1998.

Quebec has some twenty companies specializing in the recycling of plastics, two of which are among the top 100 North American companies in the fields of brokering or recycling plastics. Most of the industry is in the Montreal metropolitan region.

Plastic recycling is encouraged by a number of provincial initiatives and organizations, including IPEC, RECYC-QUEBEC or IPC, but also industry initiatives such as a motor-oil container recovery program sponsored by Canadian Tire.

STRATEGIC ORIENTATIONS

The main trend observed in North America over the past 15 years has been the restructuring of plastic recycling as a real industry. In the United States alone, for example, this industry generates more than 50,000 jobs in 1,850 companies.

Internal economic factors related to recycling include the chronic weakness of burying costs, the high costs of collection and transportation, mainly because of the low density of plastics, and a level of treatment costs that weakens profitability. Problems relating to supply include contamination, the public perception of products with recycled content, and the lack of knowledge among the public as to the recyclable nature of plastics.

In addition to these factors, plastic recycling activities are strongly affected by fluctuation in the price of recycled resin linked to cyclical and structural factors as well as variation in the price spread between virgin and recycled resins.

ALTERNATIVES TO DISPOSAL

Gasification, use of plastics in sandwich-type processes or as filler materials, pyrolysis and a number of bulk extrusion processes are environmentally safe alternatives. Some of these could be studied to determine the feasibility of introducing them in Quebec.

RECOMMENDATIONS

Despite the economic context of free trade and liberalization, a number of measures can be taken to create market conditions more favourable to the Quebec plastics recycling industry.

Focus on plastics offering the greatest potential, such as PET and HDPE in the residential sector by advocating an «All bottle collection in all Quebec market» ;

- Increase the volume of plastics recovered in Quebec. To attain this objective, the municipal and residential sectors should be targeted, in particular by setting up an information plan to increase awareness and stress the importance of recycling;
- Ensure that all the various Blue Box programs for waste plastics are as efficient as possible;
- Continue the use of deposit system for carbonated soft drink as long as the Blue Box program is efficient in gathering other containers.

In order to encourage demand for plastic products with a recycled content, action should be taken to:

- Prepare and distribute to each public administration (from departmental to municipal level) a guide to products available for purchase, and take (regulatory or other) measures to promote these types of products. These products may be made in Quebec but also, more broadly, be products of foreign origin.
- Study the possibilities of alternatives to recycling like gasification, sandwich-type processes, pyrolysis, bulk extrusion.

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	I
1 INTRODUCTION	1
1.1 SURVEY OBJECTIVES.....	1
1.2 METHODOLOGY.....	2
1.3 DOCUMENT STRUCTURE.....	2
2 PLASTICS: DEFINITION	3
2.1 HISTORICAL BACKGROUND	3
2.2 CHARACTERISTICS OF PLASTICS.....	3
2.2.1 Thermoplastics.....	4
2.2.2 Thermosets.....	5
2.2.3 Processing Methods.....	5
2.2.4 Main Types of Plastics	6
2.3 CHARACTERISTICS OF RECYCLED PLASTICS	6
3 THE RESINS AND PLASTICS MARKET	9
3.1 THE PLASTICS PROCESSING INDUSTRY IN THE UNITED STATES.....	9
3.1.1 Structure and Performance of the Industry.....	9
3.1.2 Resins Produced.....	9
3.2 THE SYNTHETIC RESIN INDUSTRY IN CANADA	10
3.2.1 Structure and Performance of the Industry.....	10
3.2.2 Trade	11
3.2.3 Prospects.....	11
3.2.4 Resins Produced.....	12
3.3 THE PLASTICS INDUSTRY IN CANADA	12
3.3.1 Importance of the Industry.....	12
3.3.2 Structure of the Industry	13
3.3.3 Use of Plastics	14
3.3.4 Trade	14
3.3.5 Deliveries of Plastic Film and Bags	15
3.3.6 Regional Distribution	16
3.4 PLASTIC PROCESSING IN QUEBEC	17
3.4.1 Structure and Performance of the Industry.....	17
3.4.2 Trade	18
3.4.3 Investments.....	19
3.4.4 The Main Quebec Companies.....	19

TABLE OF CONTENTS

4	WASTE PLASTICS IN QUEBEC	21
4.1	WASTE MANAGEMENT IN QUEBEC	21
4.1.1	Global Balance.....	21
4.1.2	Waste Materials by Sector	22
4.2	Quebec Waste Composition Analysis	24
4.2.1	Generation	24
4.2.2	Recovery.....	28
4.2.3	Estimate of Volumes Generated for Certain Categories of Plastics not found in recycling boxes	35
4.3	WASTE PLASTICS GENERATED BY ICI	41
4.3.1	Definition.....	41
4.3.2	Overall Estimate.....	42
4.3.3	Estimate by Type of Resins.....	43
4.3.4	Packaging.....	44
4.3.5	Other Sources of Waste Plastics Generated by ICI	45
4.4	AGRICULTURAL SECTOR	47
4.4.1	Agricultural Films.....	47
4.4.2	Pesticide Containers	48
4.4.3	Plastics Related to Greenhouses and Nurseries	50
4.5	ESTIMATE OF TOTAL WASTE PLASTICS GENERATION IN QUEBEC	51
5	WASTE PLASTICS RECYCLING IN QUEBEC	53
5.1	INVENTORY OF RECYCLED PLASTICS IN QUEBEC	53
5.1.1	Quantities of Plastics Recycled in 1998.....	53
5.1.2	Changes in Recycling According to Sector.....	54
5.1.3	Recycling in Quebec by Type of Plastics.....	55
5.1.4	Origin of Recovered Plastics	57
5.2	ESTIMATE OF QUANTITIES RECYCLED IN QUEBEC	57
5.2.1	Municipal.....	57
5.2.2	ICI 58	57
5.2.3	Global Estimate.....	60
5.2.4	Origin of Recycled Plastics.....	60
5.3	COLLECTION SYSTEMS	61
5.3.1	Blue Box Program	61
5.3.2	Commercial Collection	62
5.3.3	Returns	63
5.4	COMPANIES	64
5.4.1	Picture of Waste Management Companies in Quebec	64
5.4.2	Plastic Recycling Companies	65
5.4.3	Recyclers	66
5.5	USE OF RECYCLED PLASTIC BY MANUFACTURERS	67
5.5.1	Post-consumer and Post-industrial Plastics.....	67
5.5.2	Identification of Current Consumption Products Containing Plastic	68

TABLE OF CONTENTS

5.6	PROVINCIAL ORGANIZATIONS AND INITIATIVES ENCOURAGING PLASTIC RECYCLING	68
5.6.1	EPIC	68
5.6.2	RECYC-QUEBEC	68
5.6.3	Waste Plastics Round Table	69
5.6.4	The Quebec Waste Management Action Plan 1998-2008	69
5.6.5	Crop Protection Institute of Canada (CPIC).....	69
5.6.6	Société de gestion des huiles usées	70
5.6.7	Regroupement des récupérateurs et des recycleurs de matériaux de construction et démolition au Québec (3R MCDQ).....	70
5.6.8	Boissons Gazeuses Environnement (BGE).....	71
5.6.9	Examples of Sectoral initiatives.....	71
6	STRATEGIC ORIENTATION OF WASTE PLASTIC RECYCLING IN QUEBEC	73
6.1	NORTH AMERICAN TRENDS IN PLASTIC RECYCLING	73
6.1.1	Recycling Infrastructure.....	73
6.1.2	Post-consumer Plastics.....	73
6.1.3	Market.....	74
6.2	END MARKETS FOR POST-CONSUMER RESIDENTIAL AND ICI PLASTIC SCRAP	75
6.2.1	PET Bottles	75
6.2.2	HDPE Bottles and Pails.....	76
6.2.3	PP, HDPE and LDPE Injection Molding Grades – Tubs and Lids	77
6.2.4	LDPE and HDPE Polyethylene Film	77
6.2.5	Polystyrene	78
6.2.6	Additional Plastics Market Information.....	79
6.3	POST-INDUSTRIAL PLASTICS	79
6.3.1	Legal Trends	80
6.4	ECONOMIC FACTORS RELATED TO RECYCLING	80
6.4.1	Landfill Cost	80
6.4.2	Collection Costs	81
6.4.3	Transportation Costs.....	81
6.4.4	Processing Costs	82
6.5	FACTORS AFFECTING PLASTIC RECYCLING	83
6.5.1	Variation in Price of Resins	83
6.5.2	Variation in Price Gap Between Virgin and Recycled Resins	84
6.5.3	Collection and Processing Problems	85
6.5.4	Contamination Problems.....	85
6.5.5	Perception of Products with Recycled Content.....	86
6.5.6	Uncertainty about Recyclable Plastics.....	86
6.5.7	Legislation.....	87
6.6	IDENTIFICATION OF STABLE MARKETS FOR POST-CONSUMER PLASTIC MATERIALS	87
6.6.1	Identification.....	87

TABLE OF CONTENTS

6.6.2	Brokers and Recylers.....	89
6.7	ALTERNATIVES TO DISPOSAL.....	89
6.7.1	Gasification.....	89
6.7.2	Use in Sandwich-Type Processes.....	90
6.7.3	Pyrolysis.....	90
6.7.4	Bulk Extrusion.....	91
7	RECOMMENDATIONS.....	93

APPENDIX 1 REFERENCES

APPENDIX 2 CHARACTERISTICS OF PLASTICS

APPENDIX 3 SORTING CENTRES IN QUEBEC

APPENDIX 4 RECYCLERS IN QUEBEC

APPENDIX 5 PRODUCTS WITH RECYCLED CONTENT

List of figures

Figure 3-1 :	Structure of the Quebec Plastic Processing Industry.....	18
Figure 3-2 :	Export of Plastic Products 1990-1998.....	19
Figure 4-1 :	Waste Materials Balance from 1988 to 1998 (tonnes).....	21
Figure 4-2 :	Sectoral Distribution of Waste Materials Generated in Quebec.....	23
Figure 4-3	Quebec waste composition.....	24
Figure 4-4 :	Plastic Packaging generated from Quebec Households (kilotonne).....	28
Figure 4-5 :	Current Recovery of Recyclable Plastics Packaging in Quebec.....	29
Figure 4-6 :	Potential to Increase Recovery of Recyclable Plastics in Quebec to 37% by Focussing on Bottles (kilotonne).....	31
Figure 4-7 :	Opportunity to Increase Recovery of Recyclable Plastics in Quebec to 48% by Focussing on Bottles and Film (kt).....	32
Figure 4-8 :	Distribution and Changes in Sales of Non-reusable Containers in Quebec, 1985 to 1999.....	36
Figure 4-9 :	Recycling (%) of Empty Pesticide Containers in 1998.....	49
Figure 5-1 :	Distribution by Sector.....	53
Figure 5-2 :	Recycling of Plastics 1992-1998.....	55
Figure 5-3 :	Volumes of Plastics Recycled.....	56
Figure 5-4 :	Distribution of Plastics Recycled in Quebec–Municipal.....	59
Figure 5-5 :	Distribution of Plastics Recycled in Quebec – ICI.....	59
Figure 5-6 :	Changes in Quantities of Recycled Plastic in Quebec 1996-1998.....	61
Figure 5-7 :	Sales and Recycling of Soft Drink Bottles in Quebec 1986-1999.....	64
Figure 5-8 :	Distribution of Companies by Type of Plastic Recycled.....	65
Figure 6-1 :	The Most Recycled Post-consumer Plastics.....	75
Figure 6-2 :	Volume of Post-industrial Resin 1997 (kt).....	80

TABLE OF CONTENTS

Figure 6-3 : Changes in Price of Recycled Resins (1992-1999)	88
--	----

List of tables

Table 1 : Main Applications	4
Table 2 : Production of Thermosetting Resin (kt)	9
Table 3 : Thermoplastic Resin Production (kt)	10
Table 4 : Production of Pure New Resins in Canada (Metric Tonnes).....	12
Table 5 : Plastic Products Industries (1998).....	13
Table 6 : Sales and Use of Resins by Market in the United States (kt).....	14
Table 7 : Plastic Film Deliveries in Canada	15
Table 8 : Deliveries of Plastics Bags in Canada	15
Table 9 : Main Canadian Producers of Resins	16
Table 10 : Average Annual Growth Rates 1992-1996.....	17
Table 11 : Major Plastic Processing Quebec Companies.....	20
Table 12 : Waste Material Management in Quebec–Balance 1998-1998.....	22
Table 13: Comparison Results from Main Report with Data Supplied by Chamard	26
Table 14 : Plastics Waste Composition Province of Quebec	27
Table 15 : Breakdown of Plastics Packaging	28
Table 16 : Current Recovery of Recyclable Plastics Packaging (kt)	29
Table 17 : Potential Recovery of Recyclable Plastics Packaging Targeting 80% Bottles (kt).....	30
Table 18 : Potential Recovery of Recyclable Plastics Packaging Targeting Bottles and Film (kt).....	32
Table 19 : Waste plastics Generated by Soft Drinks (1999)	35
Table 20 : Waste plastics Generated by Waters Bottles	37
Table 21 : Waste Plastics Generated by Milk Containers (1998).....	38
Table 22 : Waste Plastics Generated By Milk Bags (1998)	39
Table 23 : Waste Plastics Generated By Motor-oil Containers (1998).....	39
Table 24 : Waste Plastics Generated by Windshield Washer Fluid Containers (1999) ...	40
Table 25 : Waste Plastics Generated by Antifreeze Containers (1998)	40
Table 26 : Estimate of Waste Plastics Generated by Dry-cleaning Bags	41
Table 27 : Waste Plastics from ICI by Type of Resin	43
Table 28 : Waste Plastics Generated by Motor Vehicles	46
Table 29 : Waste Plastics Generated by Agricultural Plastic Films.....	47
Table 30 : Waste Plastics Generated by Pesticide Containers	49
Table 31 : Estimate of Waste Plastics Generated by Greenhouse and Nursery Containers	50
Table 32 : Estimate of the Volume of Plastic Waste Generated In Quebec (tonnes/year)	51
Table 33 : Quantity recycled from the Municipal and ICI Sectors.....	54
Table 34 : Distribution of Recycled Plastics According to Type of Resin	56
Table 35 : Geographical Origin of Recovered Plastics.....	57
Table 36 : Municipal Recycled Plastics by Type of Resin (1998).....	58
Table 37 : ICI Recycled Plastics by Type of Resin (1998).....	58
Table 38 : Total Plastics Recycled by Type of Resin (1998).....	60
Table 39 : Geographical Origin of Recycled Plastics	61
Table 40 : Waste Plastics Recycled by the Blue Box Program from 1992 to 1998	62

TABLE OF CONTENTS

Table 41 : Sales and Recycling of Plastic Soft Drink Bottles (Millions of Containers).....	63
Table 42 : Revenue from Operations of Waste Management Companies by Type of Activity.....	65
Table 43 : Distribution of Companies according to the Number of Plastics Processed [<i>sic</i>]	66
Table 44 : Main Recyclers.....	67
Table 45 : Use of Recycled Plastics.....	67
Table 46 : Recycled Municipal Waste Plastics (1997).....	74
Table 47 : Example of Weight and Density (Uncrushed Bottles)	82
Table 48 : Costs of Processing Operations	83
Table 49 : Monthly Average Price (ton) Paid to Salvage Dealers in 1998.....	84
Table 50 : Sensitivity of Recycling Costs to Price Variations.....	84

1 INTRODUCTION

1.1 SURVEY OBJECTIVES

DESSAU-SOPRIN has been mandated by Recyc-Quebec, jointly with the Environment and Industry Council of CPIA (EPIC) and with a consultant from the Canadian Plastics Industry Association (CPIA), to study the key factors affecting the reclamation of waste plastics in Quebec.

The specific objectives of this study are the following:

- To draw an overall picture of the plastics industry in Canada and Quebec;
- To estimate the volume of waste plastics generated annually in Quebec by sector (municipal, ICI and other);
- To draw a picture of the waste plastics recycling industry in Quebec by analysing volumes processed and the sectoral structure, and by identifying initiatives to encourage recycling;
- To identify strategic factors for the development of plastics recycling;
- To draw up a list of plastic recyclers in Quebec;
- To draw up a list of Quebec products with recycled content available for purchase by municipalities;
- To draw up a list of the main stakeholders (recyclers and brokers) in North America;
- To identify some environmentally safe alternatives to disposal for waste plastics reclamation.

1.2 METHODOLOGY

Information for this study was collected from the following sources:

- Data and reports available from Recyc-Quebec and EPIC;
- Data (reports, studies, articles), mainly from associations and groups active in the area of plastics processing (Centre de recherche industrielle du Québec [Quebec industrial research centre], etc.) and the main ministries concerned (Ministry of Industry and Commerce, Ministry of the Environment, etc.);
- Communication with the various stakeholders (producers, recyclers, distributors, etc.);
- Survey of Quebec plastics manufacturers ;
- Waste composition analysis carried out in Quebec by the group Chamard - CRIQ - Roche (Caractérisation des matières résiduelles au Québec).

A complete list of information sources consulted is given in Appendix 1.

1.3 DOCUMENT STRUCTURE

This progress report contains six chapters. The chapters cover the following points:

1. Introduction;
2. Plastics: Historical Background and Principal Characteristics;
3. The Resins and Plastics Market in the United States, Canada and Quebec;
4. Inventory of Waste Plastics in Quebec by Sector;
5. Recycling of Waste Plastics in Quebec;
6. Strategic Approaches.

2 PLASTICS: DEFINITION

2.1 HISTORICAL BACKGROUND¹

In 1869, an American named John Wesley Hyatt won a contest to find a substance to replace ivory in manufacturing billiard balls with CelluloidTM, the first accidentally discovered thermoplastic. Bakelite, the first thermosetting plastic, was also produced by chance, from phenol and formaldehyde by Belgian chemist Léo Baekeland in 1907. It was after World War I that plastics entered the industrial era. Petroleum became available, petrochemistry affordable, and plastics modern.

PVC (polyvinyl chloride) was discovered in 1915 by Waldo Semon, and polyethylene in 1933. This revolutionary substance has had enormous impacts all over the world. In 1936, *Imperial Chemical Industries* developed compressors to make possible the commercial production of polyethylene. A strategic material during World War II, polyethylene enjoyed immense success among consumers and unprecedented popularity after the conflict. It became the principal plastic sold in the United States.

Since the 50s, plastics has become a major industry affecting our everyday life, from packaging and new textiles, to the production of surprising new high-tech products such as televisions, cars and computers. The world production of plastics increased from 30 million tonnes in 1970 to 134 million tonnes in 1998.²

2.2 CHARACTERISTICS OF PLASTICS

Plastic is a generic term for a family of materials made from petroleum or natural gas. Petroleum is refined or distilled: the light gas or "naphtha" fraction is isolated then "cracked" using steam, which makes it possible to obtain the basic chemical molecules: monomers (ethylene, propylene, etc.) made up of atoms of carbon, hydrogen, oxygen, etc.

¹ *Histoire du plastique* [History of plastics], ABC Plastic, 1999.

² *Production mondiale* [World production]; IISI-IPAD-PARDOS MARKETING-PÉCHINEY-SPMP, 1999.

Molecules join to form linear or branched chains, called polymers. Other elements are included in polymers to give the product specific characteristics (addition of chlorine, nitrogen, etc.). Resins can be divided into two categories: thermoplastic resins and thermosetting resins.

2.2.1 Thermoplastics

They are obtained from linear or branched chain polymers that soften under the effect of heat and harden when cold. This reversible softening and hardening capacity makes recycling of thermoplastic resins relatively simple. The cycle can be repeated numerous times without perceptible change in their properties. However, thermoplastics cannot be recycled indefinitely. A change in the properties of the material occurs under the effect of repeated high temperatures.

Table 1 : Main Applications

SPI CODE		PROPERTIES	APPLICATIONS
1	PET	Transparency, compatibility with perfumes, brilliance, shock resistance, gas barrier	Soft drink, oil, and water bottles, flasks, pots, films, trays, etc.
2	HDPE	Opacity, rigidity, chemical inertia	Tanks, containers, garbage cans, buckets, toys, milk and juice bottles, etc.
3	PVC	Transparency, rigidity	Construction materials, furniture (benches, windows, etc.), barriers, toys, soils, etc.
4	LDPE	Transparency, flexibility	Films, bags (garbage, grocery, etc.), bottles
5	PP	Rigidity, shock, freezing, microwave-safe (+120)	Boxes, trays, containers, bumpers, tubes, container lids and caps, fruit containers, yoghurt, etc.
6	PS	Transparency, opacity	Fast-food packaging, coffee cups, lid, tray, etc.
7	Other plastics	Composites	Multi-layered, degradable films, etc.

Thermoplastic resins are most extensively used in plastic processing. They include polyethylene (HDPE, LDPE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), polyamide (nylon) and polyethylene terephthalate (PET). The table above shows the main applications of the most common thermoplastics (See Appendix 2 for further information).

2.2.2 Thermosets

When a crosslinked macromolecule is heated, the product will be fixed in its heated shape. These resins are polymerized by a chemical reaction that, in general, is non-reversible. Whereas thermoplastic resins soften and can generally be reworked when heated, thermosetting resins decompose when heated. Once hardened, their shape can no longer be modified. This is why recycling them is very difficult.

Thermosetting resins are also used, in one form or another, in plastic processing, including fibre-reinforced compounds, and are widely used in preparations such as paints, adhesives and inks. This category includes phenol-formaldehyde, urea-formaldehyde, epoxy resin, polyurethane, unsaturated polyesters, alkyd resin and silicone.

2.2.3 Processing Methods

Several methods of processing plastics may be distinguished. Among the most important, we may note:

- **Extrusion:** This processing technique makes it possible to obtain finished or semi-finished objects by a continuous technological process. Extrusion is extensively used to manufacture granules and compounds that are then processed by other methods, and semi-finished products such as: plates, sheets, tubes, etc. This technique uses a machine with a heated barrel in which a screw turns, continuously pushing a material softened by heat and mechanical energy out through the opening that constitutes the die. This process is characterized by both the high level of productivity that it allows (continuous operation) and the multiplicity of products that can be produced using the same basic equipment (extruder).
- **Moulding:** To produce three-dimensional parts, an injection process is used. The most important part of the machine is the mould, which contains a hollow cast of the object to be shaped. The machine must make it possible to fill this shape with the material chosen by the user. As with the extrusion process, thermoplastic material in the form of

granules is softened under the effect of the heat in a barrel containing an endless screw. The screw then serves as a piston to push material into a mould. On contact with the cold walls of the mould, the material solidifies and gives the desired shape to the object. Moulding also takes place by injection of thermosetting plastics, using heated moulds to shape the piece. This process permits high production speeds, but the high cost of moulds must be absorbed by a large production run.

- Blow moulding: The production of hollow bodies requires a combination of extruder and blow press. The first produces a tube (parison), which is placed in a mould while a device injects compressed air into it. The air inflates the parison and forces it against the mould walls to make a bottle, for example.

2.2.4 Main Types of Plastics

There are a total of about one hundred families of polymers, each available in many grades of properties, making a total of more than one thousand different commercial products, not including alloys produced by mixing several polymers. We thus have between one thousand and two thousand different plastics.

2.3 CHARACTERISTICS OF RECYCLED PLASTICS

The two most important properties relating to the recycling of polymers are its melting point and molecular weight. The melting points of polymers in products range from 100°C (LDPE) to 260°C (PET). If a mixture of these two polymers is heated to the melting point of PET, the LDPE will deteriorate and the properties of the product will be affected. The mechanical and physical properties of polymers are directly related to the length of their molecular chain, referred to in terms of average molecular weight. Polyethylene resins subjected to heating cycles may undergo a molecular chain deterioration and therefore, a decrease in molecular weight. This decrease will have direct repercussions on the properties of the recycled material.

Colour pigments (organic and inorganic) incorporated into the polymeric matrixes to make them more attractive from a marketing point of view become an important factor to consider in recycling. Plastics from the Blue Box program are in various colours, and when they are all mixed together, the resulting colour is difficult to market even when a market exists for this type of material. Adequate recolouring remains difficult.

3 THE RESINS AND PLASTICS MARKET

3.1 THE PLASTICS PROCESSING INDUSTRY IN THE UNITED STATES

3.1.1 Structure and Performance of the Industry

The U.S. plastics manufacturing sector employed nearly 1.3 million people in 1996. If indirect employment is included, this sector employs 2.3 million people, nearly 2% of the total U.S. labour force.³ The total value shipped in this whole sector was \$274.5 billion in 1996.

With respect to financial ratios, we can simply point out that raw materials, composed essentially of resin, make up 40.9% of production costs.

3.1.2 Resins Produced

In 1973, total American production of resins was of the order of 13.3 million tonnes. In 1998, three times more was produced, 41.6 million tonnes.⁴ Thermoplastics represented 75.08% (31.6 million tonnes) of production, thermosetting, 9.9% (4.1 million tonnes) and other plastics, 14.1% (5.8 million tonnes). Most of the production of thermosetting resins (89.9%) is made up of phenolic, urea and, to a lesser extent, polyester.

Table 2 : Production of Thermosetting Resin (kt)

Thermosetting Resins	1998	%
Epoxy	290	7.0%
Phenolic	1,791	43.0%
Polyester	779	18.7%
Urea	1,173	28.2%
Melamine	132	3.2%
Total	4,165	100.0%

(Source: SPI Committee on Resin Statistics)

³ *Economics Statistics*; SPI, www.plasticindustry.org, January 2000.

⁴ *Facts & Figures of the US Plastics Industry*, SPI, December 1999, p.33.

The four main thermoplastic resins produced are high and low density polyethylene (12.6 million tonnes), PVC (6.5 million tonnes), and polypropylene (6.2 million tonnes).

Table 3 : Thermoplastic Resin Production (kt)

Thermoplastic Resins	1998	%
ABS	651	2.1%
SAN	55	0.2%
HDPE	5 875	18.6%
LDPE	6 730	21.3%
Nylon	584	1.8%
PP	6 284	19.9%
PS	2 835	9.0%
PVC	6 592	20.8%
Thermoplastic polyester (PET)	2 010	6.4%
Total	31 616	100.0%

(Source: SPI Committee on Resin Statistics)

3.2 THE SYNTHETIC RESIN INDUSTRY IN CANADA⁵

3.2.1 Structure and Performance of the Industry

The fast growth of the plastics industry has been the driving force behind the growth of the synthetic resins industry. In 1998, the value of deliveries of synthetic resins from Canadian companies amounted to \$6.0 billion and the industry employed 8,800 people in some 105 establishments.⁶ Most major companies operating in Canada belong to multinationals, mainly American and European. NOVA Chemicals, Basell, Imperial Oil, Dow Chemical and Pétromont are the biggest producers in Canada.

The Canadian industry is located mainly in three provinces: Alberta, Ontario and Quebec. Alberta factories produce thermoplastic resins using raw materials derived largely from natural gas. Companies in Ontario and Quebec produce thermoplastic resins and thermosetting resins from raw materials derived from crude oil and natural gas.

⁵ Establishments whose main activity is manufacturing or combining (for moulding) synthetic resins.

⁶ *L'industrie des résines synthétiques*[Synthetic resins industry], Industry Canada, November 24, 1999, extracts.

Comparing the growth of the resin industry with the manufacturing industries and the economy in general shows that growth in the resins industry was exceptional during the 1990s. This situation is due to downstream demand, particularly from plastic manufacturers, the opening of new factories, and increases in production capacity.

The synthetic resins industry is highly capital and technology intensive. For these reasons, per-employee output is higher than in the manufacturing industry in general. Wages in the industry are also much higher than the average for the manufacturing industry in general.

The main factors influencing the costs of resin production are the costs of raw materials, energy, property, plant and equipment, marketing and transport. The cost of raw materials, which are mainly basic petrochemical products, represented about 58% of the total value of deliveries in 1995.

3.2.2 Trade

Canadian exports of synthetic resins have increased strongly over the past decade, from 40% of total deliveries in 1990 to 62% in 1998. Canadian imports of resins also increased considerably over this period and in 1998 represented 66% of total Canadian consumption. This growth in trade in both directions reflects the rationalization and specialization of the North American resins industry as well as the increasing use of complex high performance industrial resins that are not manufactured in Canada.

Canadian and American tariffs on synthetic resins were completely eliminated on January 1, 1993. Under NAFTA, tariffs between Canada and Mexico have already been cut for certain products and will be eliminated completely by January 1, 2003.

3.2.3 Prospects

Projections for the industry over the next five years predict real growth in synthetic resin consumption, rising at an average annual rate of 5 to 7% worldwide. Growth in North America is expected to be weaker, perhaps about 3 or 4%, but still higher than the growth of the economy in general.

3.2.4 Resins Produced

Total Canadian production of pure new resins (except additives and colouring agents) was 2.5 million tonnes in 1998.⁷ Polyethylene alone represented 74.06% of this total (See Table 3-3).

Table 4 : Production of Pure New Resins in Canada (Metric Tonnes)

Pure New Resins	1998	%
LDPE + Linear Low Density Polyethylene	1,186,106	46.2%
HDPE	715,620	27.9%
PS + ABS	153,055	6.0%
PVC	445,947	17.4%
Unsaturated polyesters	67,076	2.6%
Total	2,567,804	100.0%

(Source: Statistics Canada)

3.3 THE PLASTICS INDUSTRY IN CANADA

3.3.1 Importance of the Industry

The plastics processing industry represents 0.5% of the national Gross Domestic Product (GDP), 0.5% of total national employment and 3.9% of employment in the manufacturing sector. If estimates of the plastics processing activity of companies that are not officially part of the industry are included, these proportions reach 0.9%, 0.8% and 6.0% respectively (mold and machinery suppliers included).

Over the past forty years, growth in the plastic products industry has always been greater than in the manufacturing sector as a whole. Between 1990 and 1998 for example, it was over 4% compared with 2% for the whole manufacturing sector.

⁷ *Produits chimiques, industriels et résines synthétiques* [Chemicals, industrial and synthetic resins]; Statistics Canada, N46-002-XIB, December 1999.

3.3.2 Structure of the Industry

In 1998, there were 1,375 establishments in Canada that transformed synthetic resins into plastic products. This industry employed 82,800 people, an average of 55 employees and \$9.4 million in deliveries per factory.⁸ The great majority of these companies (nearly 65%) are small businesses employing fewer than 50 people and sales under \$5 million.

Plastic products are not made only by companies belonging to the plastic products industry as such, but also by other groups of industries as a secondary activity, both for sale (plastic toys and furniture) and for internal needs (plastic bottles manufactured on site by a cosmetics manufacturer). If such activities are included, the total number of establishments processing plastics in Canada reached 2,180 in 1997, the total production of plastic products, \$19.9 billion, and the number of direct jobs, 107,900.

The plastics industry can be divided into six distinct segments, the most important of which, with the exception of *Other Industries*, are the automotive parts and accessories industry (19.3% of deliveries) and the plastic films and bags industry (9.6% of deliveries).

Table 5 : Plastic Products Industries (1998)

CTI		Establishments	Deliveries (\$million)	Jobs
1611	Foam and Blown Plastic	110	810	5000
1621	Pipes and Fittings	70	840	3700
1631	Films and Sheets	80	1,240	5,100
1691	Bags	125	1,200	7,000
1699	Other Industries	910	6,290	46,000
3256	Auto Parts and Accessories	75	2,480	16,000

(Source: Industry Canada Estimates)

⁸ *L'industrie des produits en matière plastique canadienne* [The Canadian plastic products industry], Industry Canada, 03/12/1999.

3.3.3 Use of Plastics

The three largest markets for plastic products in Canada are packaging (34%), construction (26%) and the automotive industry (18%). Outlets for plastic products in the United States are somewhat different (See Table 3-5).

Table 6 : Sales and Use of Resins by Market in the United States (kt)

	1998	%
Transportation	1,949	5.08%
Packaging	10,162	26.50%
Construction	7,764	20.25%
Electrical/Electronics	1,433	3.74%
Furnishings	1,812	4.73%
Consumption and Institutional Products	5,141	13.41%
Other	5,988	15.62%
Exports	4,091	10.67%
Total	38,341	100.00%

(Source: SPI-April 1999)

3.3.4 Trade

The value of deliveries for the whole industry was \$12.9 billion in 1998. Despite the coming into force of NAFTA, which stimulated trade, the Canadian plastics industry has a deficit trade balance. The average annual deficit observed during the past ten years is about a billion dollars, even though it has dropped slightly since 1996. The Canadian industry has about 2% of the U.S. market and about 6% of the total North American market.

Most trade is with the United States, which represented 92% of exports in 1998. 81% of imports come from the United States. Considering Canada's geographical position, this situation may be expected to continue for a good number of products, in particular because of high transportation costs limiting exporting possibilities in other more distant markets.

3.3.5 Deliveries of Plastic Film and Bags

In 1998, Canadian production of plastic film and bags manufactured from resin was estimated at 337,377 t.⁹ Nearly 75.12% (253,432 t) of this was destined for the Canadian market. Total deliveries of plastic film represented 55.6% compared with 44.4% for bags. The breakdown of deliveries to Canada by type of film is presented in the following table:

Table 7 : Plastic Film Deliveries in Canada

Plastic Film	Tonnes	%
LDPE– Packaging Film	59,509	44.05%
LDPE– Construction and Agricultural Film	21,123	15.64%
LDPE–Moulded Plastic Film and Industrial Sheet and Tube	7,166	5.30%
HDPE	X	X
Stretch Films for Packaging	X	X
Coextrusions	X	X
Other Plastic Films	37,599	27.83%
Total	135,095¹⁰	100.0%

(Source: Statistics Canada)

In 1998, deliveries of plastic bags in Canada represented a volume of 118,337 t, 78.97% of total deliveries in this sector. The various types of bags delivered in Canada break down as shown in the following table:

Table 8 : Deliveries of Plastics Bags in Canada

Plastic Film	Tonnes	%
Polyethylene garbage bags	43,122	36.44%
Polyethylene dry-cleaning bags	X	X
Polyethylene shopping bags	X	X
Polyethylene lunch bags	X	X
Bags for fashion articles and notions –LDPE	X	X
Bags for fashion articles and notions –HDPE	X	X
Other (including heavy delivery bags)	26,008	21.98%
Total	118,337¹¹	100.0%

(Source: Statistics Canada)

⁹ *Livraisons de pellicules et sacs en matière plastique fabriqués de résines* [Deliveries of plastic films and bags manufactured from resins]; Statistics Canada, Catalog 47 007 XPB Quarterly, February 1999.

¹⁰ The total differs since some data (X) is confidential.

¹¹ Id.

3.3.6 Regional Distribution

The regional distribution of the industry has not changed much over the past 10 years. Half of all establishments are still in Ontario, 27% in Quebec, 11% in British Columbia, 10% on the Prairies and 2% in the Atlantic provinces. Nearly 65% of deliveries or employment for the industry as a whole, as well as almost all of the motor vehicle parts segment, are in Ontario. The table below lists the location and production capacity of the main Canadian manufacturers of resins.

Table 9 : Main Canadian Producers of Resins

Resin	Manufacturer	Location	Capacity (kt)
LDPE	AT Plastics Inc.	Edmonton, AB	80
	Dow Chemical Canada Ltd	Sarnia, ON	80
	Nova Chemicals	Moore Township, ON	120
	Union Carbide	Prentiss, AB	
Linear LDPE	Dow Chemical Canada Ltd	Fort Sask., AB	180
HDPE	Id.	Fort Sask., AB	201
	Imperial Oil	Sarnia, ON	280
	Nova Chemicals	Joffre, AB	544
	Id.	Moore Township, ON	190
	Id.	St. Clair River, ON	265
	Pétromont	Montréal est	nd
PP	Basell	Varennes, QC	135
	Id.	Sarnia, ON	170
ABS/SAN	Bayer Inc.	La Salle, QC	35
PS	Dow Chemical Canada Ltd	Sarnia, ON	136
	Huntsman Chemical	Mansonville, QC	12
	Nova Chemicals	Montreal, QC	43
PVC	Royal Polymers	Sarnia, ON	155
	Oxyvinyls	Niagara Falls, ON	180
	Id.	Fort Sask., AB	120
PET	Eastman Chemical	Toronto, ON	45
	KOAC	Kingston, ON	220

Source: EPIC, www.plastics.ca, 1999

3.4 PLASTIC PROCESSING IN QUEBEC

3.4.1 Structure and Performance of the Industry¹²

The Quebec plastic processing industry, which includes 650 companies, has a number of subsectors, the two most important of which are packaging (38.9%) and construction (26.1%). Unlike the rest of Canada (mainly Ontario), plastic products for the transportation industry are marginal, which is explained by the limited presence of the automotive sector in Quebec (GM in Boisbriand). Diagram 3.1 (See following page) shows the relative importance of each subsector.

This sector employed 23,800 in 1998, 3,7% of all those employed in the manufacturing sector.¹³ Average annual growth rate in this sector since 1992 has been 7.2%. The most dynamic subsectors are packaging and household articles, with respective growth rates of 9.5% and 14.9%. The least dynamic subsectors are leisure and construction, with respective growth rates of -5.0% and -2.8%.

Table 10 : Average Annual Growth Rates 1992-1996

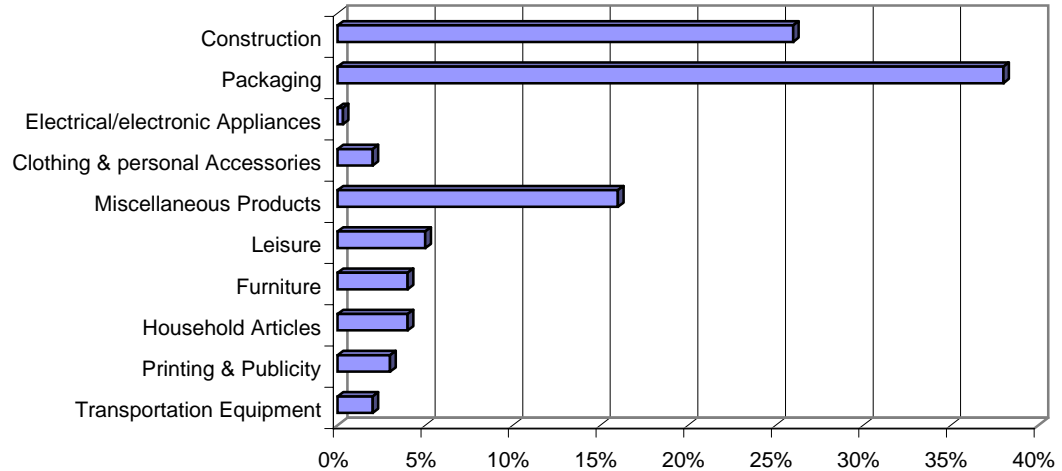
	Average Annual Growth Rate	Relative Size of Subsectors
Packaging	9.5%	38.9%
Construction	-2.8%	26.1%
Miscellaneous Products	4.5%	15.7%
Leisure	-5.0%	5.0%
Furnishings	2.4%	4.0%
Household Articles	14.9%	3.5%
Printing and Advertisement	-5.0%	3.0%
Transportation Equipment	4.1%	1.9%
Clothing and Personal Accessories	2.0%	1.6%
Electronic/electrical Equipment	-12.7%	0.3%

(Source: MIC–Analysis by groups of industries, 1996)

¹² *L'industrie de la plasturgie québécoise* [Quebec plastic processing industry], MIC, 1998.

¹³ *Produits en matière plastique: aperçu conjoncturel en 1998* [Plastic products: economic outlook - 1988], MIC, 1999.

Figure 3-1 : Structure of the Quebec Plastic Processing Industry

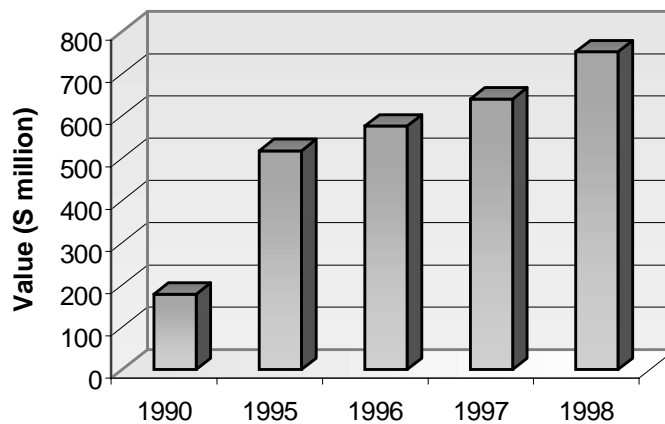


3.4.2 Trade

The value of deliveries is nearly \$3 billion per year and exports have grown very significantly since 1988, when they were \$275 million, to reach nearly the billion dollar mark in 1997, which gives a propensity to export of 34%. Plastics represented 1.3% of Quebec's international exports and in 1998 had a growth rate of 17.1%¹⁴ compared with 1988, one of the strongest among industrial exports. Thus, Quebec has a positive trade balance of \$180.6 million.

¹⁴ *Les principales industries exportatrices* [The main exporting industries]; MIC, 1999.

Figure 3-1 : Export of Plastic Products 1990-1998¹⁵



3.4.3 Investments

For seven years, Quebec companies have continually made investments to expand their operations or modernize their machinery and equipment, spending an average of more than \$80 million per year (\$85.5 million in 1998). Plastic processing has a secure supply of raw materials with eight polymerizers and some 30 companies that manufacture plastic compounds in Quebec. There is also some 50 mould makers able to meet the needs of plastics manufacturers with respect to the design and production of moulds.

3.4.4 The Main Quebec Companies

Among the main Quebec plastic processing companies that are among the top 100 in their category in North America, we can mention the following:¹⁶

¹⁵ *Statistics Canada*, revised by ISQ, Statistical Analysis Branch, September 1999.

¹⁶ *Market Data Book 1999*, *Plastics News*, December 1999.

Table 11 : Major Plastic Processing Quebec Companies

Category	Rank	Company	Sales (US\$ million)	Employees
Injection Moulder	74	IPL Inc., St-Damien	70.2	700
Extruders Pipe, Profile, Tubing	75	Les Industries Amav/Hedstrtram	20.0	n/a
		PH Tech Inc., Lévis	20.0	160
Films and Sheets	28	Groupe Intertape Polymer	202.0	1500
	69	Vifan Canada Inc., Lanoraie	52.0	200
Thermoformer	28	Twinpak, Dorval	33.0	155
	89	Marquez Transteck Ltée, Pte-Claire	5.5	75
Blow Moulder	69	Duropac Packaging, Pte-Claire	16.1	150
	97	Mirabel Plastics Inc., Montreal	9.0	128
	97	TPI Plastics, Coaticook	9.0	160

(Source: Plastics News, December 1999)

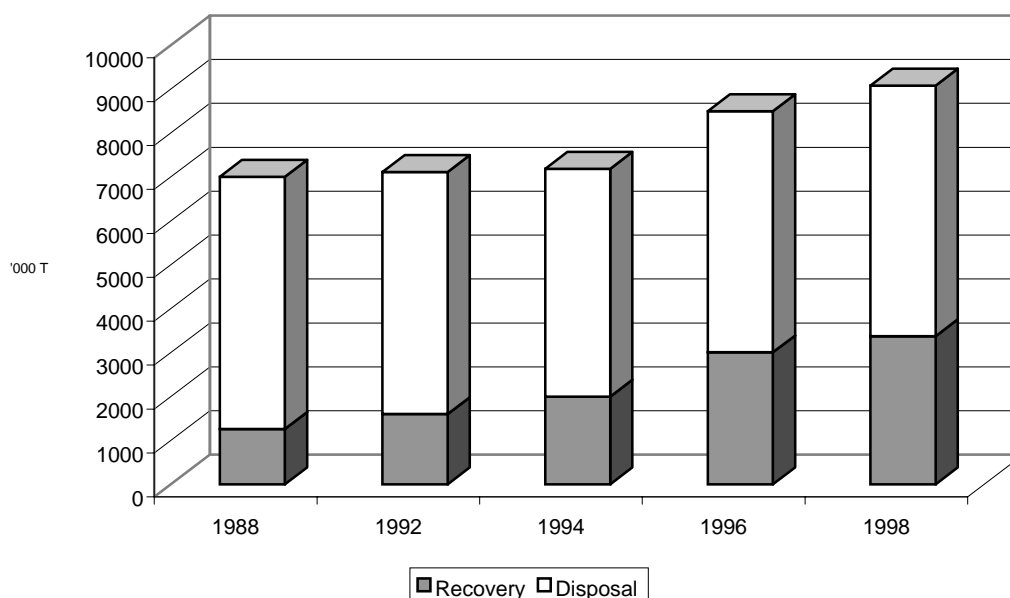
4 WASTE PLASTICS IN QUEBEC

4.1 WASTE MANAGEMENT IN QUEBEC¹⁷

4.1.1 Global Balance

In 1998, the Province of Quebec generated 9,078,400 t of waste, including construction and demolition waste, an increase of 6.84% over 1996 and 29.65% in ten years. Most of these wastes (62.8% or 5,705,000 t) were disposed of in landfill sites. However, waste materials recycling has progressed regularly in the last dozen years, since in 1998 the recycling rate was evaluated at 37% (3,372,900 t), compared with 18% in 1988.

Figure 4-1 : Waste Materials Balance from 1988 to 1998 (tonnes)¹⁸



¹⁷ *Gestion des matières résiduelles au Québec Bilan 1998* [Waste management in Quebec: Balance 1998]; extracts, RECYC-QUÉBEC.

¹⁸ Id.

In 1998, each person generated 1,240 kg of waste, of which an average of 460 kg was recycled and 780 kg disposed of (See Table 12). This represents an annual increase of 21.28% per person compared with 1988. We should note that the volume of waste generated depends in particular on the level of disposable household income as well as economic cycles, because consumption of plastic is closely related to packaging and construction.

Table 12 : Waste Material Management in Quebec–Balance 1998-1998

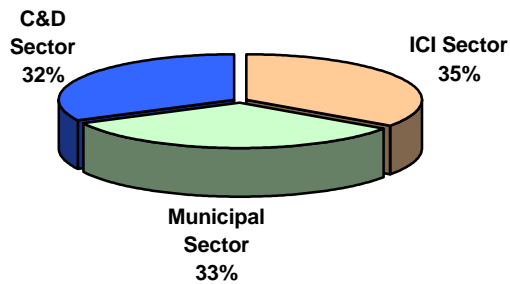
	1988	1992	1994	1996	1998
Population	6,860,400	7,150,700	7,275,000	7,208,884	7,334,094
Generation	7,002,100	7,110,600	7,183,400	8,496,590	9,078,400
Recovery, Reclamation and Recycling	1,258,100	1,597,600	1,994,000	3,005,590	3,372,900
Disposal	5,744,000	5,513,000	5,189,400	5,491,000	5,707,500
Diversion Rate	18%	22%	28%	35%	37%
Rate per Capita (tonne/person/year)					
Generation	1.02	0.99	0.99	1.18	1.24
Recycling	0.18	0.22	0.27	0.42	0.46
Disposal	0.84	0.77	0.71	0.76	0.78
% of Reduction in Disposal/1998	-	7.9%	14.8%	9.0%	

(Source: RECYC-QUEBEC, 1999)

4.1.2 Waste Materials by Sector

The three main waste-generating sectors (apart from the mining sector) are the municipal sector, the industrial, commercial and institutional sector (ICI), and construction and demolition (CD). The volumes generated by each of these sectors are in substantially equal proportions since the breakdown is the following: municipal 32.8%, ICI 32.4% and CD 32.4% (Fig. 4-2).

Figure 4-1 : Sectoral Distribution of Waste Materials Generated in Quebec¹⁹



The composition of municipal waste is influenced by location (urban, rural), the socio-demographic characteristics of the population served (income, etc.) and season (fall leaves, etc.). In total, fibres and putrescibles each make up one third of municipal waste. For ICI, fibres and metals each make up one third of waste. Construction waste is made up of asphalt and concrete, in particular. Plastics make up 6.9% of waste generated by the municipal sector and 5.6% from ICI (See Table 4-3).

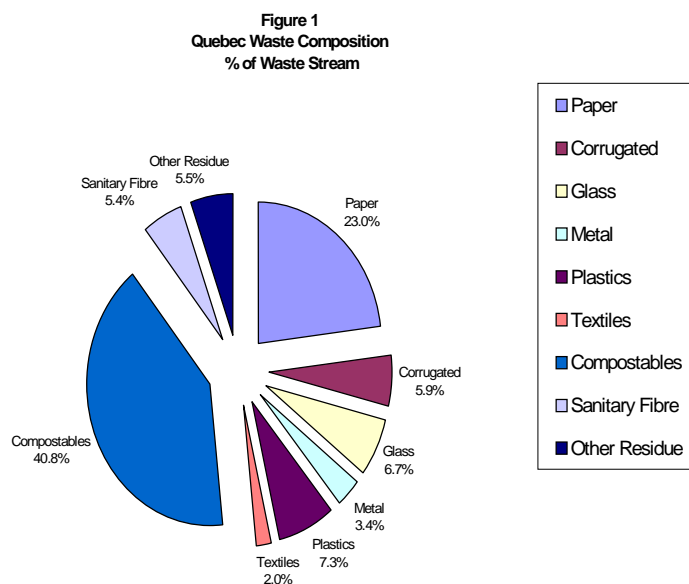
¹⁹ MEF, 1995.

4.2 Quebec Waste Composition Analysis

4.2.1 Generation

The waste composition analysis recently carried out in Quebec²⁰ has determined that each resident generates 418 kg of material that is handled by the municipalities. For the entire province, residential waste totals 3,070,200 tonnes.

Figure 4-1 Quebec waste composition



Plastics comprise 7.3% of the total waste, 30.5 kg/cap/year or 224,000t annually.

²⁰ *Caractérisation des matières résiduelles au Québec*, Chamard - CRIQ - Roche, December 2000.

EPIC commissioned Chamard et Associés Inc. to carry out a detailed characterization of the plastics included in the waste composition analysis.

Of the 224,000t of plastics in the Quebec residential waste stream, 83% or 186,000t were derived from packaging. 119,000t of the packaging waste are considered to be capable of being recycled by conventional means if they could be recovered from the waste stream and markets were available for them. The remaining 67,000t are comprised largely of film contaminated with food residues and/or used as receptacles for garbage. This material cannot readily be recycled mechanically.

A number of methodological details of the work done by Chamard are worth noting.

While the Chamard, CRIQ, Roche study was carried out over four seasons, the work, done on behalf of EPIC, represented only the last three seasons of the study.

There is a small difference in the total quantity of plastics reported by the main report and the detailed analysis. None the less by means of a process of logical manipulation and reference to the main report the total of plastics in the waste stream as extracted from the work of Chamard for EPIC is within 1.5% of that reported in the main study.

The Chamard, CRIQ, Roche report made reference in Table A 1.15 to the quantities of Film, Rigid and Other plastics in the waste stream. These quantities differ in some respects from the detailed plastics study undertaken by Chamard on behalf of EPIC as shown below in Table 13.

Table 13: Comparison Results from Main Report with Data Supplied by Chamard

Category	Report Data	Chamard Data
	kg/cap/yr	kg/cap/yr
Film	15.9	13.7
Rigid	9.2	11.6
Other	5.4	5.2

It is not possible from the information available to reconcile the differences. The Chamard data are derived from the aggregation of the detailed data while the data in the Chamard, CRIQ, Roche report are from the gross sortation. It is possible that some materials were categorized inappropriately during an initial sort. Regardless of the differences they will not affect any general conclusion which may be drawn from the results. For the purposes of this report we use the results from the detailed (Chamard) analysis.

Chamard reported composition by percent for each of the categories into which plastics were being sorted for each of the three seasons analyzed. In the autumn sort all plastic film was included in the “PE sacks, bags and wrap” category. This meant that bags used for garbage etc. were included. The procedure was changed between the autumn and winter sorts so that only clean recyclable film was counted in the “PE sacks, bags and wrap” classification. The seasonal percentages of each category were averaged and applied to the annual total per capita quantity of plastics in the waste stream (30.5) to determine the quantity of individual plastic products. The results are shown in Table 14.

Table 14 : Plastics Waste Composition Province of Quebec

(Based on Collected Garbage & collecte Sélective)²¹

Material	kg/cap/yr	kilotonnes/ yr	% of plastics
PET Soda 2l	0.27	1.983	0.9%
PET Soda <2l	1.16	8.520	3.8%
PET Custom	0.92	6.757	3.0%
Total PET Bottles	2.35	17.261	7.7%
HDPE Refundable		0.000	0.0%
HDPE Milk Jugs	0.15	1.102	0.5%
HDPE Bottles Other	3.2	23.504	10.5%
Total HDPE Bottles	3.35	24.606	11.0%
Tubs/Lids	3.45	25.340	11.3%
PP		0.000	0.0%
PVC		0.000	0.0%
PS	2.44	17.922	8.0%
Crates/Pails/Drums		0.000	0.0%
Other #7		0.000	0.0%
Total Other Rigids	5.89	43.262	19.3%
Total Rigids	11.59	85.129	38.0%
PE Clean Film	4.58	33.640	15.0%
Unrecyclable Film	9.15	67.207	30.0%
Stretch Wrap		0.000	0.0%
Shipping/Courier Bags		0.000	0.0%
LDPE Film		0.000	0.0%
Total Film	13.73	100.847	45.0%
Total Plastic Packaging	25.32	185.975	83.0%
Other Plastics	5.18	38.047	17.0%
Durable Plastics		0.000	0.0%
Total Plastics	30.5	224.023	100.0%
Total Waste kg/cap.	418		
Percentage Plastics	7.3		

²¹ Data on Quebec's deposit system show that there are 12488t of PET beverage containers on deposit with a recovery of 9073t or 72.6%.

The quantity of “tubs” as reported in the Quebec analysis (3.45kg/cap/yr) appears high when compared to the quantities reported in other Canadian waste composition analyses.

4.2.2 Recovery

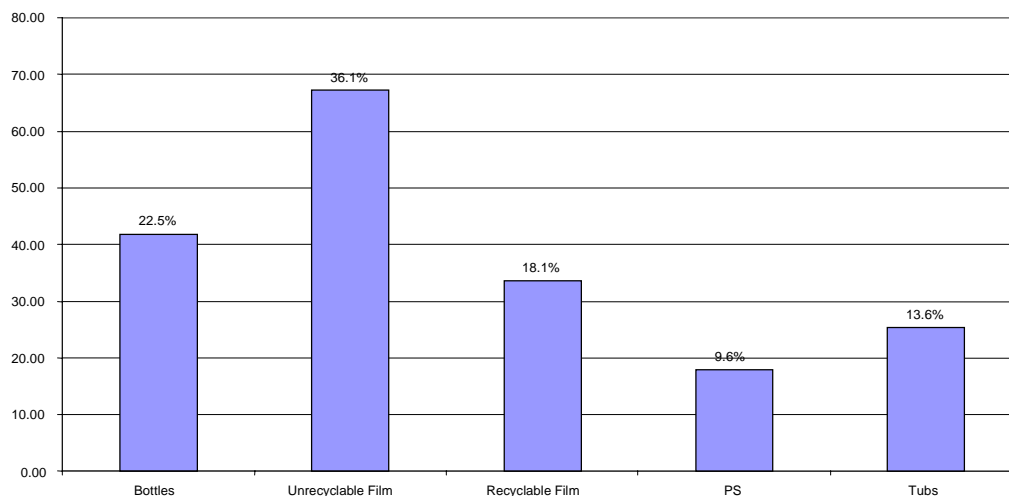
It was stated previously that 83% of the plastics in the Quebec residential waste stream (186,000t) was comprised of packaging. From the perspective of the householder packaging is the most recognizable category in the plastics stream. At the municipal level it is plastics packaging which forms the plastic component of the recycling, recovery programmes known in the Province as the “Collecte sélective”.

The breakdown of plastics packaging in the waste stream by general category is shown in Table 15 and graphically represented in Figure 4-4.

Table 15 : Breakdown of Plastics Packaging

	kilotonnes	%
Bottles	41.87	22.5%
Unrecyclable Film	67.21	36.1%
Recyclable Film	33.64	18.1%
PS	17.92	9.6%
Tubs	25.34	13.6%
Total	185.98	100%

Figure 4-1 : Plastic Packaging generated from Quebec Households (kilotonne)



Of the plastics packaging in the waste stream 64% or 119,000t of it is considered to be recyclable, when markets for the recovered materials exist, using the conventional method of sorting, washing and re-extrusion.

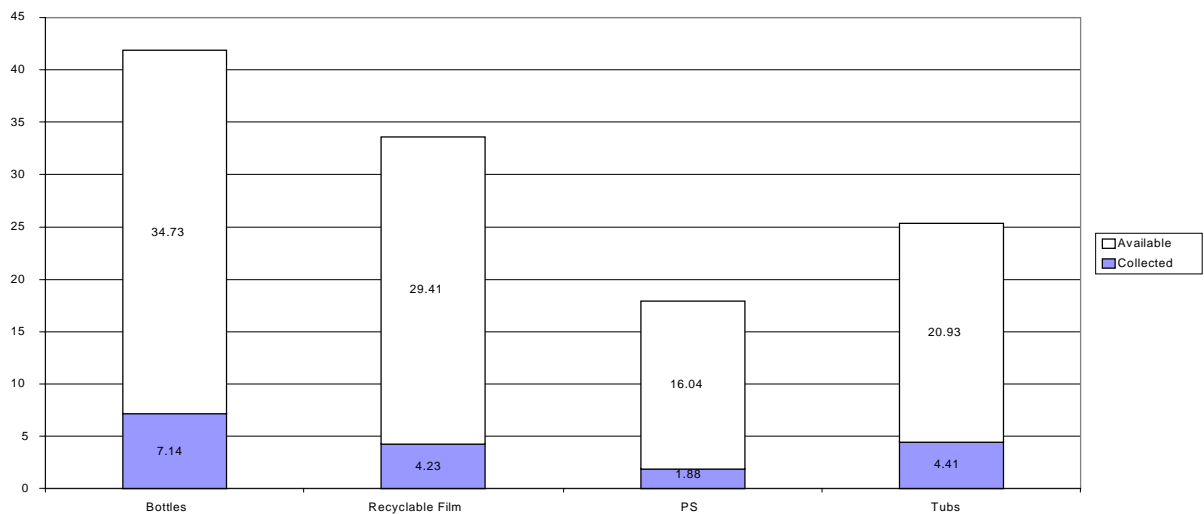
According to the analysis, which forms the basis of this report, the current recovery from waste of recyclable plastics packaging in Quebec is 14.9%. The recovery of individual categories of plastic packaging products is shown in Table 17 and illustrated in Figure 4-5.

Table 16 : Current Recovery of Recyclable Plastics Packaging (kt)

	Collected	Available	Total	% Recovery
Bottles	7.14	34.73	41.87	17.05%
Recyclable Film	4.23	29.41	33.64	12.57%
PS	1.88	16.04	17.92	10.49%
Tubs	4.41	20.93	25.34	17.40%
Total ktonnes	17.66	101.11	118.77	14.87%

Incorporating the results of the deposit system raises the recovery rate of plastics to 20.4%

Figure 4-2 : Current Recovery of Recyclable Plastics Packaging in Quebec



Bottles comprise 35% of the recyclable plastics packaging stream and it is evident from the table and chart shown above that there is substantial opportunity to increase recovery of these products.

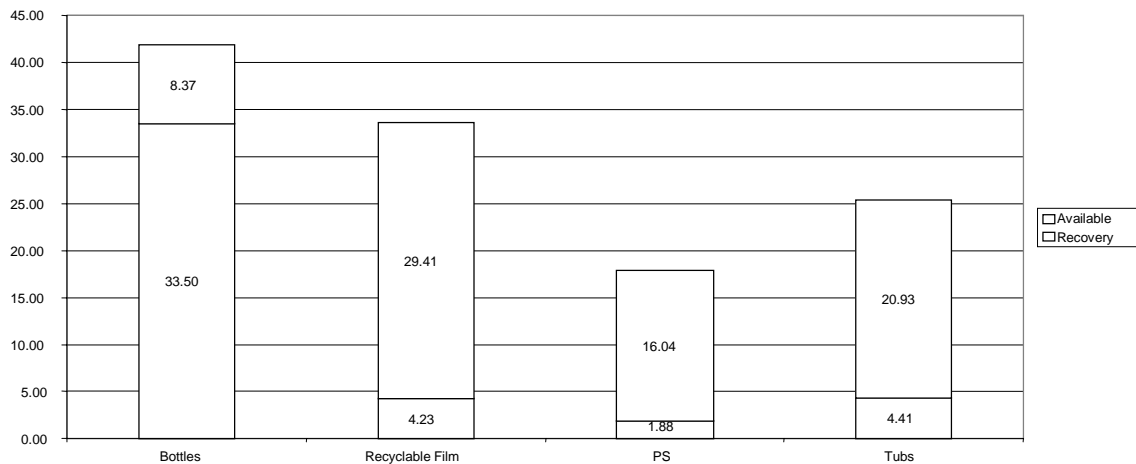
A number of municipalities in North America have piloted programmes targeting “all bottles”. The approach has been successful in increasing the recovery of bottles because it is easier to educate the householder – “if it has a neck, put it in the Collecte sélective.” There is no need for the resident to refer to material codes such as #1 or #2. Experience has shown that there has been no increase in collection or processing costs and overall recovery rates for plastics have increased dramatically.

An 80% recovery of marketable bottles (an increase from current levels of 27,000t) is not unrealistic with the result that overall recovery of recyclable plastics in Quebec would increase from the current 15% to 37%. This fact is illustrated below. When the recovery of PET from the deposit system is included plastics recovery increases to 40%.

Table 17 : Potential Recovery of Recyclable Plastics Packaging Targeting 80% Bottles (kt)

	Recovery	Available	Total	% Recovery
Bottles	33.50	8.37	41.87	80.01%
Recyclable Film	4.23	29.41	33.64	12.57%
PS	1.88	16.04	17.92	10.49%
Tubs	4.41	20.93	25.34	17.40%
Total ktonnes	44.016	74.75	118.77	37.06%

Figure 4-3 : Potential to Increase Recovery of Recyclable Plastics in Quebec to 37% by Focussing on Bottles (kilotonne)



It is evident from the previous tables and charts that the next largest quantity of plastics in the household waste stream is recyclable film. This category, which comprises 28% (33.64kt) of Quebec’s recyclable plastics in waste, is made up of clean shopping bags, dry cleaning bags, bread bags etc. along with overwraps such as that used for toilet tissue and paper towels. The markets for use of these plastics in film applications have been limited due to poor economics and limited demand. However a burgeoning opportunity for such recovered materials is opening as the demand for engineered plastic/wood composites grows in North America. Recovered polyolefine film materials provide the “glue” in the new generation of “plastic lumber”. Demand for such films is now exceeding the supply available from Industrial/Commercial/Institutional (IC&I) sources and as a result producers of plastic lumber are reaching out into the residential recycling stream. Once these markets have gained experience with residential film and are using it in a consistent fashion it would behoove the Province to increase the residential collection of recyclable film beyond the current pilot programmes.

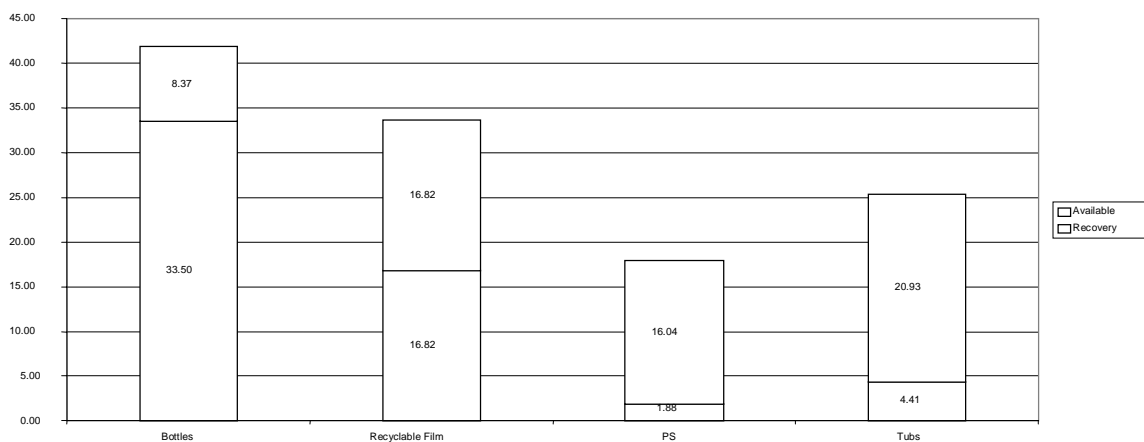
EPIC has produced a “best practices” guide for film collection and recycling which, if followed, will produce a stream of the quality necessary to serve the market.

With an all bottle collection in place and setting a target for the recovery of recyclable film at an achievable 50% the Province has the potential to increase the recyclable plastic recovery from the waste stream to 48%. This is illustrated **below**. The addition of the returns from the deposit system raises this to 50%.

Table 18 : Potential Recovery of Recyclable Plastics Packaging Targeting Bottles and Film (kt)

	Recovery	Available	Total	% Recovery
Bottles	33.50	8.37	41.87	80.01%
Recyclable Film	16.82	16.82	33.64	50.00%
PS	1.88	16.04	17.92	10.49%
Tubs	4.41	20.93	25.34	17.40%
Total ktonnes	56.61	62.16	118.77	47.66%

Figure 4-4 : Opportunity to Increase Recovery of Recyclable Plastics in Quebec to 48% by Focussing on Bottles and Film (kt)



Market opportunities are poor at the present time for the remainder of the packaging stream comprised primarily of tubs and polystyrene. Tubs are a mixture of high density polyethylene and polypropylene which are limited in compatibility one with the other and each of which is incompatible with polystyrene. The valorization of these materials along with other plastic residues from materials recovery facilities is best handled through processes such as energy recovery. Gasification combined with energy recovery is proving to be a preferred environmentally clean process to deal with these products. With conventional fuels commanding high prices industrial users of energy are actively seeking alternative fuels. The high calorific values associated with plastics make them prime candidates. In addition significant reductions in Greenhouse Gas Emissions (GHG) are achievable when the energy recovered from the gasification of plastics displaces fossil fuels such as coal.

Summary

- Plastics Represent 7.3% of the Total Residential Waste Stream or 224,000 tonnes.
- Plastics Packaging Represents 83% of Total Plastics or 186,000 tonnes.
- Recyclable Plastics Packaging Represents 64% of plastics packaging or 119,000 tonnes.
- Current Recovery of Recyclable Plastics Packaging is 14.9%.
- The Potential Exists to Increase the Recovery of Recyclable Plastics to 37% by Targeting Bottles.
- The Potential Exists to Increase the Recovery of Recyclable Plastics to 48% by Targeting Bottles and Film.
- The Addition of Materials Recovered from the Deposit System would Increase the Recoveries in (5) and (6) above to 40% and 50% respectively.

The achievement of a 50% recovery for plastics by targeting bottles and film and maintaining the current level of return from the deposit system is extremely optimistic. At the present time the collection of post consumer film is practiced no where else in the developed world apart from some communities in Quebec and Ontario. The achievement of a 50% level of recovery for this commodity is fraught with difficulty and the markets for the recovered materials are just emerging.

On the other hand the ability to use other methods to “valorise” waste plastics such as energy recovery through gasification provides ample scope to meet a 70% plastics diversion from the waste stream in an environmentally and economically sound manner.

The report “Caractérisation des matières résiduelles au Québec” prepared for the Quebec Ministry of the Environment points out that the set out rate for recycling in the Province is only 51.7%. This means that almost half of Quebec households are not participating in the “Collecte sélective”. In order to improve the recovery rate for all materials in the province it is necessary that this deficiency be addressed. In order to increase participation it will be necessary to educate more residents as to the value of recycling. The plastics industry believes that this necessary process of education affords the opportunity to increase the recycling of plastics by incorporating an “all bottle recycling program” into the basic message to householders.

4.2.3 Estimate of Volumes Generated for Certain Categories of Plastics not found in recycling boxes

As part of this study, several products were identified to assess their volume of waste. These are plastic products that are not found in recycling boxes. These categories of products are the following:

4.2.3.1 Soft Drink Bottles

Since June 1990, RECYC-QUÉBEC has been managing returns of non-reusable containers (NRC). The soft drink market has experienced strong growth over the past fifteen years since sales of containers have more than doubled [*sic*], from 422 million units in 1985 to 1.3 billion in 1999. Analysis of the three different types of containers (aluminum, plastic and glass) with respect to share of sales shows significant growth in the use of plastic: Whereas in 1985 only 6% of NRC sold were plastic, their proportion reached 29% in 1999. This growth in the use of plastic has taken place mainly to the detriment of glass (See figures on the following page).

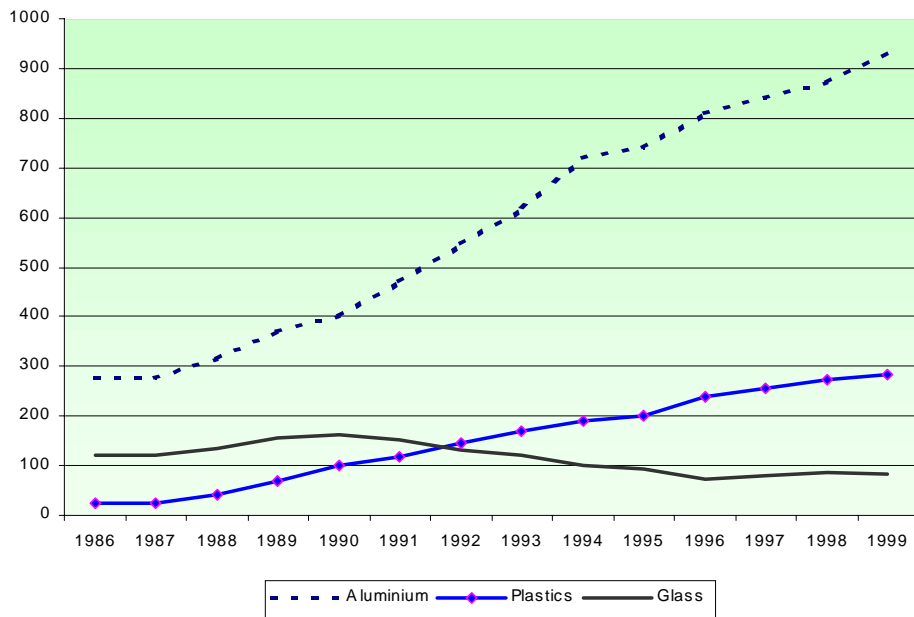
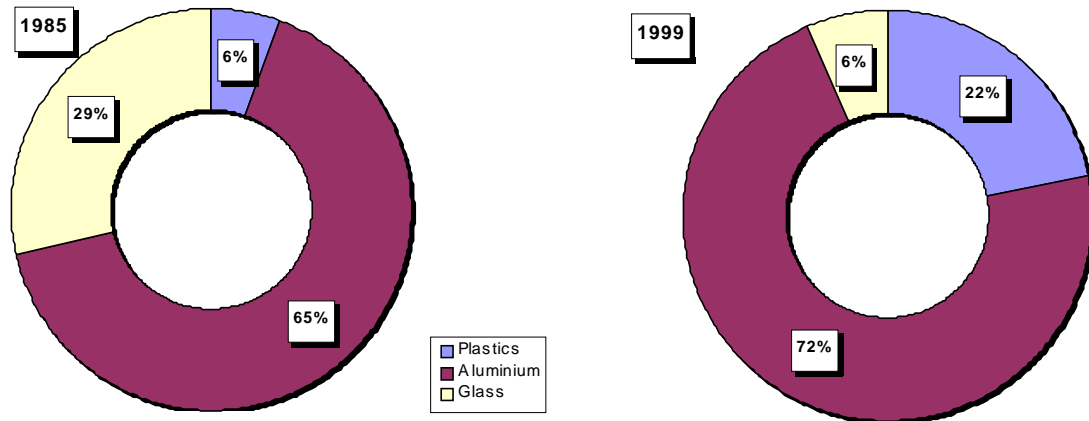
Since 1990, the container-recycling rate has increased from 53% to 76% in 1999. The goal of recycling a minimum of 80% of NRC, set out in the *Plan d'action québécois sur la gestion des matières résiduelles 1998-2008* [Quebec waste management action plan 1998-2008], has therefore almost been reached. The volume of waste plastics (PET) for soft drink bottles is estimated at 9,840 t for 1999.

Table 19 : Waste plastics Generated by Soft Drinks (1999)

REGION	NATURE OF PLASTIC	NUMBER OF CONTAINERS	TOTAL WASTE PLASTICS
Quebec	PET	276 610 149	9 840 t

(Source: RECYC-QUÉBEC)

Figure 4-1 : Distribution and Changes in Sales of Non-reusable Containers in Quebec, 1985 to 1999



Source: RECYC-QUÉBEC

In Canada, total deliveries in the soft drink industry increased from \$1.8 billion in 1990 to \$2.84 billion in 1996, an average compound annual growth rate of 4.5%. Growth in this market may be expected to continue over the coming years. As an illustration, we should note that in 1998 average consumption per capita in Quebec was 104 litres compared with 121 litres in Ontario.²² Since the industry considers that the development potential of the Canadian market is high compared with the consumption level observed in the United States (245 litres/capita in 1998), we may assume that the volume of waste plastics will also increase over the coming years.²³

4.2.3.2 Bottled Water

At present, the recycling of soft drink containers does not include containers used for the bottling of sparkling or mineral water. Their consumption has grown sharply over the past 15 years in Quebec. In 1996, 38.4 litres of bottled water per person were consumed in Quebec.²⁴ Nearly 58% of water production is bottled in 4 Ls or smaller sizes (1.5 L, 1 L, 650 mL, 500 mL and 355 mL).

The annual consumption of water in 4 L containers is estimated at 18 million units.²⁵ 1.5 L and 500 mL are the most popular sizes under 4 L. We estimate that the bottled waters sector generates 1,753 t of HDPE plastic and about 1,970 t of PET plastic annually.

Table 20 : Waste plastics Generated by Waters Bottles

SIZES	NATURE OF PLASTIC	NUMBER OF CONTAINERS	TOTAL WASTE PLASTICS
4 L	HDPE	18,000,000	1,753 ²⁶ t
- 4 L	PET	85,000,000 ²⁷	1,970 t

²² ACIBG, Internet site, 1999.

²³ Id.

²⁴ *L'industrie des eaux embouteillées au Québec* [The bottled water industry in Quebec]; Mapaq, 1998.

²⁵ *Multi Design*, Marie Ève Poulliot, personal communication, January 20, 2000.

²⁶ Approximately 70% of 4 L containers weigh 110 grams and 30% 68 grams.

²⁷ Considering the diversity of sizes, we have used the size that generated the lowest weight/volume ratio since we do not know the distribution of sales by size.

4.2.3.3 Milk Bottles and Bags

Quebec accounts for nearly 37% of Canadian dairy production. In 1998, more than 671 million litres of milk were consumed in Quebec, an average of 91.8 litres per capita.²⁸ Plastic milk bottles were first used by small dairies beginning in 1989, essentially for marketing purposes (desire to differentiate their products from those of the major dairies). The major dairies were then obliged to follow suit to satisfy demands from both consumers and certain distributors. The market share of milk sold in plastic bottles is estimated to be 7% of total sales, an annual volume of 46.97 million litres.²⁹

The segment of the milk market in plastic bottles is made up of 95% of the 2 litres size and 5% of the 1 litre size, newly introduced on the market.³⁰ In Quebec, use of the 4 L size is marginal with the exception of some geographical micro-markets such as Mont-Laurier. We should note that this size is most popular in western Canada with some 50 million units sold annually. The cost of plastic bottle packaging is greater than traditional packaging, which constitutes a serious obstacle to more widespread use. As an example, the 4 L size plastic bottle costs about 20 cents compared to 11 cents for plastic bags.

The volume of waste plastics (HDPE) is estimated at 1,175 t for 1998. However, if the present growth in sales (varying between 5 and 10% per year) continues, then waste plastics should reach 1,500 t in five years (assuming 5%/year growth).

Table 21 : Waste Plastics Generated by Milk Containers (1998)

REGION	NATURE OF PLASTIC	NUMBER OF CONTAINERS	TOTAL WASTE PLASTICS
Quebec	HDPE	23,500,000	1,175 t

(Source: Association des laiteries du Québec)

²⁸ *Fédération des producteurs de lait du Québec* [Quebec milk producers federation], 1999.

²⁹ Charles Langlois, Association des laiteries du Québec [Quebec dairies association], personal communication, January 20, 2000.

³⁰ Emballages Portala, J.P. Therrien, Director of Operations, personal communication, January 23, 2000.

Three different sizes are used for milk sold in bags: 4 L, 10 L and 20 L. The last two are used for sales to institutions. Volumes by unit are presented in the following table. The volume of waste plastics for 4 L bags (3+1 bags) at the municipal level is estimated at 2,075 t (LDPE).

Table 22 : Waste Plastics Generated By Milk Bags (1998)³¹

REGION	NATURE OF PLASTIC	NUMBER OF CONTAINERS	TOTAL WASTE PLASTICS
4 L	LDPE	76,600,000	2,075 t
10 L	LDPE	318,000	23.5 t
20 L	LDPE	588,800	68.3 t

(Source: Association des laiteries du Québec)

4.2.3.4 Motor-oil Containers

Motor-oil containers are considered hazardous domestic waste in Quebec. In 1998, more than 75.9 million motor-oil containers of all sizes were sold in Canada, 26.3 million of them in Quebec. Some companies already offer a recycling service for these containers (See Section 5.6.9). The volume of waste plastics generated by this type of container is estimated at 2,594 t (HDPE).

Table 23 : Waste Plastics Generated By Motor-oil Containers (1998)

REGION	NATURE OF PLASTIC	NUMBER OF CONTAINERS	TOTAL WASTE PLASTICS
Quebec	HDPE	26,278,000	2,594 t ³²

(Source: Autotrack-Groupe NPD, Montreal)

³¹ The respective average unit weights for the 4L, 10L and 20L sizes are 27.1 gr, 74 gr and 116 gr.

³² The average weight used for the various sizes is taken from the study *Waste Plastics in Manitoba*, January 1999.

4.2.3.5 Windshield Washer Fluid and Antifreeze Containers

Almost all windshield washer fluid in Quebec is produced by three companies, *Recochem Inc.* (the largest producer in Canada), *Société Laurentides* and *Hall-chem MFG Inc.* Many distributors such as *Canadian Tire*, *Sears* and *Wall-Mart* that sell windshield washer fluid under private brands get their supplies from outside Quebec (mainly in Ontario). From January to September 1999, 75,987 million windshield washer fluid containers (4 litres-HDPE) were sold in Canada, 26,278 million in Quebec.

The Quebec market represents annual sales varying from 32 to 36 million containers (we will use the conservative assumption of 32 million). We should note that sales of windshield washer fluid fluctuate from one year to the next, depending on the weather. The volume of waste plastics (HDPE) is estimated at 4,800 t.

Table 24 : Waste Plastics Generated by Windshield Washer Fluid Containers (1999)

REGION	NATURE OF PLASTIC	NUMBER OF CONTAINERS	TOTAL WASTE PLASTICS
Quebec	HDPE	32,000,000	4,800 t

(Source: Autotrack-Groupe NPD, Montreal)

Sales of antifreeze are proportionally less than windshield washer fluid, but still generate a significant volume of containers. Thus, more than 32,406 million containers of antifreeze were sold in Canada in 1998, 6,617 million of them in Quebec. The volume of waste plastics (HDPE) is estimated at 992 t.

Table 25 : Waste Plastics Generated by Antifreeze Containers (1998)

REGION	NATURE OF PLASTIC	NUMBER OF CONTAINERS	TOTAL WASTE PLASTICS
Quebec	HDPE	6,617,000	992 t

(Source: Autotrack-Groupe NPD, Montreal)

4.2.3.6 Dry-cleaning Bags

Annual Quebec sales of dry-cleaning bags (LDPE) can be estimated at 227 t.³³ This is a stable market that should remain stable over the next few years in terms of demand. Initiatives to recycle these packages are now under way (See Section 5.6.10).

Table 26 : Estimate of Waste Plastics Generated by Dry-cleaning Bags

REGION	NATURE OF PLASTIC	NUMBER OF ROLLS (AVERAGE 11,8 KG.)	TOTAL WASTE PLASTICS
Quebec	LDPE	19,230	227 t

4.3 WASTE PLASTICS GENERATED BY ICI

4.3.1 Definition

The ICI sector (industrial, commercial and institutional) includes all the goods and services industries, excluding the primary sector. It therefore includes 21 manufacturing sectors and public sector industries, which employ 641,300 and 33,900 respectively.³⁴ The service industries include a dozen different sectors, the most important of which are retail trade (396,900 jobs), health and social services (341,400 jobs), and educational services (231,100 jobs).³⁵ Storage and transportation activities employ 128,700.

The quantity and nature of the waste plastics vary strongly from one sector to the next, and even within each sector.

³³ Personal communication with Sylvain Drolet, Regional Director, *Les Plastiques Balcan*, January 4, 2000.

³⁴ *Enquête sur la population active* [Labour force study], Statistics Canada, cat. 71-001, classification CTI 1980.

³⁵ Id.

4.3.2 Overall Estimate

In 1985, plastic was estimated to be 7.1% of the mass of commercial waste generated in Quebec, whereas the average of all places studied in Canada and the United States was 6.17%.³⁶

In 1988, the composition of waste plastics according to type of activity in percentage by weight was estimated as follows:

- Offices: 3.0%
- Government: 3.0%
- Wholesale and Retail Commerce: 1.3%
- Food Services: 9.0%
- Education: 3.0%
- Transport Services: 7.0%
- Health Services: 14.5%
- Manufacturing: 7.0%

In Quebec, plastics made up 5.6% of the mass of ICI waste materials in 1992.³⁷ If this proportion is adopted and we consider that this sector generated 34.8% of the 9,078,400 t of waste in 1998, the volume of waste plastics can be estimated at 176,919 t. However, in the absence of a characterization study of ICI waste material, any attempt at an estimate includes a certain margin of error.

RECYC-QUEBEC carried out a characterization and reclamation study of the solid waste from a hospital located in the Montreal metropolitan region. Seven different types of plastics are generated, many of which are Javex-type containers, solute bags and their packaging. Plastics represent an annual volume of 127.2 t, 12% of the total.³⁸ The care unit alone generates nearly 76.3 t/year, which represents 21.08% of the waste generated by this sector. The 127.2 t/year are divided as follows:

³⁶ *Rapport sur la production et le traitement des déchets domestiques à Montréal* ; UQAM, September 1989.

³⁷ *Composition des résidus municipaux au Québec en 1992*; MEF, 1995.

³⁸ *Caractérisation et mise en valeur des résidus solides de l'hôpital Maisonneuve-Rosemont* [Characterization and reclamation of solid wastes at Maisonneuve-Rosemont hospital]; October 1997, page 17.

- IV bags: 11.6 t/year;
- IV bags packaging: 2.8 t/year;
- Other plastics (gallons): 112.8 t/year.

4.3.3 Estimate by Type of Resins

The assumptions used to estimate the volume and nature of waste plastics generated by ICI are based on the results of a similar study carried out in Manitoba on waste plastics.³⁹ The economic structures of Manitoba and Quebec are different, so the following results must be interpreted with caution.

The following table shows an overall picture of the distribution of plastics according to their nature. Thus, it shows that polyethylene, with nearly 92,000 t, is the type of waste plastic generated most by the ICI sectors (52%). Conversely, PET (2.0%) and PVC (3.0%) have the lowest volume, less than 16,000 t.

Table 27 : Waste Plastics from ICI by Type of Resin

SPI CODE	TYPE OF PLASTIC	TONNES PER YEAR	% OF WASTE PLASTICS
1	PET	3,538	2.0%
2	HDPE	37,153	21.0%
3	PVC	12,384	7.0%
4	LDPE	54,845	31.0%
5	PP	17,692	10.0%
6	PS	26,538	15.0%
7	Others	24,769	14.0%
	TOTAL	176,919	100.0%

³⁹ *Waste Plastics in Manitoba*; Earthbound Environmental Inc., January 1999.

There is no complete list of waste characterization studies for each of the different ICI sectors. Among the recent sectoral studies that have been carried out, we may mention the one by Public Works and Government Services Canada (PWGSC), which, following its *Protocole national de gestion des déchets solides en 5 étapes* [National 5 stage Solid Waste Management Protocol], implemented a multi-material recycling program inside its buildings.

The results of the 1998 characterization survey show that, of the 130.35 kg of waste generated per employee, 2.41 kg (1.85%) is composed of plastic.⁴⁰ Users represent about 15,000 civil servants. According to data from the *Protocole national de gestion des déchets solides en 5 étapes*, in 1995 every federal employee generated 7.86 kg of plastic included 2.96 kg of polystyrene out of a total of 175.47 kg.⁴¹

4.3.4 Packaging

Plastic packaging is a substitution material for metal, aluminium, glass, paper/cardboard and other containers. The main consumers of flexible packaging are the distribution and retail trade sectors (packaging bags, etc.). Industries, public services (schools, hospitals) and restaurants are major users of plastic bags (garbage bags). Plastic films are especially designed for the agri-food product preservation sector.

Semirigid containers are mostly used in the fast food (especially expanded polystyrene cups) and agri-food (thermoformed containers such as for yoghurt) sectors.

The National Packaging Protocol (NPP), as concluded in 1988 by the Canadian Council of Ministers of the Environment (CCME), adopted the objective of reducing by 50% the volume of packaging intended for disposal. Even though this objective was reached by 1996, this reduction in volume has very often been accomplished by substitution. For example, in the soft drink industry, the main factor (more than 50%) in reducing the volume

⁴⁰ *Implantation du programme de recyclage multi-matières dans les édifices de TPSGC* [Introduction of multi-material recycling program in PWGSC buildings]; PWGSC-Environment, May 1999.

⁴¹ *Protocole National de Gestion des Déchets solides en 5 étapes*; PWGSC, May 1996.

of packaging was the substitution of glass bottles by PET.⁴² For methodological reasons, it is impossible to extrapolate assessments of packaging volume generated by ICI in the Province of Quebec alone from NPP data.

4.3.5 Other Sources of Waste Plastics Generated by ICI

4.3.5.1 Automotive Sector

Among the main sectors using plastics in Canada, the automotive industry comes third with 18%.⁴³ The plastic automotive parts and accessories industry generated deliveries estimated at \$2,480 million in 1998. Use of plastic in the automotive industry offers makers many advantages such as decreased vehicle weight, reduced production costs and better corrosion resistance.

On average, polymer use per vehicle has increased from 27 kg in 1970 to 163 kg today.⁴⁴ According to the American Plastics Council (APC), plastic components in a car should reach 180 kg by 2004. These include thermosetting resins as well as thermoplastics and compounds.

The average weight of a vehicle in North America was 1,227 kg⁴⁵ in 1981 compared with 1,681 kg in 1970. Plastic content varies according to model, manufacturer and production year. For example, in 1994, polymers (plastic and rubbers together) constituted an average of 16% to 17% of the total mass of a Peugeot or Citroen car.⁴⁶ In North America, from APC data, we can estimate that plastics make up between 13% and 14% of the total mass of a vehicle.

In 1998, there were more than of 3,710,477 cars and light trucks on Quebec roads.⁴⁷ A 12-year life span (standard in the German automotive industry) for a vehicle has been

⁴² ACIBG, 1999.

⁴³ *L'industrie des produits en matière plastique* [The plastic products industry]; Industry Canada, December 1999.

⁴⁴ *Plastic Vehicles: Making Inroads in the Automotive World*, American Plastics Council, April 1999

⁴⁵ *A Collection of Recent Analyses of Vehicles Weight and Safety*; NHTSA.

⁴⁶ *Les plastiques dans l'automobile aujourd'hui* [Plastics in the automobile today]; PSA 1999.

⁴⁷ *Bilan routier-Données complémentaires* [Highway assessment- Complementary data]; SAAQ, 1999.

assumed to assess the waste plastics potential.⁴⁸ Thus, we can estimate at over 300,000 the number of vehicles taken off the road annually.

In Quebec, waste plastics generated at the end of the vehicles' life cycle would thus be 50,597 t per year. We should note that this assessment does not take into account plastics generated by other types of vehicles (trucks, truck tractors, motorcycles, etc.).

Table 28 : Waste Plastics Generated by Motor Vehicles

REGION	NUMBER OF CARS REGISTERED	NUMBER OF CARS SCRAPPED	TOTAL WASTE PLASTICS
Quebec	3,710,477	309,206	50,597

4.3.5.2 Construction and Demolition Sector

The construction sector employed 133,800 people in 1998, 76.8% of them in non-residential construction. In 1996, this sector is estimated to have generated 2.7 million tonnes of waste.⁴⁹ The quantities inventoried for 1998 amount to 3.0 million tonnes. Dry materials are divided into two major categories: building construction and demolition debris (45%) and road and bridge construction debris (55%).⁵⁰ In 1998, the quantity of dry materials recycled was 875,000 t.

Plastic construction products (residential, commercial, industrial and institutional) are manufactured from various resins, the most commonly used being PVC, PS, HDPE and LDPE and ABS. The main segments of the construction plastic products market are the following: pipes and fittings, insulation, sidings and panels, doors and windows, tanks, septic pits and tank liners as well as bathroom fixtures (baths, showers, sinks, etc.).

⁴⁸ *Life Cycle Assessment and Public Policy Development for Automotive Industry*; APC, April 1997.

⁴⁹ *Bilan 1996 – Gestion des résidus solides* [1996 Balance Sheet – Management of solid waste]; MEF, RECYC-QUÉBEC, Collecte sélective Québec; 1998.

⁵⁰ *Les résidus de construction et de démolition* [Construction and demolition waste]; MEF, 1999.

This sector accounted for 26%⁵¹ of the plastics used in Canada in 1998. It is difficult to estimate the volume of waste plastics generated by the C&D sector because of the lack of available data. Waste plastics fall into the miscellaneous category (5.77% or 153,900 t) in the composition of dry materials in Quebec. Even if we consider that plastic construction products make up only 2% of all materials used in construction,⁵² it is difficult to draw conclusions for the assessment of waste plastics.

4.4 AGRICULTURAL SECTOR

4.4.1 Agricultural Films

Plastic films are finding increasing applications in agriculture, in silage, greenhouse films and wrapping of hay bales. The volume of waste plastics generated by this sector is difficult to assess since to date, no exhaustive survey has been carried out for all of Quebec.

Estimates of the volume of agricultural waste plastics generated annually are based on the two main uses, silage and mulching. The quantity of silage films (LDPE) used in Quebec for 1999 is estimated by the industry at 1,360 t.⁵³ Even though this segment has experienced a slight growth in sales over the past four years (4 to 5%), the principal operators expect a slow down over the next few years.

Mulching films are placed on the soil to maintain a constant humidity rate, keep seeds from freezing, etc. The Quebec market for this type of film is estimated at 68 t.⁵⁴ This market segment is experiencing annual growth of the order of 5 to 6%.

Table 29 : Waste Plastics Generated by Agricultural Plastic Films

REGION	NATURE OF PLASTIC	NUMBER OF ROLLS	TOTAL WASTE PLASTICS
Quebec	LDPE	x ⁵⁵	1 400 t

⁵¹ *L'industrie des produits en matière plastique*; Industry Canada, December 1999.

⁵² *La transformation des matières plastiques au Québec* [Plastics processing in Quebec], MICT, March 1991, page 131.

⁵³ Personal communication with Pierre Bordeleau, Sales Manager, *Coop Fédérée*, January 4, 2000.

⁵⁴ Personal communication with Sylvain Drolet, Regional Manager, Les Plastiques Balcan, January 4, 2000.

Because these films are often in contact with the soil or various agricultural products (such as herbicides) that contaminate them, they are more difficult to recycle.

4.4.2 Pesticide Containers

In 1996, total sales of pesticides in Quebec⁵⁶ amounted to 3,680 t of active ingredients, which represents an increase of 1.3% over 1992 (first year when such figures were compiled). The agricultural sector accounts for 2,584 t, or 73.2% of pesticide sales. The two other most important sectors are the industrial sector with 436 t (12.5%), and the domestic sector with 264 t (7.5%).

In 1998, some 250,000 pesticide containers were sold in Quebec.⁵⁷ Only 75,000 of them were recycled, mainly in the form of 10 L containers (HDPE). This recycling rate, evaluated at 30% in 1998, was up from nearly nil in the early 1990s. Still, it places Quebec in last place in recycling in Canada. Mr. N. Drapeau⁵⁸ explains this situation by the fact that there are no laws in Quebec preventing producers from discarding these containers as domestic waste, contrary to other Canadian provinces, and that they may be found in the Blue Box collections.

⁵⁵ The estimate was given in total volume and not in units.

⁵⁶ *Bilan des ventes de pesticides au Québec en 1996* [Sales of pesticides in Quebec: 1996 balance sheet]; MEF Québec.

⁵⁷ *Récupération des contenants vides de pesticides: résultats 1998* [Recovery of empty pesticide containers: 1998 results]; Crop Protection Institute of Canada, Normand Drapeau, agr.

⁵⁸ Personal communication, January 6, 1999.

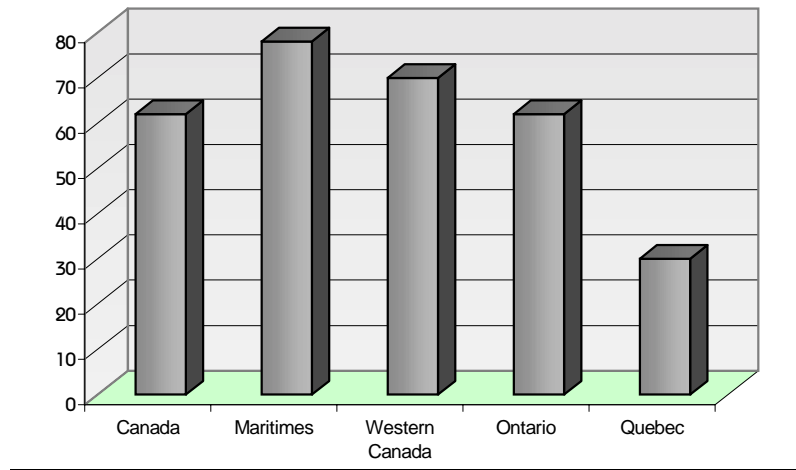
Table 30 : Waste Plastics Generated by Pesticide Containers

REGION	NATURE OF PLASTIC	NUMBER OF CONTAINERS	TOTAL WASTE PLASTICS
Québec	HDPE	250,000	37.5 t

(Source: CPIC – Crop Protection Institute of Canada)

The Canadian average for recycling was estimated at 62% in 1998;⁵⁹ the recycling rate according to provinces being as follows: Atlantic Provinces 78%, Western Canada 70%, Ontario 62%. We should note in comparison that this recycling rate is only 50% in Germany and 25% in the United States.

Figure 4-1 : Recycling (%) of Empty Pesticide Containers in 1998



Source: Crop Protection Institute of Canada (CPIC), 1998

⁵⁹ Id.

4.4.3 Plastics Related to Greenhouses and Nurseries

Plastic for greenhouse covers has a life span varying from three to four years. Mr. Claude Laniel of the *Centre d'information, de développement et d'expérimentation des serres et cultures* (CIDESC) [Greenhouse and crop information, development and experimentation centre] estimates that about 450 t is replaced every year and, therefore, available for recycling.⁶⁰ It is interesting to note that about half the greenhouse production takes place within a radius of 100 km around Montreal (Montréal, Laval and the North Shore (Laurentides, Lanaudière)).

Sales of plastic containers for use by greenhouses and nurseries on the Quebec market are estimated by the main distributor in Quebec at 200 000 cases.⁶¹ It is interesting to note that most containers are bought from Ontario and US producers.

Table 31 : Estimate of Waste Plastics Generated by Greenhouse and Nursery Containers

REGION	NATURE OF PLASTIC	NUMBER OF CASES	TOTAL WASTE PLASTICS
Quebec	PS ⁶²	200,000	2,727 t

(Source: Plant-Prod. Inc.)

It must be noted however that recycling possibilities are limited since most of these plastics have been exposed to sunlight or pesticide (problems of contamination and degradation). As well, since most of these plastics have been placed directly on the ground, they have been contaminated with soil.

⁶⁰ Personal communication, January 26, 2000.

⁶¹ Personal communication, Marie-France Chevrefils, manager Plant-Prod, January 26, 2000.

⁶² Containers are generally made from PS. However, since Ms. Chevrefils of *Plant-Prod* does not know the nature of these plastics, we must be cautious in interpreting the results: the plastics may not all be PS.

4.5 ESTIMATE OF TOTAL WASTE PLASTICS GENERATION IN QUEBEC

The estimate of the total amount of waste plastics generated in Quebec by all of the municipal, ICI and agriculture sectors (excluding the C&D sector) brings together all previously obtained information. Since this estimate is not based on a characterization survey, it presents a wide margin for error but does provide us with a rough order of magnitude.

Table 32 : Estimate of the Volume of Plastic Waste Generated In Quebec (tonnes/year)

TYPE OF PLASTIC	MUNICIPAL	ICI	AGRICULTURE	AUTOMOTIVE	TOTAL
PET	21 612	3 538	-	n/a	25 150
HDPE	52 701	37 153	37	n/a	89 891
PVC	16 208	12 384	-	n/a	28 592
LDPE	61 223	54 845	1 400	n/a	117 468
PP	31 747	17 692	-	n/a	49 439
PS	23 909	26 538	2 727	n/a	53 174
Others	36 811	24 769	-	n/a	61 580
TOTAL	224 000	176 919	4 164	50 597	425 294

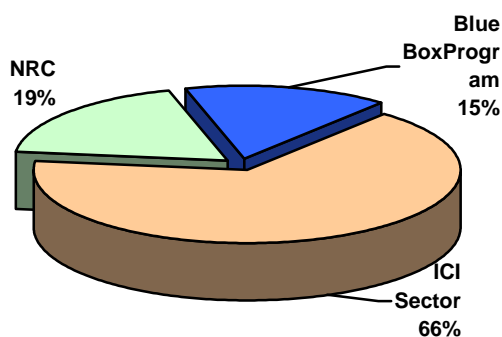
5 WASTE PLASTICS RECYCLING IN QUEBEC

5.1 INVENTORY OF RECYCLED PLASTICS IN QUEBEC

5.1.1 Quantities of Plastics Recycled in 1998

In 1998, nearly 50,500 tonnes of plastics were recycled in Quebec, 7,800 of them from the Blue Box program, 9,500 from returns of non-reusable soft drink containers (NRC), and 33,200 from the ICI sector.

Figure 5-1 : Distribution by Sector⁶³



The 17,300 tonnes recycled by the municipalities represented only 4.08% of all waste materials recycled in this sector (424,370 t). ICI plastics recycled accounts for 33,200 tonnes.⁶⁴

⁶³ *Gestion des matières résiduelles au Québec: Bilan 1998; RECYC-QUÉBEC.*

⁶⁴ Id.

Table 33 : Quantity recycled from the Municipal and ICI Sectors

	Municipal	%	ICI	%
Paper	215,600	50.80%	562,200	19.21%
Glass	56,100	13.22%	44,900	1.53%
Ferrous Metals	10,500	2.47%	905,000	30.92%
Non ferrous Metals	11,470	2.70%	95,600	3.27%
Plastic	17,300	4.08%	33,200	1.13%
Textiles	9,500	2.24%	10,700	0.37%
Tires		0.00%	43,500	1.49%
Organic Waste	90,700	21.37%	83,800	2.86%
RDD	2,500	0.59%		0.00%
Dry Materials	10,700	2.52%	1,146,200	39.17%
Other		0.00%	1,400	0.05%
TOTAL	424,370	100.00%	2,926,500	100.00%

(Source: RECYC-QUEBEC)

5.1.2 Changes in Recycling According to Sector

Globally, the relative share of plastics as a proportion of all recycled waste materials has decreased slightly over the past decade, since in 1992, plastics represented 2.07% (33,000 t) of all recycled materials, compared with 1.51% in 1998 of 50,500 t. (See Figure 5-2 on the next page).

The municipalities recycled 73.0% more waste plastics in 1998 than in 1992 (17,300 t versus 10,000 t). It appears that the proportion of plastics recycled through the Blue Box program experienced strong growth, increasing 95% from 4,000 t to 7,800 t. In 1992, 40% of waste plastics came from the Blue Box program, while in 1996, the proportion was 47.74%.⁶⁵ It is interesting to note that the relative share of plastics recycled by the municipalities decreased 20% between 1992 and 1998, dropping from 5.11% to 4.08% of all recycled waste. This must not however divert attention from the success of the Blue Box program, which has grown, especially with respect to paper.

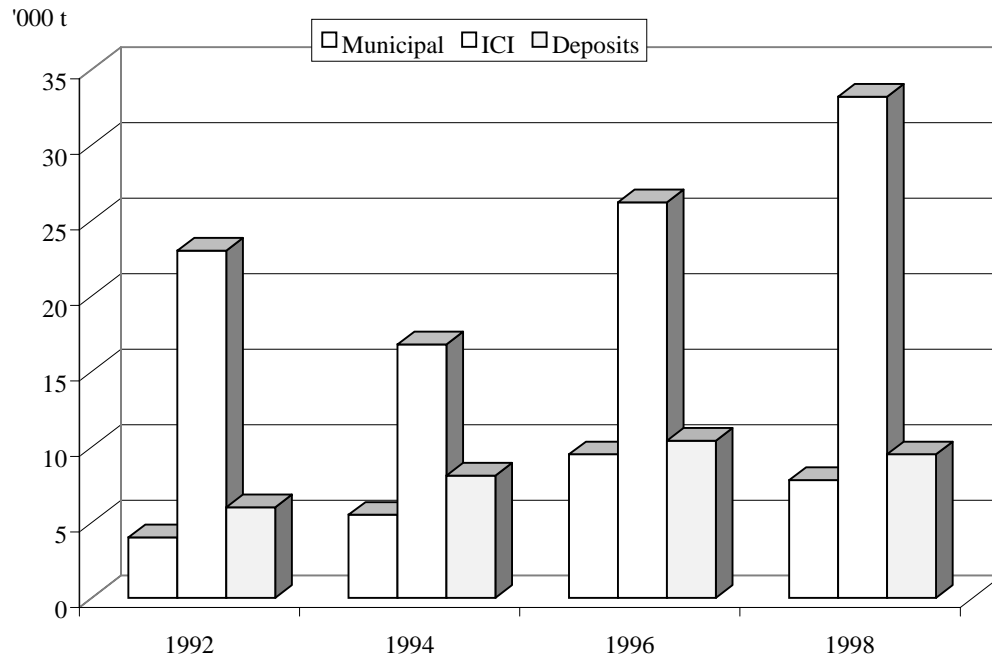
Although the ICI recycled 44.35% more waste plastics in 1998 than in 1992 (33,200 t versus 23,000 t), the proportion of plastics within all recycled materials grew only 13.41%.

⁶⁵ The proportion even incomplete for 1998 is however 45.09%.

Thus, in 1992, waste plastics represented 1.64% of all recycled materials compared with 1.86% in 1998.⁶⁶

Changes in recycling associated with the deposit system are discussed in section 5.3.3.

Figure 5-1 : Recycling of Plastics 1992-1998

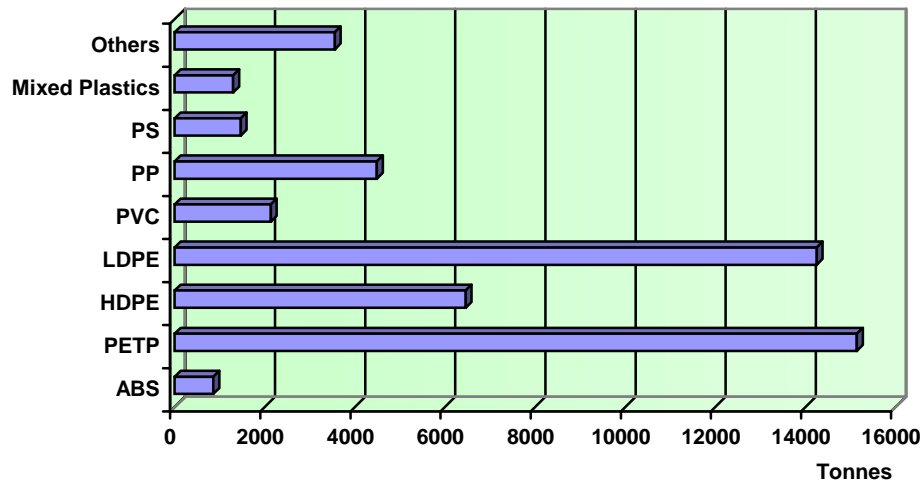


5.1.3 Recycling in Quebec by Type of Plastics

The three main resins recycled in Quebec are PET (15,140 t), LDPE (14,250 t) and HDPE (6,461 t). They alone represented 72.2% of all types of plastics recycled in 1998 (Table 34).

⁶⁶ Dry materials have been excluded from the calculations since there were no figures for 1992 and in 1998 they represent 1,146,200 t.

Figure 5-1 : Volumes of Plastics Recycled⁶⁷



Three types of plastics account for less than 9% (4,457 t) of all recycled plastics: PVC (4.29%), polystyrene (2.95%) and ABS (1.73%).

Table 34 : Distribution of Recycled Plastics According to Type of Resin

TYPE OF PLASTIC	TONNES PER YEAR	% OF WASTE PLASTICS
ABS	859	1.73%
PET	15,140	30.49%
HDPE	6,461	13.01%
LDPE	14,250	28.70%
PVC	2,132	4.29%
PP	4,488	9.04%
PS	1,466	2.95%
Mixed plastics	1,298	2.61%
Others	3,555	7.16%
Total	49,649	100.00%

(Source: RECYC-QUÉBEC)

⁶⁷ Source: RECYC-QUÉBEC

5.1.4 Origin of Recovered Plastics

Quebec imports a large quantity of recovered plastic to feed its recycling industry. Thus, of the roughly 90,730 t of plastics recovered in 1998, only 54.8% was from Quebec. The balance came 30.0% from the United States (essentially the adjacent northeastern states) and 15.2% from the other Canadian provinces.

It is interesting to note that the source of waste plastics according to the different sectors, is roughly the same between Quebec and the United States: the municipal sector (including returns) represents 33.10% for Quebec against 29.17% for the United States, while the ICI represents 66.8% respectively against 70.8%. On the other hand, waste imported from the other Canadian provinces comes mainly from the municipal sector, 57.0% of the whole.

Table 35 : Geographical Origin of Recovered Plastics

	Quebec	Other Provinces	United States	Total
Municipal	7,800	7,840	7,960	23,600
ICI	33,200	5,900	19,330	58,430
Returns	8,700	0	0	8,700
Total	49,700	13,740	27,290	90,730

(Source: RECYC-QUÉBEC)

5.2 ESTIMATE OF QUANTITIES RECYCLED IN QUEBEC

5.2.1 Municipal

Three resins make up nearly all (88.7%) recycled plastics of municipal origin, PET, HDPE and polypropylene. However, PET greatly dominates this category since it represents nearly two thirds (62.8%) of all the main types of recycled plastics. HDPE and polypropylene make up 25.82% of the other recycled resins (See Figure 5-4). Conversely, recycling of PVC, with about hundred tonnes recycled, appears marginal.

Table 36 : Municipal Recycled Plastics by Type of Resin (1998)

TYPE OF RESIN	RESIDENTIAL & MUNICIPAL	% OF WASTE PLASTICS
PET	17,530	62.85%
HDPE	4,200	15.06%
LDPE	760	2.72%
PVC	100	0.36%
PP	3,000	10.76%
PS	2,000	7.17%
Mixed	300	1.08%
Total	27,890	100.00%

(Source: RECYC-QUÉBEC)

5.2.2 ICI

Three resins stand out, in substantially identical proportions: HDPE (25.4%), LDPE (25.2%) and polypropylene (27.3%). Unlike the municipal sector, the quantity of PET recycled is marginal with less than 3% of the whole (Figure 5-5).

Table 37 : ICI Recycled Plastics by Type of Resin (1998)

TYPE OF RESIN	IC & I (TONNES)	% OF WASTE PLASTICS
PET	1,030	2.85%
HDPE	9,180	25.37%
LDPE	9,120	25.20%
PVC	4,710	13.01%
PP	9,880	27.30%
PS	320	0.88%
ABS	1,400	3.87%
Others	90	0.25%
Mixed	460	1.27%
Total	36,190	100.00%

(Source: RECYC-QUÉBEC)

Figure 5-1 : Distribution of Plastics Recycled in Quebec–Municipal

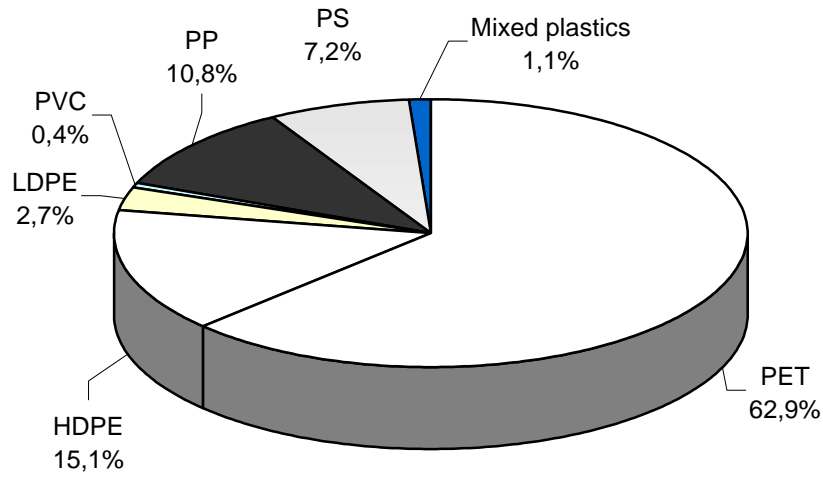
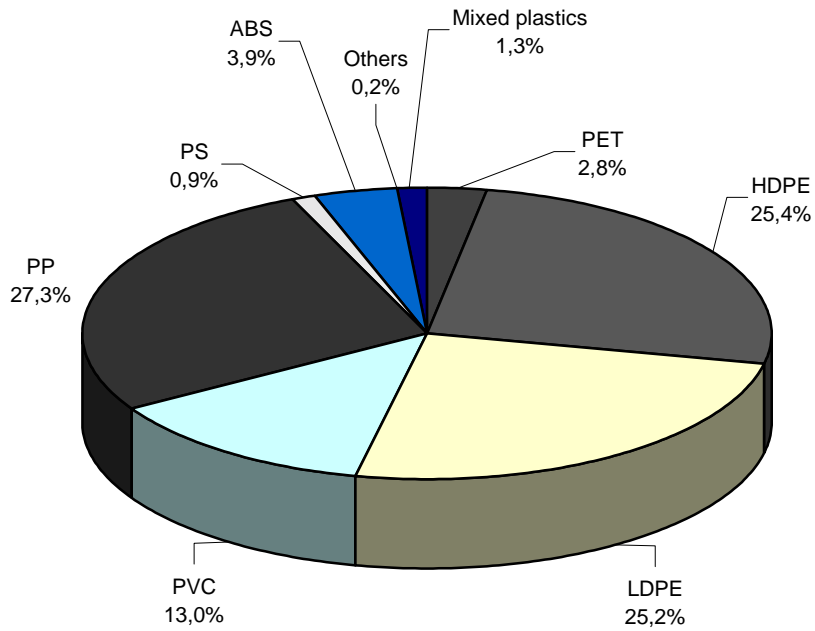


Figure 5-2 : Distribution of Plastics Recycled in Quebec – ICI



5.2.3 Global Estimate

In 1998, 64,080 t of plastic were recycled in Quebec. As we noted in the previous section, the four most important recycled resins are PET, HDPE, LDPE and PP. They make up 85.4% of all plastics recycled in Quebec.

In comparison with 1996, 7.3% less plastic was recycled in 1998. This decrease affected the three most important types of plastic: PET, LDPE and HDPE. On the other hand, PVC and PP experienced strong growth in the quantities recycled, +31.4% and +29.8% respectively (See Figure 5-6).

Table 38 : Total Plastics Recycled by Type of Resin (1998)

TYPE OF RESIN	1996 (TONNES)	1998 (TONNES)	% OF WASTE PLASTICS	RATE GROWTH
PET	20,080	18,560	28.96%	-7.6%
HDPE	13,950	13,380	20.88%	-4.1%
LDPE	11,960	9,880	15.42%	-17.4%
PVC	3,660	4,810	7.51%	31.4%
PP	9,920	12,880	20.10%	29.8%
PS	2,315	2,320	3.62%	0.2%
ABS	1,450	1,400	2.18%	-3.4%
Others	4,990	90	0.14%	-98.2%
Mixed Plastics	770	760	1.19%	-1.3%
Total⁶⁸	69,095	64,080	100.00%	-7.3%

(Source: RECYC-QUÉBEC)

5.2.4 Origin of Recycled Plastics

The volumes of recycled plastics from the other Canadian provinces or the United States correspond to the volumes recycled in these zones. However, recycled plastics from Quebec make up only 44.7% of recycled plastics. Imported plastics have already been sorted while in the case of domestic plastics this remains to be done. Besides, some recycled plastics are sold outside the province, very often for economic reasons (better sale price).

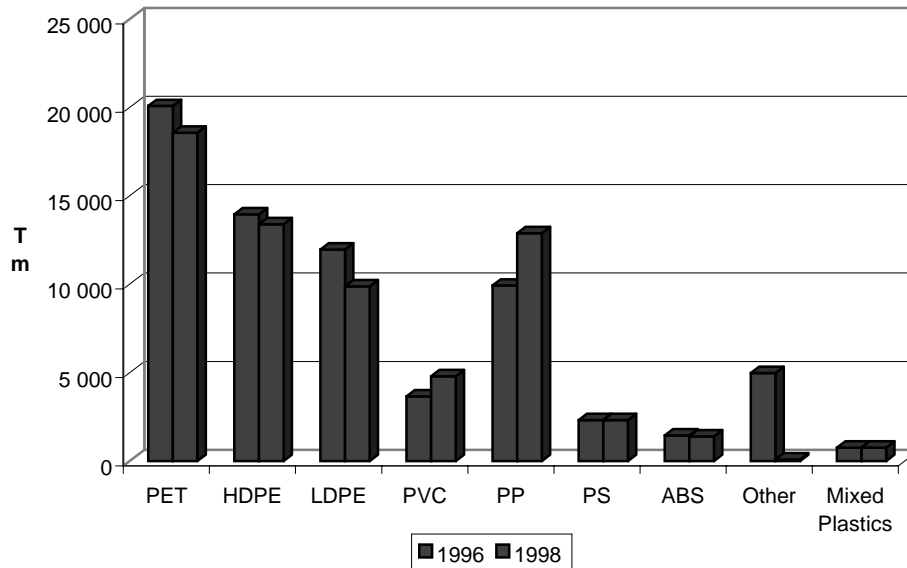
⁶⁸ All the plastics recovered from Quebec are not recycled (problems of quality, exportation, etc.).

Table 39 : Geographical Origin of Recycled Plastics

	Quebec	Other Provinces	United States	Total
Municipal	10,360	8,370	9,170	27,900
ICI	11,880	5,630	18,670	36,180
Total	22,240	14,000	27,840	64,080

(Source: RECYC-QUÉBEC)

Figure 5-1 : Changes in Quantities of Recycled Plastic in Quebec 1996-1998



5.3 COLLECTION SYSTEMS

5.3.1 Blue Box Program

The Blue Box program serves an increasing number of households in Quebec. In 1998 nearly 88.1% of the population, some 6.3 million Quebecers, had access to a Blue Box program offered by 1,037 municipalities. The quantity of materials recycled in 1998 had nearly doubled compared with 1992 to reach 268 000 t.⁶⁹

⁶⁹ *Optimisation des centres de tri* [Optimization of sorting centres]; RECYC-QUÉBEC; November 1999.

The quantity of recycled plastics increased from 4,000 t to 7,800 t between 1992 and 1998, a growth of 95%. However, between 1996 and 1998, the recycled volume fell nearly 18%, which seems to indicate the reaching of a certain saturation threshold. The decrease in prices observed at this time also had important consequences on recycling (See Chapter 6). Of the various types of plastics collected, salvage dealers mainly collect bottles and rigid containers made of PET, LDPE and HDPE. With respect to the recycling of films as well as other types of plastic, it appears that the decision whether or not to collect them is left to each one's discretion.

Table 40 : Waste Plastics Recycled by the Blue Box Program from 1992 to 1998

PLASTIC	1992	1994	1996	1998
Quantity (t)	4,000	5,500	9,500	7,800
Growth	-	37.5%	72.7%	-17.9%

(Source: RECYC-QUÉBEC)

Quebec has 40 sorting centres, each of which processes an average of 6,900 t of waste material from the municipal Blue Box program. The volume of materials processed, including ICI waste, is about 359,000 t. It is interesting to note that two sorting centres (*Matrec* in St-Hubert and *Rebuts Solides Canadien* in Montreal) process 42.3% of all processed materials⁷⁰ (See the list of these sorting centres in Appendix 3).

5.3.2 Commercial Collection

Commercial collection is carried out by private companies, ranging from locally operated small businesses to multinationals. The main companies include *Browning-Ferris-Industries Inc.* (BFI), one of the largest solid waste management companies in the world. It owns about 40 vehicles and operates in the Montreal metropolitan region. *Intersan Inc.* (a subsidiary of Waste Management Inc.), with a fleet of some 400 vehicles and four disposal sites, operates throughout the territory.

⁷⁰ *La collecte sélective au Québec 1998* [Blue box programs in Quebec, 1998]; *Collecte sélective*, November 1999.

Services offered vary from one enterprise to another, but generally include the following: rental of containers and compaction systems, waste removal and transportation, sorting and landfill services. The island of Montreal has some forty companies specializing in this activity. However, more than two thirds of the market is monopolized by three companies, BFI, Intersan and RCI.

5.3.3 Returns

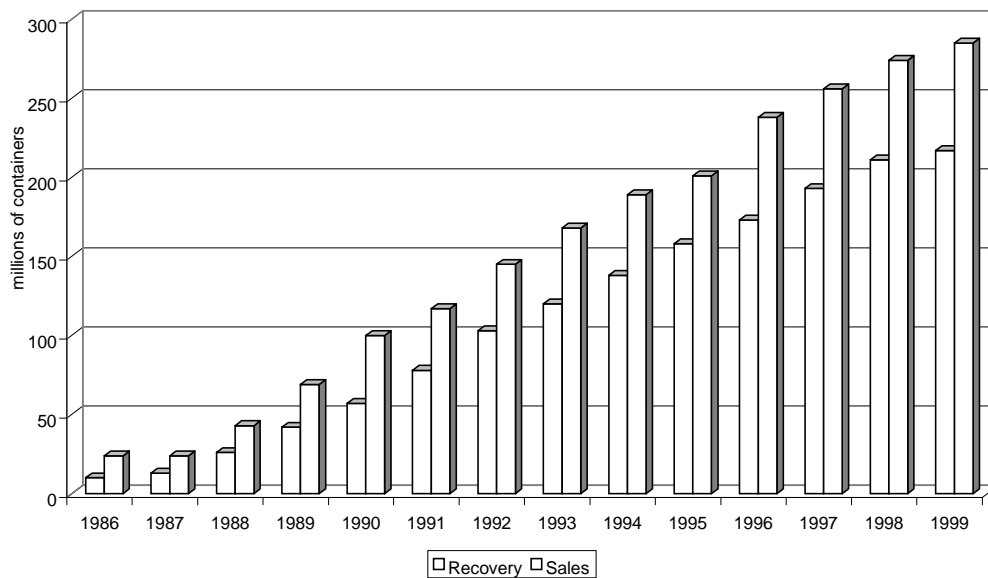
The *Act respecting the sale and distribution of beer and soft drinks in non-returnable containers* maintains a public returns program for used NRC, including soft drink containers. The financial incentive of the returns program generates more efficient recycling than the Blue Box program. Since 1987, the quantity of containers recycled has thus increased from 13 million units to 217 million in 1999. During the same period, the recycling rate increased from 54.2% to 76.2% (See Figure 5-7).

Table 41 : Sales and Recycling of Plastic Soft Drink Bottles (Millions of Containers)

	1987	1989	1991	1993	1995	1997	1999
Sales	24	69	117	168	201	256	285
Recycling	13	42	78	120	158	193	217
% Recycling	54.17%	60.87%	66.67%	71.43%	78.61%	75.39%	76.14%

(Source: RECYC-QUÉBEC)

Figure 5-1 : Sales and Recycling of Soft Drink Bottles in Quebec 1986-1999



5.4 COMPANIES

5.4.1 Picture of Waste Management Companies in Quebec

According to a survey by Statistics Canada,⁷¹ the Quebec waste management industry represented 509 companies with 5,086 jobs in 1996. Operating revenues were of the order of \$607 million (since this period, the results have changed). Analysis of revenue sources by type of activity shows the modest contribution by recycling activities, with only 7,6% of revenues (See Table 5-10).

Thus, *Collection and transportation of materials intended for recycling or reuse* represents 7.6% of revenue and *Processing of materials for recycling* represents 5.3% of revenue. Sales of recycled materials in this sector, estimated at \$20.8 million, represent 3.4% of total income.

⁷¹ *Enquête de l'industrie de la gestion des déchets, 1996* [Study of the waste management industry-1996]; Statistics Canada, October 1999.

Table 42 : Revenue from Operations of Waste Management Companies by Type of Activity

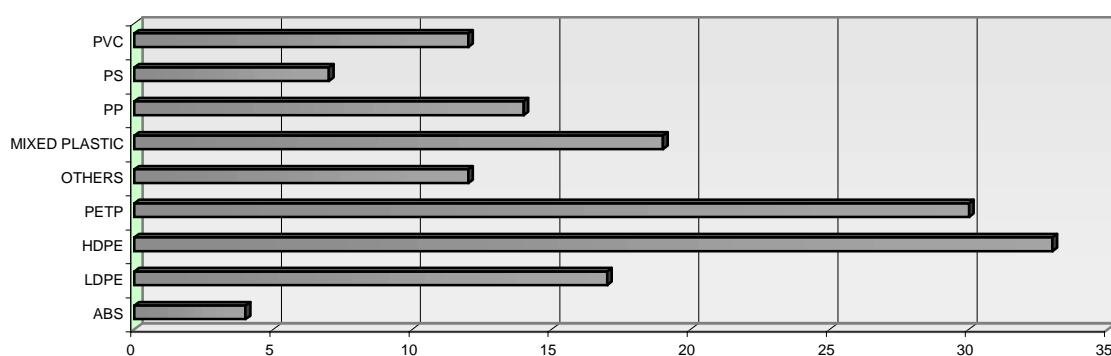
TYPES OF ACTIVITY	REVENUE (\$THOUSAND)	%
Collection and transportation of waste intended for disposal	287,021	47.3%
Collection and transportation of materials intended for recycling or reuse	46,278	7.6%
Operation of a transfer station	27,890	4.6%
Processing of materials for recycling	32,170	5.3%
Operation of a disposal plant	82,847	13.6%
Operation of a hazardous waste disposal plant	75,008	12.4%
Processing of sewage sludge	6,803	1.1%
Sale of recycled materials	20,833	3.4%
Other income	28,216	4.6%
Total income	607,066	100.0%

(Source: Statistics Canada)

5.4.2 Plastic Recycling Companies

The Province of Quebec has about sixty companies specialized in the recycling of waste plastics generated in Quebec. Nearly half of them recycle PET or HDPE, which is substantially identical to the proportions found in American industry (See Section 6.1.3). Only four companies recycle ABS (See figure below).⁷²

Figure 5-1 : Distribution of Companies by Type of Plastic Recycled



(Source: RECYC-QUEBEC)

⁷² Source Recyc-Quebec; the total number of companies for each type of plastic is higher than the real total since the same company may recycle several different types of plastic.

Nearly half the companies specialize in recycling only one type of plastic (See Table 5-11). This specialization is more the consequence of market conditions (availability of materials, more favourable price/volume ratio for some materials than for others) than a deliberate development strategy. Thus, these 32 specialized enterprises processed nearly 27,000 t in 1999, 53.5% of all waste plastics recycled in Quebec. It is interesting to note that of this group, only nine of them recycle 14,204 t (53.5%), exclusively from ICI. Conversely, few companies recycle all plastics.

Table 43 : Distribution of Companies according to the Number of Plastics Processed [sic]

PLASTICS RECYCLED	NUMBER OF COMPANIES INVOLVED	TOTAL VOLUME (TONNES)	DISTRIBUTION (%)
PET	32	26,552	53.5%
HDPE	11	3,124	6.3%
PVC	11	7,564	15.2%
LDPE	3	583	1.2%
PP	2	3,343	6.7%
PS	3	993	2.0%
Others	3	7,497	15.1%
TOTAL	65	49,656	100.0%

(Source: RECYC-QUÉBEC 2000)

5.4.3 Recyclers

Quebec has some twenty companies specialized in recycling plastic, which are listed in Appendix 4. A classification by the magazine *Plastics News* places two Quebec companies among the 100 top North American companies specialized in the brokerage or recycling of plastics.⁷³ These are the Groupe Lavergne and Recyc RPM Inc. of St-Damien.

⁷³ *North America's Plastics Recyclers & Brokers*, *Plastics News*, December 27, 1999.

Table 44 : Main Recyclers

RANK	COMPANY	SALES (\$MILLIONS)	VOLUME (TONNES)	POST-CONSUM.	POST-INDUSTRIAL.	BROKERED
10	Groupe Lavergne	34.1	22 679	45%	50%	5%
56	Recyc RPM	11.0	13 607	40%	10%	50%
103	Plastrec Inc.	6.4	-	-	-	-
117	Berou International	5.2	-	-	-	-

(Source: Plastics News)

Geographically, recycling companies are concentrated mainly in metropolitan Montreal (6), the Montérégie (6) and the Lanaudière (3), that is, three of Quebec's 17 regions. More than 80% of the recycled plastics from all of Quebec's regions (including Laval) are processed there.

5.5 USE OF RECYCLED PLASTIC BY MANUFACTURERS

5.5.1 Post-consumer and Post-industrial Plastics

Among Quebec companies offering products with a recycled content, we find that high and low density polyethylenes are most in demand. It is interesting to note that many manufacturers make direct agreements with producers of waste plastics in order to ensure a regular supply of consistent quality. The following table describes this situation:

Table 45 : Use of Recycled Plastics

Company Name	Recycled Material	Annual Volume (Tonnes)	Source
IPL Inc.	HDPE	1,000 t	90% from RPM (subsidiary)
Sol Plastiques	HDPE, LLDPE, PP,	30,000 t (forecast)	Post-consumer Post-industrial
Plastival Inc.	HDPE PVC	1,360 t 680 t (1,814 t fore.)	Post-consumer Post-industrial
Cascade Replast	Mixed plastics	560 t 550 t	Post-consumer Post-industrial
Norme Internationale Plastique Inc.	HDPE	13 t	Post-consumer
Emballages EB Limitée	LDPE, HDPE,	1,130 t	Post-industrial

(Source: Telephone Contact, January 2000)

5.5.2 Identification of Current Consumption Products Containing Plastic

Several Quebec companies offer products with recycled content. Usually, they combine virgin resins with recycled resins. A partial list of such products available is presented in Appendix 5. The finished products available are characterized by their great diversity; we can mention as examples recycling boxes, rainboots, geomembranes and palettes.

5.6 PROVINCIAL ORGANIZATIONS AND INITIATIVES ENCOURAGING PLASTIC RECYCLING

5.6.1 EPIC

The Environment and Industry Council of CPIA was created at the initiative of the CPIA (Canadian Plastics Industry Association) to facilitate waste plastics management. The EPIC supports its members with sustainable development projects and public relations. The EPIC is behind several waste material plastic management studies and projects in several provinces.

5.6.2 RECYC-QUEBEC

In 1990, the government established the *Société québécoise de récupération et de recyclage* [Quebec recovery and recycling corporation] (RECYC-QUEBEC). The mission of this corporation is to promote, develop and encourage reduction at source, re-use, recovery and recycling of containers, packaging, materials or products as well as their reclamation with the goal of resource conservation. It succeeded the *Fonds québécois de récupération et de recyclage* [Quebec recovery and recycling fund] and took over management of the non-reusable beer and soft drink container returns program.

Various assistance and consultation programs in the area of reclamation are offered by RECYC-QUEBEC. It provides active support to the recycling industry, such as for company start-ups and financing. A secondary materials market has been created, which makes it possible to know the nature and quantities of wastes offered or in demand on the market. In 1993, RECYC-QUEBEC established a program to assist reuse, recycling and

reclamation of used tires. Because of its mission, RECYC-QUEBEC plays a key role in the implementation of the Quebec Action Plan.

5.6.3 Waste Plastics Round Table

The objectives of this round table, which was set up in early 1998, are to find concerted solutions to waste plastics management and to increase knowledge in this domain. The round table worked in particular on a recycling project for Montreal's Old Port, as well as the problem of plastic film waste.

This round table is made up of the following members: Environment and Industry Council of CPIA (EPIC), *Collecte sélective Québec*, RECYC-QUÉBEC, Ministry of the Industry (Québec), Ministry of the Environment, DuPont, Pétromont and Twinpak.

5.6.4 The Quebec Waste Management Action Plan 1998-2008

After the publication of the BAPE report, this action plan, which replaces Quebec's 1989 integrated solid waste management policy, appeared at the end of 1998. Recycling targets, itemized by material, are defined for each sector. The objective for waste plastics is to reclaim 146,000 t annually. The recycling objectives are as follows:

- Municipal: to recycle 60% of rigid packaging discarded by households, the whole and 80% of non-reusable soft drink containers;
- ICI: to achieve 70% recycling of waste plastics generated in the normal course of manufacturing and marketing activities;
- Construction, renovation and demolition: 60% of all materials.

5.6.5 Crop Protection Institute of Canada (CPIC)

The CPIC is a non-profit association representing manufacturers and distributors, whose mission is to encourage the development of technologies for crop production. The CPIC has its head office in Ontario and a representative in each province.

Since 1993, the CPIC has established a program to recycle empty agricultural pesticide containers. Clean empty containers, rinsed three times and without lids and labels, are accepted at nearly 80 recycling sites, which are in fact the pesticide distributors throughout Quebec. The containers are then sent at CPIC expense to Ontario, where they will be used as fuel, mainly in cement plants.

5.6.6 Société de gestion des huiles usées

Draft regulations under the *Plan d'action québécois sur la gestion des matières résiduelles 1998-2008* proposes to make oil manufacturers and importers accountable. The industry will form the *Société de gestion des huiles usées* [Used oil management corporation] to manage and reclaim recycled oil, filters and containers. This corporation should be operational in all regions of Quebec by the fall of 2000.⁷⁴

5.6.7 Regroupement des récupérateurs et des recycleurs de matériaux de construction et démolition au Québec (3R MCDQ)

This professional association formed three years ago brings together some thirty companies involved in the recovery or recycling of products contained in dry materials. The 3R MCDQS [Quebec construction and demolition materials recuperators and recyclers group] acts as spokesman for the industry, in particular when organizing its annual *Rendez-vous*, the third of which will be held in early 2000.

Action by this group further encourages recycling of the principal wastes from this sector: asphalt, concrete, bricks, wood and metal. Plastics do not seem to be a concern at this time in spite of the presence among the members of companies like Matrec.⁷⁵ The main arguments advanced against recycling plastic are opposition to source sorting and the negligible quantities involved.

⁷⁴ *Gestion des matières résiduelles au Québec*; Marc. J. Olivier, éd. Les productions Jacques Bernier, 1999, p.150.

⁷⁵ Personal communication with Robert Ladouceur, president, January 11, 2000.

5.6.8 Boissons Gazeuses Environnement (BGE)

A deposits and recovery agreement was signed with soft drink bottlers in December 1999. The soft drink industry formed the *BGE* to govern the choice of containers by its local members and importers, as well as to manage the collection of deposits and payment of incentives to retailers.

5.6.9 Examples of Sectoral initiatives

5.6.9.1 Motor- Oil Cans

In the early '90s, Canadian Tire⁷⁶ established a motor-oil container recycling program at 87 of its stores in Quebec. The containers collected are picked up by a private business and sent to Ontario. The president of Envex estimates that some 150,000 to 200,000 containers are collected in this way, 80,000 of them by Canadian Tire. They will mostly be used as fuel. The main barrier mentioned to the development of this activity is the lack of a market, since no business in Quebec seems to recycle this type of contaminated container.⁷⁷ The volume of waste plastic (HDPE) is estimated at 2,594 t.

5.6.9.2 Dry-cleaning Bags

Among recycling initiatives, we should mention that for 7 years, the company *Les Plastiques Balcan*, producer of this product in Quebec through the distributor Groux Robertson, has been offering all cleaners the possibility of recycling used bags. Mr. Drolet estimates that the participation rate among cleaners, on a voluntary basis, varies from 5 to 10%.⁷⁸ The lack of interest among cleaners is obvious. The quantity of plastic recycled annually varies from 1,000 to 1,500 pounds. Since customers and cleaners do not do the sorting, the quantities recycled are disposed of because of contamination and low volume.

⁷⁶ Jean-Marc Leroux, in charge of the Canadian Tire recycling program for Quebec, personal communication, January 13, 2000.

⁷⁷ Michel Bourgeois, ENVEX, personal communication, January 17, 2000.

⁷⁸ Personal communication with Sylvain Drolet, regional manager, *Les Plastiques Balcan*, January 4, 2000.

6 STRATEGIC ORIENTATION OF WASTE PLASTIC RECYCLING IN QUEBEC

6.1 NORTH AMERICAN TRENDS IN PLASTIC RECYCLING

6.1.1 Recycling Infrastructure

Before 1989, plastics recycling consisted in the collection of soft drink bottles. Today, plastics recycling has become a full-fledged industry. By late 1997, some 19,200 municipalities, 59% of the total, with nearly 78% of the US population, had access to a recycling program for one or more types of plastics.⁷⁹

Thus, in 1998 in the United States, there were nearly 1,859 companies actively recycling post-consumer plastics, compared with only 310 in 1986. This industry employed nearly 52,000 people. According to the American magazine *Plastics News*, the recycling capacity of this industry is estimated at 7.5 billion pounds while sales of reprocessed plastics were assessed at 5.5 billion pounds. Production capacity is therefore greater than market demand.⁸⁰

6.1.2 Post-consumer Plastics⁸¹

According to the EPA, nearly 21,460,000 t of plastics were generated by the municipal sector in 1997. Only 5.2% of this total were recycled. The recycling rate varies from 18.95% for PET to nearly nil for PVC (less than 0.05%). In terms of volume, HDPE with 420,000 t comes first among recycled resins (See Table 46).

⁷⁹ *Recycling Perspective*; Modern Plastics Encyclopedia, 1999.

⁸⁰ *Recycled Plastics Supply/Demand*; Plastics News, December 1999.

⁸¹ *1998 Recycling Rate Study*; American Plastics Council, 1999.

Table 46 : Recycled Municipal Waste Plastics (1997)

SPI CODE	TYPE OF PLASTIC	GENERATED VOLUME (KT)	RECYCLED VOLUME (KT)	% OF RECYCLED PLASTIC
1	PET	1,900	360	18.95%
2	HDPE	4,630	420	9.07%
3	PVC	1,320	-	-
4	LDPE	5,380	100	1.86%
5	PP	2,790	120	4.30%
6	PS	2,100	10	0.48%
7	Others	3,340	100	2.99%
	Total	21,460	1,110	5.17%

(Source: EPA 1997)

In 1998, nearly 657,700 t of post-consumer plastic from bottles was recycled, which represents a recycling rate of 23.4% of sales. This rate seems to have stabilized around 24% over the past few years, in spite of continuous growth in the use of plastic to produce bottles. Of the other post-consumer plastics (bags, films, etc.), nearly 453,592 t were recycled in 1998.

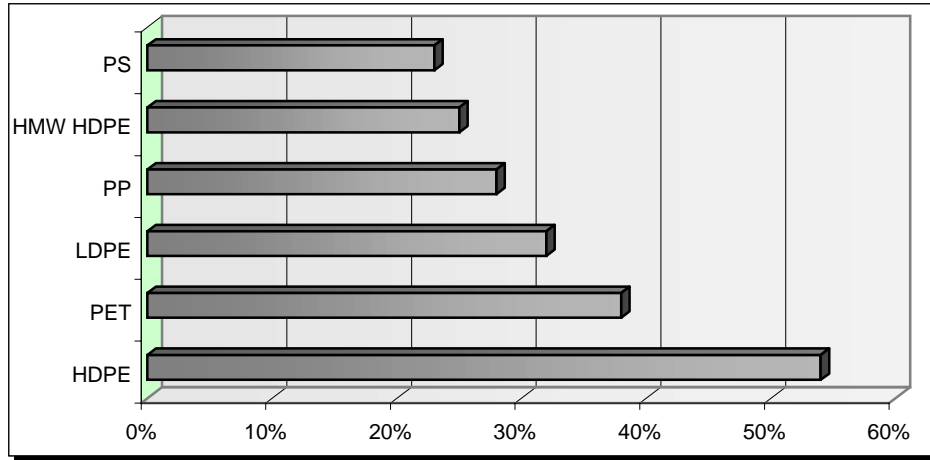
The recycling rate for soft drinks (PET) was 24.4% in 1998, which represents 322,050 t. Compared with 1997, the recycling rate has fallen (25.4%). despite an additional volume of 27,670 t of recycled plastic. Nearly 332,936 t of HDPE bottles were recycled, which represents more than half of all bottles recycled in 1998.

6.1.3 Market

The *American Plastics Council* has identified more than 1400 plastic products with recycled content. The principal outlet for recycled PET from bottles continues to be carpet and textile fibres, while for HDPE it is bottles. HDPE is the most accepted post-consumer resin. A survey of 155 companies by *Plastics News* shows that the most recycled post-consumer plastics are, in decreasing order of size, HDPE, PET and LDPE (See Figure 6-1).⁸²

⁸² *Plastics News*; December 1999.

Figure 6-1 : The Most Recycled Post-consumer Plastics



Source: Plastics News-1999

6.2 END MARKETS FOR POST-CONSUMER RESIDENTIAL AND ICI PLASTIC SCRAP

This section presents a brief overview of plastics markets by resin type for the main grades of residential and ICI plastics, including general market conditions and end uses for the material.

6.2.1 PET Bottles

North American markets for PET are very well established and recyclers do not have any difficulty selling this material. In 1998, 710 million pounds of PET bottles were recycled in the U.S. alone where PET bottle recycling capacity exceeds supply by an estimated 450 million pounds. The North American recycled plastics market for PET is supply limited, not demand limited.

PET displaces virgin polyester in many products and applications. The most common uses for recycled PET includes:

- fiber for the manufacture of carpets
- clothing and textiles applications
- fabrics in automotive products
- used in the production of clear packaging sheet and strapping
- recycled content in bottles, thermoformed trays and packaging

6.2.2 HDPE Bottles and Pails

HDPE is the most widely recycled plastic in North America. North American markets for HDPE are very well established and typically provide higher revenue than PET. In 1998, 734 million pounds of HDPE bottles were recycled in the U.S. where HDPE recycling capacity exceeds supply by an estimated 650 million pounds. Because market demand exceeds supply, many recyclers spend significant time attempting to source additional HDPE. As a result municipalities do not have difficulty selling their HDPE. The North American recycled plastics market for HDPE is supply limited, not demand limited.

Recycled HDPE is found in many different applications and uses including:

recycled content in new bottles (non-food)

- plastics pallets, totes, blue boxes, trash receptacles
- piping and drainage tiles
- plastic lumber and furniture products
- fencing and fence posts
- speed bumps and parking curbs

6.2.3 PP, HDPE and LDPE Injection Molding Grades – Tubs and Lids

Tubs and lids are primarily a mix of PP, HDPE and LDPE injection molding grades that are typically used for food and deli tubs. Polystyrene tubs are also present at up to 20% and act as a contaminant in the polyolefin stream that is usually rejected in the recycling process.

Tubs and Lids are not a good candidate for recycling because these containers only represent a small proportion of the plastics in the plastic waste stream; because they are a mixture of plastic types; because of contamination issues and because of the relatively poor market conditions.

There is a limited market demand and pricing is generally very low. If these materials are recycled, it is generally better to leave the three grades of polymer together as one recyclable stream of “mixed tubs and lids” rather than trying to collect or sort these materials by individual resin type.

Recycled tubs and lids are however being used on a very limited basis for products such as plastic crates and pallets (as recycled content), plastic lumber, furniture and garden care products.

6.2.4 LDPE and HDPE Polyethylene Film

Conventional plastic film markets have extremely stringent quality requirements and are not a robust market candidate for post-consumer film.

To successfully recycle post-consumer plastic film on a broad scale, requires the development of new markets with less stringent quality requirements. Market development work for plastic film has thus been the focus of the plastics industry for several years.

The most promising emerging market for post-consumer plastic film is the relatively recent development of the composites market, such as wood-plastic composite building materials. This is resulting from the expanding North American plastic lumber industry, with companies such as Trex, Canadian Plastic Lumber, Cascades Re-Plast, U.S. Plastic Lumber Company, Boise Cascade and AERT.

Specifications for post-consumer film, that is generally acceptable to the composites market, have been developed. It has been found that approximately 40% of residential film can be collected that can reasonably meet the quality specifications required by these markets. This stream is referred to as “Recyclable Plastic Film”. The remaining film is generally too highly contaminated for recycling and is referred to as “Non-Recyclable Plastic Film”.

The market demand and quality requirements for clean IC&I sourced film plastic follows the same basic pattern as for post-consumer film.

Other applications for LDPE and HDPE post-consumer film include plastic lumber type applications such as decking, picnic benches, furniture products, landscaping and fence posts, speed bumps and parking curbs.

6.2.5 Polystyrene

The Canadian Polystyrene Recycling Association (CPRA) plant, located in Mississauga, is Canada’s first and only dedicated polystyrene recycling facility. Most of the polystyrene they recycle is sourced from Ontario, with a small quantity coming from Nova Scotia. The facility processes approximately 5,000 tonnes per year, 250-275 tonnes of which comes directly from about 30 nearby municipalities while the major proportion is from industrial sources. The largest single source of material flowing through CPRA is from the horticulture industry.

CPRA's recycled resin is used in the manufacture of construction materials, horticultural products, office accessories and industrial reels and spools. Other applications include compact disc cases, plastic lumber applications such as decking, furniture products, landscaping, fence posts and picnic benches

Because of the lack of local markets for post-consumer polystyrene, collection for recycling is not recommend until such time as a reliable local market is established.

6.2.6 Additional Plastics Market Information

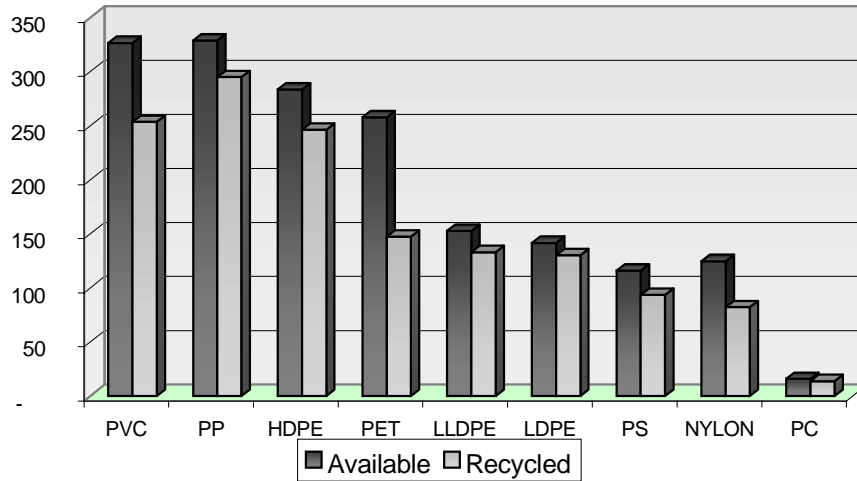
The Environment and Plastics Industry Council (EPIC) has compiled a market information database and a recycled products database. These databases provide the names of plastic recyclers by region of North America and by resin type. These databases can be accessed from the EPIC web-site at www.plastics.ca/epic

In addition, EPIC in conjunction with APC has compiled a database of products containing recycled plastics. There are some 1500 products listed along with contact information on where they can be purchased. This database can be accessed as well from the EPIC web site.

6.3 POST-INDUSTRIAL PLASTICS

The recycling rate for post-industrial plastics is relatively high. Because of the different manufacturing processes and the different stages in creating added value in the production of finished goods, an average of 5.5% of the resin used is lost.⁸³ In general, more than 80% of this is recycled through a post-industrial recycling program. PET and PVC are the resins that generate the highest volume of non-recycled resin, 113,400 t and 81,650 t respectively. Figure 6-2 (following page) shows this state of affairs.

Figure 6-1 : Volume of Post-industrial Resin 1997 (kt)



6.3.1 Legal Trends

Among the various recent legal initiatives supporting the recycling industry, we should mention the reform of the *Bottle Bill Expansion* in the United States.⁸⁴ *Senate Bill 332* would add more than 2 billion new containers to the present program by amending the definition of soft drinks, which would now include non-carbonated water, fruit juices, tea and other drinks. This would represent an additional volume of two million tonnes. Financially, it would result in an increase of nearly 75% in the industry's revenues

6.4 ECONOMIC FACTORS RELATED TO RECYCLING

The net cost of collecting, processing and marketing recyclable material is higher than the cost of disposal (excluding revenues from the sale of these materials).

6.4.1 Landfill Cost

Landfill is often presented in Quebec as an economically interesting alternative. RECYC-QUEBEC estimates that the average cost of landfill, including collection and transportation,

⁸³ *Post-Industrial and Post-Consumer Vinyl Reclaim*; Principia Partners, July 1999.

⁸⁴ Summary of SB 332 (Sher) Bottle Bill Expansion Legislation; February 2000.

is about \$60 per tonne. Such a low cost constitutes a serious economic barrier to the recycling of plastics like most other waste materials, since this cost is no deterrent.

However, the new Quebec Waste Management Action Plan should modify this situation by targeting landfill sites and obliging the companies responsible for the marketing of products to reclaim packaging and printed matter.

6.4.2 Collection Costs

To recover and process 260,000 t of waste materials through residential collections, municipalities and industry paid out \$28 million and \$2 million respectively in 1996 for an average cost of nearly \$115 a tonne.⁸⁵ Collection costs for 72% of homes are between \$10 and \$18 per dwelling unit, with a concentration between \$14 and \$18 per unit for 47% of homes.⁸⁶

6.4.3 Transportation Costs

The cost of transporting waste plastics is a major expense item. According to the location of the market, transportation costs for a shipment may vary from \$600 to \$2,200 per truck. This is high, considering the market value of waste plastics and explains for example why some large distribution companies in Quebec collect and then sell in distant markets, the United States in particular, their waste plastics at better prices, through special agreements with transportation companies. One of the keys to success in plastic recycling is therefore the proximity of a stable market generating an important volume. It must be noted that brokers always base the cost of goods on the net cost after shipping.

Unit transportation costs decrease as the density of plastic bales increases. Thus, most plastic processors require shipped quantities varying between 30,000 and 40,000 pounds in order to minimize transportation costs. This is why bale density and size are important

⁸⁵ *Optimisation des centres de tri*; RECYC-QUÉBEC; November 1999.

⁸⁶ *La collecte sélective au Québec 1998*; Collective Sélective Québec, November 1999.

economic factors. EPIC estimates that 48 bales (average weight of 750 pounds) for export can be loaded on a 48-foot truck.⁸⁷

Bale size is also an important factor: the larger it is, the more space it requires, for both storage and transportation. For example, soft drink bottles (PET) and milk bottles (HDPE), which are packaged separately and not crushed, require the following spaces:⁸⁸

Table 47 : Example of Weight and Density (Uncrushed Bottles)

	BOTTLES (PET)	BOTTLES (HDPE)
Weight of Bale	750 pounds	750 pounds
Density	32-49 pounds per m ³	22 pounds per m ³
Space Required	17-27 m ³	27-33 m ³

(Source: EPIC)

6.4.4 Processing Costs

One of the factors affecting the profitability of the various processing operations (sorting, cleaning, packaging, etc.) is the scale of manual operations. Many efforts have however been made over the past few years, such as automation of operations or the introduction of sorting methods such as so-called *positive sorting*, which is considered best for plastic containers.⁸⁹ These improvements have led to a significant reduction in contamination problems and, therefore, a substantial reduction in costs.

The costs associated with post-consumer plastic processing operations break down as follows:⁹⁰

⁸⁷ *How to Implement a Plastics Recycling Program*; EPIC, 1992, page 59.

⁸⁸ Id.

⁸⁹ *Handling Plastics in a Materiel Recycling Facility: Optimization of Actual Operations*; EPIC, 1997.

⁹⁰ *Postconsumer Mixed Plastics Recycling*; US Department of Commerce, January 1991.

Table 48 : Costs of Processing Operations

Activities	Costs (cts) /kg
Sorting	2-3
Baling	3-4
Milling	3-4
Cleaning	10-15
Flaking	5-7
Total	23-33

6.5 FACTORS AFFECTING PLASTIC RECYCLING

6.5.1 Variation in Price of Resins

The market for recycled plastics, like many other materials, fluctuates with supply and demand. Price variations in this market are especially marked, occurring from one month, one week, or even one day to the next. Among the factors that may explain this situation, we should note the structural changes in the plastics industry in the United States (factory openings and closings), the production of *off-spec* resins and an international demand affected by the Asian crisis, even though signs of recovery have appeared since late 1999.

Fluctuations in resin prices have a very strong influence on the industry. When prices rise, plastics processors cannot always have the rises immediately absorbed by their customers, which has negative effects on profit margins. These unpredictable price variations can affect the budget planning of companies involved in recycling.

For example, during the single year 1998, the price paid by recyclers for post-consumer plastic materials dropped significantly. High density polyethylene lost 52.4% of its value, falling from \$353 to \$168. Polyethylene terephthalate lost 38.3% during the same period (See Table 49).

Table 49 : Monthly Average Price (ton) Paid to Salvage Dealers in 1998

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Mixed Plast.	25	25	25	25	25	25	25	25	25	25	25	25
LDPE	20	23	23	23	23	23	23	18	18			
HDPE	353	345	268	298	255	260	233	233	168	203	168	168
PET	300	298	233	280	305	290	290	285	220	210	203	185

(Source: RECYC-QUÉBEC)

The *Recycling Council of Ontario* has recently carried out a sensitivity analysis to assess the effect of variations in the price of certain materials on municipal recycling costs.⁹¹ Table 50 shows the results of this analysis.

Table 50 : Sensitivity of Recycling Costs to Price Variations

	Price Variation	Effects on Recycling Costs
PET	+ 100\$	- 1.50\$
	- 100\$	+1.50\$
HDPE	+ 100\$	- 1.50\$
	- 100\$	+1.50\$

(Source: Recycling Council of Ontario)

6.5.2 Variation in Price Gap Between Virgin and Recycled Resins

Variations in the price gap between virgin and recycled resins also affect recycling. In the view of the industry, use of recycled plastic generates a potential risk of contamination of the whole production. As a rule, anyone who takes a risk expects in return to gain a greater advantage than if he avoided the risk. One form of compensation for this risk is the economic gain that can be earned when recycled resins are used.

The graph below shows the changes in the average price of recycled compared with virgin resins between 1994 and 1999 for two types of resins, PET and HDPE. For PET, the average gap between virgin and recycled resin was 72.5%. The standard deviation of this average was 7.5%. As an example, in October 1996, the price of recycled resin was nearly

⁹¹ *Recycling Roles and Responsibilities Final Report*; RCO, April 1998, p. 21.

one half lower than virgin resin, while in May 1999, the price difference was minimal (less than 13%).

Analysis of the situation with HDPE is even more striking. Thus, the average-price gap between virgin and recycled resins was 79.8% with a standard deviation of 10.4%. We should note that between February and June 1995, the average price of recycled resins was even higher than virgin resins.

6.5.3 Collection and Processing Problems

Plastic has a large volume in relation to its weight. It therefore occupies a lot of space in deposit containers, recycling vehicles and warehouses. For example, it occupies more than 20% of the space in landfill sites.

The different types of plastic are difficult for the public to identify. For example, the PET market requires that PP caps be removed from soft drink bottles. Removal of these caps at the sorting centre, leads to lower PET sorting rates and therefore higher costs.

6.5.4 Contamination Problems

Since recovered plastics are often a combination of residential or commercial waste materials, they may be contaminated by contact with other chemicals and/or other pathogenic elements. This is why there are restrictions for example, on use of recycled plastic to produce containers or packaging products for food.

In addition to contamination problems, which may have an impact on public health, plastics manufacturers are sensitive to problems associated with mixing different types of resins. Different resins have different molecular structures and, therefore, different physical properties such as melting point, elasticity and strength. If different types of post-consumer resins are mixed during the manufacturing process, production equipment may be damaged and the recycled plastic unusable for new products. A study carried out by the APC

(American Plastic Council) suggests that 31% to 67% of sorting work is due to contamination levels between 3.7% and 6.7%.

Some plastics such as oil or pesticide containers present high contamination levels. This increases the costs of processing them, which adversely affects their financial feasibility. They are often used as fuel.

6.5.5 Perception of Products with Recycled Content

One often invoked barrier to the marketing of recycled plastics is the perception of poorer quality among both industrial users and consumers. Consumers may view products manufactured with recycled content as inferior, because they believe that these products are not as durable or reliable as the same products made of virgin materials. Even though attitudes have changed a great deal over the past few years, this factor should not be underestimated.

A number of industrialists prefer to use virgin resins which behave predictably rather than take the risk of using recycled resins with a potential, as minimal as it may be, of contaminating production. Here again, attitudes have changed over the past few years, in particular because of improvements in the quality of recycled resins offered by re-processors. They have proven that they are capable of meeting quality and quantity criteria.

6.5.6 Uncertainty about Recyclable Plastics

The public in general is not familiar with the resin coding system found on most products for domestic use. There is also a lot of uncertainty as to the different types of plastics that may be recycled through the Blue Box program. Thus, residents may place in their Blue Boxes more types of plastic than are accepted by the program. At this point, it is interesting to mention that communication strategies are not the same from one region to the next. In addition, some types of plastics are recycled by the Blue Box program in certain cities but not in others.

As well, the public still does not understand the importance of avoiding any contact between contaminating products and waste plastics. For example, users may in all ignorance place contaminated containers in recycling boxes (oil bottles, plastic sheets from meat or cheese packaging, etc.).

6.5.7 Legislation

In Canada, recycling resin is not generally used for the production of packaging which could be in contact with food for human alimentation. This limits outlets for post-consumer resins, since the agri-food sector is one of the most important markets for packaging products. This also contributes somewhat to the negative perception of products containing recycled materials.

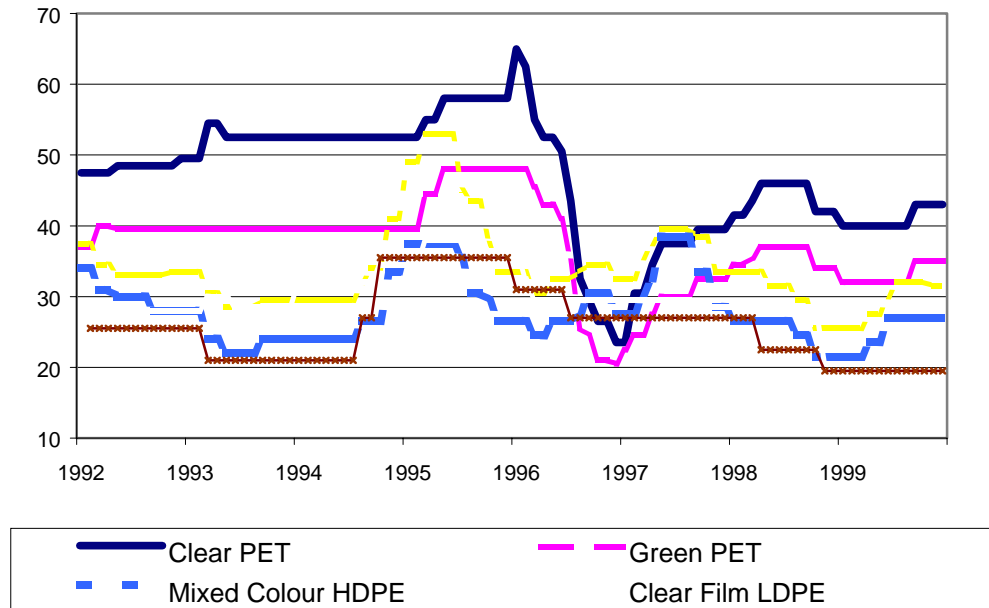
Broadly speaking, present regulations do not require producers to use a minimum of recycled content in their products. By choosing to opt for a *pull strategy*, the decision to use products with recycled content is left to the discretion of each private corporation, which is concerned above all with satisfying its shareholders.

6.6 IDENTIFICATION OF STABLE MARKETS FOR POST-CONSUMER PLASTIC MATERIALS

6.6.1 Identification

The recycling industry, plastic recycling in particular, must be able to depend on a sufficient level of revenue. As demonstrated in Section 6.3.1, the price of waste plastics can fluctuate significantly in a short lapse of time. This market price volatility can discourage plastic recycling, considering the significant risk it presents to the profitability of operations. Figure 6-3, on the following page, shows how the prices of the main recycled resins fluctuated between 1992 and 2000.

Figure 6-1 : Changes in Price of Recycled Resins (1992-1999)



Source : *Resin Pricing – Historical Data* : Plastic News, January 2000.

Despite the significant changes in the economic situation, notably during the period between 1996-1997, we see that the price level was slightly lower at the end of the decade than at the beginning. Thus, PET (clear and green) had the best price stability, with an average 1999 price equal to 90% of the 1990 price.⁹² However, it is the resin that had the greatest standard variation around the average price (\$46.70 for 100 pounds).

Certain resins are in a more worrying situation. For example, between 1992 and early 1997, the average price of PS was above \$880 (per 1 ton), while since mid 1998, it has not been above \$682. Over the decade, it thus lost nearly a quarter of its market value. This situation also prevails to a less extent for PP and clear film LDPE.

⁹² Prices in December 1999 compared with January 1992; Source: Resin pricing - historical data; Plastics News, January 2000.

However, the prices observed over the past few years must be considered in context, especially since 1997 because of the Asian crisis. With the resumption of economic activity in Asia, it seems that demand is rising again, thus pushing up prices.

6.6.2 Brokers and Recyclers

According to the magazine *Plastics News*, of the one hundred largest plastic recycling and brokerage companies in North America, only six are Canadian (four from Ontario and two from Quebec). During their latest financial year, they had total sales of about C\$1,864 million.⁹³ The first seven companies account for 25% of these sales, while half of these sales are made by only 22 companies. The total volume of recycled plastics (all types combined) is estimated at 1900 k t. We should note that the 22 largest companies process 50% of this volume.

A complete list of these companies is shown in Appendix 6.

6.7 ALTERNATIVES TO DISPOSAL

There are alternatives to simple disposal of plastics when they are unsorted or difficult to separate. Existing recycling processes or applications are, among others, gasification, landfill, pyrolysis, continuous mass extrusion of unsorted plastics, etc.

6.7.1 Gasification

This process is common in Europe but has not yet been introduced into North America for the processing of recycled plastics. Texaco is developing the process in the United States for gasification of municipal solid waste and the process is being assessed by the EPA.

The gasification process consists in submitting unsorted plastics to very high temperatures to form a gas (*syngaz*) that must be purified of its toxic substances. The purified gas is then used to produce methanol and other chemicals. The inputs to the gasification chamber are

⁹³ *North America's Plastics Recyclers & Brokers*; *Plastics News*, December 27, 1999.

subject to pre-processing consisting in shredding followed by granulometric sifting. This type of application requires a relatively large technical investment. For example, a gasification unit that can process 72 t of solid municipal waste per day requires an initial investment of about \$10.5 million and annual operating and maintenance costs of \$1 million, but makes it possible to conservatively generate revenues of \$2.9 million.

6.7.2 Use in Sandwich-Type Processes

Certain plastic parts manufactured by injection moulding have hollow sections that can be filled with recycled materials. Using two injection screws (one for virgin material and one for recycled material), virgin material is first injected which adheres to the wall of the mould, and recycled material is then forced to the centre. This type of structure is called a sandwich structure and is already used by certain automotive manufacturers to fill plastic parts. For example, GM™ fills with recycled plastics interior consoles in certain luxury cars. Since 1996, Ford™ has recycled an average of 27 million square feet of nylon carpet per year to manufacture sandwich-type injected air-conditioner modules. This technique makes it possible among other things to decrease “in-house scrap” by 20 to 30%.

6.7.3 Pyrolysis

Pyrolysis is proving to be an interesting alternative to traditional destruction by combustion, because it produces a lot less gas (decreasing downstream processing).

Like gasification, pyrolysis consists in burning a mixture of unsorted plastics at a very high temperature, under oxygen-free conditions. The decomposition products obtained are oils and diesel fuel, which can be processed by petrochemical plants. Since the petrochemical industry is a lot less prominent in Quebec than in the past, the establishment of a pyrolysis plant may be difficult.

Two processes are however being developed in Europe and are still at the preliminary experimentation stage.

6.7.4 Bulk Extrusion

A number of processes have been developed in the United States to produce materials based on unsorted plastics having wood-like characteristics (similar density and mechanical properties). The processes, similar to extrusion, consist in extruding very broad sections of recycled plastics to decrease the effect of heterogeneity in the raw material. However, as polymers have low thermal conductivity, generating a sizeable temperature gradient between the walls and the centre of the extruded piece, a more sophisticated cooling system must be adopted than in the traditional process. To improve extrusion conditions and the properties of the extruded piece, fibreglass is added to improve flex properties and inflation agents to approximate the density of wood. In Quebec, park benches in certain public places and golf courses are manufactured from recycled unsorted plastic materials. This process is however very sensitive to the raw material used and variation in the source of recycled plastics (recycling sites) greatly affects the properties of the final pieces.

7 RECOMMENDATIONS

RECOMMENDATIONS

Despite the economic context of free trade and liberalization, a number of measures can be taken to create market conditions more favourable to the Quebec plastics recycling industry. Such action should target both offer and demand.

With respect to offer, we could:

- Focus on plastics offering the greatest potential, such as PET and HDPE in the residential sector by advocating an «All bottle collection in all Quebec market» ;
- Increase the volume of plastics recovered in Quebec. To attain this objective, the municipal and residential sectors should be targeted, in particular by setting up an information plan to increase awareness and stress the importance of recycling;
- Ensure that all the various Blue Box programs for waste plastics are as efficient as possible;
- Continue the use of deposit system for carbonated soft drink as long as the Blue Box program is efficient in gathering other containers.

In order to encourage demand for plastic products with a recycled content, action should be taken to:

- Prepare and distribute to each public administration (from departmental to municipal level) a guide to products available for purchase, and take (regulatory or other) measures to promote these types of products. These products may be made in Quebec but also, more broadly, be products of foreign origin.

Study the possibilities of alternatives to recycling like gasification, sandwich-type processes, pyrolysis, bulk extrusion.

Appendix 1 References

REFERENCES

STUDIES

Caractérisation des matières résiduelles au Québec, Chamard - Criq - Roche, December 2000.

Waste Plastics in Manitoba : key factors in sustainable Plastics Diversion; Earthbound environmental, January 1999.

Plastics sorting optimization guide; EPIC, June 1995.

A sustainable approach to plastics recovery : a background paper; MacMillan & Associates / Walsh Worden Lee Business Consultants, February 1998.

Post-Consumer Plastics Recycling Strategy : an approach to sustainability; APRA, Alberta, February 1997.

Handling Plastics in a materials recovery facility : optimization of actual operations; EPIC, April 1997.

La transformation des matières plastiques au Québec : analyses et perspectives; Ministère de l'Industrie, du Commerce et de la Technologie; March 1991.

L'industrie québécoise de la plasturgie; Ministère de l'Industrie, du Commerce et de la Technologie; 1996.

Plastics recycling as a future business opportunity; Plastics Institute of America Inc., 1991.

Facts & Figures of the US Plastics Industry; Society of the Plastics Industry Inc.; 1992 edition.

Facts & Figures of the US Plastics Industry; Society of the Plastics Industry Inc.; 1999 edition.

Protocole national de gestion des déchets solides en 5 étapes; Travaux publics et services gouvernementaux Canada; June 1996.

Implantation du programme de recyclage multi-matières dans les édifices de TPSGC; TPSGC-Environnement du Québec; May 1999.

*How to implement a Plastics Recycling Program; Environment and Plastics Institute of Canada, 199**.*

Répertoire des ressources spécialisées de la plasturgie, Réseau d'information stratégique de la plasturgie, 1996 edition.

Caractérisation et mise en valeur des résidus solides de l'hôpital Maisonneuve-Rosemont; RECYC-QUÉBEC, 1997.

Profil de l'industrie québécoise de l'emballage plastique; Ministère de l'Industrie, de la Science et de la technologie, May 1997.

Rapport sur l'avancement de la collecte sélective porte-à-porte; Régie intermunicipale de gestion des déchets sur l'Île de Montréal, December 1998.

Le centre de tri performant : 2éeme colloque québécois sur la récupération et le recyclage, CRIQ, November 1999.

Post-industrial and post-consumer vinyl reclaim : Material flow.

ARTICLES

Recycling perspective; Modern Plastics Encyclopedia, 1999.

Resin overload squeezing producers' prices; Frank Esposito, Plastics News, May 1999.

Consommation de contenants et autres matières d'emballage, par industrie manufacturière, 1996, Statistique Canada n31-212-XPB, 1996 Recycled Plastics Market Database;

http://www.plasticsresource.com/recycling/marketsdb/index_bak.phtml

National Post-Consumer Plastics recycling Rate study; RW Beck & Association Services Group, 1997.

Market Status report : Postconsumer Plastics; Integrated Waste Management board, Californie.

Viability of recycling Plastics by tertiary Processes; Randall Curle, Oak Ridge National Laboratory.

Market Date book : Recyclers; Plastics News, December 1999.

Commercial Recycling; Plastics Resource, June 1999.

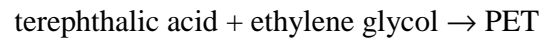
Something to hide : the sorry state of plastics recycling; EDF, R.A. Denison, PhD, October 1997.

1998 Recycling Rate Study; Plastics Resource.

Appendix 2 Characteristics of Plastics

Polyethylene Terephthalate (PET)

Linear thermoplastic polyesters result from a condensation reaction between terephthalic acid and different diols.



The PET may be in an amorphous (transparent) or partially crystalline state. Its low vitreous transition temperature (70°C) inhibits its use in the amorphous state. PET is also very sensitive to humidity before transformation, which complicates its use.

Characteristics: PET oriented to low CO₂ permeability

- Advantages:*
- Rigidity, abrasion resistance
 - Good mechanical and electrical properties.
 - Dimensional stability, water repellent
 - Low friction coefficient
 - Good fissuring behaviour under tension
 - Chemical stability, gas and solvent resistance
 - Good temperature stability.
- Disadvantages:*
- High density
 - Hygro-instability
 - Need to dry before transformation
 - UV sensitivity
- Applications:*
- Draw-yarn for clothing
 - Photographic films, tapes, adhesives, labels.
 - Insulating parts for high temperature and stress.
 - Trays for microwave ovens

Polyethylene (PE)

Polyethylene (PE) is manufactured in solution from ethylene monomers placed in the presence of titanium, aluminum and/or vanadium-based catalysts in a reactor under pressure (generally 800 kPa). The molecular weight can be controlled by this type of manufacturing process but not polydispersity. Polyethylenes are divided into two classes:

- low density polyethylene (LDPE, class 4 according to recycling codes) and;
- high density polyethylene (HDPE class 2 according to recycling codes).

With its low density, LDPE is generally less crystalline than HDPE. They must therefore be separated during recycling due to their properties but in particular due to their different applications.

LDPE has the lowest melting point of all currently used plastics (about 105°C) and this melting point may be as low as 90°C for metallocene polyethylenes.

LDPE's ductile properties make it ideal for packaging applications. In Quebec, production of packaging accounts for 39% of all Quebec plastics production and LDPE is the raw material used in 95% of cases. HDPE has several applications in the production of bottles for cleaning products (i.e.: bleach).

Low Density Polyethylene

Characteristics: Opaque solid when sufficiently thick with a waxy feeling. Flexible and supple.

Advantages:

- Flexibility
- Shock resistant, practically unbreakable,
- Great chemical inertia (hydrofluoric, hydrochloric, sulphuric, nitric acids, NH₃, etc.)
- Water proof
- Food-grade
- Excellent electrical insulating properties
- Easy to work, moulding and easy extrusion.

Polyethylene (PE) (continuation)

- Disadvantages:*
- UV sensitive in the presence of oxygen
 - Low thermal stability, flammable
 - Sensitive to stress corrosion cracking
 - Gas permeability
 - Bonding difficult, H.F. soldering. impossible
 - Destruction by rodents

Applications: Film: packaging, agricultural use, shopping bags, garbage bags, paper or aluminum backing for food products.
Domestic products: buckets, trays, watering-cans, salad strainer.
Others: toys, flexible hoses, electrical cable insulation, sailboard.

High Density Polyethylene

Characteristics: Less translucent and more rigid than LDPE.

Advantages: Same properties as LDPE but with greater rigidity and better temperature stability (sterilizable). Less sensitivity to stress corrosion cracking.

Disadvantages: Same disadvantages as LDPE.

Applications: Hollow body for bottling: bottles (detergents).
Large containers: septic tanks, barrels.
Rigid domestic articles: garbage cans, clothespins, stoppers.
Furnishings: garden furniture, stools, tables.
Handling material: fish boxes, vegetable boxes, bottle racks.
Industrial parts: turbines, pumps, valves.
Sports articles: ski bases, boats, sleds.
Packaging films: bags, record liners.

POLYPROPYLENE (PP)

Polypropylenes are polymerized by addition from propylene in presence of a catalyst. According to the conditions of polymerization, the CH₃ group characteristic of PP is found at different positions on the molecular chain. The result is a product with different properties. The isotactic structure (CH₃ group on the same side) gives rise to a rigid and resistant semi-crystalline polymer.

Characteristics: Appearance similar to HDPE, but more rigid

Advantages:

- Better mechanical strength than PE. Greater rigidity.
- Excellent flexion fatigue properties.
- Good stability at high temperature and conservation of its properties up to softening temperature.
- Good chemical resistance and absence of stress corrosion cracking.
- Good electrical properties.
- Good aspect, brilliance, scratch resistant.
- Food-grade.
- Low density.
- Good chemical inertia.

Disadvantages:

- UV sensitive in presence of oxygen.
- Fragile at low temperature,
- Bonding difficult or even impossible.

Applications:

- HDPE parts moulded with PP are possible.
- Films: packaging for food, rusks, chips, candies.
- Film: book covers and record sleeves.
- Wires, ropes and cords.
- Appliances: washing machines, hair dryers, vacuum cleaners.
- Automotive: heaters, air filters, air nozzles.
- Box with built-in hinges: glass cases, suitcases, cassette cases.
- Electrical wire insulation.

Polystyrene (PS)

Polystyrene is obtained by polymerization by addition of styrene manufactured by alkylation of benzene by ethylene followed by dehydrogenation of ethylbenzene. Two techniques are used in industry: bulk and suspension polymerization.

Characteristics: Transparent and light resin.

Advantages:

- Rigid.
- Good dimensional stability.
- Transparent.
- Food-grade.
- Ease of moulding and shaping .
- Ease of bonding, decoration and pressing.
- Excellent electric insulation.
- Good stability to gas and oils.

Disadvantages:

- Fragile, brittle, not shock-proof.
- Poor heat stability.
- Fuel and flaming droplet formation.
- Electrostatic.
- Sensitivity to solvents.

Applications:

- Thermoform packaging: cream containers, cups.
- Furnishings: bathroom cupboards, light fixtures.
- Domestic articles, toys, radios, televisions,
- Office articles.

Polyvinyl chloride (PVC)

Polyvinyl chloride may be obtained by three different polymerization techniques: emulsion polymerization, suspension polymerization and mass polymerization. However, whatever polymerization method is used, additives must be added to the PVC before it can be shaped. Stabilizers, lubricants, softeners, shockproofing and various adjuvants are added to the PVC. According to the quantity of softener added to the PVC, a more or less rigid material is obtained. Mechanical and physical properties are also influenced by the quantity of softeners used.

Characteristics: Rigid PVC

Advantages:

- Rigidity, dimensional stability.
- Abrasion resistance.
- Auto-extinguishable.
- Food-grade.
- Good chemical stability.
- Possible transparency.
- Ease of extrusion, forming, machining.
- Practically no water absorption.

Disadvantages:

- Relatively high density.
- Fragile at low temperature.
- Browning under UV
- Cl vapours given off during combustion.

Applications:

- Hoses: water supply, sewer,
- Drains, gutters.
- Bottles: food: water, oil, wine, vinegar.
- Extruded shapes: baseboards, windows.
- Credit cards, disks.

Polyvinyl chloride (PVC) (continuation)

Characteristics: Flexible PVC

Advantages:

- Flexible, usable at low temperature.

Disadvantages:

- Poorer chemical stability than rigid PVC.
- Non-food.
- Bonding difficult.

Applications:

- Floor-covering.
- Electrical cable and wire insulation.
- Footwear.
- Folder and notebook covers.
- Car-seats, furniture, luggage, tablecloths, curtains.
- Waterproof clothing, shower curtains.

Appendix 3 Sorting Centres in Quebec

SORTING CENTRES IN QUEBEC

Name	Contact	Address	Phone & fax
Région administrative : (01) Bas-Saint-Laurent			
CFER de la Mitis	M. Michel Roy, professeur	1086, rue Industriel Mont-Joli, Qc, G5H 3K8	(418) 775-4556 (418) 775-4566
CFER des Basques	M. Yvan Rioux, président	455, rue Jenkins Trois-Pistoles, Qc, G0L 4K0	(418) 851-1366 (418) 851-1674
Récupération de la Péninsule inc.	M. Phil Gauthier, président	262, rue Léonidas Rimouski, Qc, G5L 2T2	(418) 722-6766 (418) 721-0255
Récupération Grand-Portage	M. André Poitras, directeur général	100, rue Delage Rivière-du-Loup, Qc, G5R 3P9	(418)868-1729 (418) 868-1544
Récupération Matane	M. Dominic Bouffard, vice-président	75, rue Savard, C.P. 114 Matane, Qc, G4W 3M9	(418) 562-3706 (418) 562-6564
Services sanitaires Roy	M. Serge Roy, président	230, rue Varin, C.P. 430 St-Pascal-de-Kamouraska, Qc, G0L 3Y0	(418) 492-2033 (418) 492-7592
Région administrative : (02) Saguenay-Lac-Saint-Jean			
Centre de transbo. – MIRC Maria-Chapdelaine	M. Pierre Paradis, superviseur	575, 2 ^e Avenue Dolbeau-Mistassini, Qc, G8L 1V3	(418) 239-0001 (418) 239-0006
Centre de tri – MRC Lac-Saint-Jean-Est	M. Gaston Tremblay, directeur général	800, avenue Tanguay, C.P. 144 Alma, Qc, G8B 5V6	(418) 668-5847 (418) 668-0409
Centre de tri – MRC Le Fjord-du-Saguenay	M. Denis Bouchard, superviseur	1185, rue Antonio-Lemaire Chicoutimi, Qc, G7H 5C8	(418) 698-0074 (418) 698-1146
CFER du Domaine-du-Roy	Mme Annabelle Guay, responsable de l'usine	1855, rue Castonguay Roberval, Qc, G8H 2M9	(418) 275-8791 (418) 275-6788
Région administrative : (03) Québec			
Centre régional de récupération C.S. inc.	M. Michel Tremblay, directeur – Centre de tri	1780, rue Provinciale Québec, Qc, G1N 4A2	(418) 628-7391 #116 (418) 628-2025
Sani Gestion - ONYX	Mme Micheline Germain, représent. commerciale	2222, Lavoisier Sainte-Foy, Qc, G1N 4H2	(418) 681-1011 (418) 681-1166
Région administrative : (04) Mauricie			
Centre de tri – La Tuque	Mme Sophie Marcouiller, directrice de projet	999, boul. Ducharme La Tuque, Qc, G9X 3C3	(819) 523-8333 (819) 523-6009
Groupe RCM inc.	M. Michel Camirand, directeur général	247, rue Sainte-Anne Yamachiche, Qc, G0X 3L0	(819) 296-3705 (819) 296-2576
Région administrative : (05) Estrie			
Centre de tri régional de Sherbrooke	M. Claude Dandonneau, superviseur	2180, Claude-Greffard Sherbrooke, Qc, J1H 5H1	(819) 563-0011 (819) 563-4034

SORTING CENTRES IN QUEBEC

Name	Contact	Address	Phone & fax
Région administrative : (06) Montréal			
Rebuts solides canadiens inc.	M. Jean Gaudet, comptable	2525, Jarry Est Montréal, Qc, H1Z 2C2	(514) 593-9211 #23 (514) 593-4805
Région administrative : (07) Outaouais			
CFER de l'Outaouais	M. Jean Poulin, coordonnateur	220, Edmoniton Hull, Qc, J8Y 3S6	(819) 770-0103 (819) 770-5315
Rebuts solides canadiens inc. - CUO	M. Bruno Blackburn, responsable	860, boul. de la Carrière Hull, Qc, J8Y 6V6	(819) 772-1393 (819) 772-1436
Région administrative (08) Abitibi-Témiscamingue			
CFER Les Transformeurs	M. André Dupuis, agent de développement	220, avenue Marcel-Baril Rouyn-Noranda, Qc, J9X 7C1	(819) 797-6825 (819) 797-6998
Région administrative : (09) Côte-Nord			
Éco-Centre CPESI	M. Robin Desgagné, coordonnateur	170, Napoléon, C.P. 340 Sept-Îles, Qc, G4R 4K6	(418) 968-8691 (418) 964-3213
Michel Miller inc.	Mme Sonia Miller, directrice	33, avenue Babin Baie-Comeau, Qc, G4Z 3A5	(418) 296-0064 (418) 296-3385
Région administrative : (11) Gaspésie – Îles-de-la-Madeleine			
Centre de transbordement – Pointe-à-la-Croix	M. Claude Audet, directeur général / Ville	5, rue Carrière Pointe-à-la-Croix, Qc, G0C 1L0	(418) 788-2011 (418) 788-2916
Centre de tri – MRC Les Îles-de-la-Madeleine	M. Jean-Guy Arseneault, chef d'usine	735, chemin Principal, C.P. 339 Cap-aux-Meules, Qc, G0B 1B0	(418) 969-4614 (418) 969-4616
Centre de tri de la RITMRG	M. Luc Guilbeault, directeur général	498, Grande-Allée Ouest Grande-Rivière, Qc, G0C 1V0	(418) 385-4200 (418) 385-4209
Région administrative : (12) Chaudières-Appalaches			
Récupération Frontenac inc.	Mme Luce Vallières, directrice générale	217, rue Monfette Sud Theford Mines, Qc, G6G 5S5	(418) 338-8551 (418) 338-8604
Société V.I.A. inc.	M. André Poitras, directeur général	1200, rue des Riveurs Lévis, Qc, G6V 7M5	(418) 833-0421 (418) 833-9974
Région administrative : (13) Laval			
CTV Nord-Sud inc.	M. Pierre Leboeuf, directeur des opérations	275, boul. Saint-Elzéar ouest Laval, Qc, H7L 3N5	(450) 629-3231 (450) 629-5378
Région administrative : (14) Lanaudière			
Récupération Nord-Ben inc.	M. Benoit Héroux, directeur général	1481, rue Raoul Charest Saint-Paul, Qc, J6E 8S5	(450) 759-9007 (450) 759-5369
Recyclage N.V.	M. Victor Durand, directeur général	104, 2 ^e Chaloupe Notre-Dame-des-Prairies, Qc, J6E 7Y8	(450) 755-6985 (450) 755-8402
Usine de traitement des déchets de la RITDM	M. Sylvain Lafortune, prés. – Compo-Recycle	225, du Progrès Chertsey, Qc, J0K 3K0	(450) 882-9186 (450) 882-3696

SORTING CENTRES IN QUEBEC

Name	Contact	Address	Phone & fax
Région administrative : (15) Laurentides			
Corporative régionale du centre de tri CFER	M. Frédéric Potvin, directeur général	601, chemin Félix-Touchette Lachute, Qc, J8H 2C5	(450) 562-4488 (450) 562-7788
Intersan	M. Martin Dussault, coordonnateur aux comm.	2535 A, 1ere Rue Sainte-Sophie, Qc, J0R 1S0	(819) 868-9522 (819) 868-1912
RIRHL	M. André Leduc, secrétaire-très.	402, Route 117 Sud Marchand, Qc, J0T 1T0	(819) 275-3516 (819) 275-3925
Région administrative : (16) Montérégie			
Compo-Haut-Richelieu	Mme Louise Fecteau, directrice générale	825, Beaudin Iberville, Qc, J2X 5L2	(450) 347-0299 (450) 346-8464
Matrec - Transvick	M. Mario Nadon, directeur des opérations	5300, rue Albert-Mellichamp Saint-Hubert, Qc, J3Y 3X7	(450) 641-3070 (450) 641-4458
Récupération Montérégie	M. Rémi Thériault, directeur général	3225, chemin de l'Industrie Saint-Mathieu-de-Beloil, Qc, J3G 4S5	(450) 536-3666 (450) 536-3667
Recyclage de papier M.D. - FIBRES	M. Denis Émond, président	235, boul. Industriel Châteauguay, Qc, J6J 4Z2	(450) 699-3425 (450) 699-6851
RSC inc. - Châteauguay - CONTENANTS	Mme Laurianne Beaudin, directrice de l'usine	125, rue Baillargeon Châteauguay, Qc, J6J 4Z2	(450) 699-9311 (450) 699-8123
Sani-Éco - Centre de tri de la Haute-Yamaska	M. Sylvain Gagné, vice-président	530, rue Édouard Granby, Qc, J2G 3Z6	(450) 777-4977 (450) 777-8652
Région administrative : (17) Centre du Québec			
Centre de tri Gaudreau	M. Réal Fortin, directeur des opérations	350, boul. De la Bulstrode, C.P. 662 Victoriaville, Qc, J6P 6V7	(819) 758-8131 (819) 758-8606
Récupération Centre du Québec inc.	M. Daniel Lemay, directeur général	5620, Saint-Rock Drummondville, Qc, J2B 6V4	(819) 477-1312 (819) 477-1394

SORTING CENTRES IN QUEBEC

Appendix 4 Recyclers in Quebec

RECYCLERS IN QUEBEC

COMPANY	CONTACT	ADDRESS	PHONE & FAX	PLASTICS
RÉGION ADMINISTRATIVE : (04) MAURICIE-BOIS-FRANCS				
PLASTIQUES VENNECO 2000	Mme Annie Lemay, contrôleur	4161, chemin Reid, CP.21115 Shawinigan, Qc, G9N 7J5	(819) 539-6951 (819) 539-6616	PEBD
RÉGION ADMINISTRATIVE : (05) ESTRIE				
TAPIS ECO-MAT	M. Claude Fournier	709, chemin Sainte-Anne Nord Ste-Anne-de-la-Rochelle, Qc., J0E 2B0	(450) 532-6060 (450) 532-4948	Plastiques. Rechapage de tapis à endos de vinyle (tapis d'entrée, tapis d'hiver, tapis absorbant à surface de fibre de polypropylène).
RÉGION ADMINISTRATIVE : (06) MONTRÉAL				
GENFOT	M. Christian Lecavalier Directeur approvisionnement	554, Montée-de-Liesse Montréal, Qc, H4T 1P1	(514) 341—3950 (514) 341-1861	PVC flexible. Manufacturier de bottes.
LES PLASTIQUES PETCO INC.	M. Jean-Luc Lavergne, président	8800, Crescent 1, Anjou, Qc, H1J 1C8	(514) 354-5757 (514) 354-3087	PÉT. Manufacturier de granules et feuille pour thermoformage.
BÉROU INTERNATIONAL	M. Victor Fortin, président	9701, Colbert, Anjou, Qc, H1J 1Z9	(514) 353-8954 (514) 353-1775	Plastiques (PÉT, PEHD, PEBD...)
MASPLAS INTERNATIONAL INC.	M. Jean-Luc Lavergne, président	8800, Crescent 1, Anjou, Qc, H1J 1C8	(514) 354-5757 (514) 354-3087	Plastiques (PÉT, PÉhd, PVC, PÉbd, PP, PS, ABS, etc.). Manufacturier de granules.
PLASTIQUES ANJOU INC.	M. Georges Apelian Directeur commercial	9060, boul. Parkway Anjou, Qc, H1J 1N5	(514) 352-6060 (514) 352-9177	PEHD, PEBD. Manufacturier de granules
SOLPLASTIQUES	M. Max Maurice Directeur général	1501, rue des Futailles Montréal, Qc, H1N 3P1	(514) 254-8525 (514) 254-6325	PEHD, PEBD, PP, PS
RÉGION ADMINISTRATIVE : (12) CHAUDIÈRE-APPALACHES				
PLASTIQUES NELSON LTÉE	M. Nelson Gagnon Président	150, rue Principale Tring-Jonction, Qc, G0N 1X0	(418) 426-2696 (418) 789-2552	PEHD, PVC, acrylique, polycarbonate, ABS, etc. Manufacturier de granules.
RECYC R.P.M. INC.	M. Luc Métivier, président	59, rue Commerciale Saint-Damien-de-Buckland, Qc, G0R 2Y0	(418) 789-2450 (418) 789-2552	PÉhd, PVC, PP, PS, etc.. Manufacturier de granules
RÉGION ADMINISTRATIVE : (13) LAVAL				
IPES INC.	M. Bernard Pelsser Directeur opérations	101, rue Saulnier Laval, Qc, H7M 1S9	(450) 662-0734 (450) 662-2049	PEHD. Manufacturier de granules
RÉGION ADMINISTRATIVE : (14) LANAUDIÈRE				
IPEX INC.	M. Gilles Bastien Directeur des opérations	901, route 344 L'Assomption, Qc, J0K 1G0	(450) 589-5544 (450) 589-5958	PVC. Manufacturier de granules et utilisateur.
PLASTREC INC.	M. Jean Roy, président	1301, rue Frontenac Berthierville, Qc, J0K 1A0	(450) 836-8131 (450) 436-1986	PÉT. Contenants consignés.
REPROPLASTIK INC.	M. Joseph Riccio, président	3480, chemin Gascon Terrebonne, Qc, J6W 5C7	(450) 477-6922 (450) 477-4317	PEBD. Manufacturier de granules.
RÉGION ADMINISTRATIVE : (15) LAURENTIDES				

RECYCLERS IN QUEBEC

COMPANY	CONTACT	ADDRESS	PHONE & FAX	PLASTICS
SAINTE-BRUNO PLASTIQUES INC.	M. Michel Sévigny	5, rue St-Alphonse Sainte-Thérèse, Qc, J7E 1G3	(450) 971-0228 (450) 971-0622	Plastiques flexibles et rigides
RÉGION ADMINISTRATIVE : (16) MONTRÉGIE				
JALISSON INC.	Mme. Jalisson Lise présidente	1475, rue Marie Victorin St-Bruno-de-Montarville Qc, J3V 6B7	(450) 653-1535 (450) 653-1956	PP, PS, PEHD, PEBD. Transformation de matières plastiques.
LES PLASTIQUES SUPÉRIEURS INC.	M. Gérard Rivet acheteur	1840, rue Montarville Saint-Bruno, Qc, J3V 3V4	(450) 653-7778 (450) 653-0098	PET, PEHD, PVC, PEBD, PP
LES PRODUITS POLYCHEM LTÉE	M. Serge Bourret, directeur des ventes	725, rue Gaudette Saint-Jean-sur-Richelieu, Qc, J3B 7S7	(450) 348-7392 (450) 349-2225	Plastiques (PÉT, PÉhd, PÉbd, PP, PS, ABS). Manufacturier de granules.
NOVA PB INC	M. Robert Lavigne, président	1200, rue Gamier, CP 210 Ste-Catherine, JOL 1E0	(450) 632-9910 (450) 632-9090	PP
PLASTIQUES DC INC.	M. Robert Latraverse, Vice-président	750, rue Vadnais Granby, Qc, J2J 1A7	(450) 777-7555 (450) 777-3008	PET, PVC, PP, PS, PC, ABS. Manufacturier de granules, services de granulation.
POLYFAB	M. Joel Bussières, président	CP 80030 Chateauguay, Qc, J6J 5X2	(450) 692-3610 (450) 692-4081	PEHD, PEBD, PET, PP, PS, PVC
RÉGION ADMINISTRATIVE : (17) CENTRE DU QUÉBEC				
CASCADES RE-PLAST	M. J.-G. de Charrette, directeur	1350, chemin des 4-saisons, CP 514, Notre-dame-du-Bon- Conseil, J0C 1A0	(819) 336-2440 (819) 336-2442	Plastiques. Manufacturier de matériaux de construction de plastique.

Appendix 5 Products with recycled
content

PRODUCTS WITH RECYCLED CONTENT

Product	Company	Address	Phone & fax	Internet site	Recycled content (%)	Origins	Details
Bacs de récupération	IPL inc.	140, rue Commerciale Saint-Damien (Québec) G0R 2Y0	(418) 789-2880 (418) 789-3153	http://www.ipl-plastics.com	PÉhd (50%)	Postconsommation et postindustrielle	Formats: 44 lites et 64 litres
Bacs de recyclage	SolPlastiques	1501, rue des Futailles Montréal (Québec) H1N 3P1	(514) 254-8525 (514) 254-6325	http://www.solplastiques.com	PÉhd (100%)	Postconsommation et postindustrielle	Bacs de recyclage d'une capacité de 58 litres
Bacs roulants	IPL inc.	140, rue Commerciale Saint-Damien (Québec) G0R 2Y0	(418) 789-2880 (418) 789-3153	http://www.ipl-plastics.com	PÉhd (50%)	Postconsommation et postindustrielle	Formats: 240 litres et 360 litres
Bacs tout usage	SolPlastiques	1501, rue des Futailles Montréal (Québec) H1N 3P1	(514) 254-8525 (514) 254-6325	http://www.solplastiques.com	PÉhd (100%)	Postconsommation et postindustrielle	Dimensions des bacs: 16"x24"x12", 16"x24"x9", 16"x24"x6"
Bois Synthétique Resource	Plastival inc.	3050, boul. Industriel Laval (Québec) H7L 4P7	(450) 629-5050 (450) 629-5052	http://www.plastival.com	PÉhd (100%)	Postconsommation	Réno-Dépôt, Canac-Marquis, MacMillan Bloedel, Centre Re-Source
Bottes de pluie Kamik	Genfoot inc.	554, montée de Liesse Saint-Laurent (Québec) H4T 1P1	(514) 341-3950 (514) 341-1861	http://www.kamik.com	PVC (10% à 100%)		Sears, Yellow, Zellers, Canadien Tire
Contenants de récupération d'huiles usées	Wedco, Produits Moulés	1289, rue Newton Boucherville (Québec) J4B 5H2	(450) 655-7220 poste 255 (450) 655-2592		PÉhd (100%)	Postindustrielle	Canadian Tire (W-76: bacs ouverts 15 litres; W-77: bacs fermés 12 litres; W-78: bacs fermés 6 litres)
Contenants pour le tri des matières résiduelles «Tri-Source»	Norme Internationale Plastique inc.	641, rue de la Métairie Île-des-Sœurs (Québec) H3E 1S9	(514) 852-2123 (514) 852-7731	http://www.fortunee1000.ca/ni	PÉhd #2 (100%)	Postconsommation	Formats: 2 litres, 3,28 litres, 4 litres
Corbeilles DUO	Compagnie de Gestion Alger inc.	1150, boul. Lafèche Baie-Comeau (Québec) G5C 3B2	(418) 295-3382 (418) 589-6016	http://www.quebecctel.com/cga	ABS, PP (100%)	Postconsommation et postindustrielle	
Géomembranes de polyéthylène «Type Ecoliner®»	Solmax International inc.	2801, boul. Marie-Victorin Varennes (Québec) J3X 1P7	(450) 929-1234 (450) 929-1227	http://www.solmax.com	Polyéthylène (PÉhd, PÉbd) (15% à 30%)	Postconsommation et postindustrielle	

PRODUCTS WITH RECYCLED CONTENT

Product	Company	Address	Phone & fax	Internet site	Recycled content (%)	Origins	Details
Mallettes, porte-documents	Eco Folio enr.	172, rue Prairie L'Acadie (Québec) J2Y 1E9	(450) 349-2463 (450) 349-8064	http://www.members.xoom.com/eco_folio_enr	Plastiques (100%)	Postconsommation et postindustrielle	
Mobilier urbain	Centre Re-Source Rive-Nord	1041, rue Le Viger Lachenaie (Québec) F6W 6B6	(450) 492-1680 (450) 492-1596		PÉhd (contenants de lave-glace, contenants de lait) (100%)	Postconsommation	Plusieurs autres applications possibles. Distributeurs de profilés de plastique en 17 formats. Ex. ¾"x6", 2"x10", etc. 8 couleurs disponibles
Mobilier urbain	Cascades Re-Plast	1350, chemin Quatre-Saisons Notre-Dame-du-Bon-Conseil (Québec) J0C 1A0	(819) 336-2440 (819) 336-2442		PÉhd, PP, PS, Pébd, PET, PVC (100%)	Postconsommation	Distribution Richard Tessier, Nicolet; Équiparc inc., Iberville; Équipement Récréatif Jambette, Lévis
Palettes de manutention	SolPlastiques	1501, rue des Futailles Montréal (Québec) H1N 3P1	(514) 254-8525 (514) 254-6325	http://www.solplastiques.com	PÉhd (100%)	Postconsommation et postindustrielle	Dimension de palettes: 48"x40", 48"x45", 24"x40"
Paniers à rebuts	Équiparc inc.	190, Route 133 Sainte-Anne-de-Sabrevois (Québec) J0J 2G0	(450) 346-1882 (450) 346-2598	http://www.equiparc.com	Plastique et acier (75%)	Postconsommation et postindustrielle	
Patios, terrasses	Centre Re-Source Rive-Nord	1041, rue Le Viger Lachenaie (Québec) F6W 6B6	(450) 492-1680 (450) 492-1596		PÉhd (contenants de lave-glace, contenants de lait) (100%)	Postconsommation	Plusieurs autres applications possibles. Distributeurs de profilés de plastique en 17 formats. Ex. ¾"x6", 2"x10", etc. 8 couleurs disponibles
Planches pour patios et balcons	Cascades Re-Plast	1350, chemin Quatre-Saisons Notre-Dame-du-Bon-Conseil (Québec) J0C 1A0	(819) 336-2440 (819) 336-2442		Pébd, PÉhd, PP (100%)	Postindustrielle	Rno-Dépôt, BMR, Rona Quincailleur
Poubelles Corbi	IPL inc.	140, rue Commerciale Saint-Damien (Québec) G0R 2Y0	(418) 789-2880 (418) 789-3153	http://www.ipl-plastics.com	PÉhd (50%)	Postconsommation et postindustrielle	
Protège-lames de patins	Plastipro Canada Itée	6855, boul. Couture Saint-Léonard (Québec) H1P 3M6	(514) 321-9840 (514) 321-2287	http://www.plastipro.com	PVC, PÉhd, Pébd, PP (20% à 50%)	Postconsommation et postindustrielle	Vente directe (quantité minimum)

PRODUCTS WITH RECYCLED CONTENT

Product	Company	Address	Phone & fax	Internet site	Recycled content (%)	Origins	Details
Rampes	Centre Re-Source Rive-Nord	1041, rue Le Viger Lachenaie (Québec) F6W 6B6	(450) 492-1680 (450) 492-1596		PÉhd (contenants de lave-glace, contenants de lait) (100%)	Postconsommation	Plusieurs autres applications possibles. Distributeurs de profilés de plastique en 17 formats. Ex. ¾" x6", 2" x10", etc. 8 couleurs disponibles
Reliures à anneaux	Atelier Poly-Teck inc.	151, rue Léger Sherbrooke (Québec) J1L 2G8	(819) 563-6636 (819) 564-6590	http://www.poly-teck.qc.ca	Plastique et acier (75%)	Postconsommation et postindustrielle	Équiparc inc.
Sacs à ordures	Les Industries Polykar inc.	7275, boul. Thimens Saint-Laurent (Québec) H4S 2A2	(514) 335-0059 (514) 335-0117		PÉbd, PÉhdl (80%)	Postconsommation et postindustrielle	Tous les distributeurs de produits sanitaires et tous les distributeurs en alimentation
Sacs à polyéthylène	Emballages E.B. Itée	100, avenue Lafontaine C.P. 190 East Broughton (Québec) G0N 1G0	(418) 427-2177 (418) 427-3569		PÉbd, PÉhdl (0 à 100% selon les besoins du client)	Postindustrielle	
Tapis avec endos de vinyle recyclé	Tapis Éco Mat	209, chemin Ste-Anne-Nord Sainte-Anne-de-la-Rochelle (Québec) J0E 2B0	(450) 532-6060 (450) 532-4948		PVC, PP (85% à 100%)		
Tuiles	Plastipro Canada Itée	6855, boul. Couture Saint-Léonard (Québec) HIP 3M6	(514) 321-9840 (514) 321-2287	http://www.plastipro.com	PVC, PÉhd, PÉbd, PP (50%)	Postconsommation et postindustrielle	Vente directe (quantité minimum)