PLASTICS STUDY

Prepared for:

Resource Recovery Fund Board
14 Court Street
Suite 305
Truro
Nova Scotia B2N 3H7

Prepared By:

PHA Consulting Associates
9979 Highway 221
P.O. Box 296
Canning
Nova Scotia B0P 1H0

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TABLE OF CONTENTS

LIST OF ANNEXES

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

ACRONYMS AND ABBREVIATIONS

ABS	Acrylonitrile Butadiene Styrene
ASR	Auto Shredder Residue
ASTM	American Society for Testing and Materials
BBPP	Blue Box Program Plan
BMP	Best Management Practice
BPI	Biodegradable Plastics Institute
CMP	Current Management Practice
CPIA	Canadian Plastics Industry Association
CPRA	Canadian Polystyrene Recycling Association
DSD	Duales System Deutschland
EOL	End of Life
EPR	Extended Producer Responsibility
EPIC	Environment and Plastics Industry Council
EU	European Union
HDPE	High Density Polyethylene
HIPS	High Impact Polystyrene
HRM	Halifax Regional Municipality
IC&I	Industrial, Commercial and Institutional
LDPE	Low Density Polyethylene
MDL	Municipality of the District of Lunenburg
MRF	Materials Recovery Facility
N/A	Not Applicable
NaPP	National Packaging Protocol
ND	No Data
NPC	National Packaging Covenant
NSEL	Nova Scotia Environment and Labour (Nova Scotia)
OECD	Organisation of Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OH&S	Occupational Health and Safety
PC	Polycarbonate
PET	Polyethylene Terephthalate
PLA	Polylactic Acid
PP	Polypropylene
PPO	Polyphenylene Oxide
PS	Polystyrene
RRFB	Resource Recovery Fund Board
V	Vinyl
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

Objective

The overall objective of this study is to identify and recommend measures for achieving enhanced plastics recovery and recycling in Nova Scotia. Specific objectives include:

- Development of an inventory of post-consumer plastic discarded in Nova Scotia.
- Review of collection systems for post consumer plastics.
- Identification of markets for recovered post-consumer plastics.
- Identification of special issues and barriers relevant to post-consumer plastics recovery and recycling.
- Recommendation of actions to be taken to achieve enhanced plastics recovery and recycling in the province.

Plastics In Nova Scotia

Plastics used in Nova Scotia originate from a variety of sources:

- Plastics products manufactured and sold in the province.
- Plastic products manufactured elsewhere and imported into the province.
- Products that contain plastics that are manufactured and sold in the province.
- Products that contain plastics that are manufactured elsewhere and imported into the province.
- Plastics packaging associated with these products.

Plastics products used in Nova Scotia may be either "durable" or "non durable". At the end of their life, however – and regardless of whether they are reused – they are discarded and must be managed as either a secondary resource or as a waste.

Management of Discarded Plastics in Nova Scotia

An estimated 71,407 tonnes of plastics are estimated to have been discarded by Nova Scotians in 2006. This quantity is expected to increase to at least 96,347 tonnes by 2016 – an increase of approximately 35 percent at a time when the population is forecast to increase by only 3.4 percent. An estimated 67 percent of plastics discarded in Nova Scotia in 2006 were used in packaging applications; the balance were discarded by residents and IC&I entities following use in a variety of other applications in the transportation, electronics, construction or other sectors.

Recovery of plastics for recycling is limited almost entirely to recovery of some components of plastics packaging discarded by residents and recovered through municipal and RRFB programs; it is estimated that approximately 40 percent of residentially-generated plastics packaging is recovered through these initiatives. In total, however, only 13.8 percent of plastics generated in Nova Scotia are estimated to have been recovered for recycling in 2006.

Plastics markets are strong. However, large quantities of plastics are sold in commingled formats that do not attract a high price. All markets for recovered plastics are outside Nova Scotia, and many are overseas. It is not clear that plastics recovered for recycling are necessarily recycled.

The application of "best management practice" (BMP) would result in the reutilisation of at least 80 percent of plastics discarded annually in Nova Scotia.

Issues

Rapidly growing use of plastics in Nova Scotia coupled with continuing low levels of recovery and reutilization of plastics creates the following issues:

- Provincial legislation establishes that a maximum of 300 kgs per capita of solid waste should be sent for disposal in 2015. Continuing reliance on disposal for management of over 85 percent of plastics discards – equivalent to an estimated 86 kg/person in 2016 - is incompatible with this objective. The application of BMP would reduce this amount to 20 kgs/person in 2016.
- There is an absence of effective monitoring of plastics banned from landfill, and this appears to result in significant quantities of these plastics being discarded in landfills.
- Reliance on external markets for plastics reutilisation means that Nova Scotians do not gain economic benefit associated with the reutilisation of local plastics resources. It also means that there is no assurance that plastics recovered for recycling are in fact being recycled. It is clear that there is demand in Nova Scotia for at least some high quality secondary plastics, and this demand has high growth potential.
- The transportation of plastics to markets outside Nova Scotia incurs costs and results in negative environmental impacts – particularly the generation of greenhouse gases – that would be avoided if recovered plastics were processed/utilized in Nova Scotia.

Current management frameworks for plastics in Nova Scotia represent an open-ended and continuing unfunded public liability of growing consequence. The entities responsible for management of plastics packaging in Nova Scotia – municipalities and RRFB – have no control over the type, quantity or quality of plastics in the province and yet are required to plan, implement and pay for actions to achieve legally established objectives for which plastics producers have no obligation or accountability. New institutional arrangements are required that link producers with the consequences – financial and environmental – of their products and which achieve tangible coordination between all stakeholders in support of legally established environmental objectives.

The Canadian Council of Ministers of the Environment has adopted *Canada-Wide Principles for Extended Producer Responsibility* that provide an appropriate basis for the design and implementation of enhanced plastics recovery and reutilization frameworks in Nova Scotia. Accordingly, the recommendations of this document are framed in the context of application of these Principles in Nova Scotia, specifically in the context of the above issues, while at the same time implementing immediate actions that will assist in optimizing existing plastics recovery and reutilization infrastructures.

Recommendations

The following recommendations are made to achieve enhanced plastics recovery and reutilisation in support of achievement of legally established environmental objectives in ways that maximize economic opportunities in Nova Scotia:

1. Enhanced plastics recovery and recycling/composting in accordance with "Best Management Practice" can recover and reutilize 80 percent of the plastics discarded in Nova Scotia, as compared to current management practices that achieve an estimated recovery and reutilization of less than 14 percent of discarded plastics in the province in 2006.

2. Plastics recovery and recycling/composting at - or approaching - the Best Management Practice (BMP) level will:
    - Make a substantive contribution to achievement of the waste disposal goal of 300 kgs/person/year by 2015 established in the *Environmental Goals and Sustainability Act, 2006*
    - Create jobs, manufacturing industry and spin-off benefits in Nova Scotia.

3. The Department of the Environment and RRFB should make the enhanced recovery of plastics at – or approaching – the BMP a priority and should place enhanced plastics recovery in the context of an EPR framework:

4. The RRFB should Chair and coordinate two initiatives, in partnership with government, municipal and industry stakeholders in order to commence implementation of Recommendation 3, above:
    - *Plastics Products EPR Feasibility Assessment Study* This study should review options and opportunities for recovering and recycling/composting designated plastics. Particular focus should be placed on options and opportunities for enhanced recovery and recycling/composting of plastics: (i) from the residential, IC&I, C&D and agricultural sectors; and (ii) used for packaging, and with particular reference to the IC&I sector. The study should recommend EPR implementation actions, timing and costs/revenues, and should include consideration of the implementation of a mixed plastics processing facility to receive plastics waste-resources generated in Nova Scotia. As appropriate, the recommendations of the study should build on the plastics recycling infrastructure already established in the province.
    - *Mixed Plastics Processing Feasibility Assessment and Expressions of Interest* A Mixed Plastics Processing Feasibility Assessment should be undertaken in support of a mixed plastics processing facility to receive and process mixed plastics recovered in Nova Scotia through an EPR initiative. Among other things, the feasibility assessment should identify potential facility suppliers/operators, preferred technologies, probable costs, business risks and business risk mitigation strategies. Based on the outputs of this assessment, RRFB should issue a call for Expressions of Interest in establishing a mixed plastics processing facility dimensioned in accordance with a plastics products EPR initiative in Nova Scotia.

5. Based on the recommendations of the *Plastics Products EPR Feasibility Assessment Study* the Minister should designate and define an expanded range of plastic products for the purpose of an EPR initiative for enhanced plastics recovery and recycling/composting in Schedule B of the Solid Waste-Resource Management Regulations. The Regulations should specify a date by which a plan or plans acceptable to the Minister should be submitted by producers of Scheduled plastics products and the date by which the EPR initiative will commence implementation.

6. Plans should specify an EPR program consistent with the CCME Canada-Wide Principles and Nova Scotia policy, and using the outputs of the *Plastics Products EPR Feasibility Assessment Study* as appropriate. Among other things, plans should:
    - Provide for EPR management of all designated plastics from all generators;
    - Provide for the end-management of bioplastics separately from plastics manufactured from hydrocarbons;
    - Address, as necessary, issues of non-competition/lack of competition that may be associated with collaborative producer initiatives to implement plastics product EPR initiatives;
    - Include the option of receipt of mixed recovered plastics at a mixed plastics processing facility at prevailing market prices and based, as appropriate, on the outputs of the *Mixed Plastics Processing Feasibility Assessment*;
    - Specify the institutional, organisational and financial arrangements necessary to ensure the effectiveness of the EPR initiative; and
    - Specify, as appropriate, mechanisms to ensure the transparency, efficiency and effectiveness of the EPR initiative, and accountability for the results of the initiative.

7. In implementing and coordinating Recommendations 3 - 5, the Department of Environment and Labour and the RRFB should be guided by their recent experience in the development of an EPR program for end-of-life electronics.

8. RRFB should coordinate the implementation of a mixed plastics processing facility in accordance with the proposals and requirements of producers as set out in their EPR plans. A mixed plastics processing facility might therefore be independently owned/operated, owned/operated by RRFB or owned/operated by a plastics EPR entity[1].

9. The net costs of managing plastics through the EPR initiative should be included in the price of plastics in the consumer chain.

10. As an immediate step in accordance with EPR principles and to achieve early economic and environmental benefits in Nova Scotia from enhanced plastics recovery and recycling/ composting, the Minister should take the following action:
    - Designate and define windshield washer fluid (WWF) containers under Schedule B of the Solid Waste-Resource Management Regulations and require producers who use the containers to create (as necessary) an entity and to register with that entity.
    - Require producers who use these WWF containers to submit EPR plans for the management of the containers, using the outputs of this document as appropriate.
    - Require that WWF EPR plans include: (i) a consumer refund, financed by producers, for the return of the containers to a collection point; (ii) the optimization of existing recycling infrastructure in Nova Scotia; and (iii) the sale of recovered plastics at market prices to one or more Nova Scotia end-users or, if end-users are not available, to an intermediate processing facility located in Nova Scotia and that shipment of WWF containers out of the province will

[1] For example, the polystyrene industry created the Canadian Polystyrene Recycling Association as an industry EPR entity, and this entity built and operates Canada's largest polystyrene recycling facility in Mississauga, Ontario.

only be acceptable if end-users and/or intermediate processors are unavailable to absorb the tonnage of recovered plastics.

- Define in legislation that "biodegradable plastics" mean those that meet ASTM Standard D6400 or D6868 or equivalent standard.
- Require that any plastic that is claimed to be "biodegradable" or "compostable" must: (i) have been tested in accordance with the requirements of ASTM Standard D6400 or D6868 or equivalent standard; (ii) be certified by the Biodegradable Products Institute as compliant with ASTM Standard D6400 or D6868 or equivalent standard; and (iii) bear the logo issued by the Biodegradable Products Institute to plastics that meet ASTM Standard D6400 or D6868.

11. Each Solid Waste-Resource Region in Nova Scotia should be requested/required by the Minister to develop a plan regarding the actions necessary within the region to achieve the BMP for management of plastics discards. These plans should address all plastics from all sources in the region, and should include mechanisms at the municipal level for ensuring that municipalities and their agents take the steps necessary to implement and monitor that plastics banned from disposal are not disposed of. These plans should constitute a municipal input into the preparation of the EPR initiative identified in the above Recommendations.

12. Recommendations should be developed through the RRFB for the enhanced recovery and recycling of other discards in Nova Scotia in support of achieving the waste disposal goal of 300 kgs/person/year by 2015 established in the *Environmental Goals and Sustainability Act, 2006*.

1. INTRODUCTION

1.1 Context

Plastics are among the most commonly used materials in Nova Scotia and elsewhere in Canada. In recent decades they have become a dominant material in applications as diverse as packaging, electronic products, agriculture, construction and fishing. New plastics applications are being developed, and new plastics are themselves being developed.

While the application of plastics has brought many benefits, the management of discarded plastics has presented environmental challenges:

- Governments – including those in Nova Scotia - are increasingly seeking to reduce dependence on the disposal of waste, including plastics.
- Management of plastics through disposal results in the loss of the energy and material values of the plastics.
- Governments across Canada, and including all levels of government in Nova Scotia, have identified the environmental desirability of recycling discarded plastics, but infrastructures for plastics recycling remain imperfect notwithstanding the high technical potential for recycling plastics.
- Discarded plastics may escape into the environment more easily than some other materials because of their light weight and structure, and may have significant negative impacts that include causing damage to wildlife and reducing aesthetic values[2].
- Plastics that escape into the marine and terrestrial environments have accumulated in quantity because of the long periods of time that are required for the degradation of traditionally-manufactured plastics.

Plastics recycling systems have been developed in Nova Scotia over the past decade. However, large proportions of recyclable plastics not being recovered for recycling, and these plastics therefore continue to be managed through disposal mechanisms. The management of these plastics through disposal not only carries negative environmental impacts, but also results in the loss of opportunity to realize benefits associated with the recycling of plastics. The benefits of enhanced plastics recycling include reduced greenhouse gas emissions as compared to the manufacture of plastics from virgin resources, conservation of energy and material resources, and the creation of economic opportunities and employment associated with the recovery and recycling of plastics.

1.2 Scope

The scope of this study extends to all post-consumer plastics discarded in Nova Scotia.

1.3 Objectives

The overall objective of this study is to identify and recommend measures for achieving enhanced plastics recovery and recycling in Nova Scotia. Specific objectives include:

[2] Environment Canada, *Marine Debris – What's the Problem?*, The Green Lane – Environment Canada, 2 August 2002; http://www.ns.ec.gc.ca/udo/cry.html

- Development of an inventory of post-consumer plastic discarded in Nova Scotia.
- Review of collection systems for post consumer plastics.
- Identification of markets for recovered post-consumer plastics.
- Identification of special issues and barriers relevant to post-consumer plastics recovery and recycling.
- Recommendation of actions to be taken to achieve enhanced plastics recovery and recycling in the province.

1.4 Report Format and Preparation

The legal and institutional framework governing the management of discarded plastics in Nova Scotia is summarised in Section 1.5. In Section 2, an inventory of post-consumer plastics generation is presented. Section 3 addresses collection systems for post-consumer plastics. Section 4 sets out markets and factors relevant to the marketing of plastics. In Section 5, current management practice and best management practice for plastics discarded in Nova Scotia are set out, and issues/barriers associated with the transition from current management practice to best management practice are identified. Section 6 sets out recommendations for enhanced plastics recovery and recycling in Nova Scotia.

This report has been prepared in close consultation with stakeholders in the solid waste-resource management sector in Nova Scotia, and with the range of stakeholders in Nova Scotia and elsewhere relevant to the recovery and recycling of plastics. The study has been prepared under the overall supervision of a Steering Committee that includes representation from the Resource Recovery Fund Board, Inc. (Chair), Nova Scotia Environment and Labour (NSEL), and the Regional Waste-Resource Management Coordinators.

1.5 Legal and Institutional Framework

The legal framework for the management of discarded plastics (and other discarded materials) is established in the *Environment Act*. Part IX of the *Environment Act* addresses "Waste-Resource Management". Among other things, this provides that:

- The target is established to achieve a 50 percent solid waste diversion goal.
- The target is established to ensure that disposal of residual wastes in 2015 is not greater than 300 kgs/person/year.
- The Minister may enter into agreements to, among other things:
  - Establish cost sharing arrangements or provide financial incentives to encourage source reduction, reuse, recycling and composting;
  - Implement policies to recycle waste materials, promote energy conservation and to purchase products made from recyclable materials;
  - Prepare model by-laws and promote the enactment of municipal legislation respecting waste-resource management, including littering, recycling and composting;
  - Encourage industry stewardship.
- The Minister may, among other things:

  - Establish restrictions and prohibitions on the storage and disposal of types of waste or recyclable materials in specified types of waste treatment, storage or disposal facilities;
  - Develop codes and guidelines for the use and content of recyclable materials in the manufacture of new substances or products
  - Prescribe minimum content requirements for recyclable materials in specific substances or products, or establish restrictions on the production or sale of products that cannot be reused or recycled.
  - Designate materials the use of which is banned or reduced, or for which composting or recycling must be undertaken to manage the materials following their discard, and/or for which manufacturers, distributors and retailers may be obliged to provide depots or other mechanisms for collection and recovery following discard.
- The Minister may establish or adopt programs or policies respecting the use of packaging and labelling of materials including, but not limited to:
  - Imposing requirements or standards with respect to the type, size, labelling, composition and disposal of packaging, including standards for material degradability and recyclability;
  - Reducing or mitigating the adverse effects created by packaging;
  - Establishing measures to encourage source reduction, reuse and recycling of packaging;
  - Providing information on packaging to enable consumers to identify products or packaging that have the least impact on the environment;
  - Requiring any person who produces or sells a product or substance to: (i) accept the product or substance, or packaging associated with the product or substance, from any person, except for a person engaged in commercial waste management, including recycling, who no longer wants the product, substance or packaging; and (ii) manage the product, substance or packaging in such a manner that there are no adverse effects upon the environment.
  - The approval of packaging and the labelling of materials.

In 1995, Nova Scotia adopted a Solid Waste-Resource Management Strategy under authority of the *Environment Act* that details provincial policy with respect to management of discarded materials and which reflects principles of "sustainable development". The strategy is premised on the need to provide for:

- Environmental protection and ecological value;
- Wise and efficient use of renewable and non-renewable resources; and
- Economic opportunities through the development of a vibrant environmental industries sector.

In order to give effect the Strategy, *Solid Waste-Resource Management Regulations* have been adopted under Section 102 of the *Environment Act* that establish the specific legal and institutional framework to give effect to the Strategy. Of relevance to this document, these regulations:

- Establish the mechanisms for the Resource Recovery Fund to finance various activities related to the recovery and recycling of discarded materials including: (i) development of industry stewardship programs; (ii) funding of municipal or regional diversion programs; (iii) development and operation of a beverage container deposit refund system; (iv) development of education and awareness in

support of source reduction, reuse, recycling and composting; and (v) promotion of value added manufacturing.
- Establish a Resource Recovery Fund Board (RRFB) to administer the Fund.
- Ban specific materials from disposal, including the following of relevance to this document: redeemed beverage containers, low density polyethylene bags and packaging, and high density polyethylene bags and packaging.
- Establish seven solid waste-resource management regions in Nova Scotia.
- Establish the framework for industry stewardship agreements, including the ability of the Minister to establish a surcharge on a designated material.

Discarded plastics are addressed within this framework as one of the range of materials that are discarded in the province. Specific provisions for the management of discarded plastics are not made in the legal framework, except with respect to plastics that are included on the list of materials that are banned from disposal as waste.

The institutional arrangements for management of solid waste-resources in Nova Scotia include:

- *Nova Scotia Environment and Labour* . NSEL establish solid waste-resource management policy in the province under authority of the Minister and are responsible for solid waste-resource planning at the provincial level and for compliance and enforcement of regulatory requirements.
- *Resource Recovery Fund Board, Inc. (RRFB).* RRFB is an incorporated, non-profit entity responsible for the administration of the Resource Recovery Fund. Accordingly, the RRFB administers a provincial deposit-refund system for beverage containers (including plastic beverage containers) in the province.
- *Municipalities.* Municipalities are responsible for collection and management of household solid waste-resources in accordance with the applicable regulations, and may also be involved in management of waste-resources from other sectors according to local by-law. Municipalities organise themselves within each of the solid waste-resource management regions referenced above in the ways they deem appropriate. Thus, in some cases solid waste-resource management is undertaken by the municipal entity itself, in other cases municipalities within a solid waste-resource region have formed a separate entity owned by its municipal members, and in other cases municipalities within a solid waste-resource region coordinate their individual activities to achieve solid waste-resource management objectives.
- *Private Sector.* The private sector is responsible for the management of the wastes that it generates in accordance with law. Municipalities typically make solid waste-resource management facilities available to the private sector on a fee basis.
- *Individuals.* Individuals are responsible for managing their wastes in ways that do not damage the environment and accordance with the infrastructures that are provided to them for this purpose.

2. INVENTORY OF PLASTICS USE AND WASTE GENERATION IN NOVA SCOTIA

2.1 Plastics Use In Nova Scotia

Plastics used in Nova Scotia originate from a variety of sources:

- Plastics products manufactured and sold in the province.
- Plastic products manufactured elsewhere and imported into the province.
- Products that contain plastics that are manufactured and sold in the province.
- Products that contain plastics that are manufactured elsewhere and imported into the province.
- Plastics packaging associated with these products.

Data on plastics use in Nova Scotia (or elsewhere in Canada) are not available. However, the Canadian Plastics Industry Association (CPIA) maintains data on plastics shipments by dollar value (i.e. the value of plastics products shipped by Canadian manufacturers), and this is presented in percentage terms in Figure 1. While the data do not address exports and imports of plastics, the data in the Figure identify:

- The range of products that plastics are used in.
- The relative importance to the industry of different applications of plastics, which may be taken as indicative of general plastics use in Nova Scotia.

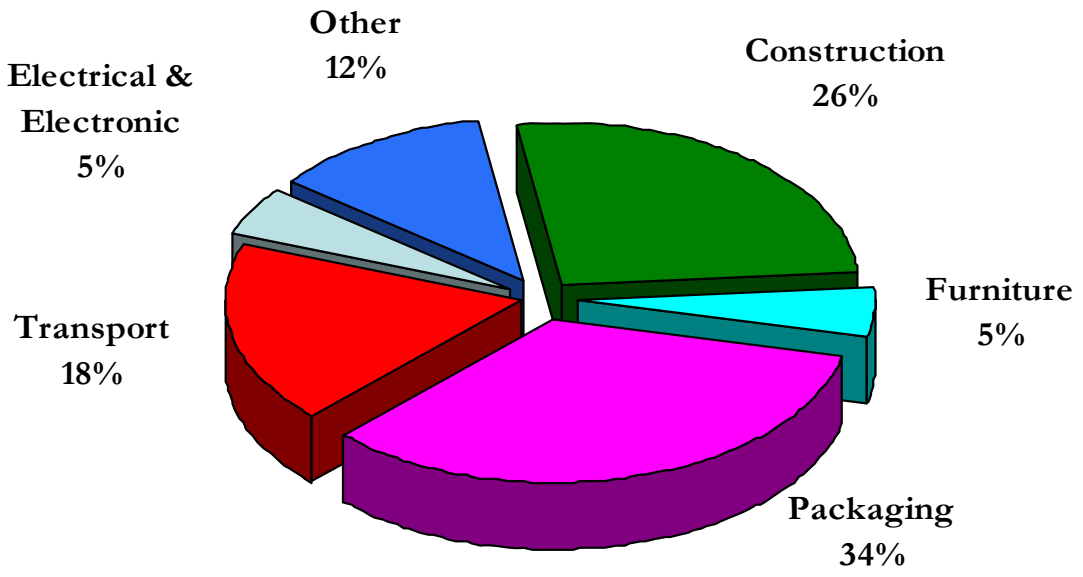
2.2 Plastics Discards in Nova Scotia

Ultimately, all plastics are discarded by the user. Thus, all plastics identified in Figure 1 that are used in Nova Scotia are ultimately discarded together with imported plastics that are not included in Figure 1. However, the quantity of plastics that is discarded over a given period of time varies as a function of:

- The intended use of the plastic. Some plastics products are considered to be "non-durable". These products (e.g. plastics packaging) are generally used for short periods of time that may be measured in days or weeks. Other products are considered to be "durable". These products (e.g. plastic construction products) are intended to be used over long periods of time that may be measured in years or decades.
- The extent to which the plastic product is reused. For example, durable plastics products used in transportation (e.g. as part of an automobile) may be used by one or by several users, depending on how long the automobile is in use and how many owners it has.

In addition, plastics may be discarded by a manufacturer. Within the plastics manufacturing industry, off-specification product may be discarded, together with plastic products that are of no value to the manufacturer for other reasons.

Figure 1
Plastics Use In Canada By Value of Shipment (2005)



Source: Canadian Plastics Industry Association

Some types of plastics discards are managed internally by the industry, and have been managed this way throughout the history of the industry. Primarily, internal management of plastics discards by the industry occurs with respect to plastics that are available in large quantities from manufacturers of plastics products (measured in tonnes) and which are clean (i.e. free of non-plastic materials) and homogenous (i.e. consist of only one type of plastic). Plastics materials that meet these characteristics are typically traded between a generator of the discard and a processor or manufacturer that can use the discarded materials; brokers are frequently involved in these transactions.

Plastics products discarded by the users of the products are not managed internally by the plastics industry. These "post-consumer" discards include the discard of durable and non-durable plastics products and products containing plastics. "Post-consumer" plastics discards are characterised by the discard of small amounts of plastics by many generators dispersed across large areas; in addition, post-consumer plastics discards may be contaminated with non-plastic materials and may include several different types of plastics in association with each other. These plastics have insufficient financial value to attract the participation of plastics product manufacturers in their recovery for recycling. Accordingly, the management of these plastics falls to public sector entities and it is on these plastics discards that the following sections focus.

2.2.1 Packaging

Direct measurement of the generation of plastics packaging waste at the provincial level in Nova Scotia has not been undertaken. However, plastics packaging discards may be estimated at the provincial level using the following methodology:

First, estimates have been developed of the total quantity of plastics discards generated by the residential and IC&I sector and which are managed through municipal or contracted waste-resource management collections. These quantities have been developed as follows:

1. HRM has identified that total annual residential discards in the municipality are equivalent to 371 kgs/person (includes residential waste, organics and recyclables streams collected for processing at facilities in HRM). Within this amount, total quantities of packaging discards can also be estimated:

    - The annual quantity of plastics that is not separately collected has been estimated through waste audit.
    - The quantity of plastics separately collected through municipal curbside collection is known.
    - The proportion of beverage container plastics recovered in HRM through the provincial deposit/refund system can be estimated by pro-rating the tonnage of these plastics recovered in HRM on the basis of the ratio of the HRM population to the provincial population.

    These data identify that plastics comprise 9.92 percent of residential discards, and that plastics packaging specifically comprises 8.45 percent of residential discards[3]. The difference between these two figures is attributable to discarded plastic "residential small durable products".

2 Average annual per capita residential waste generation in the province has been estimated by Nova Scotia Environment and Labour to be 274.24 kgs/person (including materials collected at the curb for recycling, composting or residual disposal, but excluding "bulky waste" and construction and demolition materials). The percentages calculated through Point 1, above, can be applied to this per capita figure to estimate total residential plastics discards in the province, and total residential plastics packaging discards[4].

2. HRM has identified the total quantity of plastics packaging generated by the IC&I sector collected through non-hazardous solid waste collection service[5]. This quantity is equivalent to 1.2 times the quantity of residential plastics packaging materials[6]. It is assumed that this ratio is generally applicable across the province, and that plastics packaging discarded by the IC&I sector is therefore

[3] Within the HRM data for the residential sector, there is a category of "Other Plastic" that contains a variety of discards that are not specifically classified. EPIC has identified through audit that an average of 5.46 kgs/person of residential small durables products are discarded annually; this quantity is attributed to the HRM "Other Plastic" category, and quantities in excess of this amount are assumed to be plastics packaging not specifically identified elsewhere in the HRM database.

[4] The population of Nova Scotia is assumed to be 934,400 people in 2006.

[5] While the precise quantities of IC&I plastics separately managed for recycling is unknown, it is very small (see Section 3) and is not considered significant in this analysis.

[6] Within the HRM IC&I database, there is a category of "Other Plastics". It is assumed that the ratio of discarded durable plastic products to discarded plastics packaging for the IC&I sector is the same as for the residential sector; i.e. 84.76 percent of "other plastics" are discarded durable items and the balance are miscellaneous plastics packaging.

1.2 times as great as for the residential sector. Likewise, it is assumed that the proportion of discarded durable plastics in the IC&I sector across the province is the same as in HRM.

Application of points 1 – 3, above, allows estimates to be made of total plastics discarded to non-hazardous solid waste collection services in the residential and IC&I sectors in Nova Scotia.

Second, estimates have been developed regarding the composition of plastics discarded by the residential and IC&I sector, as follows:

3. HRM has classified residual plastics generated by the residential and IC&I sectors that are sent for disposal. The classification allows identification of plastic films separate from rigid plastic materials. It is assumed that this ratio of rigid to film plastic applies across the province.

4. The Environment and Plastics Industry Council (EPIC) of CPIA has undertaken audits that can be used to estimate the composition of residential rigid and film plastics packaging according to type of plastic. These composition data can be applied to the quantities of plastics estimated through points 1 – 3, above.[7]

Application of this methodology and data results in estimates of plastics packaging quantity and composition in Nova Scotia. This is illustrated in Figure 1; estimates of residential and IC&I packaging quantities and composition are shown in Table 1.

2.2.2 Transportation

Estimation of the plastic discards generated in the transportation sector in Nova Scotia focuses on the application of plastics in motor vehicles. There are two considerations: (i) the plastics that are used; and (ii) change in plastics use during the lifespan of a vehicle.

Vehicle Lifespan Motor vehicles have an average lifespan of approximately 10 years in Nova Scotia. Thus the vehicles that are appearing as "discards" today are vehicles that were manufactured, on average, 10 years ago, and which therefore have the plastics composition of vehicles manufactured at that time.

Plastics Use A wide range of plastics is used in the manufacture of both North American motor vehicles and motor vehicles imported into Nova Scotia. The major plastics used in motor vehicles in 1996 (i.e. the average year of manufacture of motor vehicles reaching the end of their life in 2006) include the following, together with the proportion of each for that year in brackets[8]:

- Polyurethane (33%)
- ABS (21%)

[7] The data developed by EPIC relate specifically to residential plastics packaging. However, since plastics packaging discarded by the IC&I sector is largely similar to the plastics packaging discarded by the residential sector (i.e. in both cases bottles, jugs, jars, tubs, trays, pails, lids, other rigid containers and film), it is considered that the application of the EPIC data in plastics packaging discarded by the IC&I sector provides a reasonable approximation of the composition of plastics discards for the purposes of this document.

[8] Collation by author and personal communication with Barb Robertson, American Plastics Council-Automotive Learning Centre – 27 December 2006

Figure 2:
Estimated Composition of Plastics Packaging Discards in Nova Scotia (2006)

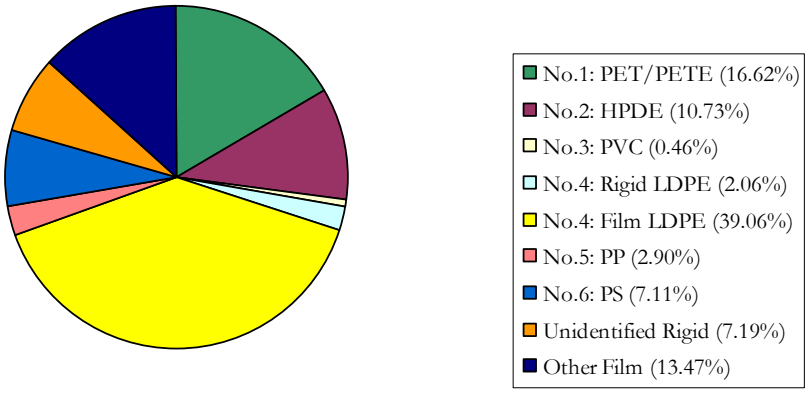


Table 1
Estimated Plastics Packaging Discarded In Nova Scotia (2006)

	Composition (percent of Total Plastics Packaging)[1]	Residential Plastics Packaging Discards (tonnes)	IC&I Plastics Packaging Discards (Tonnes)	Total Plastics Packaging Discards (Tonnes)
Rigid Plastics				
No. 1: PET/PETE	16.62	4,064	3,866	7,931
No. 2: HDPE	10.73	2,624	2,496	5,119
No. 3: V	0.46	113	107	220
No. 4: LDPE	2.06	504	479	983
No. 5: PP	2.90	709	674	1,383
No. 6: PS	7.11	1,739	1,653	3,390
No. 7: Other	ND	ND	ND	ND
Unspecified	7.19	1,757	1,671	3,429
Sub-Total – Rigid Plastics	47.07	11,510	10,946	22,455
Film Plastics				
No. 4: LDPE	39.06	7,565	11,263	18,827
No.7 Laminates/Other	13.47	2,581	3,843	6,424
Sub-Total – Film Plastics	52.93	10,146	15,106	25,251
Total Estimated Plastics Packaging Discards	100	21,656	26,052	47,706

Notes
1. Composition of plastics packaging derived from data provided by EPIC.
2. Small, but unknown, quantities of film plastics are comprised of HDPE, but this is not separately shown in Table 1. Data may not add due to rounding.

- PP (18%)
- Nylons (10%)
- Other (PVC, polycarbonate, polyethylene, thermoplastic olefin, thermoset polyester, thermoplastic polyester - 18%)

Assuming an average vehicle weight of 1,825 kgs[9] and the retirement in 2006 of 40,000 light vehicles that were sold as new in 1996 (equivalent to the approximate number of new vehicle sales in Nova Scotia in 1996), the following amounts of plastics may be estimated for motor vehicles that reached the end of their lifespan in 2006 in Nova Scotia:

- Polyurethane: 1,999 tonnes
- ABS: 1,272 tonnes
- PP: 1,090 tonnes
- Nylons: 606 tonnes
- Other: 1091 tonnes

An average of 162 kgs of plastic was estimated to have been used in the manufacture of a North American light vehicle in 2005, an increase of 49 percent since 1990. This comprises 8.3 percent of a light vehicle by weight[10]. Imported vehicles have broadly similar plastics composition and use[11].

2.2.3 Electrical and Electronics Products

Plastics generated in electrical and electronic products in Canada has recently been estimated in *Electronic Waste Recovery Study*, prepared in 2006[12]. Table 2 identifies the composition of plastics in computers, computer peripherals, TV's and cell phones, together with the tonnage of these plastics that is associated with the current annual discard of these products in Nova Scotia. Additional plastics are also generated from other electronic products (e.g. stereos, handheld electronic devices); however, the product categories identified in Table 2 comprise approximately 95 percent of the tonnage of electronics products discarded in the province annually and additional quantities of plastics are therefore minor.

The plastics used in electronics are defined as "engineering grade" plastics; these plastics are distinguished from "commodity" plastics used in, for example, packaging, by properties that allow the plastics to perform in more demanding applications. Engineering grade plastics are more expensive to produce, but also carry a higher value on the secondary plastics market.

2.2.4 Furniture

Plastics are used in several furniture applications. Rigid plastics may be used as structural or non-structural elements. As a fabric, plastics are used for furniture coverings, either with or without

[9] National Highway and Transport Agency data for 2007 model year.
[10] Barb Robertson, American Plastics Council-Automotive Learning Centre – personal communication, 27 December 2006
[11] Collation of data by author.
[12] PHA Consulting Associates, *Electronic Waste Recovery Study*, Resource Recovery Fund Board, 2006: Chapt. 1

Table 2
Estimated Discard of Plastics in Electronics In Nova Scotia (Tonnes, 2005)

	HIPS	ABS	PPO	PP	PC/ABS	OTHER	TOTAL
Composition (Percent)							
Televisions	75	8	12	3	0	2	100
Computers and Related Equipment	5	57	36	0	2	1	101
Cell Phones	0	0	0	0	81	19	100
Tonnes							
Televisions	180	19	29	7	0	5	240
Computers and Related Equipment	30	345	218	0	12	6	611
Cell Phones	0	0	0	0	2	1	3
Total	210	364	247	7	14	12	854

blending with other materials. Plastic foams are used in furniture upholstery. Furniture may be manufactured entirely from plastics, or plastics may be used in combination with other materials.

The most common plastics in furniture manufacture include vinyl, ABS, acrylic, polyurethane (rigid and foam), polyester (particularly PET), and PP.

In recent years, plastic products have been developed to substitute for wood and these have been used in the manufacture of picnic tables and outdoor chairs. The plastics used in these products are typically manufactured from mixed plastics recovered from post-consumer recycling programs. In some cases, plastics are mixed with non-plastics materials (e.g. wood) to create a composite material with superior properties for specific applications.

Data on the quantities of plastics generated through discarded furniture in Nova Scotia are not available.

2.2.5 Construction

Recent work has identified that plastics comprise an estimated 2 percent by weight of Nova Scotia's total construction and demolition waste[13]. This work has identified that the two predominant types of product in construction and demolition debris that contain plastics are siding and carpet, although significant quantities of other specific plastic product waste may also be present (e.g. house wrap):

- Plastic siding that is used in Nova Scotia is manufactured from vinyl. An estimated 140 tonnes of vinyl are discarded per year by the construction industry, including amounts discarded as a function of demolition activities.
- An estimated 7,500 tonnes of carpet manufactured from synthetic materials are discarded per year in Nova Scotia; synthetic materials used in carpet manufacture are typically plastics. Synthetic carpets

[13] Dillon Consulting, *Construction and Demolition Debris Management Study*, Nova Scotia Department of Environment and Labour/Resource Recovery Fund Board, 2006.

are manufactured with a "face" and a "backing". The face of a carpet is manufactured using nylon (nylon 6,6 or nylon 6), polypropylene or polyester. The backing of a synthetic carpet is manufactured from either latex or PVC and polypropylene.

Other plastics materials are generated in smaller quantities by the construction sector. Plastic film (LDPE and laminates), PP and ABS are all used in aspects of construction and all are generated as discards from construction activities. These plastics are estimated to comprise less than 1 percent of discarded plastics in the construction sector.

Plastics are beginning to be used in construction applications as a substitute for wood. Plastic products have been developed in recent years to substitute for dimensional lumber, particularly in applications where bearing strength requirements do not constrain applications, such as decks and fence posts. Plastic products are also available to substitute for traditional plywood. These plastics products are typically manufactured from mixed or resin-specific plastics recovered from post-consumer sources. Discards of these plastics are believed to be very small at present because the products have generally been on the market for less than 10 years (and therefore have not reached the end of their useful life) and because they make up a small percentage of the products used in the marketplace.

2.2.6 Other

Agriculture

Agricultural applications of plastics include use of LDPE film:

- For outside storage of hay
- As roof material for horticultural structures (e.g. greenhouses)
- For control of weeds.

These plastics have a lifespan of between one growing season and 5 years. Plastics used for weed control typically have a life of one growing season; although LDPE film is used almost exclusively for this purpose in Nova Scotia, fully biodegradable plastics products are available for most agricultural weed control applications[14]. The lifespan of plastics used in hay storage is one year. Plastics used in horticultural structures may have a lifetime of 3 – 5 years, depending on local conditions and the design life of the product.

Data on the quantity of plastics used annually in agriculture in Nova Scotia are not available. However, discussions with suppliers suggest that in the range of 375 – 500 tonnes of plastic LDPE film may be used annually in the province, a large majority of which would require disposal within one year of purchase. Future growth is projected for roof material in horticultural structures, but limited growth in other applications is projected.

[14] Biodegradable plastics are discussed further elsewhere in this document (see, for example, Section 5.1)

Fisheries

HDPE, PP and nylon are widely used for manufacturing fishing nets, ropes, lines and related equipment. The municipality of Barrington disposed of 66 tonnes of rope and netting in 2004/05 and 70 tonnes of these materials in 2005/06, indicating that significant quantities of these materials are available in communities in which fisheries activities are important. However, provincial data are not available on plastics discards by the sector.

Clothing

Polyester is widely used in clothing. As a fabric, polyester may be blended with other materials (e.g. cotton) or may be used without blending. As a fill, spun polyester is used in winter clothing. The most common form of polyester used in clothing is PET.

Residential Small Durables

A wide variety of miscellaneous small durable plastic products are discarded by households. These products include toys, garden products and other miscellaneous items. EPIC estimates the discard of these items to amount to 5.46 kgs/person/year in the residential sector (see Section 2.2.1).

2.3 Projected Plastics Discards

Table 3 summarises the quantities of plastics discards that are estimated to have been generated in Nova Scotia in 2006 and that are projected in 2011 and 2016. Future discards assume the following:

- *Packaging* The projections in Table 3 assume compound annual growth of 3 percent/year in plastics packaging[15] combined with population growth from 934,400 people in 2006 to 949,000 people in 2011 and 958,000 people in 2016[16]. This growth rate may be conservative: plastics packaging grew at an average compound rate of approximately 5 percent per year based on plastics packaging estimates from 1992 for the Halifax area and measured plastics packaging discards for HRM in 2005/06[17]. The total quantity of plastics packaging discards in Nova Scotia is projected to increase by 35 percent during the 2006 – 2016 period, and by 32 percent on a per capita basis. The composition of plastics packaging, however, is assumed to remain unchanged through the projection period; this is discussed further in Section 5.3. Plastics packaging represents an estimated 67 percent of all plastics discards in 2006, and this share is projected to rise over the next decade.

  Transportation Plastics discards from the transportation sector are projected by extending trends in the growth of plastics in vehicle manufacture in the 1990 – 2000 period to vehicles that will be discarded in the 2006 – 2016 period. It is assumed that the number of vehicles that are discarded during this period will be proportional to change in population as estimated by Statistics Canada (see above), and that the composition of plastics discarded from vehicles will be similar during the.

[15] This growth rate is estimated based on *Paper Versus Plastic in Packaging*, Fredonia Group, 2005 reported in CanPlastics.com (http://www.canplastics.com/issues/ISArticle.asp?id=64023&issue=01082007) on 8 January 2007. This estimate is for total plastics packaging in the US, but is considered applicable to Canada because of the high level of integration of the plastics packaging industry between the two countries. It is assumed that this growth projection will apply equally to all packaging types.

[16] Statistics Canada, *Population Projections for Canada, Provinces and Territories: 2005 – 2031: Catalogue No.: 91-520-XIE – Scenario 3: Medium Growth Scenario*, Ottawa, 2005.

[17] Calculated from waste audit and plastics recovery data provided by Laurie Lewis and Fred Wendt, Halifax Regional Municipality, December/January 2006/07 (personal communication) and Sound Resource Management Group/Angus Environmental Ltd., *Review of Waste Management Systems Options*, City of Halifax, 1992

Table 3
Projected Plastics Discards: 2006 - 2016

		Estimated Plastics Discards (Tonnes)		
Non Durables	**Type of Plastic**	**2006**	**2011**	**2016**
Packaging	No.1: PET	7,931	9,338	10,928
	No.2: HDPE	5,119	6,027	7,053
	No.3: PVC	220	259	303
	No.4: LDPE	19,810	23,324	27,295
	No.5: PP	1,383	1,628	1,906
	No.6: PS	3,390	3,991	4,671
	No.7: Other	ND	ND	ND
	Unspecified Rigids	3,429	4,037	4,725
	Unspecified Film	6,424	7,563	8,851
Sub-Total		*47,706*	*56,167*	*65,732*
Percent of Total		*67*	*68*	*68*
Durables				
Transportation	Polyurethane	1,999	2,319	3,061
	ABS	1,272	1,476	1,948
	No.5: PP	1,090	1,264	1,669
	Nylons	606	703	928
	Other	1,091	1,266	1,671
Sub-Total		*6,058*	*7,027*	*9,276*
Percent of Total		*8*	*9*	*10*
Electronics	HIPS	210	228	245
	ABS	364	396	426
	PPO	247	268	288
	No.5: PP	7	8	8
	PC/ABS	14	16	18
	Other	12	12	13
Sub-Total		*854*	*927*	*999*
Percent of Total		*1*	*1*	*1*
Construction	Carpet	7,500	7,616	7,689
	Vinyl	140	142	144
	Other	70	71	72
Sub-Total		*7,710*	*7,830*	*7,904*
Percent of Total		*11*	*9*	*8*
Furniture	Various	ND	ND	ND
Sub-Total		*ND*	*ND*	*ND*
Percent of Total		*ND*	*ND*	*ND*
Other				
Agriculture	No.4: LDPE	438	482	530
Fisheries	No.1 HDPE, No.5 PP, Nylon, Other	ND	ND	ND
Clothing	Polyester, Other	ND	ND	ND
Small Durables	Various	8,641	10,174	11,906
Sub-Total		*>9,079*	*>10,656*	*>12,436*
Percent of Total		*13*	*13*	*13*
TOTAL		**>71,407**	**>82,607**	**>96,347**

forecast period as compared to the earlier period. Growth in plastics discarded from the transportation sector is projected to increase by 53 percent over the period, although this will still represent less than 10 percent of plastics from all sources discarded during the projection period. End-of-life vehicles are transported out of the province for processing, and accordingly plastic wastes from these vehicles that are disposed of in Nova Scotia are highly limited

- *Electronics* Plastics discards from the electronics sector are based on data and estimates contained in recent work completed for RRFB[18]. Approximately 1 percent of plastics discarded each year will be from the electronics sector.

- *Construction* It is assumed that change in plastics discards from the construction industry will be a function of population growth, as estimated by Statistics Canada (see above). Plastics discards from the construction sector are projected to decline over the projection period as a percentage of all plastics discarded in Nova Scotia; this relative decline will occur only because discards of plastics from other sources will increase faster than discards associated with the construction sector.

- *Furniture* A lack of information concerning plastics discards associated with furniture prevents preparation of projections in this regard. Based on the sales data presented in Figure 1, however, it may be assumed that future plastics discards from furniture sales might be in the order of 5 percent of total plastics discards in the province.

- *Other* Significant plastics discards from other sources are projected to occur in the agricultural and fisheries sectors, from discarded clothing and from small durable products discarded in the residential sector. Projections related to the agricultural sector are based on discussions with industry suppliers, and assume growth in both applications and discards of 2 percent/year over the projection period. Data are unavailable for estimating plastics discards associated with fisheries and discarded clothing. It is assumed that the discard of small durable products from the residential and IC&I sectors will grow in the same proportion as plastics packaging.

There following uncertainties are associated with the projections identified in Table 3:

- *New plastics applications* The plastics industry is highly innovative and has a history of developing products with superior performance as compared to traditional materials. Table 3 anticipates new applications to the extent feasible; however, the history of the industry has often been to exceed expectations in this regard rather than under-perform and it is therefore possible that the Table underestimates plastics discards in the future.

- *Changing plastics composition* Table 3 assumes that plastics will continue to be applied in the same ways that they are today (e.g. that film plastics will continue to be LDPE). However, new plastics (e.g. bioplastics) - may be developed and/or applied at levels that become a significant component of plastics discards over the projection period. One such family of plastics – polylactic acid (PLA) plastics, which are biodegradable[19] – is scarcely used in Nova Scotia presently but is experiencing

[18] PHA Consulting Associates, *Electronic Waste Recovery Study*, Resource Recovery Fund Board Inc. (and others), 2006.
[19] The definition of "biodegradable" plastic varies according to jurisdiction. Unless otherwise specified, the term "biodegradable plastic" is used in this document to mean plastic that biodegrades in municipal composting systems in compliance with ASTM Standards No. D6400 and No. D6868

rapid growth in other jurisdictions (e.g. U.K. and elsewhere in Europe) as a result of its preferred use over non-biodegradable plastics; it is anticipated that PLA or similarly biodegradable plastics may become a widely used plastic in Nova Scotia in future, but the probable extent of its future application is the province is currently conjectural.

- *Population* The population of Nova Scotia is assumed to continue to grow modestly over the period from 934,400 people in 2006 to 949,000 in 2011 and 958,000 in 2016. Future population levels are inherently subject to numerous factors, however, and while the selected population growth scenario is considered to be a "medium" growth scenario, it is only one of 6 scenarios that Statistics Canada has developed for Nova Scotia, each based on different growth assumptions.

Notwithstanding these uncertainties, the estimates in Table 3 are considered to form an adequate basis for the analyses and recommendations of this document.

3. COLLECTION, PROCESSING AND TRANSPORTATION SYSTEMS FOR DISCARDED PLASTICS

This section begins with the identification of the range of possible collection systems for plastic discards. Current collection systems in Nova Scotia are then assessed, followed by identification of processing and transportation of recovered plastics. Collection systems in a number of relevant jurisdictions in Canada and elsewhere in the world are assessed, with specific emphasis on the stewardship arrangements that apply in these jurisdictions and the impacts of these arrangements.

3.1 The Range of Collection Options for Plastic Discards

Table 4 presents the range of options that are applied for the collection of plastic discards in jurisdictions around the world. The advantages and disadvantages of each option are identified in the Table together with the overall effectiveness of the various options, their suitability for specific types of plastics discards and the relative cost to collect the plastics.

The collection options identified in Table 4 have widely varying characteristics. The following are key:

- *Collection entity* Some options require the generator of plastic discards to bring the discarded plastics to a collection point; these include "delivery to drop-off bin, landfill, transfer station or material recovery facility", "return to retailer", "return to OEM/Brand Owner", and "collection site network". Other options (i.e. "curbside collection" and "bulky waste collection") require municipalities or their agents to perform the collection. Independent operators implement one collection option (i.e. "asset management/ non-profit collection"). Manufacturers and/or brand owners are not responsible for undertaking collection under any of these options, although they may participate in the financing of collection (see Section 3.4).

- *Type of Plastics Discard* Different collection options are appropriate for different types of plastic discard. Two considerations are key:

  - Where the discard has residual value as a product (e.g. discarded durable plastic products that are destined for reuse), appropriate collection systems allow the discard to be handled in ways that preserve its integrity as a product by minimising risk of product breakage or damage. These systems involve either the generator returning discarded plastics products to an appropriate collection site or retailer, or collection by an independent operator with a desire to handle the product in ways that preserve its value.
  - Where a plastic product is discarded to a recycling or disposal stream, the size of the discard is key to determining an appropriate collection system. Smaller items may be collected by the municipality through curbside collection, while larger items may be collected through less frequent bulky waste collections.

- *Generator of the Plastics Discard* For some types of collection, a key distinction is made between residents/small businesses and IC&I generators. Residents/small businesses receive municipal curbside collection of recyclable materials including plastics (except where this service is not

Table 4
Collection Options for Recycling of Discarded Plastics

Collection Option	Advantages	Disadvantages	Design Measures To Enhance Effectiveness	Suitability for Discarded Plastics	Relative Cost To Collect[2]
Delivery to Drop-off Bins, Landfill, Transfer Station, or Materials Recovery Facility	Can be piggy-backed onto other resource/waste management services Training of staff and management can be integrated with existing waste management services	Landfills and transfer stations may not be conveniently located for users Availability of collection not easily communicated May be OH&S concerns associated with breakage of plastic products High levels of product breakage incompatible with reuse strategies for durable plastic products Full time monitoring required to ensure proper use	May attract highest levels of household and small business participation in municipalities where waste generators are accustomed to delivering discarded materials to management facilities Effectiveness increased if linked to a ban on disposal Quality of materials collected maximized if the drop-off point is supervised	May be appropriate for plastic discards intended to be recycled or disposed of, and where breakage will not result in OH&S concerns, but inconvenient for most users	$ - $$$
Curbside Collection	Typical collection method in Nova Scotia for household durable and non-durable plastics discards, and for other household discards.	Inappropriate for collection of plastics products to be reused, since product integrity will not be maintained. Inappropriate for plastics discards that exceed size dimensions for curbside collection. Inappropriate for collecting plastics discards from IC&I, agricultural other business sectors	Attracts highest levels of participation from households when collection of plastics is integrated with collection of other materials for recycling Effectiveness increased if linked to ban on disposal	Appropriate for household plastic discards intended to be recycled or disposed of and where breakage will not result in OH&S concerns.	$$$
Bulky Waste Collection	Piggy-backs onto other resource/waste management services Suitable for collection of residential plastic discards, and plastics associated with other discards, that are too large to be collected through curbside collection Availability of collection easily integrated with other resource/waste management communications	Inappropriate where reuse of plastic discard is desired, since high breakage levels occur with this approach Inappropriate for collecting plastics discards from IC&I, agricultural other business sectors	Attracts high levels of participation from households Effectiveness increased if linked to ban on disposal	Suitable for bulky plastic discards destined for recycling or disposal that do not pose an OH&S concern if they break	$$$
Return to Retailer	Reflects product stewardship principles Convenient to consumer for durable plastic product discards Easy to communicate collection service at point of sale Handling of discarded plastic products provides new retailer business/marketing opportunities Provides opportunity for return of durable product discards using reverse distribution channels	Likely to be retailer resistance Inconvenient to consumer for non-durable plastic product discards Training of retailer staff and management required Likely to require separate storage space at retailer Plastic products sold through internet/mail order purchases may not have a retail point of sale Retailers will incur additional costs	Would attract high levels of participation from households and business Effectiveness increased if linked to ban on disposal, or deposit/refund or used product payment to incentivize the approach	Suitable for all discarded plastics	$
Return to OEM/Brand Owner[3]	Consistent with product stewardship principles Places accountability for managing discarded plastics on the OEM/brand owner	Likely to be OEM/brand owner resistance Inconvenient to consumer for non-durable plastic product discards. OEM/brand owner is not be identified on some plastics. OEM/brand owner training of staff and management required OEMs/brand owners will incur additional costs	Would require most OEM's/brand owner to establish a presence in Nova Scotia directly or through an agent. Effectiveness increased if linked to ban on disposal, deposit/refund or used product payment to incentivize the approach, and automated technology to sort discards according to OEM/brand owner.	Only feasible if OEM or their agents are clearly identified on plastic product. Not pragmatic for non-durable plastics products.	$ - $$

Table 4
Collection Options for Recycling of Discarded Plastics

Collection Option	Advantages	Disadvantages	Design Measures To Enhance Effectiveness	Suitability for Discarded Plastics	Relative Cost To Collect[2]
Contract Collection	Collection frequency, scope and scale tailored to meet the specific requirements of the contracting entity. Collection entity already a functioning business with professional expertise.	Not generally applicable to the residential generator of plastics discards	Attracts high levels of participation from IC&I sector Ban on disposal increases effectiveness	Suitable for the range of discarded plastics products destined for recycling or disposal	$$-$$$
Asset Management/ Non Profit Collection	Links to existing collection infrastructure Professional expertise already functioning as a business Competitive industry maximises cost-effectiveness Availability of collection service easily communicated to consumers	Applicable only to plastics discards with sufficient value to attract collection by asset managers/non-profit entities	Attracts high levels of participation from IC&I sector where costs can be reduced or income generated Ban on disposal and deposit/ refund or used product fee increases effectiveness	Suitable for discarded plastic products (e.g. late-model electronics) with sufficient residual value to attract asset managers/ non-profit entities	$ - $$
Collection Depot Network	Can be piggy-backed onto other resource/waste management services Training of staff/management can be integrated with existing waste services Siting may be linked to existing collection sites Easily communicated particularly where consumers are accustomed to collection sites.	OH&S concerns related to soiled plastic discards would limit application to clean discards only	Attracts high levels of participation from households and small businesses when conveniently located, properly managed, and appropriately incentivized (e.g. through deposit/refund system and ban on disposal)	If properly designed and operated, appropriate for larger EOL electronic products intended for reuse or recycle or which pose an OH&S concern if they break	$ - $$

Notes
1. Municipal collection may be performed by municipality directly, or a public or private entity on behalf of the municipality
2. The symbol "$" indicates relatively low cost; the symbol "$$$" indicates relatively high cost. In some cases, a collection option may incur a wide range of costs depending on the specific design of the collection option; where this is the case, the range of relative cost is shown.
3. This includes return to the OEM itself, or return to an entity designated by the OEM.

provided by the municipality) but typically municipal collection is not available to the IC&I sector, who make their own arrangements for collection of recyclables, including plastics. These arrangements are typically tailored to the needs of the individual entity.

- *Cost and Convenience* The cost structures of the different collection options vary in both the cost that is incurred, and who is responsible for paying the cost. Low-cost options involve the generator of a plastic discard taking the discard to a collection point; these collection costs are paid directly by the generator of the discard. These options are inconvenient for the generator to the extent that the generator must take the initiative to make a dedicated trip to a collection point; consequently, these systems are typically incentivized through, for example, a deposit/refund system that provides a "reward" for returning a discard to a collection point. The most convenient collection options are those in which the collection agent comes to the generator of plastic discards (e.g. through curbside collection); however, these are the most expensive options. Costs must also include processing and transportation to market where, in the case of municipal service, the municipality is responsible for these tasks as well as the cost of collection.

3.2 Collection of Plastics Discards in Nova Scotia

There are four approaches to collection of post-consumer plastic discards in Nova Scotia:

- Curbside collection for plastic discards in the residential sector
- A collection depot network for plastics recovered under the provincial deposit/refund system for used beverage containers from both the residential and the IC&I sectors
- Asset management/non-profit collection of late model electronics from the IC&I sector
- Commercial collection of plastic discards from the IC&I sector.

Curbside Collection Plastics discards are collected through two curbside collection activities. Plastic discards that are destined for recycling are source separated by residential generators across Nova Scotia. These plastics are collected by municipalities as source separated plastics. Plastics that may be collected this way include plastics banned from disposal (LDPE and HDPE bags and packaging)[20], beverage containers that have not been returned by the consumer for refund, and other plastics that a municipality may collect in order to divert materials from landfill in accordance with provincial solid waste management policy.

Generally, municipalities collect commingled plastics that have been source-separated from other solid waste-resources. At the point of collection, commingled plastics may have also been commingled with other dry recyclables (e.g. glass); sorting is then required to separate plastics from other dry recyclables. Municipalities either own, operate or contract facilities for processing and incur related costs.

[20] HRM is the only municipality that has a formal protocol for inspecting deliveries for banned or unacceptable materials targeted for diversion. Also, the use of a "front end processor" by HRM to recover recyclable materials contributes to on-going compliance.

Source separated plastic discards collected through curbside collection by municipalities in Nova Scotia are exclusively plastics packaging materials from the residential sector and small businesses served through municipal collection. Based on a survey of municipal plastics recovery and recycling undertaken in November 2006 in support of the preparation of this document, the total annual tonnage of plastics recovered in Nova Scotia through curbside collection is estimated to be as follows:

	No.1: PET	**No. 2: HDPE**	**No.4: LDPE**	**No. 1 – 7: Commingled**	**Total**
Annual Total Residential Plastics Collected (tonnes)	150	424	1,425	1,663	3,662

Source: Survey by project team, November 2006

As identified above, it is not possible to identify the tonnages of different plastics in the commingled tonnage because these plastics are collected and sold in "commingled" formats.

Plastics discards that are collected as part of residual waste are destined for disposal. These include all plastics discards generated by households except those that are collected through curbside collection for recycling and those are recycled through a collection depot, see below.

Collection Depot Plastic (and other) beverage containers that are redeemable under the provincial deposit/refund system are collected at privately operated depots. In response to a survey of municipal plastics recovery and recycling undertaken in November 2006 in support of the preparation of this document, the RRFB (which purchases all beverage containers recovered by the depots) reports annual beverage container plastics recovery as follows (in tonnes) for fiscal 2005/06:

	No.1: PET	**No. 2: HDPE**	**Other Plastics**	**Total**
Annual Total Beverage Plastics Collected (tonnes)	3,025	249	1,830	5,104

Source: RRFB, January 2007

Plastics associated with end-of-life motor vehicles are not separately collected in the province. End of life vehicles are collected at automotive scrap yards, and these may be considered as a type of "collection depot". All scrapped vehicles are shipped out of province for processing, including the plastics associated with them. Recovery of plastics from these vehicles at the point of processing is limited or absent.

Asset Management/Non-Profit Collection Asset management collection of plastics in Nova Scotia is largely limited to late model computers and related electronics equipment[21]. The total quantity of discarded plastics that are collected through this mechanism is unknown. However, available data suggests that the total quantity of plastics associated with electronic equipment collected annually through asset management/non-profit organisations is not more than 100 tonnes per year.

[21] [21] PHA Consulting Associates, *Electronic Waste Recovery Study*, Resource Recovery Fund Board, 2006: Chapt. 3.

Table 5
Summary of Current Plastics Recycling Collection in Nova Scotia
(Annual Tonnes)

	No. 1: PET/ PETE	No. 2: NDPE	No. 4: LDPE	Commingled No.1 – No.7	Engineered Plastics	Total
Municipal Curbside Collection	150	424	1,425	1,663		3,663
Collection Depot	3,025	249		1,830		5,104
Collection from IC&I Sector				1,000		1,000
Electronics					<100	<100
TOTAL	**3,175**	**673**	**1,425**	**4,493**	**<100**	**9,867**

Contract Collection of Plastics The IC&I sector (including agriculture and fisheries as well as other IC&I activities) manages its plastics wastes through contract collection. Collection of discards may be associated with recycling of the discards, or with disposal.

As part of the survey undertaken in support of the preparation of this document, municipal officials were asked whether they received or processed plastics from the IC&I sector, and private sector processors of secondary materials and brokers were asked whether they handled IC&I plastics for recycling. Some municipalities responded that they accept plastics if they are brought to a materials recovery facility or other location specified by the municipality, but municipalities report that they receive negligible quantities of plastics from the IC&I sector. One broker responded that approximately 25 percent of their plastics brokering business is related to plastics sourced from the IC&I sector (and 75 percent related to plastics from the municipal sector), but others indicated that they do not knowingly handle any plastics from the IC&I sector. This suggests that the total quantity of IC&I plastics destined for recycling in Nova Scotia is probably not greater than 1,000 tonnes per year, with the remainder being disposed of.

Table 5 summarises the collection of plastics for recycling in Nova Scotia. Plastics materials identified in Table 3 in excess of those identified in Table 5 are managed through disposal.

3.3 Transportation and Processing of Plastics Discards Collected in Nova Scotia

Residential plastics discards to be recycled are collected from households in Nova Scotia and are transported in the collection vehicle (primary transportation) to a materials recovery facility (MRF), where they are processed according to the needs of the end-use market and are baled. Transportation by truck is then undertaken to the market for the plastic (secondary transportation). Secondary transportation costs vary according to market arrangements and distance of transportation; transportation costs in the range of $15 – 25/tonne are generally incurred, however, although one operator is reportedly paying a transportation cost of $80/tonne.

In loose form, plastics have a low weight:volume ratio; i.e. they occupy large amounts of space relative to their weight. Accordingly, plastics incur high transportation costs relative to the weight of plastics that are transported. Manufacturers overcome this problem in two ways when they market new plastics products:

- The value of a product lies in the utility of the product itself, not the weight of the materials used to manufacture it, so the issue of a low weight:volume ratio is not relevant.
- Plastics manufacturing materials that are sold on a weight basis are shipped in a format that achieves a high weight:volume ratio; thus plastic materials may be shipped as pellets or flake that is used by the purchaser to manufacture a product.

Achieving high weight:volume ratios in collection and transportation of recyclable plastics requires that a form of densification is applied to the collected plastics. Densification at the point of collection is constrained by the following factors, however:

- Generators may include non-plastic contaminants with the plastics they make available for collection. Many plastics recycling technologies are highly sensitive to non-plastic contamination, however. Once densified, non-plastic contaminants may be difficult and/or costly to remove.
- Generators may include plastics that are not part of a collection program in the plastics they make available for collection, and it may not be feasible to remove these following densification.

Accordingly, densification technologies at the point of collection are generally limited to levels of compaction that allow non-complying materials to be removed at a MRF.

For a range of discarded durable plastic products (e.g. electronics) plastics occur in combination with other materials that result in an overall higher weight:volume ratio. Plastic wastes in end-of-life vehicles are typically crushed along with the rest of the vehicle at the point of collection.

3.4 Collection and Management of Plastics Discards in Canada and Internationally

The options available for collection of plastics in other Canadian jurisdictions and internationally are the same as those identified in Table 4. However, the legal and institutional frameworks that govern the collection of plastics (and their subsequent management) differ in other jurisdictions as compared to Nova Scotia and this results in different – often enhanced – opportunities for plastics recovery and recycling.

The countries of the Organisation for Economic Development and Cooperation (OECD) share generally similar levels of social and economic development, and may be considered relevant in contrasting and comparing collection of plastics discards in Nova Scotia with similar collections elsewhere in the OECD. Consideration of legal and institutional frameworks for the collection of plastics in other jurisdictions is therefore undertaken with respect to the most relevant OECD jurisdictions, in addition to the most relevant Canadian jurisdictions.

Traditionally in Canadian and OECD jurisdictions, the cost of managing residential plastics (and other) discards has been deemed a waste management cost for which municipalities are responsible. Accordingly, initiatives to introduce enhanced management of plastics (and other) discards were based on the same idea that management of discarded residual materials is a municipal function, to be financed from municipal revenues.

Over time, however, it has become apparent that this approach presents municipalities with an unfunded environmental and financial liability that they cannot control and which becomes increasingly difficult to finance. In essence, this model allows producers (including those in the plastics industry) to market products without regard to the environmental or financial consequences on municipalities – and their residents – of these products when they are discarded. The consequence has been a rising quantity of discarded materials whose management requires increasing municipal funds – a consequence that is environmentally and financially unsustainable.

Increasingly, jurisdictions are adopting "extended producer responsibility" (EPR) legal and institutional frameworks to address this issue. The OECD defines EPR as:

> *A policy approach in which producers accept significant responsibility - financial and/or physical - for the treatment or disposal of products. The two distinguishing features of EPR policies are: the shifting of responsibility upstream to the producer, and the provision of incentives for producers to include environmental considerations in the design of their products.* [22]

While there is widespread agreement on the desirability of the EPR approach, however, the way in which it is implemented varies between jurisdictions. For analytical purposes it is helpful to consider the application of EPR in a "voluntary" and in a "mandatory" context:

- *Voluntary EPR.* The voluntary approach to EPR is based on the negotiation of agreements between producers and governments to achieve specified change in the environmental management of products. Voluntary EPR approaches to the management of plastics discards have been adopted in Canada and Australia among other jurisdictions.
- *Mandatory EPR* The mandatory approach to EPR is based on establishing EPR requirements in legislation or regulation that bind producers to specific requirements. Mandatory EPR has been adopted at the level of the European Union and in Germany and Japan among other jurisdictions.

Table 6 details the application of voluntary and mandatory EPR in these jurisdictions in – primarily - the packaging sector, including plastics[23]. EPR programs related to other plastics products (and products in which plastics are a major constituent) have also been implemented, including programs in the electronics, motor vehicle and carpet industries. However, it is the packaging industry that has the widest track record in EPR and, as identified above, approximately two-thirds of plastics discards in Nova Scotia occur in the packaging sector.

[22] EPR is not defined in Nova Scotia legislation, although "industry stewardship" is elaborated in the Solid Waste-Resource Regulations issued under the *Environment Act*

[23] EPR programs have also been implemented in Nova Scotia (e.g. for milk containers), but these have been more limited in scope and not as directly relevant to the plastics sector as the initiatives identified in Table 6.

Table 6: Assessment of Selected Extended Producer Responsibility Programs For Collection of Plastics Discards

COUNTRY	OBJECTIVES AND DESCRIPTION OF EPR INITIATIVE	RESULTS	NOTES
"Voluntary"			
Canada – National	*National Packaging Protocol (NaPP)* Objective To reduce the amount by weight of packaging (including plastics) requiring disposal by 50 percent between 1989 and 2000. Key Elements NaPP was negotiated between the packaging industry, federal, provincial and municipal governments and environmental NGO's. Policy priority given to source reduction and reuse as well as recycling. Implementation left to provinces.	Objective achieved.	The effect of NaPP was to favour plastics packaging since diversion objective was stated in total tonnes of packaging EPR framework did not require producers to contribute financially to discarded packaging
Canada – Ontario	*Blue Box Program Plan (BBPP)* Objective To increase the diversion of municipal Blue Box materials in an economically sustainable manner. Key Elements Mechanism for cost-sharing residential recycling program in Ontario. "Blue box wastes" defined in legislation, and include plastics. "Stewards" defined to include brand owners and first importers of discarded products that are comprised of designated materials. Stewards have agreed to finance 50 percent of BBPP costs, calculated to include total operational costs plus market development, communications, administration, and an "Effectiveness and Efficiency" Fund; contribution of individual stewards is determined through a formula. Stewards contribute approximately $55 million/year to municipalities (2007) to offset municipal BBPP costs.	2003 and 2005 materials recovery increase of over 10.4 percent by weight; projected costs for 2006 and 2007 are projected to be $10 million and $14 million respectively less than would have been the case without the BBPP.	Effective BBPP program cost-sharing has been achieved, and mechanisms are in place to enhance recycling performance, including all aspects of recycling plastics. Improved environmental performance of designated materials not addressed, including plastics; increasing levels of waste generation may be institutionalised
Australia	*National Packaging Covenant (NPC)* Objective To ensure that lifecycle management of packaging and paper and the implementation of collection systems including kerbside recycling schemes, produces real and sustainable environmental benefits in a cost effective manner. Key Elements Non-prescriptive, self regulated approach to life cycle management of plastics discards and other packaging. Private sector signatories submit plans that address minimizing environmental impacts of packaging, develop markets for recycled materials, and contribute financially to recycling programs. Implementation began in 1999; strengthened application for 2005-2010: (i) addresses plastics Nos.4-7, (ii) establishes recycled content targets for packaging and recycling targets for packaging materials including 50% increase in plastics packaging recycling, and (iv) targets "no new packaging to landfill"	"Only limited evidence of the 'real and sustainable environmental benefits' that NPC is intended to result in"[1].	Initial NPC implementation marked by inadequate levels of voluntary participation, uneven implementation, and free-riders.
"Mandatory"			
European Union	*EU Directive on Packaging and Packaging Waste* Objective To reduce negative environmental impacts associated with packaging and packaging waste. Key Elements Specific targets for the recovery and recycling of specific packaging materials, criteria for quantities of designated toxic materials allowed in packaging, requirement for market development for recyclable materials, requirements for public education	Verified increase in recycling rates and decrease in landfill rates (rates vary by country)	Countries are individually responsible for compliance with the Directive and must adopt their own measures for achieving compliance. Some countries have set targets for prevention of packaging waste and for reuse.
Germany	*Packaging Ordinance* Objective To promote design of environmentally-preferred packaging, limit consumption of virgin materials and energy, and reduce pollution associated with materials extraction and energy generation. Key Elements Requirement for producers and retailers (individually or collectively) to take back and treat post-consumer packaging, targets for reuse, recycling and heavy metals content of packaging.	Packaging consumption decreased by 14 percent by weight over first 10 years of implementation[2].	Producers and retailers created Duales System Deutschland (DSD) to manage used packaging nationally. Recycling costs have come down, helping to create recycling sustainability.
Japan	*Container and Packaging Recycling Law* Objective To promote the reduction of wastes by managing used packaging through recycling. Key Elements Plastics and other packaging materials designated for recycling. Responsibilities for used plastics and other packaging assigned to consumers, businesses and government. Government determines recyclable quantities on an annual basis. Business calculate the quantities of materials they must recycle; consumers source separate; municipalities collect designated recyclable materials. Designated corporation responsible for coordinating recycling of used packaging: corporation contracts haulers, and pays haulers based on receipts issued by the recycler confirming materials will be recycled. Extensive record keeping and labelling requirements	2000-2006 increase in plastics (excluding PET) recycling of 300% and 140% for PET. 2007– 2010 projected increase in recycling of plastics (excluding PET) of 40% and 21% for PET (all by weight)[3]	The law is intended to divert materials from landfill through the mechanism of recycling. Law does not directly address waste minimization, except that heavier packaging costs more to manage, and this encourages development of lighter packaging (particularly plastics) over time.

Notes: 1). Nolan ITU, *Evaluation of the National Packaging Covenant*, Melbourne, 2004: Vol. 1, p. iii.; 2). Quinn, Lisa, *Stewardship of Plastics Packaging Materials in Manitoba*, University of Manitoba 2004; pp 62/63; 3). Ministry of Economy, Trade an Industry, *3R Policies: Statistics*, Tokyo, 2004 and Japan for Sustainability Newsletter 1 February 2006.

Voluntary EPR programs have been implemented where either:

- There is a desire to achieve a harmonised policy approach to management of a product (in this case, used packaging), but there is no jurisdiction with authority to impose policy harmonisation. These situations occur in federal jurisdictions where environmental regulatory authority rests at the provincial or state level, and where all provinces or states recognise the value of a harmonised policy framework across the federation; or
- There is compelling reason for all industry players to agree on a joint course of action. This may occur because the scale of benefits that can be achieved is attractive to the sector as a whole, or because the consequences of failing to act as a sector are sufficiently serious.

In Canada, the National Packaging Protocol (NaPP) was a policy tool for achieving the objective of reducing the tonnage of packaging going to disposal by a defined amount and through policy actions that all provinces, industry and NGO stakeholders agreed with. Prescriptive and regulatory measures regarding how this was to be achieved were not identified in the NaPP; instead, the packaging sector was given flexibility to meet the requirements in the most cost-effective ways, although the NaPP explicitly referenced that "regulations will be implemented as necessary" to achieve the NaPP objectives. Rapid increases in landfill costs that were not directly connected to the NaPP gave impetus to the development and application of reusable industrial packaging and lighter consumer packaging, both of which benefited the plastics industry.

One industry that has voluntarily responded directly to the threat of direct regulatory action is the polystyrene industry, which has established the Canadian Polystyrene Recycling Association (CPRA) in response to the perceived probability of direct regulatory actions by provincial governments to impose polystyrene recovery and recycling requirements. CPRA developed a national polystyrene recycling strategy, built a recycling facility and commenced implementation of the strategy, but implementation waned as it became clear that provincial regulatory action to require recovery and recycling of polystyrene would not, in fact, be introduced. The facility continues to operate; however, in Canada polystyrene collection for recycling is largely limited to southern Ontario[24].

The Blue Box Program Plan (BBPP), see Table 6**,** represents a culmination of almost 20 years of efforts in Ontario to negotiate a long term basis for the packaging industry to provide financial support to municipalities, who implement the program. The BBPP was finally negotiated because the Minister required that a stewardship plan be developed and agreed. As with the NaPP, the consequence to the packaging industry (and other "stewards") of failing to address this issue was perceived to be direct regulatory intervention by the provincial government. Key issues for the stewards include their ability to manage their own funds and to work with municipalities to improve efficiency and effectiveness as a mechanism for minimising the costs of the stewardship participation of the industry. However, the BBPP does not fully meet the OECD criteria for EPR since it does not provide incentives for producers to include environmental considerations in the design of their products.

[24] Polystyrene is also undertaken in other countries, and private sector polystyrene industry associations in 31 countries (including Canada) have signed an international agreement to facilitate the recycling of their products (see www.epsrecycling.org).

In Australia, wider and more ambitious goals for packaging management were established in the National Packaging Covenant (NPC), see Table 6. However, these goals were poorly defined, required implementation at the state (note federal) level and only applied to companies that individually signed on as participants in the NPC. Inadequate definition of objectives, complex implementation methodologies, and private sector concern about free-riders resulted in poor levels of participation and disappointing results. The NPC has been re-focussed and includes more tangible targets to be achieved by 2010. The more direct approach now being undertaken in Australia is evidenced by the a decision by the State of Victoria to ban plastic carry out bags, except for those bags on which retailers place a levy of at least $A 0.10[25].

By definition, mandatory EPR programs require that specific goals be achieved or that specific actions be taken by the regulated parties. Implementation may be flexible, however. The EU Directive on Packaging and Packaging Waste, see Table 6, sets specific and ambitious goals for the management of used plastics and other packaging. Implementation, however, is the responsibility of EU member States, some of which (e.g. Denmark) have adopted implementation measures that include voluntary EPR actions.

In Germany, see Table 6, the creation of a mandatory EPR initiative in the packaging sector has placed direct responsibilities on producers and retailers that were initially resisted but which have resulted in significant improvement in the management of used plastics packaging and other packaging materials. High costs associated with this initiative were primarily a function of a lead-in period that was insufficient to allow for economies of scale or for negotiation of competitive contracts for packaging management. Similarly in Japan, very great increases in the quantities of used plastics (and other) packaging have been achieved as a result of specific stakeholder responsibilities set out in legislation, as detailed in Table 6, and large additional gains are projected from the 917,300 tonnes of plastics recovered in 2006.

Effective EPR programs are characterised by:

- Tangible, measurable and monitored goals for the management of designated products or materials.
- Clearly articulated stakeholder responsibilities for achieving the goals, and credible penalties for stakeholders that fail to assume their responsibilities.
- Measures that bind the participation of all stakeholders in a sector; free-riders are eliminated in successful programs in order to ensure a "level playing field" for all stakeholders, although *de minimis* provisions may be considered if the participation of the smallest stakeholders is considered to be economically burdensome on the stakeholders, or administratively complex.
- Clear rules, decision-making structures and formulae for financial contributions.

Some EPR frameworks are more prescriptive than others in terms of how targets are met. Higher levels of specificity in this respect require greater levels of monitoring. On the other hand, a focus on results (i.e. a measurable target) reduces monitoring requirements by the regulator/administrator,

[25] Environment Victoria, *Free Plastic Bags To Be Banned*, 17 July 2006, Carlton Victoria; www.envict.org.au

and provides producers of regulated products/materials flexibility in how they meet the targets. Financial frameworks that provide for the costs of EPR initiatives to be directly allocated to specific products go one step further: they provide incentive to producers to compete on the basis of the EPR performance of the product. This results not only in compliance with EPR objectives, but also in product innovation that both reduces the cost of achieving compliance with EPR objectives and in improved environmental performance of the product itself (e.g. source reduction benefits that minimize virgin resource and energy use, and which also reduce the costs of end-of-life management).

These requirements can most effectively be met through EPR requirements set out in regulating frameworks and which establish an equitable basis of performance for all regulated parties.

The dominant theme of the EPR initiatives identified in Table 6 has been the reduction of waste requiring disposal as measured on a weight basis. This has been beneficial to manufacturers of plastics and plastic products since plastics are amenable to a very wide range of applications while also being lightweight in comparison to other competing materials. While the application of plastics has resulted in decreases in the unit weight of products, however, the tonnage of discarded plastics managed through disposal has continued to grow continuously over the past two decades; this is expected to continue over the next decade in the absence of interventions to develop enhanced recycling capacity.

EPR is also applied in other Canadian jurisdictions and internationally to other plastic products, or products containing significant quantities of plastics, in addition to packaging:

- The EU has adopted a Directive on End-Of-Life Vehicles that requires, among other things:
  - "Economic operators" to establish collection systems that are available for the public to return end-of-life vehicles at no cost;
  - The separation/segregation of "large plastic components"; and
  - The reuse and recycling of at least 80 percent of end-of-life vehicles by weight.

- Carpet manufacturers in the US have voluntarily established the Carpet America Recovery Effort, an organisation charged with coordinating achievement of the recovery and recycling of at least 20 percent of used carpets in the US by 2012. CARE was established through a Memorandum of Understanding signed by industry members, governments (national, state and local) and non-governmental organisations; in 2005 it diverted approximately 126,500 tonnes of carpet from landfill of which approximately 92 percent was recycled and which represents approximately 5 percent of the carpet estimated to have been discarded in the U.S. in that year[26].

- The electronics industry participates in voluntary and mandatory EPR initiatives in Saskatchewan, Alberta and British Columbia as well as in the EU and in several OECD and non-OECD jurisdictions.

[26] The remaining 8 percent of recovered carpet was burned for energy recovery, see CARE 5th Annual Conference, May 2007, Fifth Annual CARE Report Summary: http://www.carpetrecovery.org/conf2007_resources.php

4. MARKETS FOR NOVA SCOTIA PLASTICS

This section details the markets that are available for post-consumer plastics recovered in Nova Scotia, factors relevant in the marketing of plastics recovered in Nova Scotia and prices for plastics recovered in Nova Scotia.

4.1 Markets for Nova Scotia Plastics

Currently, plastics that are recovered in Nova Scotia for recycling are sold to markets in Atlantic Canada, Quebec and Ontario. Markets that are located outside this general geographic range become progressively more expensive to access as a consequence of increasing transportation cost. Table 7 identifies recycling markets for plastics within Canada as far west as Toronto; other markets in southern Ontario are identified where the market has a particular expertise that may be attractive for the recycling of plastics recovered for recycling in Nova Scotia.

The following are key points associated with the markets identified for plastics recycling:

- Most markets accept more than one type of plastic; however, some markets may limit their activities to recovery/recycling of rigid or of film plastics.
- Markets for plastics recovered in Nova Scotia are of two kinds:
  - Manufacturers that make a final product.
  - Brokers and intermediate processors who sell recovered plastics to a manufacturer. Brokers on-sell the plastics without undertaking intermediate processing. Intermediate processors may undertake a variety of operations, including separation of commingled plastics, cleaning of plastics, or flaking/pelletizing/grinding of plastics for sale to an end-user.
- There is a large, but non-quantified, export market for plastics recovered in Nova Scotia. Discussions with several of the markets identified in Table 7 highlighted that the export of plastics plays a major role in the overall marketability of recovered plastics. The primary export destination for plastics recovered in Nova Scotia (and elsewhere in Canada) is Asia, and specifically China. All those contacted who are engaged in export of recovered plastics claim that the plastics they export are recycled, not burned or incinerated. However, none of the markets has a mechanism for verifying that this is in fact the case.

The markets identified in Table 7 all accept used plastics packaging recovered by municipalities as well as other plastics from durable and non-durable discarded products of the resin type identified in the Table.

4.2 Factors in Marketing Plastics

The following are key in the marketing of plastics recovered in Nova Scotia:

- *Avoidance of contamination from non-plastic materials* Most markets require that contamination of recovered plastics by non-plastic materials (e.g. stones, paper, "garbage") should not exceed 2 percent by weight of the plastic. Markets that accept higher levels of contamination offer lower prices and may undertake work themselves to remove the contaminants.

Table 7
Selected Canadian Markets for Recycling Plastics Recovered in Nova Scotia (2006)

PLASTIC	NAME OF COMPANY	LOCATION OF END-USE MARKET OR BROKER	CONTAMINATION	MINIMUM QUANTITY[1]	DELIVERY FORMAT	FREQUENCY OF DELIVERY
No.1 PET	*Antek Madison www.antekmadison.com	Toronto, Ont. (416) 321-1170	0.5%	Truckload	1000 lb bale or larger	As necessary
	Genor Recycling Services	Brantford, Ont. (519) 756-5264	2%	Truckload	Baled	As necessary
	Groupe Lavergne www.lavergneusa.com	Anjou P.Q. (514) 354-5757	Varies	Truckload	Baled	May be defined in contract
	Haycore Canada www.haycore.com	Russell, Ont (613) 445-3610	0.5% - 2%	Truck load	Baled	As necessary
	*HGC Management	Belleville, Ont. (613) 968-3848	0.5%	Truckload	1000 lb bale or larger	As necessary
	Novapet	Amherst, NS (902) 667-1398	Varies	Truckload preferred	Baled preferred	As necessary
	*Tristar Exports Int.	Richmond Hill, Ont. (905) 773-2936	No limit	Container load	Baled or flake	
	*Turtle Island Recycling www.turtleislandrecycling.com	Toronto, Ont. (416) 406-2040	Varies	Truckload	Baled	As necessary
No.2: HDPE	*Antek Madison www.antekmadison.com	Toronto, Ont. (416) 321-1170	0.5%	Truckload	1000 lb bale or larger	As necessary
	Cascades Re-Plast www.cascadesreplast.com	Notre Dame Bon Conseil, P.Q. (819) 336-2440	0.5% - 2%	Truckload	Baled	As necessary
	EnviroAge Plastic Industries	Charlottetown, PEI (902) 566-4322	5%	10,000 pounds/ 4500 kgs	Baled	As necessary
	Genor Recycling Services	Brantford, Ont. (519) 756-5264	2%	Truckload	Baled	As necessary
	Haycore Canada www.haycore.com	Russell, Ont (613) 445-3610	0.5% - 2%	Truck load	Baled	As necessary
	*HGC Management	Belleville, Ont. (613) 968-3848	0.5%	Truckload	1000 lb bale or larger	As necessary
	Novapet	Amherst, NS (902) 667-1398	Varies	Truck load preferred	Baled preferred	As necessary
	*Novaponics	Dartmouth, NS (902) 422-1702	Varies	Container load	Baled	As necessary
	*Terrence Commerce Inc.	Richmond Hill, Ont. (905) 709-2981	5%	ISO Container	Baled	As necessary
	Recyc RPM www.recycrpm.com	St. Damien, P.Q. (418) 789-2450	2%	Truckload	Baled	As necessary
	SolPlast www.solplastics.com	Montreal, P.Q. 1-888-765-7527	No metal, glass, wood or paper	Truckload	Baled	As necessary
	*Turtle Island Recycling www.turtleislandrecycling.com	Toronto, Ont. (416) 406-2040	Varies	Truckload	Baled	As necessary
No.3: Vinyl	Haycore Canada www.haycore.com	Russell, Ont (613) 445-3610	0.5% - 2%	Truckload	Baled	As necessary
	Recyc RPM www.recycrpm.com	St. Damien, P.Q. (418) 789-2450	2%	Truckload	Baled	As necessary
No.4: LDPE	*A.R.Impex www.arholding.com	Waterloo, Ontario (519) 886-9634	20%	Truckload	Baled	Contract on quantity, not price
	EnviroAge Plastic Industries	Charlottetown, PEI (902) 566-4322	5%	10,000 pounds/ 4500 kgs	Baled	As necessary
	Haycore Canada www.haycore.com	Russell, Ont (613) 445-3610	0.5% - 2%	Truck load	Baled	As necessary
	*HGC Management	Belleville, Ont. (613) 968-3848	5%	Truckload	Baled or loose	As necessary
	*Novaponics	Dartmouth, NS (902) 422-1702	Varies	Container load	Baled	As necessary

Table 7
Selected Canadian Markets for Recycling Plastics Recovered in Nova Scotia (2006)

PLASTIC	NAME OF COMPANY	LOCATION OF END-USE MARKET OR BROKER	CONTAMINATION	MINIMUM QUANTITY[1]	DELIVERY FORMAT	FREQUENCY OF DELIVERY
	Recyc RPM www.recycrpm.com	St. Damien, P.Q. (418) 789-2450	2%	Truckload	Baled	As necessary
	SolPlast www.solplastics.com	Montreal, P.Q. 1-888-765-7527	No metal, glass, wood or paper	Truckload	Baled	As necessary
	Think Plastics www.thinkplastics.ca	New Hamburg, Ont. (519) 662-6667	No rocks, twine or "garbage"	Truckload	Bundled/baled	As necessary
	*Turtle Island Recycling www.turtleislandrecycling.com	*Toronto, Ont. (416) 406-2040*	*Varies*	*Truckload*	*Baled*	*As necessary*
No.5: PP	Genor Recycling Services	Brantford, Ont. (519) 756-5264	2%	Truckload	Baled	As necessary
	Haycore Canada www.haycore.com	Russell, Ont (613) 445-3610	0.5% - 2%	Truckload	Baled	As necessary
	*HGC Management	Belleville, Ont. (613) 968-3848	0.5%	Truckload	1000 lb bale or larger	As necessary
	SolPlast www.solplastics.com	Montreal, P.Q. 1-888-765-7527	No metal, glass, wood or paper	Truckload	Baled	As necessary
	*Terrence Commerce Inc.	Richmond Hill, Ont. (905) 709-2981	5%	ISO Container	Baled	As necessary
	*Tristar Exports Int.	Richmond Hill, Ont. (905) 773-2936	2%	Truckload/ Container load	Baled/regrind	As necessary
	*Turtle Island Recycling www.turtleislandrecycling.com	*Toronto, Ont. (416) 406-2040*	*Varies*	*Truckload*	*Baled*	*As necessary*
No.6: PS	Canadian Polystyrene Recycling Assoc. www.cpra-canada.com	Mississauga, Ont. (905) 612-8290	No liquids/food waste; maximum non-PS plastics varies by resin	No limit	Bagged or baled	As necessary
	Haycore Canada www.haycore.com	Russell, Ont (613) 445-3610	0.5% - 2%	Truck load	Baled	As necessary
	*HGC Management	Belleville, Ont. (613) 968-3848	0.5%	Truckload	1000 lb bale or larger	As necessary
	SolPlast www.solplastics.com	Montreal, P.Q. 1-888-765-7527	No metal, glass, wood or paper	Truckload	Baled	As necessary
	*Turtle Island Recycling www.turtleislandrecycling.com	*Toronto, Ont. (416) 406-2040*	*Varies*	*Truckload*	*Baled*	*As necessary*
No.7: Other/ Commingled	*Antek Madison www.antekmadison.com	Toronto, Ont. (416) 321-1170	5 percent	Truckload	1000 lb bale or larger	As necessary
	Cascades Re-Plast www.cascadesreplast.com	Notre Dame Bon Conseil (819) 336-2440	Varies	Truckload	Baled	As necessary
	Genor Recycling Services	Brantford, Ont. (519) 756-5264	2%	Truckload	Baled	As necessary
	Haycore Canada www.haycore.com	Russell, Ont (613) 445-3610	0.5% - 2%	Truck load	Baled	As necessary
	*HGC Management	Belleville, Ont. (613) 968-3848	0.5%	Truckload	1000 lb bale or larger	As necessary
	SolPlast www.solplastics.com	Montreal, P.Q. 1-888-765-7527	No metal, glass, wood or paper	Truckload	Baled	As necessary
	*Turtle Island Recycling www.turtleislandrecycling.com	*Toronto, Ont. (416) 406-2040*	*Varies*	*Truckload*	*Baled*	*As necessary*

Note 1: "Truckload" is equivalent to 16 – 18 tonnes

Sources: 1. Survey by project team, November 2006 – January 2007; 2. *2004-2005 Scrap Plastics Markets Directory*, Resource Recycling Inc., Portland, 2004; 3. *Recycled Products and Markets Database*, American Plastics Council, 2006; 4. Répertoire Québécois des Récupérateurs, Recycleurs et Valorisateurs, Recyc-Québec, 2006.

Organisations in asterisked (*) *italic* font are understood to broker plastics. Other organizations may undertake intermediate processing, manufacture of an end-product or brokering activities.
Other organizations may also receive plastics recovered in Nova Scotia. Organizations identified in Table 7 may vary the plastics they receive and the specifications they apply to the plastics they receive.

- *Avoidance of cross-contamination from other plastics* Where plastics are sold as a single resin product (e.g. PET, HDPE etc.) cross contamination from other plastics should be avoided. Generally, cross-contamination of greater than 2 percent by weight is considered unacceptable for these markets. Similarly, plastics that are sold as "commingled" should contain only the plastics that are specified to be included in the commingled shipment.

- *Delivery Quantity and Frequency* Markets identified in Table 7 typically require delivery of plastics in "truckload" quantities. Definitions of "truckload" vary but 16,000 kgs/35,000 lbs is a typical definition. Markets that are in Atlantic Canada, however, expressed a willingness to consider smaller delivery quantities, to a minimum delivery of 4,500 kgs/10,000 lbs.

  Most markets accept delivery on an "as-needed" basis; i.e. arrangements for delivery can be made when a supplier has the minimum shipment quantity. Some markets prefer to operate on a contract basis, but contracts of this nature are limited to the supply of plastics materials without reference to price. The reason for this is that market prices for secondary plastics fluctuate widely in very short periods of time, and markets prefer not to commit to prices that may not be justified when a shipment of plastics is received, see Section 4.3.

  Markets for plastics recovered in Nova Scotia generally expect plastics to be delivered in a baled format.

The coding system adopted by the industry for identifying the "commodity" plastics used in packaging (i.e. plastics No.1 through No.7) is widely used in the secondary plastics industry for identification of plastics. However, it appears that both foreign and domestic manufacturers, and the secondary plastics sector may be deliberately abusing this system:

- There have been persistent reports that overseas and domestic manufacturers may label their products incorrectly with respect to the type of plastic the products are made from; anecdotal reports suggest this may also be occurring in Nova Scotia[27]. This is a serious issue in terms of the credibility of the plastics industry to support recycling through voluntary application of the coding standards. The mis-labelling of products in this way can seriously threaten the viability of recycling infrastructures if a particular discard of a stated plastic type is collected for recycling, and is later discovered to be a different resin than it claims to be.

- Recovered plastics may be sold as a higher value resin than is actually the case. Several instances of this practice have been anecdotally reported in the preparation of this document, although none directly relate to Nova Scotia plastics or organisations. However, practices of this sort place the secondary plastics industry in disrepute, and this will impact Nova Scotia in future if secondary plastics transactions in general are perceived as a risky commercial undertaking.

4.3 Market Prices for Plastics

Average quoted prices for secondary plastics and prices received for secondary plastics recovered in Nova Scotia in 2006 are identified in Table 8. Prices are quoted at two levels:

[27] Personal communications by the author with plastics processors and brokers during 2004 – 2007.

Table 8
Market Prices for Post Consumer Secondary Plastics (2006, $/tonne)

	No 1: PET (Mixed Colour)	No.2: HDPE (Mixed Colour/ Natural)	No.3: V	No. 4: LDPE (Mixed Colour)	No.5: PP	No.6: PS	No.7: Other and Commingled	Engineering Grade Resins (See Note 1)
Prices Paid for Post-Consumer Plastic								
Quoted Spot Market Price – Canada	$190 – 410	$385-860/ $400-875	ND	$54-170	ND	$75	$100-175	N/A
Prices Received by Nova Scotia Operators	$300	$440-635/ ND	N/A	$75-250	N/A	N/A	$100	N/A
Re-Sale Price of Post-Consumer Resin								
Value of Regrind/Flake and Pellets	Flake: $875 – 965 Pellets: $1100 – 1200	Mixed Colour Flake: $735 – 780 Pellets: $965 – 1,015 Natural Flake: $1035-1104 Pellets: $1265-1,335	Flake: $645 – 780 Pellets: ND (See Note 2)	Flake: $575 – 690 Pellets: $805-920	Flake: $665 – 760 Pellets: $920 – 1015 (See Note 2)	Flake: $920 – 1150 Pellets: $1200 – 1425	Flake: N/A Pellets: N/A (See Note 3)	Flake: $1035 - 1150 Pellets: $1150 - 1380

Notes

1. Engineering resins include high impact HIPS, ABS, PPO, nylons and other plastics found in specialized applications in durable products (e.g. in electronics and motor vehicles). These resins are not currently collected from post-consumer sources in Nova Scotia.
2. Values of regrind/flake and pellets for these materials are based on post-industrial waste. These materials are not currently collected in Nova Scotia except as a component of commingled plastics.
3. Commingled plastics are either used as is without resale as regrind, flake or pellets, or are separated and sold as one of the resins identified in the Table.

Prices are in $Canadian and exclude cost of transportation. Quoted prices are current in January 2007, but are a guide only and specific markets may offer different prices.

Sources: (i) Data reported by Nova Scotia Solid Waste-Resource Regions; (ii) Corporations Supporting Recycling, Toronto; (iii) Recyc-Québec, Montreal; (iv) Verespej, M., *Plastics News*, January 2007.

- Prices paid for post-consumer plastics; these are the prices that municipalities (or solid waste-resource regions) are paid for the plastics they sell.
- Prices paid to intermediate processors by end-users. Typically, plastics recovered from post-consumer sources are processed by an intermediate processor into flake or pellet format, which is then sold to an end-user and from which a new plastic product is manufactured. In some instances, an end-use manufacturer may purchase post-consumer plastics for the prices identified in the bullet above; the end-user themselves would then create a flake or pellet which they would use internally for manufacture of a new product.

Except as noted, prices quoted in Table 8 are for post-consumer plastics. Post-industrial secondary plastics are also traded, as identified in Section 2.2. These plastics are generated from off-spec products, trimmings from manufacture processes and from other sources internal to the industry. Typically, these sources of plastic are cleaner and more homogenous than post-consumer plastics, and have therefore commanded a higher price than post-consumer plastics. In some instances, however, flake and pellet prices for post-consumer secondary plastics trade at a premium over post-industrial secondary plastics; post-consumer mixed colour HDPE, for example, trades at up to $90/tonne more than the equivalent post-industrial secondary plastic.

Table 8 does not include prices for No.3: V or No.5: PP. These plastics make up only a small percentage of post-consumer plastics and are generally not separately collected in Nova Scotia or elsewhere. However they may be included in commingled plastics. Work in North America has been undertaken in, particularly, the U.S. to develop markets for No.3:V, but a sufficient market on which to base a quotable price has not developed.

Engineering grade resins are not currently recovered from post consumer sources in Nova Scotia. These resins are found in a wide variety of durable products and have properties that are linked to specific performance requirements in the applications in which they are used. Examples of engineering grade resins commonly found in durable products include nylons, ABS, PO and HIPS among a wide variety of such resins.

Several markets commented in discussion during the research to prepare this document that the issue of price should be distinguished from the issue of market application. While market prices may vary widely over short periods of time, several markets stated that there they are always able to utilise recovered plastics that meet quality criteria specified above (e.g. with respect to contamination).

5. CURRENT MANAGEMENT PRACTICE AND BEST MANAGEMENT PRACTICE FOR POST CONSUMER PLASTICS IN NOVA SCOTIA

5.1 Current Management Practice

Table 9 identifies current management practice (CMP) for discarded plastics in Nova Scotia. The CMP comprises two elements: recycling and disposal. Reuse of plastics may also take place:

- EPIC has found that on average 92 percent of Canadians reuse plastic bags and that approximately 50 percent of plastic shopping bags in Canada are reused for the purpose of containing wastes.
- Motor vehicles are commonly resold for reuse as second hand vehicles, and some plastic components may be removed from a vehicle at the end of its life for sale on the reuse market.
- Some electronics may be commonly reused. In particular, late-model computers and related equipment may be reused, as may cell phones; these are very largely transported out of the province for reuse. Older computer equipment is not widely reused.
- Furniture may be reused, and small amounts are repaired for resale.

While reuse has the effect of reducing the quantity of plastics that are discarded, however, the reused plastics are eventually discarded and must be recycled or disposed of at that time.

From data presented in Table 3 and in Table 5, it can be calculated that an estimated 13.8 percent of plastics that were discarded in Nova Scotia in 2006 were recycled in that year. These plastics were recovered almost entirely from discarded plastics packaging recovered from the residential sector.

Table 10 details plastics packaging recovery in the residential sector. As shown in the Table, a total of 8767 tonnes/year of plastics is recovered from the residential sector and recycled[28]. About half of the plastics (48.8 percent) recovered by municipalities from the residential sector are sold as commingled plastics; plastics sold according to resin type amount to 51.2 percent of the tonnage of plastics recovered by municipalities. All residential plastics recovered for recycling are collected through curbside collection, except plastics packaging collected through return of regulated beverage containers to collection depots. Plastics recovered from Regions 1, 2, 3, 5 and 6 are sold as commingled plastics; in Region 4, recovery of plastics is limited to No.1: PET, No.2: HDPE and No.4: LDPE. Lower per capita residential plastics recovery rates in Region 4 than elsewhere in the province may be attributable to the more limited range of plastics collected in the region as compared to other regions.

Plastics recovered through the RRFB-administered beverage container deposit/refund program are the single largest source of plastics packaging recovery, accounting for 58.2 percent of recovered residential plastics packaging, notwithstanding that regulated beverage containers recovered through

[28] Some municipalities accept plastics other than packaging in the recycling programs, but the quantities involved are negligible.

Table 9
Current Management Practice and Best Management Practice (2006)

PLASTICS	CURRENT MANAGEMENT PRACTICE				BEST MANAGEMENT PRACTICE (TONNES)			
	RECYCLED		DISPOSED		RECYCLED		DISPOSED	
	TONNES	PERCENT	TONNES	PERCENT	TONNES	PERCENT	TONNES	PERCENT
Packaging	9,767	20.4	37,939	80.0	33,149 → > 38,165	69.5 → >80.0	14,557→ <9,541	30.5 → < 20
Transportation	Minimal	< 1	<6,058	> 99	>4,846	> 80	<1,212	< 20
Electronics	<100	< 11.7	>754	> 99	>683	> 80	<171	< 20
Construction	Minimal	< 1	<7,710	> 99	>6,168	> 80	<1,542	< 20
Furniture	Minimal	< 1	ND	> 99	ND	> 80	ND	< 20
Other	Minimal	< 1	>438	> 99	>350	> 80	< 88	< 20
Small durables	Minimal	< 1	<8,641	> 99	>6,913	> 80	<1,728	< 20
TOTAL	9,867	13.8	>61,540	> 86	52,109 →>57,126	73 →> 80	19,298 → <14,282	27 → < 20

Table 10
Recovery of Residential Plastics Packaging

	SEPARATED SINGLE RESIN			COMMINGLED RESINS	TOTAL	PER PERSON
	NO.1: PET	NO.2: HDPE	NO.4: LDPE			
Region 1: Cape Breton	22	5	208	360	**595**	4.80
Region 2: Eastern Region; Region 3: Northern Region; Region 5: Valley Region	60	9	527	765	**1361**	5.84
Region 4: Halifax Region	41	408	398		**848**	2.23
Region 6: South Shore/West Hants	27	2	292	289	**610**	7.13
RRFB	3025	249		1830	**5104**	5.46
SUB-TOTAL	**3,175**	**673**	**1,425**	**3,367**	**8,518**	9.43
Other[1]				249	**249**	4.56
TOTAL	**3,175**	**673**	**1,425**	**3,616**	**8,767**	9.38

Note: 1. "Other" values are interpolated and represent the amount of plastics assumed to be recovered from municipalities that were unable to provide plastics recovery data.

the RRFB-administered beverage container deposit/refund program are estimated to comprise less than 20 percent of residential plastics packaging.

From data presented in Table 3 and Table 5, it can be calculated that an estimated 20.4 percent of the current annual plastics packaging used in Nova Scotia is recovered and recycled. The great majority of recycled plastics packaging is estimated to be recovered from the residential sector through municipal recycling programs and the beverage container deposit/refund system. When only packaging from the residential sector is considered, an estimated 40.4 percent of discarded packaging material generated by the residential sector is recycled. There is wide distribution in recovery rates within this figure, however:

- Approximately 80 percent of beverage containers are recovered through the provincial beverage container deposit/refund system, and it is assumed that this figure also applies specifically to plastic beverage containers recovered through this program. The 5,104 tonnes of plastic beverage containers that is recovered and recycled represents 80 percent of an estimated total of 6,370 tonnes of plastic beverage container plastic used in Nova Scotia.

HRM conducted waste auditing in fiscal 2003/04 and used this data to extrapolate and apply figures for plastics packaging not being source separated by consumers in waste delivered for processing at landfill in 2005/06. The following data is relevant to the HRM context (but not elsewhere because of different plastics recycling programs):

- A total of 28,044 tonnes of plastics packaging from IC&I and residential generators was sent for disposal in fiscal 2005/06.
- Of this amount, 11,164 tonnes is defined as "not acceptable as waste"; these materials are banned from disposal under provincial regulation (see Section 1.5) Thus, 40 percent of plastics that were sent for disposal should in fact have been managed in ways other than disposal; in the absence of other options, this amount should have been recycled. Film plastics from both the residential and IC&I sectors – very largely No.4 LDPE – make up approximately 75 percent of this amount.

Other municipalities have also undertaken waste audits to determine the opportunity for enhanced recovery of waste-resources. Valley Waste-Resource Management, for example, determined that approximately 38 percent of residual waste generated by residents and 44 percent of residual waste generated by the IC&I sector was incorrectly sorted by the generator (i.e. materials were sent for disposal that should have been sorted for recycling or composting). In this case, the quantity of plastics was not separately identified, but would appear to comprise a significant proportion of the improperly sorted fraction[29].

Precise estimates of the quantity of regulated plastics (i.e. regulated plastic beverage containers, and HDE and LDPE packaging) that are sent for disposal across the province are not possible on the basis of the available data. However, the total quantity of regulated plastics that is estimated to be discarded annually is 31,299[30]. A total of 9,767 tonnes of discarded plastics packaging is estimated to be recycled, including plastics packaging comprised of all plastics from all sources. Thus, the total estimated tonnage of all plastics recovered and recycled is considerably less that the estimated tonnage of regulated packaging that is discarded. In the absence of other management options, it is therefore concluded that a large proportion of regulated packaging is being managed through disposal in contravention of provincial regulation. Based on data estimates of plastics discards and recovery/recycling in Nova Scotia, it appears that LDPE discarded by the IC&I sector may be the largest quantity of regulated packaging managed through disposal, but significant quantities of LDPE discarded by the residential sector appear to be managed through disposal as well as other regulated packaging discarded by both the IC&I and residential sectors.

[29] *Waste Audit Reports*, Valley Waste-Resource Management, 2005.
[30] Figure calculated based on total estimated HDPE and LDPE packaging discards identified in Table 1, plus an estimated 6370 tonnes of discarded plastic beverage container plastic, see above in Section 5.1.

The quantity of discarded plastics that were recycled from other sectors is believed to be minimal:

- In the transportation sector, end of life vehicles are transported out-of-province for management. Plastics are a primary constituent of auto shredder residue (ASR), a generic term for the variety of materials that remain to be managed following the processing of end-of-life vehicles for the recovery of, primarily, metals. Research efforts have been undertaken around the world to develop technologies for the recovery of recyclable materials from ASR, but the standard management approach remains disposal through landfilling; in some instances, ASR is incinerated.
- Electronics that are discarded in Nova Scotia are managed either through landfilling directly or as a component of mixed scrap metal collections. Mixed scrap metal is transported for management outside the province, and is processed using technology similar to that used to process end-of-life vehicles. Plastics that are separated from electronics in this way are managed through disposal.
- No recycling of plastic discards generated by the construction industry have been identified in Nova Scotia. These discards are managed in construction and demolition waste disposal sites in the province.
- No recycling of furniture has been identified in the province, although reuse of furniture takes place.

Recycling of "other" plastics is very limited. Small amounts of agricultural plastics are recovered and recycled. Plastics from other applications are not known to be recycled.

5.2 Best Management Practice

"Best management practice" (BMP) is defined as:

> *Management that best meets established policy objectives under the assumption that available systems and technologies are employed to the range of plastics discarded in Nova Scotia.*

This definition of BMP links the management of plastics to both established policy objectives, and to available systems and technologies. The definition is "knowledge-based"; i.e. it is a definition that reflects what current technology is capable of. As detailed in Section 1.5, the policy context for the BMP in Nova Scotia includes the following:

- Legislation that identifies the targets of 50 percent waste diversion and a maximum disposal of 300 kgs/person/year by the year 2015[31]. Under provincial and federal policy, waste diversion includes waste reduction, reuse, recycling or composting, and waste disposal includes incineration and land disposal.
- Legislative recognition of "producer responsibility" and "shared responsibility" concepts in the management of discarded products[32].
- The banning of specific materials from disposal, including a ban on the of disposal regulated beverage containers and on both low-density and high density polyethylene bags and packaging[33].
- The power of the Minister to undertake, or to require others to undertake, actions to achieve waste-resource policy objectives, including actions by manufacturers, distributors and retailers.

[31] See *Environment Act, Part IX*
[32] *Environment Act 1994-1995*, Nova Scotia Environment and Labour, Halifax, 1995
[33] *Solid Waste-Resource Management Regulations*, Nova Scotia Environment and Labour, 1996

The management of discarded plastics may include the following approaches, each of which will contribute to achievement of provincial policy objectives. These approaches are presented in descending order of environmental preference and are collectively referred to as the hierarchy of preferred waste-resource management approaches:

- *Source reduction* Source reduction refers to the reduction in the quantity of materials that are discarded. Plastics have played an important role in reducing the quantity of residual waste (measured on a weight basis) requiring disposal in past years through providing lightweight alternatives to heavier packaging, and through the lightweighting of plastics products themselves. Continued source reduction benefits will continue to be achieved through the application of plastics in coming years.

- *Reuse* Reuse refers to the direct reuse of a product, with or without superficial actions (e.g. washing or cleaning) to prepare the product for reuse and without changing the form of the product. Some plastics products, such as grocery bags, are widely reused. Continued benefits will continue to be achieved through reuse of some plastic products.

- *Recycling* refers to the reutilization of materials in a manufacturing process. Notwithstanding the benefits of source reduction and reuse, it is clear from the quantity of current and projected future plastics discards that enhanced recycling of plastics will be required if Nova Scotia is to achieve its waste diversion and disposal policy objectives.

- *Composting* Traditional plastics are manufactured from hydrocarbons and are therefore not amenable to composting. However, fully biodegradable plastics are becoming increasingly common and are compostable in commercial composting facilities. The composting of plastics may be a feasible management strategy consistent with provincial policy in the future.

- *Disposal* Disposal includes measures that either destroy or make unavailable the material value of plastics (or other materials). Disposal approaches include incineration (with or without energy recovery) and land disposal. Plastics may continue to go to disposal. However, achievement of the provincial disposal goal of a maximum disposal of 300 kgs./person/year in 2015 will require that plastics that are managed in this way should be limited only to those plastics that cannot be managed in other ways.

Broader policy contexts are also relevant. In particular, Canada is a signatory to both the United Nations Framework Convention on Climate Change and to the Kyoto Protocol under that Convention. With respect to systems/technologies that are appropriate to achieving Canada's policy with respect to climate change, Environment Canada concludes that: "recycling is by far the best option—saving between 1.1 and 2.8 tonnes of carbon-dioxide equivalent per tonne of waste compared to landfilling. Combustion, on the other hand, creates 1.8 to 2.3 tonnes more carbon-dioxide equivalent per tonne of waste than landfilling"[34]. Canada is a signatory to the Stockholm Convention on Persistent Organic Pollutants, which establishes general and specific criteria for control of dioxins and furans that are produced through incineration of municipal and other wastes;

[34] *Envirozine, Issue 29,* Environment Canada, February 2003.

chlorinated plastics, in particular, have been linked to the production of dioxins and furans from incineration of municipal waste.

Table 9 identifies the BMP for plastics discarded in Nova Scotia. The BMP represents the quantities of plastics that could have been recycled in Nova Scotia in 2006 if collection, transportation and processing were optimised.

The BMP for plastics packaging identifies values of 69.5 percent and 80.0 percent. The value of 69.5 percent represents the percent of plastics packaging that would be recovered and recycled if 95 percent of regulated plastics in Nova Scotia were recovered and recycled. "Regulated plastics" in this context includes plastics that are subject to the provincial beverage container deposit/refund system together with HDPE and LDPE packaging, which are banned from disposal. The value of 95 percent is used in recognition that there will be some "leakage" of materials from any recovery system for used plastics, but that plastics that are recovered will be managed at close to 100 percent within the system[35].

Table 9 also identifies a BMP of 80 percent for plastics packaging, as well as for other plastics discards in the province. For plastics packaging, this BMP represents the level of recovery and recycling of plastics if collection, transportation and processing of all plastics packaging (and not simply regulated plastics packaging) were optimised. Likewise, a BMP of 80 percent of plastics discards from other sectors assumes that collection, transportation and processing of the range of discarded plastics is optimised. Within the context of the BMP definition identified above, the recovery and recycling of 80 percent of discarded plastics is considered to be reasonable because:

- Plastics that are recyclable with technology applied elsewhere in the world comprise an estimated 85 percent or more of the plastics that are applied in durable and non-durable products sold in Nova Scotia.
- As identified above, it is likely that any collection system for plastics will fail to capture all the plastics that are targeted for collection. However, losses will be small (1 – 2 percent) after recovered plastics enter a recycling infrastructure.

The extent to which the BMP is achieved is a function of: (i) the issues that must be addressed to move from existing CMP levels of plastics recovery and recycling to the BMP levels; and (ii) the ways in which these issues are resolved. These are addressed in the following section.

5.3 Achieving Best Management Practice: Issues and Barriers

Achieving the BMP set out in Section 5.2 will require that the following are addressed:

- Application of technologies
- Enhanced and targeted plastics recovery
- Continued public awareness

[35] It is noted that the legal framework bans 100 percent of HDPE and LDPE packaging and regulated plastic (and other) beverage containers from landfills and incinerators.

- Enhanced capacity and strengthened investment and cost recovery frameworks
- Early action to ensure that the maximum waste disposal goal of 300 kgs/person/year is achievable by 2015.
- Appropriate institutional architecture.

These issues are linked: actions to address opportunities or constraints related to one of these issues will impact on others, and actions on each of these issues will be required to achieve the BMP – or to make significant progress towards its achievement. An over-arching framework is therefore required in which all stakeholders play roles to guide appropriate actions in support of progress towards the BMP. The implementation of such a framework will require adjustments to the institutional architecture that supports recovery/recycling of plastics in Nova Scotia. This section addresses these issues.

5.3.1 Application of Technologies

Traditionally, the management of post-consumer plastics through non-disposal methods has meant the application of recycling technologies. Composting will become an increasingly viable option in coming years.

Recycling of post-consumer plastics can be undertaken in one of two ways:

- *Mechanical Recycling* refers to the processing of recovered plastics into new products. Plastic materials may be separated according to their resin type and may be recycled into new products that are similar to the original product. Alternatively, mixed plastics may be recycled into products that are very different as compared to the original products that were made from any of the plastics (e.g. plastic lumber). Generally, mechanical recycling of plastics results in the degradation of the plastic in terms of technical criteria necessary to ensure high quality products and recovered plastics may therefore make up only a proportion of the plastics in a new product, or may require additives to compensate for loss of a desired property (e.g. strength).

- *Chemical Recycling* refers to the process of converting recovered plastics into a chemical feedstock which can then be reprocessed into new plastics. This process does not result in loss of the properties of the plastics, and allows plastics to be recycled into applications that may not be feasible under mechanical recycling (e.g. food-contact applications). However, this process requires larger investments and volumes of plastics materials than mechanical recycling. This approach is used or the recycling of carpets. Similar processes may be used to recover energy from plastics through non-incineration techniques, but these have not proved to be commercially viable.

Most types of plastics recovered in Nova Scotia are recycled by mechanical recycling although, as reported elsewhere in this document, none of this recycling is undertaken in Nova Scotia and large, but unquantified, amounts of plastics recovered in Nova Scotia are sold overseas for recycling without verification of whether and how recycling is in fact undertaken. Plastics recovered in Nova Scotia will generally require the application of mechanical recycling in the absence of chemical recycling facilities, although for some specific materials and markets (e.g. used synthetic carpet) plastics may be recycled through chemical recycling processes. Although some municipal representatives expressed uncertainty regarding the availability of markets for increased quantities of

plastics that might be recovered, none of the markets contacted in the preparation of this document expressed concern regarding ability to sell/utilise recovered plastics for recycling that met maximum contamination criteria. Municipalities expressed concern regarding the cost of enhanced recovery/recycling of plastics.

Products manufactured from degradable plastics may be composted; currently, PLA may be the degradable plastic that is experiencing the greatest growth among the several different families of bioplastic because of its ability to be composted[36]. The quantity of bioplastics used and/or currently discarded annually in Nova Scotia is not known, but is certainly very small. This may change rapidly in future; in Europe, the food and beverage industry is responding to public demand and regulatory requirements for enhanced management of packaging through increased adoption of PLA plastics in place of traditional hydrocarbon-based plastics. One manufacturer predicts that biodegradable plastics may substitute for up to one third of current plastic applications in Europe[37].

Issues related to the use and management of bioplastics are currently the focus of debate among producers, users and managers of plastics in Nova Scotia. On one hand, the composting of plastics may be desirable for several reasons:

- Appropriate plastics could be integrated into Nova Scotia's composting programs simply by discarding the plastics in the green bin (although technical issues related to processing may need to be addressed, see below).
- Contamination of plastics from organic materials – a major constraint to current plastics recovery/recycling initiatives – would not be a constraint to collecting compostable plastics in the green bin.
- Increased diversion of plastics from disposal might be achieved rapidly.

On the other hand, compostable and other bioplastics may negatively impact current recycling initiatives or may have negative environmental impacts:

- There is no generally accepted labelling scheme in Nova Scotia for plastics that are biodegradable in accordance with ASTM standards D6400 and D6868, so consumers may not identify them as compostable.
- There is widespread misunderstanding of the

Box 1
Some Current Applications of Bioplastics

- Doggy bags
- Shopping bags
- Organic waste collection bags
- Mulch film
- Disposable hygiene products
- Disposable cutlery
- Planter pots
- Food packaging
  - Tray
  - Bottle
  - Blister pack
  - Bread bag
- Cosmetics packaging
- Void fill
  - Loose fill bead
  - Bubble wrap
- Packaging for recycled paper products
- Coated paper products

[36] Criteria for composting of plastics are set out in the following: ASTM D6400 for film plastic, and ASTM D6868 for packaging that uses biodegradable plastic coatings over paper and other compostable substrates. These criteria are applied to the ability of a plastic to degrade under municipal (not backyard) composting system operating conditions.
[37] *BioPolymers: A Manufacturers Perspective*, John MacKee, Marley/Vertex Products: presentation to Degradable Plastics Workshop 2005, Plastics New Zealand.

different types of "bioplastics" and which are "photo-degradable", "hydro-degradable", "biodegradable", "bioerodable" and "compostable". Recent technical standards by the ASTM (Standard No. D6400: Specifications for Compostable Plastics and Standard No. D6868: Specification for Biodegradable Plastic Coatings on Paper and other Compostable Substrates) help clarify these issues at a technical level. Products that meet these standards must:

- *Disintegrate during composting*: non-degraded plastic should not be readily visible in the finished compost, nor should it need to be screened out prior to the sale of the finished compost;
- *Biodegrade rapidly*: compostable plastic materials should biodegrade at rates similar to known compostable materials such as food waste; and
- *Have no impact on the finished compost*: the process of disintegration and biodegradation must not harm the ability of the compost to support plant growth nor introduce unacceptable levels of heavy metals or other toxic substances into the environment.

- Technical issues such as processing the plastics as part of the preparation of materials for composting would need to be addressed.
- Incorporation of compostable plastics into existing plastics recycling programs may result in contamination of, and non-recyclability of, hydrocarbon-based plastics that would otherwise be recycled.
- Concerns have been raised concerning the potential for: (i) non-compostable plastics to enter the compostable plastics stream; and (ii) increased heavy metal content in compost as a result of composting plastics.

Appropriate introduction of bioplastics into Nova Scotia should include the following:

- Identification in legislation of an appropriate standard that defines compostability with respect to plastics. This has already been identified as a priority in amendments to the *Environment Act*, effective December 2006, but requires action to give effect to the need for definition of a standard. The ASTM standards, above, may be appropriate.
- Legal requirements for the labelling of biodegradable plastics, including minimum size and colour of labelling and symbols[38]. The Biodegradable Products Institute(BPI) in the US certifies products that are demonstrated to meet either ASTM Standard No. D6400 or ASTM Standard No. D6868, see above; products that meet these standards may use the logo in Box 1 to communicate that they meet biodegradability standards.
- Verified ability of composting operators to include the plastics in their operations.
- Verified demonstration that composting of plastics does not result in negative compost quality impacts; in principle, products that meet the above ASTM standards are satisfactory in this regard, but compost product quality should in any event be monitored.

Box 2
Logo for Plastics That Meet ASTM Standard D6400 or D6868

[38] The current labelling of plastics No.1 through No.7 is not a fully appropriate model as the symbols are often small, hard for the consumer to use as a means of plastics identification and inadequately regulated/supervised leading to instances of mislabelling of plastics.

- Appropriate funding mechanisms to support municipal and private sector compost facility capital and operational costs..

5.3.2 Enhanced and Targeted Plastics Recovery

Enhanced and targeted plastics recovery can be achieved through:

- All municipalities accepting commingled plastics No. 1 through No.7 in their residential plastics recycling programs, and either separating commingled plastics prior to sale to markets, or marketing the plastics as commingled.
- Specific focus on the recovery of non-durable plastics from the IC&I sector, and durable plastics discards from the range of sectors identified in Table 3. Each solid waste-resource region should be required by the Department of the Environment to develop a plan for maximising the recovery of these plastics discards and this should include enforcement of the bans on disposal of HDPE and LDPE packaging.
- Application of "clear bag" waste disposal. In these systems, residents are required to use a clear, see-through bag to set out their discarded materials destined for disposal. This approach has been used in several municipalities in recent years and has generally resulted in increased quantities of plastics being separated and made available for recycling by households. Data from the Department of Environment and Labour identify that these programs may have a dramatic impact on the quantity of residential plastics that are recovered; for example, a 28% increase in plastics recovery is reported for Solid Waste-Resource Management Region 2 (Eastern Region), a 45 percent increase in West Hants (Region 6 – South Shore/West Hants), a 91 percent increase in Solid Waste Resource Management Region 7 (Western Region) and over 200 percent in Richmond County (Region 1 – Cape Breton). On the other hand, plastics recovery appears to have been flat or to have declined a little in Cumberland County (Region 1 – Northern Region) following the introduction of "clear bag" waste disposal.

  The reasons for the wide variation in these increases are not clear. As identified above, large proportions of recyclable plastics are typically not separated by residents for recycling. Since "clear bag" programs allow neighbours and others to identify recyclable materials improperly placed in a bag destined for disposal, it appears that the underlying impact of "clear bag" programs is to "shame" people into putting recyclable materials into a recycling bag and not a bag destined for disposal. It is likely that variation in increased recovery of plastics using "clear bag" programs is related to the relative susceptibility of people in different areas to being "shamed", fear of being caught not recycling a recyclable material and, possibly, large percentage increases in plastics recovery being recorded in areas where initial plastics recovery rates were very low[39].

  The application of "clear bag" programs has generally achieved higher plastics recovery from residents who participate in curbside collection programs. In the IC&I sector and the recovery of plastics from apartments, "clear bag" programs may also result in increased plastics recovery. However, in these cases bagged materials destined for disposal may be placed in bins and the "shaming" mechanism that appears to apply to bagged waste placed on the curb adjacent to a home (or small IC&I establishment) in a curbside collection program would therefore not apply.

[39] Concerns have been raised that this approach results in loss of privacy regarding what people discard. However, this can be addressed by allowing the placement within the clear bag destined for disposal of dark, non-see-through bags for the legitimate discards of wastes that cannot be recycled.

> Maximizing plastics recovery from the IC&I sector through the application of "clear bag" programs will therefore depend on monitoring/inspection of "clear bags" to identify recoverable plastic, rather than reliance on the "shaming" mechanism that appears to apply in curbside collections

Further provincial leadership will be necessary to address capacity, cost and accountability issues associated with achieving enhanced and targeted plastics recovery (see Section 5.3.4).

5.3.3 Continued Focus on Public Awareness

Public awareness in support of plastics recovery and recycling should be maintained and enhanced where new or expanded initiatives are undertaken. Part of the communication message should identify the benefits of plastics to Nova Scotians, but should also identify the priority of recovery / recycling of post-consumer plastics and the environmentally-sound management of plastics. Instances of plastics suppliers providing environmentally irresponsible advice have been documented in the preparation of this document[40]; this can be avoided through messages prepared and delivered as part of an EPR initiative as outlined above.

5.3.4 Enhanced Capacity and Strengthened Investment and Cost Recovery Frameworks

As identified in Table 9, achievement of the BMP in 2006 would have required the recovery/ recycling of 57,126 tonnes of plastics in Nova Scotia instead of the 9,867 tonnes that is estimated to have actually been recovered. The capacities necessary to achieve this level of recovery/ recycling will require additional investment in human resources, and in collection and processing infrastructure; affordable cost recovery structures will be required that ensure that costs are paid for. Municipalities are unwilling to take on additional costs in these regards, and have long identified the core issue of funding as a key constraint to their ability to meet aggressive waste-resource recovery/ recycling goals. As identified in Section 3.4, it is increasingly accepted that accountability for achievement of waste diversion objectives requires regulatory frameworks that set out the responsibilities of industry/producers and other stakeholders in: (i) financing the creation and operation of waste-resource recovery/recycling infrastructure; (ii) separating and collecting plastics; and (iii) in the marketing and application of recovered materials.

5.3.5 Early Action Achieve 2015 Disposal Goal.

Early action is required to design and implement measures to achieve the BMP identified in Section 5.2. If current recovery rates are maintained, 13.8 percent (13,295 tonnes)of a projected 96,347 tonnes of discarded plastics will be recovered in 2016, implying the disposal of 83,052 tonnes of plastics, or 63,783 tonnes more than would be disposed of if the BMP is achieved; this represents the avoidable disposal of an estimated 66 kgs/person of plastics in that year that would otherwise be recovered through the achievement of the BMP, or 22 percent of the maximum level of disposal (i.e. 300 kgs/person/ year) targeted by the province for 2015.

Parallel actions are also required to address plastics discards from other sectors. Impacts from other sectors in this regard will be more modest in terms of reducing reliance on disposal, however,

[40] For example, one supplier of plastic film to the agricultural sector in Nova Scotia stated that he advised farmers in the province to burn the plastic after use and was unaware of the pollutants resulting from this course of action.

because of the dominance of plastics packaging as a component of total plastics discards in Nova Scotia.

5.3.6 Appropriate Institutional Architecture For Plastics Recovery/Recycling

There is a functional and operational disconnect between industry stakeholders that manufacture/ use plastics, government, consumers and those who are responsible for managing discarded plastics. This has resulted in:

- The continuing introduction of new plastic products and new types of plastic by producers/goods manufacturers and packagers without significant consideration of the waste-resource management consequences of these plastics.
- Labelling of plastics for recycling purposes that is not necessarily consumer-friendly and may not be accurate.
- Municipalities accepting, by default, an unfunded liability over which they have no control; i.e. a continuing and increasing quantity of plastics discards the management of which they are required to finance but over which they have no substantive influence or control.
- The externalisation of the costs of management of used plastics packaging so that these costs are not considered by industry stakeholders that produce or use plastics.
- An absence of environmental price signals or direct and enforced regulatory actions regarding environmentally-preferred plastics. As a consequence, there is neither incentive nor requirement for industrial stakeholders that produce or use plastics to consider the environmental impacts of their products.
- The maturity of existing residential plastics recovery programs at levels that do not – and cannot – meet provincial regulation regarding the prohibition on the disposal of regulated plastics. These programs have been operating for over 6 years in most cases. The programs are voluntary and, except for the provincial deposit/ refund system, they are not incentivized. Significant gains in the recovery of residential plastic discards will require that: (i) all municipalities collect all plastics No.1 – No.7; (ii) application of mechanisms to maximise the effectiveness of existing programs (e.g. application of "clear bag" programs; (iii) residents are held accountable for separating - or failing to separate – their plastics. Significant gains in recovery of plastics may also be achieved through incentivizing the recovery system.

An environmentally sustainable approach to the recovery/recycling of post-consumer plastics in accordance with Nova Scotia legislation and policy necessarily requires the enhanced participation of all stakeholders including industrial stakeholders that produce and use plastics, government, consumers and those that operationally manage post-consumer plastics.

This can be addressed through the introduction – by regulation – of EPR requirements that include the financial and technical participation of producers in the management of post-consumer plastics discards. This approach can be accommodated in the Nova Scotia solid waste-resource management legal framework. The BBPP recently concluded in Ontario establishes principles and benchmarks that might be applied (with appropriate modification) to non-durable plastics discards in Nova Scotia and the emerging EPR program for discarded electronics in Nova Scotia provides a basis for elaborating similar programs for durable plastic products. The most appropriate Nova Scotia model for the process of developing an EPR initiative with respect to plastics discards may lie

in the wording of regulation achieved in consultation with the electronics industry regarding the roles and responsibilities of that industry for the management of its discarded (durable) products. Appropriate design of an EPR initiative will result in not only improved recovery/recycling of plastics, but also in the additional benefits associated with sustainable management of plastics waste-resources identified in Section 1.1.

6.0 ENHANCED PLASTICS RECOVERY AND RECYCLING IN NOVA SCOTIA

6.1 Rationale for Enhanced Plastics Recovery and Recycling

As set out in previous sections:

- At least 71,407 tonnes of plastics waste (76 kgs/person) are estimated to have been discarded in Nova Scotia in 2006, of which:
    - At least an estimated 55,482 tonnes (78 percent of generation) of plastic waste was disposed of in landfills in the province in 2006.
    - An estimated 9,867 tonnes (14 percent of generation) were collected for recycling in 2006. Within this amount, an estimated 8,767 tonnes of plastics were collected for recycling by municipalities from the residential sector; this plastics material is almost entirely packaging and amounts to an estimated 40 percent of plastics packaging waste generated by that sector. Recovery of plastics packaging generated by the IC&I sector in 2006 is estimated to have been about 1000 tonnes, or about 4 percent of the quantity of plastics estimated to have been generated by that sector.
    - An estimated 6058 tonnes (8 percent) of plastics generated from the transportation sector in Nova Scotia in 2006 were transported outside the province for management in an unseparated state. Data on the fate of these plastic wastes is not available, but their management is believed to have been largely or entirely through disposal (see Section 2.3).

- Plastics collected for recycling in 2006 were sold (directly or through brokers/intermediate processors) to end-users located outside the province and in many cases outside North America. The fate of these plastics is unclear; it is likely that at least some of the plastics were managed through disposal, specifically as a fuel. The actual rate of recycling for plastics separated and sold for recycling is therefore lower that identified above.

- Provincial legislation establishes that a maximum of 300 kgs per capita of solid waste should be sent for disposal in 2015. Disposal accounted for the management of over 85 percent of plastics discards in 2006 (i.e. 66 kgs/person); in the absence of action to enhance plastics recovery and recycling, a similar performance in 2015 will result in the disposal of over 83,000 tonnes of plastics discards, equivalent to 86 kgs/person.

- Best management practice (BMP) – defined as "*management that best meets established policy objectives under the assumption that available systems and technologies are employed to the range of plastics discarded in Nova Scotia*" – is currently capable of achieving the recovery and recycling of an estimated 57,126 tonnes of plastics generated in Nova Scotia, equivalent to 80 percent of plastics estimated to have been discarded in the province in 2006. The application of the BMP in 2006 would have reduced disposal of plastics discards from 66 kgs/person to 15 kgs/person. The application of the BMP to plastics discards in 2015 would reduce disposal of plastics from a projected 86 kgs/person if current management practices are maintained to 20 kgs/person.

- Existing plastics recovery and recycling is effectively entirely dependent on external markets – many of them overseas - for the reprocessing of recovered plastics. The transportation of plastics to these markets incurs costs and results in negative environmental impacts – particularly the generation of greenhouse gases – that would be avoided if recovered plastics were processed in Nova Scotia. In addition, the processing of recovered plastics in Nova Scotia would result in both direct and indirect

job creation in both the processing of the plastics and in spin-off manufacturing associated with the local availability of secondary plastics materials.

The BMP sets the standard for the contribution of enhanced recovery and recycling of plastics to the waste disposal target that has been established for the province. Achievement of the BMP, however, requires a new institutional architecture for plastics recovery and recycling based on EPR principles, and the application of this architecture in ways that will: (i) minimize the environmental impact of plastics recovery and recycling systems; and (ii) maximize economic benefits associated with plastics recovery and recycling for Nova Scotia. Accordingly, this section sets out:

- Parameters for the application of EPR in support of enhanced plastics recycling and achievement of provincial requirements.
- A feasibility plan for the immediate implementation of an initiative to recover a specific plastic waste for reprocessing in Nova Scotia.
- An action plan for the implementation of plastics processing facilities sufficient to process the range of plastics recovered in Nova Scotia.

Each of the above are separately considered in this Section, and implementation actions are identified for each. Section 7 presents recommendations that integrate all actions (as well as actions identified elsewhere in this document).

6.2 Parameters for the Application of EPR in Support of Enhanced Plastics Recycling

The Canadian Council of Ministers of the Environment (CCME) has established "Canada-Wide Principles For Extended Producer Responsibility (EPR)"[41], see Annex B. EPR is defined by CCME as "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle". "Producers" are defined by CCME to include "the most responsible entity which may include but is not limited to the brand owner, manufacturer, franchisee, assembler, filler, distributor, retailer or first importer of a product who sells, offers for sale or distributes the product in or into a jurisdiction". CCME further identifies that EPR includes:

- Increasing producer responsibility by shifting responsibility upstream toward the producer and away from municipalities and/or regional or provincial waste management authorities; and
- Providing incentives to producers to incorporate environmental considerations in the design of their products.

Product stewardship is currently applied to a limited range of plastic products in Nova Scotia (i.e. plastic – and other – beverage containers). As applied, however, product stewardship for these products is an internally administered initiative that is undertaken without the participation of the producers. The application of EPR to these and other plastics products will bring a range of benefits, however:

[41] *Canada-Wide Principles for Extended Producer Responsibility,* Canadian Council of Ministers of the Environment, June 2007

- Financial and other mechanisms can be created to encourage environmentally-enhanced design of plastics products and to drive a culture of continuing environmental improvement in design of plastics products.
- Industry capacity can be applied directly to the challenge of managing plastics in accordance with Nova Scotia policy to reduce management costs and apply best practices.
- Resources can be dedicated to building local infrastructures to maximise employment and other economic benefits associated with plastics recovery and recycling – an advantageous opportunity compared with the current export of plastics out of the province with the loss of economic opportunity and the creation of environmental impacts that export entails.
- Plastics producers will become accountable for the fate of the plastics products that they put on the market, including the provision of financing in support of the recovery of these products. The amount of financing that would be created through this approach would depend on many factors associated with the definition of the precise obligations of producers and the EPR actions that were undertaken. The Government of Ontario has required producers of a variety of plastics products to participate in an EPR initiative to support the financing of the provincial "Blue Box Program" (see Section 3, above). In 2007, plastics producers will provide financial support in the amounts of $0.11644/kg of PET bottles, $0.09929/kg of HDPE bottles and $0.1472/kg of other plastics collected through the program. The application of these unit rates to plastics recovered by municipal recycling programs in Nova Scotia would result in financial support by producers of approximately $2.995 million in 2007.

The national policy on EPR established by CCME provides an appropriate policy context for the development of EPR for plastics products in Nova Scotia in broad harmonization with EPR programs developed in other jurisdictions in Canada. In Nova Scotia, the Solid Waste-Resource Management Regulations made under Section 102 of the *Environment Act* provide a sound legal basis for the translation of the CCME policy direction into a specific EPR program for plastics products; this regulation has most recently formed the legal basis for an Electronic Products Stewardship Program in the province.

Within the context of the Canada-Wide Principles established by CCME, application of an EPR initiative should be characterised by the following:

- Clarity of purpose. The objectives of the initiative should be clearly defined.
- Clarity of roles and responsibilities. The different stakeholders should be defined, together with the roles of each and the responsibilities of each for achieving results that contribute to the overall objectives of the EPR initiative.
- Accountability. Stakeholders should be accountable for acting in accordance with their roles and for achieving the results for which they are responsible.
- Efficiency and effectiveness. A continuing focus on reducing costs and maximizing benefits should characterize the EPR initiative.
- Competition. While companies may form collaborative entities to achieve EPR objectives, a diversity of such entities is required to avoid the creation of monopolies and to ensure competition in the management of used products.
- Transparency. Technical, financial and other information related to the EPR initiative should be openly available to the stakeholders and to the public.

In order to create an EPR initiative in support of enhanced plastics recovery and recycling consistent with the CCME Canada-Wide Principles and the application criteria identified above, the following should be undertaken:

- Plastic products for the purpose of the EPR initiative should be defined in Schedule B of the Solid Waste-Resource Management Regulations, and the Regulations should specify a date by which a program acceptable to the Minister should commence implementation. Initial priority should be given to plastics packaging not already addressed by the Regulation.
- The RRFB should Chair and coordinate a study, in partnership with government, municipal and industry stakeholders, that reviews options and opportunities for recovering and recycling designated plastics. Particular focus should be placed on options and opportunities for enhanced recovery and recycling of designated plastics from the residential, IC&I, C&D and agricultural sectors. The study should recommend EPR implementation actions, timing and costs/revenues, and should include consideration of the implementation of a mixed plastics processing facility to receive plastics waste-resources generated in Nova Scotia (see Section 6.4, below).
- Producers should be required by the Minister to propose an EPR program consistent with the CCME Canada-Wide Principles and Nova Scotia policy, and using the outputs of the above study as appropriate. The program should define the roles and responsibilities of the stakeholders, the accountability of stakeholders for undertaking their roles and achieving the results required of them, mechanisms to ensure transparency, efficiency and effectiveness, and solutions that provide economic benefits to Nova Scotia.

In coordinating these actions, the Department of Environment and Labour and the RRFB should be guided by their recent experience in the development of an EPR program for end-of-life electronics.

6.3 Feasibility of Recovering Windshield Washer Containers for Reprocessing in Nova Scotia

During the research and analysis undertaken in support of this document, an immediate opportunity has been identified to recover windshield washer containers for reprocessing in Nova Scotia. This product packaging is HDPE - a material banned from landfill in the province and a high-yield marketable commodity in the recycling stream with potential to contribute to economic development in Nova Scotia if it is recovered through an appropriate infrastructure. Accordingly, the feasibility of recovering and processing these containers has been undertaken and is presented in Annex C. The feasibility analysis identifies that:

- The creation of value-added economic opportunity in Nova Scotia based on waste-resources depends on delivery of high quality materials to markets in Nova Scotia. The utilisation of WWF containers in Nova Scotia therefore requires their collection and management separate from other plastics, rather than the generally prevailing current management of WWF containers through disposal or, if separated, as a low grade commodity resource mixed with other plastics.

- Technically-feasible options are available for the separate recovery and management of WWF containers.

- The preferred option for recovery of WWF containers is to implement an EPR program that would require producers to prepare and implement plans approved by the Minister with specified objectives:
  - The recovery program should target 100 percent recovery of WWF containers, although it is likely that the recovery of 80 percent of WWF containers sold in Nova Scotia may be realistic initially.
  - Recovery plans submitted by producers should demonstrate the capacity to achieve this objective within one year of implementation.
  - Producer plans should be developed in accordance with the CCME Canada-Wide Principles,
  - Producer plans should be required to demonstrate that greenhouse gas emissions will be minimized (e.g. through volume reduction of WWF containers at the point of recovery in an Enviro-Depot).
  - Recovered WWF containers should be sold to end-users in Nova Scotia, unless this is not feasible at prevailing market prices in which case the containers should be sold to intermediate processors. Recovered WWF containers should only be shipped out of province for recycling if there are no markets in Nova Scotia.

- An EPR initiative to recover WWF containers is estimated to be capable of recovering at least 80 percent of WWF containers generated in Nova Scotia annually, or approximately 1,171,000 million containers per year. This is estimated to be approximately a 100 percent increase over the number of containers that are currently recovered.

- The benefits of an EPR program would include (in addition to enhanced recovery of the containers and contribution to the provincial waste disposal goal):
  - Creation of a value-added resource, in accordance with provincial policy.
  - Creation of sustainable new manufacturing in Nova Scotia based on recovered WWF containers, in accordance with provincial environmental and economic policy.
  - Increased direct and indirect jobs in Nova Scotia in accordance with provincial environmental and economic policy.
  - Reductions in greenhouse gas emissions, in accordance with provincial policy, as compared to the current practice of shipping plastics out of province for management.

These benefits can be achieved at a conservatively-estimated, maximum cost of $0.07bper WWF container sold, or $0.19 per vehicle in Nova Scotia per year (see Annex C, Table C-2).

6.4 Action Plan For The Implementation Of Mixed Plastics Processing Facilities

The application of EPR for the management of plastics discards would bring many advantages in Nova Scotia, as set out above, and can result in the processing of recovered plastics in Nova Scotia in place of the shipment of plastics out of the province and overseas for processing and reutilisation.

Recovered plastics should be managed according to their highest and best use. Clean, uncontaminated plastics can be most easily recycled and typically command higher market prices than other plastics. To the extent possible, it is therefore desirable to collect and separately manage different types of plastics. Plastic beverage containers are managed this way in Nova Scotia, and

there is potential for similar mechanisms to be applied to specific additional products (e.g. WWF containers). However, the environmental pressure to increase waste diversion from disposal and to meet the waste disposal goals established by the Department of Environment and Labour necessitate that the majority of plastics will continue to be collected in a commingled format and that they will be handled in a MRF before being shipped to a processor or an end-use market.

The implementation of a mixed plastics processing facility can bring several advantages:

- Mixed plastics streams can be separated in the facility according to resin type and the recovered materials can be sold into a wide variety of resin-specific markets at higher prices than would otherwise be possible.
- Cleaned mixed plastics may be sold for use in plastic lumber and similar lower grade applications.
- The availability of dependable and clean plastics – in mixed-resin or resin-specific formats – can attract investment in secondary plastics applications to Nova Scotia.

6.4.1 Overview of Mixed Plastics Processing

Mixed plastics processing is intended to achieve the cleaning of plastics, and their separation and processing, according to resin type sufficient to meet end-user requirements.

Typical operations associated with mixed plastics processing include:

- Debagging/debaling of received plastics
- Separation of film plastics from rigid plastics
- Size reduction of plastics
- Washing of plastics.
- Drying of plastics
- Packaging for shipment to end-use markets.

Film plastics are typically managed separately from rigid plastics.

The debagging/debaling of plastics is an automated, mechanical operation. The separation of rigid from film plastics might be done prior to receipt of plastics at the processing facility (e.g. at a MRF) , or might be an automated, mechanical operation at the processing facility supported by a manual quality control. The size reduction, washing and drying of plastics are automated processes; "dry" wash processes may be used and these result in reduced water and energy use. The extent of separation of resin types is a function of the facility design and available technology. Technology development in this regard has been very rapid over the past 15 years, and current technologies to separate plastics according to resin type include a variety of scanners that separate plastics according to specific properties, as well as float/sink and air classification technologies.

Mixed plastics processing facilities vary in size, but are generally large scale facilities with throughputs of 1000 kgs of material per hour and higher. A facility of this size would process 2,500 tonnes of mixed plastics per year on a single 8 hour shift/day and 6 day/week basis. On a 2

shift/day basis, a facility of this size would be sufficient to process all plastics currently recovered by municipal recycling programs in the province.

The quality of the final products associated with mixed waste plastics processing depend on the following:

- The input materials, including the extent to which they have been previously sorted (e.g. film from rigids) and the level of contamination associated with them.
- The effectiveness of the technology used for processing.
- Quality control at the facility, including manual support for automated processes where necessary.

The processing of mixed plastics is capable of producing (at a minimum) high quality PET, HDPE and LDPE streams, plastics that comprise approximately two-thirds of the plastics generated in Nova Scotia[42]. A clean, dry stream of other resins in commingled format may also be produced.

6.4.2 Implementation Of Mixed Plastics Processing In Nova Scotia

Rationale

The continued export of recovered secondary plastics out of Nova Scotia is unsustainable:

- It results in high levels of greenhouse gas emissions;
- It removes the possibility of creating economic opportunity associated with manufacture of plastic products using secondary plastic;
- It ties achievement of Nova Scotia's waste-resource utilisation goals to the continued willingness of distant buyers to accept low quality contaminated mixed plastics.

Sufficient volume of plastics are generated in Nova Scotia to justify a mixed plastics processing facility. Such a facility could, in time, develop as a regional or international processing facility in accordance with market opportunities and waste-resource management decisions in the region and elsewhere in the world. However, the facility need not depend on plastics materials from elsewhere.

Implementation Steps

Within the context of the creation of an EPR program for the management of plastic waste-resources generated in Nova Scotia, the following should be undertaken:

1. In parallel with the study referenced in Section 6.2, above, the RRFB should have a detailed feasibility assessment prepared in support of a mixed plastics processing facility to receive and process mixed plastics recovered in Nova Scotia. Among other things, the feasibility assessment should identify potential facility suppliers/operators, preferred technologies, probable costs, business risks and business risk mitigation strategies.

[42] The actual availability of these plastics may be less than this amount because of the PET and HDPE currently recovered through the beverage container deposit/refund system.

2. Following the completion of the feasibility assessment, the RRFB should issue a call for Expressions of Interest from suppliers/operators of mixed waste plastic processing facilities. The Expressions of Interest should include, but not necessarily be limited to, details regarding types of plastics accepted, minimum throughputs, technologies used, prior experience of the supplier/operator, technical specifications of product outputs relevant to end-use processors.
3. Expressions of Interest received from suppliers/operators should be included in the documentation made available to plastics producers by the Department of Environment and Labour. Plans submitted by producers should be required to demonstrate consideration of the option of supplying a mixed plastics processing facility located in the province, based on quotes they receive from suppliers of mixed plastics processing technology, with the objective that EPR plans developed by producers would result in the supply of such a facility with plastic waste-resources under prevailing market conditions when such a facility is available.
4. RRFB should coordinate the implementation of a mixed plastics processing facility in accordance with the proposals and requirements of producers as set out in their EPR plans. A mixed plastics processing facility might therefore be independently owned/operated, owned/operated by RRFB or owned/operated by a plastics EPR entity[43].
5. The net costs of managing plastics through the mixed plastics processing facility should be included as one of the costs associated with EPR management of plastics, and should be included in the price of plastics in the consumer chain.

[43] For example, the polystyrene industry created the Canadian Polystyrene Recycling Association as an industry EPR entity, and this entity established polystyrene recycling facilities in Mississauga, Ontario.

7.0 RECOMMENDATIONS

The following is recommended to enhance plastics recovery and recycling in Nova Scotia:

1. Enhanced plastics recovery and recycling/composting in accordance with "Best Management Practice" can recover and reutilize 80 percent of the plastics discarded in Nova Scotia, as compared to current management practices that achieve an estimated recovery and reutilization of less than 14 percent of discarded plastics in the province in 2006.

2. Plastics recovery and recycling/composting at - or approaching - the Best Management Practice (BMP) level will:
    - Make a substantive contribution to achievement of the waste disposal goal of 300 kgs/person/year by 2015 established in the *Environmental Goals and Sustainability Act, 2006*
    - Create jobs, manufacturing industry and spin-off benefits in Nova Scotia.

3. The Department of the Environment and RRFB should make the enhanced recovery of plastics at – or approaching – the BMP a priority and should place enhanced plastics recovery in the context of an EPR framework:

4. The RRFB should Chair and coordinate two initiatives, in partnership with government, municipal and industry stakeholders, in order to commence implementation of Recommendation 3, above:
    - *Plastics Products EPR Feasibility Assessment Study* This study should review options and opportunities for recovering and recycling/composting designated plastics. Particular focus should be placed on options and opportunities for enhanced recovery and recycling/composting of plastics: (i) from the residential, IC&I, C&D and agricultural sectors; and (ii) used for packaging, and with particular reference to the IC&I sector. The study should recommend EPR implementation actions, timing and costs/revenues, and should include consideration of the implementation of a mixed plastics processing facility to receive plastics waste-resources generated in Nova Scotia. As appropriate, the recommendations of the study should build on the plastics recycling infrastructure already established in the province.
    - *Mixed Plastics Processing Feasibility Assessment and Expressions of Interest* A Mixed Plastics Processing Feasibility Assessment should be undertaken in support of a mixed plastics processing facility to receive and process mixed plastics recovered in Nova Scotia through an EPR initiative. Among other things, the feasibility assessment should identify potential facility suppliers/operators, preferred technologies, probable costs, business risks and business risk mitigation strategies. Based on the outputs of this assessment, RRFB should issue a call for Expressions of Interest in establishing a mixed plastics processing facility dimensioned in accordance with a plastics products EPR initiative in Nova Scotia.

5. Based on the recommendations of the *Plastics Products EPR Feasibility Assessment Study* the Minister should designate and define an expanded range of plastic products for the purpose of an EPR initiative for enhanced plastics recovery and recycling/composting in Schedule B of the Solid Waste-Resource Management Regulations. The Regulations should specify a date by

which a plan or plans acceptable to the Minister should be submitted by producers of Scheduled plastics products and the date by which the EPR initiative will commence implementation.

6. Plans should specify an EPR program consistent with the CCME Canada-Wide Principles and Nova Scotia policy, and using the outputs of the *Plastics Products EPR Feasibility Assessment Study* as appropriate. Among other things, plans should:
    - Provide for EPR management of all designated plastics from all generators;
    - Provide for the end-management of bioplastics separately from plastics manufactured from hydrocarbons;
    - Address, as necessary, issues of non-competition/lack of competition that may be associated with collaborative producer initiatives to implement plastics product EPR initiatives;
    - Include the option of receipt of mixed recovered plastics at a mixed plastics processing facility at prevailing market prices and based, as appropriate, on the outputs of the *Mixed Plastics Processing Feasibility Assessment*;
    - Specify the institutional, organisational and financial arrangements necessary to ensure the effectiveness of the EPR initiative; and
    - Specify, as appropriate, mechanisms to ensure the transparency, efficiency and effectiveness of the EPR initiative, and accountability for the results of the initiative.

7. In implementing and coordinating Recommendations 3 - 5, the Department of Environment and Labour and the RRFB should be guided by their recent experience in the development of an EPR program for end-of-life electronics.

8. RRFB should coordinate the implementation of a mixed plastics processing facility in accordance with the proposals and requirements of producers as set out in their EPR plans. A mixed plastics processing facility might therefore be independently owned/operated, owned/operated by RRFB or owned/operated by a plastics EPR entity[44].

9. The net costs of managing plastics through the EPR initiative should be included in the price of plastics in the consumer chain.

10. As an immediate step in accordance with EPR principles and to achieve early economic and environmental benefits in Nova Scotia from enhanced plastics recovery and recycling/ composting, the Minister should take the following action:
    - Designate and define windshield washer fluid (WWF) containers under Schedule B of the Solid Waste-Resource Management Regulations and require producers who use the containers to register with the Department of Environment and Labour.
    - Require producers who use these WWF containers to submit EPR plans for the management of the containers, using the outputs of this document as appropriate.
    - Require that WWF EPR plans include: (i) a consumer refund, financed by producers, for the return of the containers to a collection point; (ii) the optimization of existing recycling infrastructure in Nova Scotia; and (iii) the sale of recovered plastics at market prices to one or

[44] For example, the polystyrene industry created the Canadian Polystyrene Recycling Association as an industry EPR entity, and this entity built and operates Canada's largest polystyrene recycling facility in Mississauga, Ontario.

more Nova Scotia end-users or, if end-users are not available, to an intermediate processing facility located in Nova Scotia and that shipment of WWF containers out of the province will only be acceptable if end-users and/or intermediate processors are unavailable to absorb the tonnage of recovered plastics.

- Define in legislation that "biodegradable plastics" mean those that meet ASTM Standard D6400 or D6868 or equivalent standard.
- Require that any plastic that is claimed to be "biodegradable" or "compostable" must: (i) have been tested in accordance with the requirements of ASTM Standard D6400 or D6868 or equivalent standard; (ii) be certified by the Biodegradable Products Institute as compliant with ASTM Standard D6400 or D6868 or equivalent standard; and (iii) bear the logo issued by the Biodegradable Products Institute to plastics that meet ASTM Standard D6400 or D6868.

11. Each Solid Waste-Resource Region in Nova Scotia should be requested/required by the Minister to develop a plan regarding the actions necessary within the region to achieve the BMP for management of plastics discards. These plans should address all plastics from all sources in the region, and should include mechanisms at the municipal level for ensuring that municipalities and their agents take the steps necessary to implement and monitor that plastics banned from disposal are not disposed of. These plans should constitute a municipal input into the preparation of the EPR initiative identified in the above Recommendations.

12. Recommendations should be developed through the RRFB for the enhanced recovery and recycling of other discards in Nova Scotia in support of achieving the waste disposal goal of 300 kgs/person/year by 2015 established in the *Environmental Goals and Sustainability Act, 2006*.

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REFERENCES

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KEY CONTACTS

The following key individuals were contacted in the preparation of this document:

Robertson, Barb., American Plastics Council Automotive Learning Centre
Burke, D., Solid Waste-Resource Management Region 1 (Cape Breton Region)
Chassie, D., Halifax C&D Ltd.
Cirko, C., Environmental and Plastics Industry Council
Conrad, G., Retail Gasoline Dealers Association
Green, G., Solid Waste-Resource Management Region 7 (Western Region)
Haverkort, N., Solid Waste-Resource Management Region 2 (Eastern Region)
Kenny, R., Nova Scotia Department of Environment and Labour
Lewis, L., Solid Waste-Resource Management Region 4 (Regional Municipality of Halifax
Lyon, D., Resource Recovery Fund Board Inc.
MacKenzie, T., Solid Waste-Resource Management Region 1 (Northern Region)
MacQueen, D., Nova Scotia Department of Environment and Labour
Paris, J., Resource Recovery Fund Board Inc.
Proctor, D., Solid Waste-Resource Management Region 3 (Northern Region)
Rogers, B., Association of Enviro-Depot Operators
Van Rooyen, Solid Waste-Resource Management Region 5 (Valley Region)
Walsh, V., Solid Waste-Resource Management Region 6 (South Shore-West Hants Region)
Wendt, F., Solid Waste-Resource Management Region 4 (Regional Municipality of Halifax

Numerous other individuals were contacted related to specific aspects of this document. These included individuals with Environment Canada, municipalities, industry associations, plastics product manufacturers, equipment suppliers, purchasers of secondary plastics, processors of secondary plastics, suppliers of windshield washer fluid and others.

Annex A

OPTIONS FOR PLASTICS RECYCLING FEASIBILITY ASSESSMENT

PLASTICS STUDY

OPTIONS FOR PLASTICS RECYCLING FEASIBILITY ASSESSMENT

Background

This Annex presents options for enhanced plastics recycling in accordance with requirements for the Plastics Study Mid-Project Client Meeting. The options that are presented in this document have been discussed with the Steering Committee and a preferred option has been selected for further assessment in the Project Task 6: Feasibility Analysis, and is elaborated elsewhere in this report.

Options For Consideration

The following options are presented for the consideration of the Steering Committee.

1. Upgrading plastics quality as a function of MRF processing. This option would result in the washing and drying of plastics at a MRF. Implementation of this option would result in the recovery for recycling of essentially all plastics packaging generated by residents, and could be extended to plastics packaging recovered from the IC&I sector. Key issues include:

    - Identification of markets for recovered plastics. Pragmatically, this option likely requires that plastics are size-reduced, and washed/dried as commingled materials, although a rigids/film sort may also be feasible which would provide LDPE-rich and mixed rigids streams. Current markets for Nova Scotia plastics are generally based on commingled streams (except HRM and limited quantities of IC&I plastics), and identification of markets would likely not be a major issue in principal.
    - Technology demonstration. Washing of plastics has been undertaken by others, but technology selection and implementation will require care to ensure optimised operations.
    - Additional costs will be incurred as compared to those that are currently incurred for management of plastics. Appropriate EPR design will minimise/negate costs to municipalities.
    - It is not clear that washing/drying at a MRF carries net advantages as compared to similar operations at the end-user. In particular, size reduction of mixed plastics makes it difficult for an end user to assess the type of material they buy.

2. Recovery/recycling of a single resin plastics discard. This option would target the recovery of an individual plastic product that is discarded on a widespread basis; windshield washer containers are recommended. These are manufactured from HDPE and carry high material value. Key issues include:

    - Design/application of a recovery system to ensure the recovery of the containers. A deposit/refund is recommended, with possibility for return of the containers through Enviro-Depots.
    - Application would be through existing infrastructures, and may support the development of new, value-added manufacturing in Nova Scotia.
    - Recovered plastics could be managed as either a single-resin material, or as a mixed-resin material.

- The application of a deposit/refund would be undertaken through design of either a EPR or a product stewardship initiative.
- Implementation requires an interested proponent.

3. Recovery/recycling of mixed resin plastic discards. This option would target the recovery of rigid and film plastics from the IC&I sector[45]. A processing line would be procured capable of processing 1,000 kgs./hour and would operate according to demand; this would provide a nominal domestic processing capacity of 6,240 tonnes per year. Plastics would be processed to produce a plastic lumber product. Key issues would include:

    - EPR institutional design would include producers in the costs of plastics recovery (and might be extended to recovery of other plastics).
    - The required technology has been proven elsewhere, but would require careful selection and implementation will require care to ensure that the system is optimised.
    - Effective mechanisms for monitoring/enforcing the management of discarded plastics by the IC&I sector would be required.
    - Implementation requires an interested proponent.

Table A-1 summarizes key aspects of these options.

Recommendation for Discussion

1. Establish parameters for EPR/industry stewardship to support enhanced plastics recycling/compliance with provincial requirements.

2. Develop action plan for implementation of Option 3.

3. Develop business plan for implementation of Option 2.

[45] Alternatively, or in addition, currently recovered residential plastics could be processed by the facility. This would ensure that plastics that are recovered are, in fact, recycled in Nova Scotia as compared to the uncertainty regarding the current destination and fate of many plastics recovered for recycling.

Table A-1
Summary of Options for Plastics Study Feasibility Assessment of Enhanced Recycling of Plastics

OPTION	DESCRIPTION	RATIONALE	TECHNICAL ELEMENTS	STAKEHOLDERS TO BE CONSULTED	PRELIMINARY APPROXIMATE EQUIPMENT COSTS	ADVANTAGES/DISADVANTAGES
1. Upgrading plastics quality as a function of MRF processing. *Target: "dirty" plastics packaging*	Washing/drying of plastics at MRF in order to create marketable plastic materials	High levels of plastics recovery requires clean plastics to enter the market place Existing residential plastics recovery fail to capture large quantities of plastics but are at, or near, maturity in most Nova Scotia jurisdictions Would facilitate compliance with Nova Scotia law – which municipalities do not currently adhere to Application of EPR	Design of EPR/industry stewardship framework Collection of "dirty" plastics and/or recovery of dirty plastics from residual waste Washing of plastics at MRF Drying of plastics at MRF Baling of plastics Sale of recovered plastics	Municipal representatives Plastics brokers/end-users Equipment suppliers	$0.5 - $0.75 million	*Advantages* Producers engaged in recovery/recycling of plastics; high, positive impact on diversion of plastics from disposal; potential to attract value-added industry to Nova Scotia; maximises use/ benefit of current infrastructure; engages residents in enhanced recycling activities *Disadvantages* Technically difficult and costly option; new municipal processing, technical and other capacity required by municipalities; lack of stakeholder support
2. Recovery/ recycling of a single resin plastics discard. *Target: Windshield washer bottles*	Recovery of specific discarded plastic product for recycling in Nova Scotia	Short-term action to rapidly demonstrate the continuing development of plastics recycling in Nova Scotia High level of likelihood that existing plastics processors would participate Provides a small-scale model of wider EPR initiatives that could be undertaken with appropriate institutional design	Design of EPR/industry stewardship framework Targeting of specific plastic discard and mechanisms for its recovery Recovery of selected plastic Reprocessing of plastic Sale of plastic product	Suppliers of windshield washer fluid Retail Gasoline Dealers Association RRFB Potential plastics reprocessor in Nova Scotia Equipment suppliers	$0.1 million – $0.25 million	*Advantages* Producers engaged in recovery/recycling of plastics; rapid and visible enhancement of plastics recovery/recycling; could support existing Enviro-Depot network; may result in high value-added plastic product. *Disadvantages* Focuses on single product of limited quantities; not clear who would implement
3. Recovery/ recycling of multiple resin plastic discards. *Target: Rigid and film plastics from IC&I sector; processing of residential plastics*	Recovery of specified plastic materials for recycling in Nova Scotia	Maximizes the opportunity to recover the large volumes of recyclable plastics that are available in Nova Scotia. Maximizes employment and value-added benefits associated with recycling of recovered plastics Application of EPR Facilitates compliance with Nova Scotia law	Design of EPR/industry stewardship framework Targeting of specific generators of plastics (e.g. IC&I sector) Recovery of targeted plastics Reprocessing of plastic Sale of plastic product	Plastics brokers/end-users Equipment suppliers Potential plastics reprocessor in Nova Scotia	$1.75 million – $2.5 million	*Advantages:* Producers engaged in recovery/recycling of plastics; extends reach of current plastics recovery using existing infrastructure; high, positive impact on diversion of plastics from disposal; creation of new industry, employment and products in Nova Scotia *Disadvantages* Not clear who would implement.

Annex B

CANADA-WIDE PRINCIPLES FOR EXPTENDED PRODUCER RESPONSIBILITY

ANNEX B

CANADA-WIDE PRINCIPLES FOR EXTENDED PRODUCER RESPONSIBILITY

Preamble

Stewardship, or the responsible management of the environment and its natural resources, requires governments, industry and consumers to assume a greater responsibility for ensuring that the products we manufacture, use, reuse or dispose of have a minimum impact on the environment.

Canada ranks as one of the highest producers of solid waste per capita in the world. The latest survey by Statistics Canada shows that in the year 2002 just over 32.4 million tonnes of waste were managed in Canada with only 25% of this being recycled or reused. Governments across Canada are struggling with the rising costs associated with managing the country's increasing quantity of wastes being generated across the country. Governments also recognize that increasing quantities and types of wastes are producing harmful impacts to our environment and wasting valuable resources.

CCME has explored the potential for extended producer responsibility (EPR) as a public policy to help address the problems associated with our growing waste stream. CCME determined that national definitions and principles for EPR would promote harmonization of approaches and help provide a level playing field for application of EPR initiatives across the country.

Definitions

"**Extended producer responsibility (EPR)**" means an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle.[46]

Two related features of EPR policy include:

1. Increasing producer responsibility by shifting responsibility upstream toward the producer and away from municipalities and/or regional or provincial waste management authorities.
2. Providing incentives to producers to incorporate environmental considerations in the design of their products.

Stewardship processes/programs/regulations may result in EPR as long as there is consistency with principles of EPR.

[46] Based on the Organisation for Economic Co-operation and Development (OECD) definition for EPR. <http://www1.oecd.org/publications/e-book/9701041e.pdf>

"**Producer**" means the most responsible entity which may include but is not limited to the brand owner, manufacturer, franchisee, assembler, filler, distributor, retailer or first importer of the product who sells, offers for sale, or distributes the product in or into a jurisdiction.

Canada-wide Principles for Extended Producer Responsibility

In accordance with the CCME guiding principles for pollution prevention, producers are responsible for their products at end-of-life. CCME has developed a list of Canada-Wide Extended Producer Responsibility Principles (EPR) for management of waste materials, in consultation with stakeholders.

The objective of the Canada-Wide Principles for EPR is to assist and support jurisdictions in the development of EPR programs. The overarching goals of the principles are to minimize environmental impacts, maximize environmental benefits, promote the transfer of end-of-life responsibility for the product and/or material to the producer, and encourage design for environment (DfE). Design for environment (DfE) examines a product's entire lifecycle and proposes changes to how a product is designed in order to minimize its environmental footprint. Incorporating DfE may contribute to natural resource and energy conservation, biodiversity preservation, source reduction, waste minimization, and pollution prevention.

While recognizing differences in the legislative/regulatory framework and existing programs among jurisdictions, CCME encourages regional or national cooperation in the development of EPR programs. Specific measures undertaken by each jurisdiction are at their discretion, with the goal of effective, efficient, and harmonized implementation.

To promote harmonization of approaches to the greatest extent possible, CCME endorses the following guiding principles for the design and development of EPR policies and programs[47]:

I. Environmental Principles

1. To the greatest extent possible, programs seek to reduce the environmental impact of a product.

2. EPR programs are consistent with the 4R waste management hierarchy:
    a. Reduce, including reduction in toxicity and redesign of products for improved reusability or recyclability
    b. Reuse
    c. Recycle
    d. Recovery, of materials and/or energy

[47] Based on principles originally proposed by the Organisation for Economic Co-operation and Development (OECD)

3. EPR programs encourage producers to incorporate design for environment to minimize impacts to environment and human health.

II. Program Design Principles

4. EPR programs transfer end-of-life responsibility for waste product or materials to producers from municipalities and other waste management authorities.
5. Potential programs undergo a comprehensive analysis to assess whether they are appropriate for EPR and to define the role of the various actors in the product chain.
6. Policy instruments selected are flexible and determined on a case-by-case basis.
7. Local governments and other stakeholders are engaged to discuss environmental goals, objectives, priorities and performance measurement, and to enhance a program's acceptability and effectiveness.
8. EPR program and policy development and implementation is based on transparency.

III. Implementation Principles

9. Programs and policies are designed and implemented in a way that environmental benefits are maximized while economic dislocations are minimized.
10. A communication strategy is devised to inform participants in the product chain, including consumers, about the program and enlist their support and co-operation.
11. EPR programs undergo periodic evaluations to ensure that they are functioning appropriately, are subject to performance measurement, and include accessible and transparent reporting.
12. Costs of program management are not borne by general taxpayers.
13. Consumers have reasonable access to collection systems without charge, to maximize recovery opportunities.

Annex C

FEASIBILITY OF RECOVERY AND RECYCLING OF WINDSHIELD WASHER CONTAINERS

ANNEX C

FEASIBILITY OF RECOVERY AND RECYCLING OF WINDSHIELD WASHER CONTAINERS

Background

Windshield washer fluid (WWF) is a commodity product sold throughout Nova Scotia for the purpose of cleaning automobile windshields and windows. The product is sold in a plastic container manufactured from a uniform HDPE plastic material. Typically, consumers use the fluid for filling a windshield washer reservoir in their vehicle; the container is then discarded.

Objectives

The objectives of an initiative to recover and recycle windshield washer containers would be two-fold:

- To enhance the diversion of materials away from disposal, in accordance with provincial policy.
- To build a new, Nova Scotia industry for which the recovery and recycling of WWF containers is an integral component.

Stakeholders

The following groups of stakeholders are involved in the marketing, use and management of windshield washer fluid and the management of discarded containers.

- Manufacturers. No windshield washer fluid manufacturers are known to operate in Nova Scotia, although manufacturers operate in other provinces.
- Packagers/Distributors. Windshield washer fluid enters Nova Scotia through packagers/ distributors. In some cases, the distribution entity is directly linked to the manufacturer; in other cases, the distribution entity is a packager who mixes anti-freeze with water and packages and distributes the resulting blend as windshield washer fluid.
- Wholesalers. Wholesalers sell windshield washer fluid to retailers.
- Retailers. Retailers are the entities that provide windshield washer fluid to the consumer. Retailers of windshield washer fluid include grocery stores, hardware stores, convenience stores, service stations, automobile mechanic shops and car dealerships. Typically, windshield washer fluid is made available to the consumer through sale of containers of the fluid, in which case the consumer takes possession of the container and is responsible for the fate of the container at the time of discard. However, entities engaged in the automotive trade and maintenance sector generate containers through filling the windshield washer reservoir of customers vehicles, and in this instance windshield washer containers are retained by the trade or maintenance sector entity.
- Consumers. As indicated above, consumers who take possession of WWF through the purchase of a container of WWF are responsible for the discard of the empty container.
- Waste/Recyclable Materials Haulers. Haulers of waste and recyclable materials transport WWF containers from the point of generation to either a processor of recyclable materials or a disposal site.
- Recyclable Materials Processor/Landfill Operator. Processors of recyclable materials receive WWF containers and prepare them for shipment to an end use plastics market; typically, plastics recovered

in Nova Scotia are exported for processing. WWF containers that are delivered to landfills are managed with other waste and are lost to further opportunity for recovery/recycling.

Market Profile and Quantities of WWF Containers

Supply of WWF Manufacturers and packagers/distributors of WWF in Canada include the following:

RW Packaging Ltd., Winnipeg, MB
Irving Oil, St. John, NB
Drew Canada, Div. Ashland Canada Corp., Greater Toronto Area
Hal-Chem Mftg, Boucherville PQ
Lordco Parts Ltd, Maple Ridge, BC
Shrader Canada, Oakville
Societe Laurentide, Shawinigan, PQ
Recochem, Montreal, PQ
Produits Sanitaires Unique, La Pocatiere, PQ
Vulsay Industries Ltd., Brampton, Ont
MarkLyn Co. Inc., Brampton, Ont
Godden Manufacturing, Scarborough, Ont
Zep Manufacturing, Dorval, PQ
Norchem, Div. Avmor Ltee, Laval, PQ
Chemac Industries Inc., Vernon, BC
Kleen Flo Tumbler Industries Ltd., Brampton, Ont
Gotham Industries, Ste. Therese, PQ

WWF manufactured or packaged/distributed by any of these companies may be sold in Nova Scotia. In addition, it is possible that WWF manufactured or packaged in or distributed from the US may also enter the Nova Scotia market place.

Quantity of WWF and WWF Containers Data is not available from WWF manufacturers or packagers/distributors to allow a precise mapping of the amount of WWF supplied by different companies or to estimate the total quantity of WWF sold into the Nova Scotia market. Data from Statistics Canada has been reviewed, but information relating to WWF sales is reported in aggregate with data for other automotive products and cannot be separately identified.

However, work has been undertaken by Environment Canada to estimate the quantity of volatile organic compounds (VOC's) attributable to WWF usage in Canada[48]. Notwithstanding that the work was undertaken in 2000 and uses 1995 data, this provides a basis for estimating the market for WWF in Nova Scotia, from which the quantity of WWF containers generated in the province can be estimated as follows:

- Environment Canada estimates that windshield washer fluid use in Canada resulted in the release of 60,000 tonnes of VOC's in 1995. Statistics Canada estimates that the population of Nova Scotia in 1995 comprised 3.152 percent of the population of Canada. Based on the assumption that the

[48] Paine, P., Prinsen J.H., et al., *The Contribution of Methanol (VOC) Emissions from Windshield Washer Fluid Use to the Formation of Ground Level Ozone,* SAE Technical Paper Series 2000-01-0663, Society of Automotive Engineers, 2000.

distribution of VOC emissions at a provincial level can be pro-rated on a population basis. The emission of VOC's from use of WWF in Nova Scotia in 1995 is therefore be estimated to be 60,000 t * 3.152 percent = 1,891.2 t

- VOC emissions associated with WWF in 1995 were associated with the use of methanol as the active ingredient in WWF. Typically, formulations of WWF in 1995 were comprised of 38 percent methanol and 62 percent water, and 100 percent of methanol in WWF volatilizes over time. If VOC emission from methanol in WWF was 1891.2 t in 1995, it follows that the total WWF used in Nova Scotia in 1995 was 4,976.8 tonnes.
- Taking into account the different specific gravity of water and methanol, WWF containing 38 percent methanol weighs 0.924 kgs/litre. It therefore follows that 4,976.8 tonnes of WWF is equivalent to 5.386 million litres of WWF.
- WWF is sold in Nova Scotia in containers that hold 3.78 litres. It follows, and is concluded, that 5.386 million litres of WWF was sold in 1.425 million containers in 1995.

The validity of this conclusion depends on whether it is reasonable to pro-rate VOC emissions attributable to WWF in Nova Scotia on the basis of the ratio of population of the province to the population of Canada. VOC emissions from WWF occur as a result of vehicle use; Natural Resources Canada reports that the number of on-road vehicles per capita in Nova Scotia in 2005 was within 1.7 percent of the national average[49]. Therefore it appears that for the purposes of this analysis vehicle use in Nova Scotia does not vary significantly on a per capita basis as compared to average vehicle use in Canada. Pro-rating VOC emissions associated with WWF – and, therefore WWF use – on the basis of population is therefore considered a reasonable approach to estimating WWF use in Nova Scotia.

Statistics Canada reports that the population of Nova Scotia in July 2007 was 2.73 percent greater than in 1995. Therefore it is concluded that the quantity of WWF used in the province will also be 2.73 percent greater in 2007 than in 1995, and that the market for WWF in Nova Scotia in 2007 will be 1.464 million containers of WWF[50].

Containers used by different manufacturers of packagers may be designed in different formats, and may therefore weigh different amounts. However, on average an empty WWF container is estimated to weigh 0.13 kgs, excluding the cap. It is therefore estimated that WWF containers in Nova Scotia will total 190,320 kgs in 2007.

WWF Container Generation The preparation of a program to recover WWF containers requires estimates of: (i) when the containers are generated; (ii) who generates them; (iii) spatial distribution across the province.

When WWF Containers Are Generated WWF container generation is highly seasonal. Retailers contacted in the course of preparing this analysis report that 90 percent of their WWF sales occur

[49] Natural Resources Canada, *Canadian Vehicle Survey 2005, Summary Report*, Ottawa, 2006 http://www.oee.nrcan.gc.ca/Publications/statistics/cvs05/chapter2.cfm?attr=0

[50] Based on an estimated 532,464 on-road vehicles in 2007 (estimate based on Natural Resources Canada data, above) this is equivalent to 2.75 containers of WWF per on-road vehicle.

between October and March, and that within this period the majority of WWF is sold in the December-February period. Since WWF is used by consumers over a period of time and the container is not discarded until it is empty, it is likely that 90 percent of the generation of WWF containers occurs in the November – April period, with peak generation (65 percent of total) in the January – March period and the remaining generation in the period (25 percent of total) in October - December. Therefore it is estimated that 1.317 million WWF containers, comprising 171,200 kgs of HDPE, will be generated in the November – April period (and a majority of this in the January – March period) and that the balance of WWF containers will be generated over the remaining months of the year.

Who Generates WWF Containers There are two main categories of WWF container generator: (i) individual consumers who buy and use WWF, and who therefore discard the empty container when they no longer require it; and (ii) establishments associated with the automotive trade, including gas stations, new car dealers, mechanic shops and related facilities who fill vehicle WWF reservoirs as a service to their customers, and who then discard the empty containers.

Data on the quantity of WWF containers that are generated by these two groups of stakeholders can be estimated based on consultations undertaken in the preparation of this analysis. Based on the data available, the automotive trade may discard in the order of 15 – 25 percent of the WWF containers that are generated in the province annually (i.e. 220,000 – 365,000 containers per year). Individual consumers may discard in the order of 75 – 85 percent of the WWF containers that are generated in the province (i.e. 1.1 million – 1.244 million containers per year).

The majority of WWF containers are therefore estimated to be generated by residents; these containers are generated in small quantities by a large number of people. Smaller numbers of WWF containers are generated by the automotive trade, but the volume of generation is relatively high for each outlet that generates the containers.

Spatial Distribution of WWF Container Generation The table below identifies the estimated spatial distribution of discarded WWF containers in Nova Scotia, calculated by pro-rating the total number of discarded WWF containers according to population:

The "regions" identified in the above table correspond to the solid waste-resource management regions of the province. Within these regions the respective shares of WWF containers generated by the automotive trade and by residents is expected to be similar.

Existing Management Practice

Legal Framework "High density polyethylene bags and packaging" are banned from landfills and incinerators in Nova Scotia. WWF containers are a type of packaging and are manufactured from

Estimated Spatial Distribution of WWF Containers

REGION	POPULATION	PERCENT OF PROVINCIAL POPULATION	WWF CONTAINERS	WEIGHT OF PLASTIC (KGS)
1. Cape Breton Region	144,657	15.48	226,645	29,464
2. Eastern Region	76,264	8.16	119,488	15,533
3. Northern Region	107,133	11.47	167,853	21,821
4. Halifax Region	382,203	40.90	598,825	77,847
5. Valley Region	82,590	8.84	129,400	16,822
6. South Shore/West Hants Region	95,252	10.19	149,238	19,401
7. Southwest Nova Region	46,306	4.96	72,551	9,432
Total	**934,405**	**100**	**1,464,000**	**190,320**

high density polyethylene, and they are therefore banned from landfill disposal. Although there are no data on the extent to which WWF containers are in fact removed from the waste stream for recycling, the following may be considered:

Current Practice Consultations have been undertaken with stakeholders in the automotive trade regarding the fate of WWF containers. No formal or informal recovery or recycling initiatives have been identified within the sector. WWF containers from these generators are currently discarded for disposal.

The fate of WWF containers generated by residents is less clear. WWF containers are accepted in all municipal recycling programs in the province. Although the containers are prohibited from landfill disposal:

- There are no consumer incentives to recover WWF containers, other than the availability of municipal recycling programs that are themselves voluntary and which are not incentivised.
- There are no industry or other programs to collect WWF containers from either consumers or the IC&I sector.
- There is no effective enforcement of the ban on landfilling of high density polyethylene packaging at either municipal or provincial levels, and only HRM has formalized landfill inspection protocols to divert HDPE (and other materials banned from disposal) generated from the IC&I sector. As well HDPE appearing in the form of redeemable beverage containers are removed as part in the Front End Processing operation of the HRM Waste Processing and Disposal Facility operations.

Based on these considerations, it is reasonable to conclude that the proportion of WWF containers recovered from the IC&I sector approaches zero, and that the proportion of WWF containers recovered from households is generally similar to the overall proportion of plastic recovered from the residential sector (i.e. approximately 40 percent). Based on the estimates, above, of IC&I and

residential sector generation of WWF containers, it appears that approximately one third of WWF containers may be recovered for recycling, and that two-thirds are disposed of in landfills.

WWF containers that are collected from residents for recycling are processed by municipalities and are sold through a broker/dealer network for processing. There are no secondary plastics processing facilities in Nova Scotia, and all recovered plastics are therefore exported from Nova Scotia. The export of plastics from Nova Scotia incurs costs and necessarily has negative environmental impacts through the creation of greenhouse gases associated with transportation and in other ways. The export of plastics from the province also results in the loss of economic opportunity and employment associated with the reprocessing of the plastics.

Options for Enhanced Recovery and Enhanced Marketing of WWF Containers

Table C-1 summarizes options for enhanced recovery of WWF containers. The options for enhanced recovery and utilization of WWF containers identified in Table C-1 incorporate options that either build on or strengthen existing recovery/utilization infrastructures or which envisage the possibility of new recovery/utilization infrastructures:

- Option 1: Implement a product stewardship program for WWF container management. This option builds on the stewardship model for beverage containers in Nova Scotia. This model, however, is one which is financed by consumers and which is operated by the public sector; as such, it does not provide incentives for environmentally enhanced delivery of products or the packages that are used for product delivery. While the model is effective in recovering containers, it does not support upward movement within the waste management hierarchy. However, this approach would allow for recovered materials to be sold in Nova Scotia for reprocessing.

- Option 2: Implement industry financing support program for WWF container management. This option provides for industry involvement in the recovery of WWF containers, but only to the extent that relevant industry stakeholders contribute to the cost of WWF container recovery and marketing. While this may be a positive consideration from some perspectives, this approach does not engage producers in environmentally-preferred design of WWF containers or delivery of WWF, and does not necessarily result in enhanced recovery of WWF containers. Without parallel actions to define which entities are responsible for recovery of WWF containers from the IC&I sector, it is not clear who would have this responsibility or what the obligations of the IC&I sector would be in this regard. WWF containers would continue to be processed and marketed by municipalities in ways that are similar to those that are currently used, with the result that WWF containers from most – and perhaps all – municipal recovery programs would be exported from the province.

- Option 3: Design/implement EPR program for WWF container management. An EPR initiative for WWF container management would focus producers on not only the challenge of environmentally effective management of WWF containers, but also environmentally-preferred ways to deliver WWF and the containers that are necessary for its delivery. An EPR initiative would therefore ensure not only cost-effective recovery, but recovery costs that are met by producers either through increased costs that are passed on to consumers or in other ways. Competition would be stimulated with respect to environmental performance of WWF delivery and WWF containers, possibly attracting new entities with

Table C-1
Options for Enhanced Recovery of WWF Containers in Nova Scotia

OPTION	DESCRIPTION	ADVANTAGES	DISADVANTAGES	COST TO PUBLIC ENTITIES	EVALUATION
1. RRFB-Administered Stewardship program for WWF container management	Similar approach to beverage container recovery: RRFB would manage container recovery program based on WWF container deposit/refund mechanism; recovered material would be sold in Nova Scotia	Recovery level of 80% if linked to deposit/refund system Approach would build on existing Enviro-Depot network RRFB could select a processor on environmental and social criteria in addition to economic criteria	Approach is not consistent with CCME EPR Canada-Wide Principles Approach does not promote waste reduction or design-for-environment objectives Addition of deposit/refund to WWF containers may be perceived as arbitrary	Low/no cost	Less preferred option
2 Industry financial support for WWF container recovery through municipal programs	Producers would pay municipalities and others for the cost of WWF container recovery in existing or new recovery systems	New revenue stream for municipal/other recycling programs	May be viewed as arbitrary by WWF producers Would not necessarily enhance WWF container recovery or cost-effectiveness Would not necessarily result in utilization of recovered WWF containers in Nova Scotia	Low cost	Less preferred option
3. EPR program for WWF container management	Producers would develop and implement a WWF container recovery program at their cost in accordance with CCME guidelines	Recovery level of at least 80% if linked to deposit/refund system Consistent with CCME EPR Canada-Wide Principles Cost of container management integrated into overall product cost Promotes competition on the basis of container management cost	Low level of awareness and acceptance among WWF producers regarding EPR May be perceived as arbitrary by producers in the absence of a wider EPR initiative	No cost	Preferred option
4. Drive WWF containers into existing recycling systems	WWF containers would be driven into existing recycling systems through rigorous enforcement of the ban on disposal of HDPE packaging	Helps optimize municipal recycling systems. Improves cost-effectiveness of existing recycling systems	Unwillingness of province to enforce bans and unwillingness of most municipalities to ensure compliance makes recovery levels uncertain and variable over time Would not result in enhanced utilization of recovered WWF containers in Nova Scotia	Medium/high cost	Less preferred option
5. Purchase empty containers	Recovery entities would recover WWF containers through purchase of the container and would recover costs through sale of recovered materials	Incentive-based approach to WWF container recovery Purchase price would reflect market conditions Recovery of high quality HDPE material	Varying WWF recovery according to price paid Market price would fluctuate and may dip to levels that make purchase unrealistic "Recovery entities" would require definition New infrastructure may be required to manage container purchase/sale	No cost	Less preferred option

new approaches to responding to these priorities. WWF containers could be separated from other containers and would be available for reutilization in Nova Scotia provided that an appropriate mechanism was established to achieve this level of separation of WWF containers from other recyclable materials; the appropriate mechanism – well demonstrated in Nova Scotia in other contexts - would be to provide consumers with a refund for the containers and to link this with the existing Enviro-Depots, which have extensive experience in implementation of implementation of refunds for recyclable materials and which achieve the recovery of approximately 80 percent of beverage containers sold annually . Specific implementation of this approach would be in accordance with a plan submitted by producers and agreed by the Minister.

WWF stakeholders may consider an EPR initiative focused only on WWF containers to be arbitrary given that the containers comprise a small part of the waste stream; thus, an EPR initiative with respect to WWF containers may be best placed in a wider EPR program context.

- Option 4: Drive WWF containers into existing recycling systems. This option would maximize the recovery of WWF containers through existing recovery systems. Rigorous enforcement of the ban on disposal of WWF containers would, in theory, require all containers to be managed through recycling streams since other management options would not be available; this approach would be accompanied by public awareness/education communications to reinforce awareness in generators of the requirement to recycle WWF containers. In practice, however, consistent enforcement of landfill bans has not been a priority at provincial or, in the majority of cases, municipal levels and is unlikely to become so over extended periods of time for WWF containers. Accordingly, increased WWF container recovery may be modest under this option.

  Additionally, application of this approach under current infrastructure and market conditions would result in continued reliance on markets external to Nova Scotia with the attendant consequences this has on: (i) higher GHG emissions associated with transportation; and (ii) the continuing loss of economic opportunity to Nova Scotia associated with exporting recovered HDPE from the province.

  Notwithstanding these concerns, a ban on the landfilling of WWF containers is a helpful measure in supporting enhanced recovery of WWF containers if undertaken in parallel with one of the measures identified above.

- Option 5. Purchase empty containers. Unlike containers currently recovered through a deposit/refund system, WWF containers contain sufficient plastic material to have a tangible value based on the quantity of material they contain. At an average weight of 130 grams, WWF containers have a value 7.8 cents each, assuming a market value of $600/tonne for natural (clear) HDPE. This might serve as a baseline for paying consumers for their empty WWF containers. Thus, consumers might be paid 5 cents a container, and the balance (2.8 cents) might be retained by the collection agent to pay for overhead and transportation costs. High quality HDPE would be recovered.

  Experience elsewhere with systems of this type (and in Nova Scotia with respect to recovery of beverage containers) is that the payment of 5 cents for a container is sufficient to attract large numbers of consumers to participate, and to attract service groups, municipalities and others to separate and recover containers for the value they represent. However, the infrequent generation of the containers by individuals suggests that a higher payment is likely to be necessary to attract high levels of participation.

Market prices for secondary HDPE have varied by 55 percent over the 12 month period to October 2007. A recovery system based on payment linked to market price has high potential to fail when market prices – and therefore the price paid for a WWF container – sink below what consumers might find a sufficiently attractive price to win their support in the WWF container recovery initiative. Expectations that such a recovery system should recover all its costs are likely to be misplaced when market prices fall.

Based on these considerations, Option 3: EPR Program for WWF Container Management is the preferred recovery approach.

Markets for Recovered WWF Containers

WWF containers are manufactured from natural (i.e. clear) HDPE. Secondary natural HDPE is in high demand globally. No end-users of natural HDPE are known to be operating in Nova Scotia. However:

- The Novapet facility in Amherst undertakes an intermediate processing of natural HDPE, which is then transported out of province or processing at an end-use market.
- At least one manufacturer in Nova Scotia is known to be willing to purchase WWF containers (and other HDPE) for manufacture of value added end products in Nova Scotia. These products would include safety products and barriers for use in the transportation sector.

Accordingly, it is concluded that markets for recovered WWF containers exist in Nova Scotia. The Minister should require that the plan submitted by producers under Option 3, above, for the management of WWF containers through an EPR initiative include the sale of recovered HDPE to an end-use processor in Nova Scotia unless it can be demonstrated that this is not feasible at prevailing market prices; in which case sale to an intermediate processor located in the province may be undertaken. Shipment of the recovered plastics out of the province should be permitted only in the event that no processing options are possible in the province at prevailing market prices.

Financial Analysis

Clearly, the costs of WWF container recovery under Option 3, above, depend on the specific plan developed by producers. However, indicative costs can be developed on the basis that the plan incorporates the following, consistent with the preferred Option 3, presented above:

- Delivery of WWF containers to collection points by consumers.; the preferred collection points are Enviro-Depots at which consumers would receive a refund for the container. The collection of the containers from consumers would therefore be a consumer cost.[51]
- Storage of WWF containers at Enviro-Depots in woven plastic sacks of 0.975 m^3. It is assumed that an average of 5 sacks would be required per Enviro-Depot, and that WWF containers would be size-reduced as the sacks were filled.

[51] In practice, consumers would typically combine the delivery of WWF to an Enviro-Depot with a trip that they would in any case make to either the Enviro-Depot or for some other purpose in the vicinity of the Enviro-Depot, so that the typical incremental additional cost to the consumer would be small or zero.

- Volume reduction of containers at the Enviro-Depots using either compaction or granulation
- Transportation of volume-reduced WWF containers to an end-use market or an intermediate processor in Nova Scotia.

The cost elements of this approach are therefore:

- Handling of WWF containers from the time of their delivery to the Enviro-Depot to their departure from the Enviro-Depot. It is assumed that an average of 10 seconds will be required to handle each container at the time that it is delivered to the Enviro-Depot and placed in a storage sack with its cap removed, and that either: (i) in the case of volume reduction through baling, it is assumed that the equivalent of 5 minutes will be required per storage bag to bale WWF containers and to load bales into a truck for delivery to an end- or intermediate- user; or (ii) in the case of granulation, 10 seconds will be required to granulate each WWF container and load into a gaylord, and the total time required for handling/loading gaylords would be the same as the total time required to handle/load bales.
- Size reduction of WWF containers at the Enviro-Depot. The most common and preferred technologies for volume reduction of plastics are compaction and granulation. Enviro-Depots are not generally equipped with either technology. Therefore procurement would be required of one or the other according to which was preferred.
- Transportation of size-reduced containers to an end- or intermediate- processor. For this analysis, it is assumed that materials would be delivered to Halifax for processing by an end-user, and that average travel distance would be 200 kms.

Table C-2 presents the financial analysis for the preferred model for enhanced recovery of 1,171,200 WWF containers (reflecting 80 percent of the total WWF containers estimated to be generated annually in the province) in support of value-added manufacturing in Nova Scotia. The table presents financial estimates for the use of either compaction or granulation as the preferred method of volume reduction; one or the other technology would be applied, but not both.

Table C-2 is calculated on the following cost assumptions with respect to use of compaction technology:

- *Storage Bags* Woven bags of 0.975 cubic metre are assumed at a unit price of $25, including taxes; an average of 5 bags for each of the 81 Enviro-Depots in Nova Scotia are assumed, depreciated over 3 years.
- *Compaction* A vertical baler is assumed producing a bale of 375 kgs at a quoted unit price of $22,950 including delivery, installation and taxes. Annual costs include depreciation at 10%/year and an assumed operation cost equal to 15% of the total capital cost. Each of the 81 Enviro-Depots in the province would require a baler.
- *Labour* Based on the handling time requirements set out above, handling costs are estimated in Table C-2 on the basis of total wages (including benefits) of $12/hour.
- *Transportation* The cost of transportation is estimated based on commercial quotes received for the transportation of bales of plastics over a 200 km. distance.

The following cost assumptions apply in the case of use of granulation technology for volume reduction of WWF containers.

Table C-2
Financial Summary of Annual Recovery of WWF Containers in Nova Scotia

ESTIMATED COSTS		
COST ITEM	**CAPITAL COST ($)**	**ANNUAL COST ($)**
Compactor		
Storage bags	10,125	3,375
Compacter	1,858,950	464,738
Labour		48,804
Transportation		142,512
TOTAL	***1,869,075***	***659,428***
Cost Per WWF Container Sold	***1.27***	***0.45***
Granulator		
Storage Bags	10,125	3,375
Granulator	526,500	53,700
Labour		82,962
Transportation		54,036
TOTAL	***536,625***	***194,073***
Cost Per WWF Container Sold	***0.37***	***0.13***
ESTIMATED REVENUE		
REVENUE ITEM	**UNIT REVENUE ($)**	**REVENUE ($)**
152 tonnes of natural HDPE	$600/tonne	91,200
NET ESTIMATED COST (Granulation Option)		
NET TOTAL COST		**102,873**
Net Cost Per WWF Container Sold		**0.07**

- *Storage Bags* The same assumptions are used for storage bags as are used in the case of compaction technology, above.
- *Granulator* A granulator specifically manufactured for granulation of HDPE bottles is assumed based on a quoted unit price including delivery, installation and taxes. The granulator produces a coarse size reduction that results a gaylord weight of 989 kgs. Annual costs are estimated based on an annual 10% depreciation and operational costs based on 2.6 kwh/hour of electrical usage per granulator over a total of 3,253 hours/year required to process the containers and an electrical cost of $0.1181/kwh, reflecting prevailing 3rd Quarter 2007 power rates to small commercial enterprises. Each of the 81 Enviro-Depots in the province would require a granulator.

- *Labour* Based on the handling time requirements set out above, handling costs are estimated in Table C-2 on the basis of total wages (including benefits) of $12/hour.
- *Transportation* The cost of transportation is estimated based on commercial quotes received for the transportation of individual gaylords of plastics over a 200 km. distance.

Based on the assessment in Table C-2, volume reduction is less costly on both a capital and an annual basis using granulators as compared to using compactors. It is estimated that recovery of WWF containers in Nova Scotia using the preferred approach above will cost an average of $0.13 per WWF container estimated to be sold into the province.

Revenues shown in Table C-2 are based on market prices in the 3rd Quarter of 2007. While these are at historically high levels, there is broad consensus that the price of hydrocarbon fuels is likely to remain within their current range in coming years; there is a close correlation between these prices and the value of secondary plastics, and it is therefore considered likely that current market prices for natural HDPE are sustainable. After consideration of revenue at current levels, the cost of recovery of WWF containers through the preferred option is estimated to be $0.07/container.

Some costs and revenues are not included in Table C-2. The following will incur cost:

- *Communications.* The recovery of WWF containers will need to be communicated to consumers, and an on-going communication profile will be necessary.
- *Management and overhead.* Management and overhead costs will be incurred by producers and by Enviro-Depot operators. In the case of Enviro-Depot operators, these will be modest. The extent of these costs to producers will depend on how they organize themselves to implement the program.
- *Auditing* Producers will need to have appropriate auditing procedures in place to verify recovery and recycling data. Various technologies are available for this purpose, and would be selected according to producers preferences and needs.

Table C-2 is a conservative (i.e. high) estimate of the actual costs that would be incurred to implement a WWF container recovery program through the model presented because:

- *Increased revenue from granulation of materials* Enviro-Depots will be able to process an additional range of materials once equipped with a granulator, and will therefore be in a position to increase their revenues.
- *Capital cost savings* Capital costs do not take into account potential savings as a result of bulk procurement in support of the program.
- *Labour and transportation cost savings* The time associated with labour to process WWF containers is identified in the above analysis; however, in many - perhaps most - cases no additional costs would in fact be incurred by Enviro-Depot operators since the granulation of containers could be scheduled within the working day of current staff. If labour costs were paid through a handling fee of $0.035/container (generally similar to handling fees currently paid to Enviro-Depot operators for management of beverage containers), a labour

cost saving of $41,977 would be achieved as compared to what is presented in Table C-2. Likewise, transportation assumes the transport of single gaylords of plastic, whereas transportation of multiple loads would reduce transportation costs. An overall reduction of $50,000 in labour and transportation costs as compared to those estimated above would reduce the net cost of WWF container management to $0.036 per WWF container sold.

- *Increased levels of recovery*. It is possible that recovery levels of WWF containers might exceed the 80 percent level assumed in this analysis. The possibility of enhanced recovery levels is linked to the size of refund that consumers receive when they return their containers, and to the level and effectiveness of communications regarding the program.
- *Increased value of secondary HDPE*. The value of secondary HDPE is already historically high, as set out above, and design of program finances should not assume continuing increases in the value of this material. However, it is feasible that higher prices will prevail in future and this would result in increased program revenues, and decreased net costs.

Based on this analysis, the financial sustainability of a program to recover WWF containers for value-added recycling in Nova Scotia would be achieved through the addition by producers of $0.20 to the price of a 3.78 litre container of WWF. The management of this money by producers would be as follows:

REVENUE		
Annual Revenue Generated:	1.464 million containers of WWF sold @ $0.20 each	$292,800
Total		*$292,800*
EXPENDITURES		
Net Recovery Cost	From Table C-2	$102,873
Refunds of $0.10 Paid To Consumers (80 percent level of recovery)	1.171 million containers @ $0.10 each	$117,000
Public Education, Management and Overhead, Auditing	Lump Sum	$72,927
Total		*$292,000*

Implementation

Implementation of this approach would require the following steps to be taken:

1. Designation by the Minister of WWF containers under the Solid Waste-Resource Management Regulations for the purpose of an EPR program.
2. Registration by the Department of Environment and Labour of producers of WWF for the purpose of the WWF container recovery program.
3. Preparation of a plan by WWF producers for recovery of WWF containers and agreement by the Minister to the plan.
4. Implementation of the plan by producers and the entities they partner with.

A producer that sells WWF in the province would be required to be registered with the Department of Environment and Labour and to submit – individually, or as part of a group - a recovery program plan for WWF containers that is acceptable to the Minister; failure to register or to gain the approval of the Minister for a WWF container recovery plan would result in a prohibition on the sale of the product by that producer. Producers would be free to develop a recovery program with or without the participation of existing recovery entities (e.g. municipalities, Enviro-Depots etc.). However, the Minister should require that:

- The recovery program achieve the recovery of a minimum of 80 percent of WWF containers sold in Nova Scotia
- Recovery plans submitted by producers demonstrate the capacity to achieve this objective within one year of implementation.
- While producers may associate for the purpose of recovering WWF containers, no association of WWF producers should comprise more than 33 percent of the WWF market in Nova Scotia.
- Producer plans should be developed in accordance with the CCME Canada-Wide Principles for Enhanced Producer Responsibility.
- Producer plans should be required to demonstrate that greenhouse gas emissions will be minimized (e.g. through volume reduction of containers at the point of recovery in an Enviro-Depot).
- Recovered containers should be sold to end-users in Nova Scotia, unless this is not feasible at prevailing market prices in which case the containers should be sold to intermediate processors in the province. Recovered containers should only be shipped out of province for recycling if there are no markets in Nova Scotia.

Timing for the implementation of this initiative should be as follows, from the date of designation of WWF containers under the Solid Waste-Resource Management regulations:

- Within 2 months, registration of producers.
- Within 5 months, submission of a plan for WWF containers by producers.
- Within 7 months, approval of an acceptable producer recovery plan by the Minister.
- Within 9 months, commencement of implementation of the approved plan by producers.

Benefits

Implementation of this plan will have the following benefits:

- Increased diversion of materials from disposal, in accordance with provincial policy.
- Creation of a value-added resource, in accordance with provincial policy.
- Creation of sustainable new manufacturing in Nova Scotia based on recovered WWF containers, in accordance with provincial policy.
- Increased direct and indirect jobs in Nova Scotia.
- Reductions in greenhouse gas emissions, in accordance with provincial policy, as compared to the current practice of shipping plastics out of province for management.