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Economic Impacts of the B"C" Recycling Regulation

Prepared for:

***Ministry of Environment
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I. SUMMARY AND CONCLUSIONS

Extended Producer Responsibility (EPR), also called product stewardship¹, is an environmental policy approach used in British Columbia and elsewhere to consider the whole life cycle of a product, from selection of materials and design to its end of life, including the post-consumer stage. Under the British Columbia Ministry of Environment's stewardship policy, producers and consumers assume the cost of industry product stewardship programs rather than general taxpayers or local government. Product stewardship contributes directly to two of the Ministry's primary goals:

- ❑ Removing toxins from the waste stream helps keep the water, land and air clean and safe.
- ❑ Recycling provides British Columbians with a convenient opportunity to participate in the sustainable use of British Columbia's resources.

In British Columbia, the Recycling Regulation (2004) provides a single, results-based regulation under the Environmental Management Act that requires producers of designated materials to take full responsibility for managing their products at end-of-life under an approved product stewardship plan. The regulation sets targets and expected outcomes that are consistent with the Ministry's 2002 Product Stewardship Business Plan. The Ministry is responsible for developing new product stewardship programs, monitoring the results of these programs and ensuring compliance is achieved.

The approach taken is to assemble information on stewardship activities in 2007 to develop impact estimates for a one-year period².

Total Employment Generated

The estimated total employment generated directly by stewardship management including recycling activities is estimated to be about 1,600 Full Time Equivalents (FTEs). Allowing for some associated indirect job creation related to the purchases of inputs used by the stewardship and recycling activities, the overall employment impact grows to a little over 2,100 FTEs as a combined total for direct and indirect employment³. Beverage containers and beer containers account for almost three quarters of the employment; tires, electronics and used oil are the other substantial employment generators.

Greenhouse Gas Emissions

The study examined the environmental benefits of recycling by the Stewardship organizations in terms of three measures of reduced emissions using the Waste Reduction Model (WARM) created and supported by the US Environmental Protection Agency (EPA): metric tonnes of carbon equivalent (MTCE), metric tonnes of carbon dioxide equivalent (MTCO2E), and energy units (mega joules) across the range of material types handled by the BC Stewardship organizations (MSW)⁴. Under an Alternative Waste Management Scenario, the amounts of materials recycled through the BC Stewardship organizations are modelled to estimate a reduction of 73,000 MTCE, a

¹ To the Government of British Columbia, "product stewardship" essentially means that those who produce, sell or use a product take responsibility for the economic and environmental impacts of that product. *British Columbia Ministry of Water, Land and Air Protection. Stewardship Options: A Review of Service Delivery Models. 2002.*

² In a few instances, 2006 data were used to supplement unavailable 2007 data.

³ Based on the average indirect employment multiplier derived from BC Input Output Model. See Garry Home, *British Columbia Economic Multipliers and How to Use Them*, BC Stats, April 2007.

⁴ Note that WARM does not handle paints, flammables or pesticides in its calculations.

reduction of about 267,000 MTCO₂E. Aluminium cans and tires account for about 82% of these reductions⁵. On the energy side, the total change in energy use by switching from the baseline to the alternative recycling analysis is 5.3 million gigajoules. Based on national average coefficients used, WARM estimates that this is equivalent to:

- ❑ 72,950 Passenger cars removed from the roadway each year
- ❑ 858,913 Barrels of oil
- ❑ 39,830,817 Gallons of gasoline

Avoided Costs

Discussions with landfill operators revealed that diverting hazardous waste materials to stewardship management provided significant benefits to their operations as well as society in general. Avoiding environmental contamination and subsequent remedial clean up is the main source of benefit. This allows the operators to avoid the substantial costs of handling hazardous materials. The Capital region noted that it costs them about \$500,000 to handle the hazardous materials that they receive that is not covered by stewardship. This is about 10% of the total volume of hazardous materials they receive. This appears to be the most substantial benefit because the amount of materials handled by the stewardship organizations is relatively small, about 4% of the total tonnage handled by landfill sites.

Study purpose and scope

This study examines the economic impacts associated with the products handled by eight stewardship programs operating in BC:

- ❑ **Beverage Container Stewardship Program:** (Encorp Pacific for non-alcoholic beverage containers, wine, spirits, non-refillable beer, cider and cooler containers; Brewers' Distributor Ltd., for refillable glass bottles and aluminum cans for domestic beer, ciders and coolers).
- ❑ **British Columbia Used Oil Management Association (BCUOMA):** used oil, containers and filters.
- ❑ **Post-Consumer Pharmaceutical Stewardship Association:** leftover pharmaceuticals.
- ❑ **The Product Care Association:** flammable liquids and solvents, paints, pesticides, gasoline.
- ❑ **Tree-Marking-Paint Stewardship Association:** tree-marking aerosol paint.
- ❑ **Tire Stewardship BC (TSBC):** tires.
- ❑ **Electronics Stewardship Association of BC (ESABC):** computers and peripherals, televisions and printers.
- ❑ **Western Canada Computer Industry Association (WCCIA):** computers and peripherals as well as printers.

Funding for these stewardship organizations comes mainly from an advance disposal fee or deposit paid at the time of purchase⁶. Where the deposits are refundable for returned containers, the net revenue (deposits paid less deposits refunded) is used by the stewardship organization to contribute to its operating expenses. In total, the stewardship organizations had total revenues of about \$109 million in 2007, 79% from fees and deposits and 21% from other sources such as selling recovered materials.

⁵ WARM defines recycling tires in this analysis as retreading and does not include other recycling activities (i.e. crumb rubber applications), so it is an approximation of the BC situation where about 80% of recycled tires are processed into crumb rubber.

⁶ The terms are meant to be generic to cover the various terms used by the stewardship organizations.

The stewardship organizations managed about 121,000 tonnes of solid materials in 2007. Glass, tires and plastic account for about 90% this solid waste. In addition, the liquid wastes managed amounted to a little over 51 million litres of used oil, solvents, flammables, pesticides and gasoline. The solid materials amount to about 4% of the 2.9 million tonnes of solid waste handled in landfills in BC⁷.

Beverage Container Stewardship

The Beverage Container Stewardship Program operated by Encorp collected and handled about 76,000 tonnes of materials in 2007, about 57,000 tonnes of glass, 11,000 tonnes of plastics and 5,000 tonnes of aluminium. The major growth came in glass collections that increased almost six-fold over 2006. Unclaimed deposits, container recycling fees and sales of recyclable materials provided most of the \$60 million in revenue. Handling fees to depots, transportation and processing, and depot operations expenses exceeded revenue by about \$4 million. Administration and consumer awareness spending added another \$6 million. The operating deficit was covered by accumulated surpluses from past operations. Direct employment in stewardship and recycling activities amounted to about 775 FTEs.

Beer Container Stewardship

Operated by Brewers Distributing, the Beer Container Stewardship collected about 30.5 million dozen aluminium cans (over 89% return rate) and 11 million dozen standard refillable bottles (93% return rate) and about 3.5 million dozen non-standard bottles (100% recovery rate). Revenues to contribute to the collection and recycling activities included about \$5.4 million from unclaimed deposits and about \$9.6 million from aluminium can sales. Direct employment was estimated to exceed 405 FTEs, much of which is located in depots operations that are not exclusively devoted to handling beer containers.

Tire Stewardship

Tire Stewardship BC manages the collection, processing and recycling of used tires in the province. TSBC collected 40,000 tonnes of tires in 2007, up from about 29,000 tonnes in 2003, and paid out about \$4.1 million in transportation incentives. About 33,000 tonnes of tires entered the processing stream and attracted over \$7.2 million in incentive payments. The split of the scrap tires was about 26,400 tonnes to the product stream, and about 6,600 tonnes to the tire derived fuel stream (TDF). The 26,400 tonnes in the product stream breaks down into about 1,200 tonnes for the production of blasting mats, 16,000 to 18,000 tonnes ends up as fine crumb, and 5,000 tonnes of nylon fibre and 5,000 tonnes of steel extracted from the whole scrap tires in the crumb manufacturing process. Stewardship management, collection processing and manufacturing activities are estimated to generate employment for about 122 FTEs.

Used Oil Stewardship

The Used Oil Management Association manages the Used Oil Stewardship program in BC. Used oil recovered in 2007 reached a little over 49 million litres, with collections growing at about 3.7% annually over the last four years. Filter collections have been growing annually about 3.6%, reaching about 5.2 million units in 2007. Oil container collections are growing at 10% annually and exceeded 1.4 million in 2007. Total revenue in 2007 was about \$10.6 million, most of it from environmental handling fees. Return incentives and infrastructure development incentives of \$9.3 million were the main operating expense, accounting for over 90% total operating and

⁷ A 2006 figure that is the most recent data available from Statistics Canada.

administration costs. Direct employment in stewardship, collection, transportation and processing generated about 103 FTEs employment.

Electronics Stewardship

Two stewardship organizations, Electronics Stewardship Association of BC and the Western Canada Computer Industry Association dealing with computer components and monitors started operating in the last half of 2007. The impacts of electronic stewardship are preliminary estimates until a clearer picture emerges after some market organizational issues are resolved. For 2007, the two organizations collected close to 3,000 tonnes of electronics materials (displays, CPUs and peripheral devices). Teck Cominco processed a little over 1,000 tonnes of this material at its Trail operations, contributing to Teck's total throughput of almost 4,500 tonnes. The remaining materials are shipped to Alberta and Ontario for processing. Environmental handling fees generated revenue of \$12.7 million, which covered the costs of depots, payments to processors and transportation from depots to consolidation sites, and from consolidation to processors. Total direct employment was estimated at about 116 FTEs.⁸

Paint, Flammables, Pesticides Stewardship

The Paint, Flammables and Pesticide Stewardship Program, operated by Product Care, recovered 2.2 million litres of paint, almost 59,000 litres of gasoline and flammables, and close to 11,000 litres of pesticides. All of this material is recycled in some way. The paint is reprocessed as paint, as input to other products such as concrete, or in fuel re-blending. The gasoline and fuels are used for fuel and the pesticides are incinerated. Stewardship activities are funded by \$6 million in eco fees that are used to cover the costs of collection, disposal, transportation, promotion and administration. The estimated employment impact associated with these activities is about 73 FTEs.

Tree Paint Stewardship

The Tree Paint Stewardship organizes the recycling of tree paint aerosol containers by forest product companies and brand owners. In 2006, about 142,000 containers were processed and 2,100 litres of paint recovered. The recovered paint is used mainly as fuel. The level of recovery has declined somewhat in the past five years in response to the slowdown in the forest industry as a result of the pine beetle, softwood lumber issues and the increased value of the Canadian dollar.

Eco fees have been stable in the \$34,000-35,000 range, about 35% of which is allocated to processing fees and 45% covers operating costs, leaving a small contingency surplus.

Pharmaceuticals Stewardship

The Post Consumer Pharmaceutical Stewardship Association organizes the collection and disposal of unused medications from participating pharmacies across the province. The collected materials are incinerated in Alberta. In 2006, about 20,000 kilograms of medication were diverted from landfills or disposal in sewer systems. The cost of the program was \$257,000, covering management, communications, collection, transportation, storage, promotional activities and disposal. The economic impacts are minor.

⁸ This a gross value that does not take into account temporary employment reductions in some processing companies pending resolution of outstanding market organization issues.

II. BACKGROUND

1. CONTEXT

Extended Producer Responsibility (EPR), also called product stewardship⁹, is an environmental policy approach used in British Columbia and elsewhere by proactive jurisdictions to consider the whole life cycle of a product, from selection of materials and design to its end-of-life, including the post-consumer stage. This approach primarily transfers the end-of-life management responsibilities for a product to the producer and the consumer, rather than municipal government.

EPR/product stewardship programs in British Columbia are primarily based on two key features of EPR policy:

- ❑ The shifting of responsibility (physically and/or economically, fully or partially) upstream to the producer and away from municipalities.
- ❑ The providing of incentives to producers to take environmental considerations into the design of the product.

In effect, for products that contribute to the municipal solid waste stream, this approach is an expression of the polluter-pay principle.

The Organisation for Economic Co-operation and Development (OECD), a body with considerable expertise and experience in the field of EPR/product stewardship,¹⁰ has produced a variety of guidance packages for jurisdictions to consider in planning and monitoring stewardship programs. The OECD suggests that effective stewardship programs should be guided by a set of 15 guiding principles. For current purposes, we note three of these principles that, while not specific to purpose of the current study, nevertheless help to provide some underlying rationale:

- ❑ A comprehensive analysis of a stewardship program should be made (e.g., which products, product categories and waste streams are appropriate for stewardship, whether historical products should be included, and the roles of the actors in the product chain).
- ❑ Stewardship programs should undergo periodic evaluations to ensure that they are functioning appropriately and are flexible enough to respond to these evaluations.
- ❑ Programs should be designed and implemented in a way that environmental benefits are obtained while domestic economic dislocations are avoided.

British Columbia is considered to be one of the leading jurisdictions in Canada with respect to implementing EPR/product stewardship programs. The province has pioneered numerous product stewardship programs that have effectively transitioned from government-operated and financed programs to industry-operated and financed programs over the past decade. A review of the literature indicates that other jurisdictions in Canada consider the British Columbia approach to be leading edge. Currently, there are seven operational product stewardship programs, with plans to add more programs in the future.

⁹ To the Government of British Columbia, “product stewardship” essentially means that those who produce, sell or use a product take responsibility for the economic and environmental impacts of that product. *British Columbia Ministry of Water, Land and Air Protection. Stewardship Options: A Review of Service Delivery Models. 2002.*

¹⁰ Hereafter referred to as stewardship programs.

Under the Ministry of Environment’s stewardship policy, producers and consumers assume the cost of industry product stewardship programs rather than general taxpayers or local government. Product stewardship contributes directly to two of the ministry’s primary goals:

- ❑ Removing toxins from the waste stream helps keep the water, land and air clean and safe.
- ❑ Recycling provides British Columbians with a convenient opportunity to participate in the sustainable use of British Columbia’s resources.

The Ministry is responsible for developing new product stewardship programs, monitoring the results of these programs and enforcement aspects of the programs. To this end, the Recycling Regulation (2004) was created to provide a single, results-based regulation under the Environmental Management Act. The regulation requires producers of designated materials to take full responsibility for managing their products at end-of-life under a product stewardship plan submitted to and approved by the director. The regulation sets targets and expected outcomes that are consistent with the Ministry’s 2002 Product Stewardship Business Plan and other Ministry policies. Funding and management of their programs are the producers’ responsibilities. The Ministry is responsible for designating products for new product stewardship programs, and for monitoring and enforcing current product stewardship programs. New product categories can be added under the Regulation and the Ministry has a Service Plan Goal to add two new products every 3 years.

The stewardship programs currently operating cover the following products:

- ❑ Beverage containers (plastic, glass and polycoat).
- ❑ Used lubrication oil, oil filters, and oil containers.
- ❑ Pharmaceutical products.
- ❑ Electronics (two stewardship programs).
- ❑ Beer containers (glass and aluminum).
- ❑ Solvents and flammable liquids including gasoline, paint, pesticides.
- ❑ Tires.
- ❑ Tree-marking paint.

Note that a direct government program rather than a private sector stewardship program currently handles Lead Acid Batteries. Thus, while subject to recycling, the program does not fit the private sector framework in which the other stewardship programs operate and was therefore excluded from the scope of this study.

III. PURPOSE OF THE STUDY

1. OVERVIEW

The purpose of this study is to develop a series of quantifiable economic and environmental benefits that can be directly attributed to the implementation of BC product stewardship programs operating under the 2004 Recycling Regulation. In addressing this objective, the measures developed to quantify the benefits include the following:

- ❑ Economic impact to the collection and processing industry – revenues, expenditures of the stewardship organizations.
- ❑ Number of jobs created by the stewardship activities on an aggregate and per tonne of waste diverted vs. landfilled basis.
- ❑ Value of recovered material in end-markets (metal, plastic, paper).
- ❑ Reduced landfill development and operation cost (i.e. extended landfill life, avoided landfill siting costs, etc.).
- ❑ Reduced costs of extraction/processing of virgin materials for products (including energy savings).
- ❑ Reduced or avoided greenhouse gas emissions.

2. STUDY CONSIDERATIONS

Data gaps exist in this study because the relevant information is unavailable (in some cases, it is considered to be proprietary). This is the single major constraint of this study. Where such data gaps occur, they are noted in the discussion of the particular stewardship program. A qualitative discussion replaces the sought after quantitative estimates in such cases.

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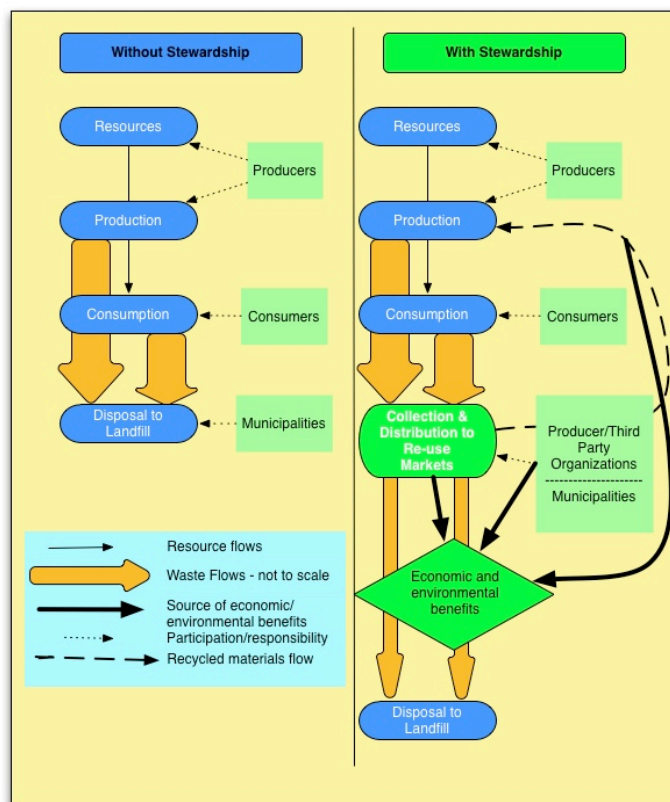
IV. APPROACH AND METHODS

This section outlines the methodology used in this study and the measures used to quantify the benefits of implementing BC's Product Stewardship policy through the Recycling Regulation (2004) and the use of private sector stewardship organizations.

1. CONCEPTUAL VIEW

Figure 1 shows our general conceptualization of how the product stewardship approach changes the handling of end-of-life product generated waste streams and the economic and environmental impacts that result. The thin black vertical arrows show the flows of resources to production, then to consumption, and finally to waste disposal. The dotted arrows indicate participation or responsibility. The dashed arrow shows the return of salvaged materials to the production stage where they would replace virgin raw materials. The thick black arrows side show the sources of economic and environmental benefits.

Figure 1
Conceptualization of the Study



2. STUDY SCOPE – PRODUCTS COVERED

The specifics of the study require dealing with the 11 products for which there are currently seven stewardship programs. These products are listed in the left-hand column of Table 1, grouped according to the responsible Handling Organization as appropriate. Information sources used to obtain data for each program in this study are outlined in the right-hand column.

Table 1
Scope of Products Assessed

Product	Handling Organization	Information Sources
Beverage Containers	<ul style="list-style-type: none"> For non-alcoholic beverage containers, Encorp Pacific For refillable glass bottles and aluminum cans for domestic beer, ciders and coolers, Brewers' Distributor Ltd. For wine, spirits, non-refillable beer, cider and cooler containers, formerly the Liquor Distribution Branch, now Encorp 	<ul style="list-style-type: none"> Encorp Annual Reports, website, interviews Brewers Distribution Annual Report, website, interview Encorp
Lubrication oil, oil filters and oil containers	<ul style="list-style-type: none"> British Columbia Used Oil Management Association (BCUOMA) 	<ul style="list-style-type: none"> Annual Reports, website, interviews with BCUOMA, processors and recyclers
Pharmaceutical products	<ul style="list-style-type: none"> Residuals Management Group Ltd., through funding by the Post-Consumer Pharmaceutical Stewardship Association. 	<ul style="list-style-type: none"> Annual Reports and web site provide; interview
Paint	<ul style="list-style-type: none"> The Product Care Association Tree-Marking Paint Stewardship Associations 	<ul style="list-style-type: none"> Unused or left-over paint and paint aerosols; Annual Report, interview, website Annual Reports and web site
Solvents and flammable liquids, gasoline and pesticides	<ul style="list-style-type: none"> Product Care 	<ul style="list-style-type: none"> Stewardship Plan approved in July 2007; Annual Reports, interview, web site
Tires	<ul style="list-style-type: none"> Tire Stewardship BC 	<ul style="list-style-type: none"> TSBC is comprised of the Rubber Association of Canada, the Retail Council of Canada and Western Canada Tire Dealers Association. Stewardship program on January 1, 2007 (previously a government run program); interviews with TSBC, materials processors, website, annual; reports.
Electronics	<ul style="list-style-type: none"> Electronics Stewardship Association of BC (ESABC) Western Canada Computer Industry Association (WCCIA) 	<ul style="list-style-type: none"> ESABC started operations August 1, 2007; WCCIA started November 1, 2007. Limited data from annual reports and interviews with the stewardship organizations and processors.

3. STUDY SCOPE – TIME PERIOD

The approach taken is to create an impact estimate for the year 2007 based on available information. In effect, some data and other information for the years 2006 and 2007 have been blended in order to develop a data set which is as close to complete as possible for one complete calendar year. This approach is required because some stewardship organizations commenced operation during 2007 and therefore 2007 data was not available in all cases. The required assumptions used for each organization are explained as they are introduced to the analysis presented in Section V of this report. The intent is to build a credible description and analysis of a representative year of operation for the stewardship programs.

4. SPECIFIC METHODS

As much as possible, this study reports quantified estimates for five impact measures evaluated at the program-level rather than a product-level, to correspond with the seven stewardship programs currently operating under the BC Recycling Regulation. The analytical focus adopted is to define and estimate the economic and environmental benefits on a “with” stewardship programs and “without” stewardship programs basis. “Without” is interpreted to mean that waste materials would be moved directly to landfill locations rather than undergoing the recycling activities ‘with’ the stewardship program. Despite the general program level focus, it is necessary to examine how the recycling of each product is handled within its specific stewardship program to get a clear view of how economic and environmental benefits are generated.

Economic Impact to Collection and Processing Industry

The information used to quantify this measure comes from revenues and expenditures data for collection, processing, and recycling for each stewardship program. The information sources included Stewardship Plans, the Annual Reports for each program, program websites and interviews with representatives of the stewardship organizations.

Number of Jobs Created

The number of direct jobs created is measured as the number of employees in the collection, processing, recycling, and related transportation service for each program. Some of these jobs are with the stewardship organizations themselves, others are with organizations sub-contracted to provide services to the stewardship organizations. This information was collected by interviews with program representatives and a review of annual reports. Indirect job creation arises in two ways. First, purchases of inputs from other BC businesses by the stewardship organizations and their sub-contractors create additional jobs. These can be estimated using the BC Input Output model. Second, the use of recycled materials to produce other products leads to additional job creation. Estimates of these jobs are based on interviews with the businesses using the recycled materials as inputs. The total annual volume of waste diverted from landfill for each stewardship program was obtained from annual reports and interviews.

Value of Recovered Material in End-Markets / Reduced Costs of Extraction/Processing

This measure of impacts/benefits has two parts: the value of recovered materials and the avoided costs of extracting/processing virgin materials.

Value of Recovered Material in End Markets

This measure involves estimating the value of materials recovered such as aluminum, plastic, glass bottles, paint, oil, oil filters, and plastic oil containers. End-market price data is used and attributed to the percentage of recovered material which is in fact recycled to a secondary market (not including the percentage incinerated in energy-from-waste facilities or otherwise incinerated or landfilled) for each program. Where the data are unavailable or inadequate, we have attempted to develop proxy data using information from the Recycling Industry Framework maintained by Natural Resources Canada. The value of recovered material sold is calculated as a price per tonne (or some suitable unit) multiplied by the number of tonnes sold. Ranges of values are used where there is too much underlying variability in the materials market to support a single point estimate.

Reduced/Avoided Costs of Extraction/Processing

Estimating the savings (reduced costs (dollars and energy)) from avoided extraction of raw materials starts by establishing the extent to which recycled material can replace virgin material (one to one ratio, or something else) as determined by consultation with industry sources. Applying this ratio to the volume of recycled material (estimated above) gives an estimate of avoided extraction/primary processing activities. Where possible, the actual avoided costs can be estimated using costs in dollar value and costs in energy as identified from Statistics Canada primary statistics (raw materials index), and data from the Natural Resources Canada Energy Use Handbook for primary industries.

Reduced Landfill Development and Operation

Using the estimates of the volume of recycled materials that no longer end up in landfill sites, we conducted interviews with representatives of landfill operators to determine the impact of the reduced waste volumes on their operations. The variables considered included: reduced operating costs, reduced capital costs, extended life of current landfill operations or postponement of expansion of existing facilities or construction of new facilities.

Reduced or Avoided Greenhouse Gas Emissions

The study estimated avoided greenhouse gas emissions from primary processing using information on energy use and greenhouse gas emissions at the aggregate sectoral level estimated by the used the Waste Reduction Model (WARM)¹¹ created and supported by the US Environmental Protection Agency (EPA). Alternative estimates are available in the Natural Resources Canada Energy Use Handbook.

5. INTREPRETING THE RESULTS

The results of this study are meant to give an indicative estimate of the economic impacts of recycling waste materials handled by the Stewardship associations operating in BC under the Recycling Regulation. The impacts are measured according to the available information on the economic activities induced by the recycling of waste materials instead of disposing of these materials in landfills. Although these activities vary across the waste materials and Stewardship organizations, typically they consist of the activities of the organizations themselves, directly or

¹¹ WARM Version 8, 8/06, available at http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html
The GHG emission factors in WARM were developed following a life-cycle assessment methodology using estimation techniques developed for national inventories of GHG emissions, as described in the EPA's report *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*.

through sub-contractors, of collecting, transporting, processing and distributing the waste materials or their component parts to recycling companies in BC or elsewhere. This study restricts the impact estimates geographically to BC.

There are a number of data gaps and methodological issues that need to be understood to appreciate the finding of the study in context. They are issues that may be resolved as the Stewardship program mature and more and better data accumulate. The main ones are summarized below. It should be kept in mind that the study focused only on trying to provide an estimate of the economic impacts on a one year basis.

6. DATA ISSUES

The data sources for this study included interviews with representatives of the stewardship organizations, recycling companies and landfill authorities, annual reports and other special studies from the stewardship organizations, and published reports and documents.

There are gaps in the available data that arise because the private sector recycling companies, and in some cases the stewardship organizations, consider information on their activities as proprietary. This is especially the case in regard to sales, revenue and related information. For this reason, the study tends to focus on impacts in terms of employment generated, amplified by such other information as could be collected directly or estimated using available information or coefficients from published statistics or documents. As far as possible, the impacts in BC are estimated by tracking the flow of the waste materials from collection through to disposal into recycling markets.

7. METHODOLOGICAL ISSUES

The greenhouse gas emissions estimate applies only to a reduced level of primary processing as a result of reduced use of virgin materials through greater use of recycled materials. These estimates were developed using the WASTE Reduction Model (WARM)¹² created and supported by the US Environmental Protection Agency (EPA). Other greenhouse gas emissions were not considered or included such as: (1) transportation emissions for curb side pick up of traditional municipal waste (because these may be largely offset by similar transportation needs for each stewardship program involving recycling either through drop off depots or regional collection); and (2) landfill methane, because none of the products in this list are anticipated to be a significant source of landfill methane if disposed of in a landfill.

¹² WARM Version 8, 8/06, available at http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html
The GHG emission factors in WARM were developed following a life-cycle assessment methodology using estimation techniques developed for national inventories of GHG emissions, as described in the EPA's report *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*.

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V. PROGRAM ECONOMIC IMPACTS

The analysis presented in this section includes a program description for each of the seven stewardship programs, followed by the economic impact analysis for each.

1. BEVERAGE CONTAINER PROGRAM

Overview

- ❑ **Summary of Initiative:** This program operates under the Beverage Container Schedule under the Recycling Regulation. Producers (brand-owners) of designated products (see below) develop stewardship plans in order to sell, offer for sale or distribute beverage products in British Columbia (BC). The stewardship plan describes how the program is operated and funded. Retailers charge a deposit for each container sold and consumers redeem the majority of beverage containers for refunds.
- ❑ **Objectives:** The purpose of the Beverage Container Program is five-fold.
 1. To ensure that the beverage industry has a role in protecting the environment by recovering and properly managing post-consumer beverage containers.
 2. To minimize industry free riders by establishing a level playing field for the beverage industry.
 3. To save taxpayer money through avoided recycling, landfill and litter costs.
 4. To increase the recovery of beverage containers.
 5. To foster the growth of secondary markets for beverage container packaging in BC.

Products Targeted

- ❑ **Designated Products:** All non-alcoholic containers that hold beverages offered for sale in BC (not refillable) including aluminum cans, refillable glass bottles, non-refillable glass bottles, plastic containers made of high density polyethylene, plastic containers made of resins other than high density polyethylene, bimetal cans, drinking boxes, bag in a box, gable top containers, and stand up pouches. In terms of alcoholic beverages, the program includes aluminum cans, and standard and non-standard glass refillable bottles. Milk cartons and jugs are exempt from the Recycling Regulation and are not subject to deposit or refund, however they are now included in the program due to a voluntary stewardship initiative (see program details). The designated products apply to the residential sector only. However, there are new program changes with commercially used containers voluntarily being recycled as well.
- ❑ **End-of-Life Product Issues:** As a result of the Beverage Container Stewardship Program, there are no beverage containers sold in the province that are not refillable or recyclable (a minor exception is noted below in the Final Disposition of Product category). Additionally, due to significant increases in the quantity and quality of the recovered material (very little contamination), new secondary markets have emerged in and around British Columbia.

Key Responsibilities

Producers/brandowners¹³/importers/distributors of beverage containers are responsible for funding the program and ensuring that their containers are refillable or recyclable and are recovered for reuse or recycling. Producers/brandowners usually use a third party, known as a "stewardship agency" to undertake the obligation on their behalf.

Stewardship agencies are required to manage the stewardship program. For beverage containers, there are four stewardship agencies:

- ❑ **Encorp Pacific Canada (Encorp):** represents brand-owners of non-alcoholic beverages and under a contract with the Liquor Distribution Branch (LDB) manages the containers for which that agency is responsible. Encorp return centres include over 167 independent depots and approximately 350 to 400 major corporate grocers. Only major grocers are serviced directly with the Encorp system; the depots service small grocers.
- ❑ **Liquor Distribution Branch:** is the stewardship agency for wine, spirit, non-refillable beer, cider and cooler manufacturers. The LDB container management system provides for returns at all LDB outlets and rural agency stores province-wide, as well as at Encorp depots. Since 2001, the LDB has contracted with Encorp Pacific to recover containers through the depot network and to provide transportation services for containers collected through Government Liquor Stores.
- ❑ **Brewers Distributors Ltd. (BDL):** represents brand-owners of refillable glass bottles and aluminum cans for domestic beer, ciders and coolers. BDL provides for retail returns at all LDB retail outlets, Cold Beer and Wine stores, and at Encorp depots.
- ❑ **The BC Dairy Council:** opted to establish a voluntary collection program for milk containers and Encorp is the service provider to collect and recycle milk cartons and jugs.

Encorp's activities are divided into two major sectors: first is the delivery of product stewardship agency services for the non-alcoholic beverage brand owners who are members of Encorp. The second major sector of Encorp's business is that of a service provider on contract for industry sectors that are not part of Encorp's beverage company membership.

Program Details

Encorp runs the Beverage Container program (other than beer in refillable bottles and aluminum cans, which are collected by Brewers Distributing under a separate stewardship program and discussed separately). Although there is no commercial relationship between Encorp and Brewers, some Encorp depots do handle refillable beer bottles and aluminum cans. In terms of the containers handled, 90% of the collection is accomplished by depots and 10% by retail stores that accept returns. Encorp is adding two to five depots to the provincial network annually. Milk containers were added in the last 12 months through an agreement with the BC Dairy Council under its voluntary recycling program.

¹³ A distributor that imports products to British Columbia would be deemed to be the brandowner for stewardship purposes.

Materials Recovered

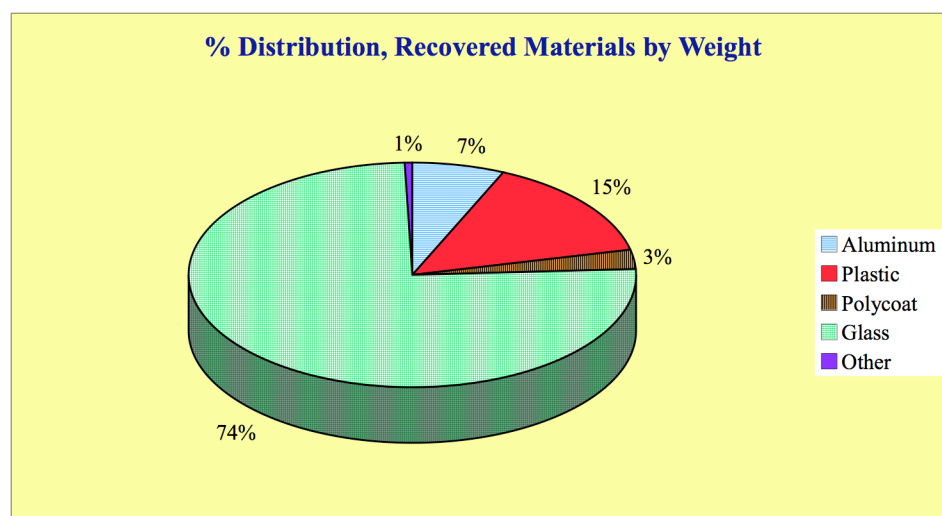
The Recycling Regulation calls for 75% recovery for the complete category of beverage containers. In terms of the individual container categories, the 2007 recovery rates were— 85% for 2 litre plastic containers, over 80% for aluminum cans; almost 73% for plastic; 54% juice packs/tetra packs (polycoat); and 96% for glass. The recycle rate is showing slow improvement, especially for polycoat and plastic, while glass and aluminum are relatively stable. Table 2 shows the distribution of recovered materials by type and by weight, and the recovery rates, for 2005 – 2007. Total tonnes recovered jumped by over 180% to over 76,000 tonnes in 2007 over 2006, largely because of the increase in glass bottle recovery from 69% to over 96%. The recovery rates for aluminum, plastic and other materials have been relatively stable.

Table 2
Recovery of Beverage Containers, 2005 - 2007

Type	Containers Sold			Containers Recovered			% Recovery Rate			Metric Tonnes Of Material Recycled		
	Million											
Aluminum	2007	2006	2005	2007	2006	2005	2007	2006	2005	2007	2006	2005
	462.5	469.3	459.6	371.1	376.4	373.0	80.2	80.2	81.2	5,128	5,171	5,124
Plastic	477.9	431.5	367.3	347.5	311.1	261.6	72.7	72.1	71.2	11,087	9,122	8,253
Polycoat	152.9	153.0	153.4	82.4	82.5	83.7	53.9	53.9	54.6	2,097	2,027	2,058
Glass	189.6	59.9	57.2	182.4	41.1	38.8	96.2	68.6	67.9	57,344	10,369	9,845
Other Metals	7.3	8.6	6.2	3.9	4.2	3.8	53.6	49	60.9	258	283	290
Pouches	13.9	9.4	10.4	5.1	3.9	5.0	37	41.7	47.9	30	22	29
Bag in Box												
Liquor	1.2			0.6			53.8			145		
Total	1305.3	1131.6	1054.1	993.1	819.2	765.8	76.1	72.4	72.7	76,089	26,995	25,599

Figure 2 shows the distribution of recovered materials by weight for 2007. The pronounced increase in sales and recovery of glass containers in 2007 accounts for their dominance in terms of weight (74%).

Figure 2
Material Recovered by Weight, % Distribution



Encorp is now focused on targeting that portion of the product disposal system where there is currently a very low rate of recycling. This includes the commercial office sector and the Industrial-Commercial-Institutional sector, which is the largest source of beverage containers not currently recycled. Another target is multi-family dwellings, which is the second highest source of materials going to landfill. Success in these areas will lead to further increases in the recycling rates.

At the time of drafting this report, Encorp sells the materials it recovers: 75 cents per pound for aluminum and 20 cents per pound for plastic. However, Encorp reports that the revenue generated (for example, \$15.6 million in 2007) does not cover the full cost of the recycling and materials recovery.

Employment

Total employment generated by recycling beverage containers (excluding employment in recycling operations, which is reported separately) is estimated at almost 745 FTEs:

- ❑ **Depots:** about 91% (680 FTEs).
- ❑ **Encorp administration:** (3.5%, 26 FTEs).
- ❑ **Transportation:** (2.5%, about 19 FTEs) (Encorp uses 10 transportation contractors who work only for Encorp in the collection and transportation of the material. They cover approximately 80% of the collection of containers, while the remaining 20% are collected through the use of commercial transportation companies who are contracted on an as-needed basis.); and,
- ❑ **Processors:** who bale the containers for shipment to the recyclers (2.7%, 20 FTEs).

Recycling

Generally, aluminum cans are recycled into new aluminum cans and aluminum products (discussed further below under beer containers). Polyethylene Terephthalate plastic is recycled into new non-food bottles and plastic film. High density polyethylene plastic is recycled into non-food containers such as oil, detergent, spray bottles and plastic film. Poly Vinyl Chloride plastic is recycled into Poly Vinyl Chloride piping, (very little PVC is used for beverage packaging). Bag-in-box containers are recycled into low grade paper products such as cardboard. Foil bladder is recycled into new plastic for non-food containers. Glass is recycled into fiberglass home insulation, new bottles, manufactured glass products, aggregate road base, decorative blocks, landscape material, drainage tile, construction aggregate and sand blasting material. Bi-metal is recycled into metal products. Gable top material is recycled into paper products, including filler plys for medium and grey gypsum wallboard cover. Aseptic containers are only 75% recyclable, with only the paper fraction of the container being recycled into paper products, including filler plys for medium and grey gypsum wallboard cover, and the balance being disposed in landfill. Similarly, some of the foil bladder from 'bag-in-the-box' containers and the aluminum/plastic residual from aseptic containers are disposed in landfill.

Recycling economic impact from beverage containers come mainly from plastics and polycoat, and glass containers. Aluminum cans are crushed and shipped to the United States for recycling into new cans. The discussion of recycling aluminum beer cans provides more detail.

A discussion of recycling activities pertaining to each type of product material is presented below.

Plastic Recycling

Merlin Plastics, the major recycler of plastic containers collected by stewardship programs, buys plastic containers from three stewardship organizations¹⁴:

- ❑ About 1,000 tonnes per month of plastic beverage bottles from Encorp (Beverage Container Stewardship Program);
- ❑ Over 100 tonnes per month of used plastic oil bottles from the BC Used Oil Management Association, which totalled about 1,400 tonnes in 2007.
- ❑ About 100 tonnes of plastic in 2007 in the form of 5 gallon plastic paint pails and plastic gasoline containers from Product Care Association, up from 43 tonnes in 2003.

The three stewardship programs account for 50-60% of total throughput of plastic by Merlin Plastics. Merlin operates two plants, one for sorting and cleaning, the other plant to recycle the plastic into pellets and flakes. Merlin will buy the plastic containers from the stewardship organizations if the raw materials are fully sorted and meet Merlin's specifications for processing. Any cleaning and sorting that Merlin must do is charged back to the stewardship organizations.

All the material used in Merlin's High Density Polyethylene (HDPE) recycling operation is post consumer bottles (# 2 Plastics identification code). The bottles are sorted, ground into a 1/2" flake, washed, dried and pelletized. All the recycled material used in Merlin's PET (Polyethylene Terephthalate Polymer --the # 1 Plastics identification code) operation also represents post consumer bottles. The bottles are sorted, ground into a 3/8" flake, washed and dried.

Merlin exports over 90% of the pellets and flakes that it produces to the United States where it is used as input to produce a wide array of products. The small quantity of flakes and pellets sold in BC is used to manufacture drainage tiles, oil bottles, antifreeze containers and windshields.

Merlin produces three kinds of HDPE pellets:

- ❑ **Natural:** for which the feed stock is milk jugs, juice bottles and water bottles. The products produced include household and industrial chemical/cleaning bottles, communication pipe lines, and extrusion profile cores or channels.
- ❑ **Colored:** for which the feed stock is food, cleaning and shampoo bottles, antifreeze and windshield washing fluid bottles, yogurt containers and oil bottles. The products produced include oil and detergent bottles, and corrugated drainage pipes
- ❑ **Injection:** for which the feed stock is pails. The products produced include garden/potting containers, drain tile for septic tanks, and large pails and buckets.

Merlin produces two kinds of PET flakes:

- ❑ **Clear:** for which the feedstock is Pop bottles, Juice bottles and Other PET containers. The products produced from this feedstock include structural layers for pop bottles, liquor bottles, water bottles, liquid detergent bottles, and juice bottles.
- ❑ **Green:** for which the feedstock is Pop bottles, Juice bottles and Other PET containers. The products produced include carpets, and fiberfill for sleeping bags, pillows and ski jackets. This material can also be rolled into clear sheets for VCR and audio cassettes.

¹⁴ The discussion of plastic recycling is consolidated here because the Beverage Container Stewardship Program is the source of almost 90% of the plastic collected by the three stewardship programs.

Employment

Merlin has been operating for about 20 years. The company started with three employees and now has over 100 people working in its plastic recycling business. Since the beginning of the stewardship program, Merlin estimates that its business has almost tripled. The company estimates that about 75% of their staff is engaged in activities related to the plastics coming from the three stewardship programs.

Glass Recycling

Table 3 shows the amount of cullet (recycled glass pieces) received by the Owens Illinois plant near Vernon, BC over 2001-2007¹⁵. As can be seen, after dropping from 2001 to 2005, their use of cullet has increased sharply to over 10,000 tonnes by 2007. This represents cullet from all over BC including purchases from Encorp. Owens Illinois expects to increase its purchase of recycled glass in 2008 and beyond. Currently, they pay \$50-64 per tonne, depending on the market, for recycled glass delivered to their plant by truck.

Table 3

Owens Illinois Vernon Plant - Receipts of Cullet from BC (tonnes)							
	2001	2002	2003	2004	2005	2006	2007
Amber	2319	855	733	217	35	968	1739
Flint	4804	1250	951	1085	392	4124	8538
Green	1330	67	176	28	58	24	45
Total Tonnes	8453	2172	1861	1330	485	5116	10322

Source: Personal Communication, Owens Illinois

There are three main benefits from using cullet¹⁶.

- ❑ It reduces the amount of energy used for glass manufacture (glass made with 100% cullet can use 20-35% less energy than glass made wholly from raw materials);
- ❑ It reduces the consumption of virgin raw materials (1.1 tonnes of raw materials – silica sand, lime, dolomite and soda – saved for every tonne of cullet used); and
- ❑ It reduces harmful emissions to the atmosphere from the manufacturing process. (Every tonne of waste glass recycled into new items saves 315 kg of carbon dioxide.)

Owens Illinois currently operates with 10% or less cullet (of which over 80% is sourced from BC) in the feedstock to produce glass. This level of cullet yields an energy savings of about 650 MJ per tonne of production. The energy savings per tonne continue to increase at decreasing rate until cullet accounts for about 50% of the material inputs to the glass manufacturing process, so additional energy savings can be expected as Owens Illinois increases its use of cullet for feedstock. There are no substantial employment impacts.

In addition to the foregoing, a glass recycling company operating for Encorp sells coloured glass to a company in Washington state for wine-bottle making and coloured glass to a BC company for drainage medium, and sand blasting.

¹⁵ Glass recycling is the process of turning waste glass into usable products. Depending on the end use, this commonly includes separating it into different colors. Glass normally comes in a number of colours. The major types are: flint glass (clear glass); green glass; and brown/amber glass.

¹⁶ United Kingdom Environmental Technology Best Practice Program, *Improving Cullet Quality*, 1997.

Financial Aspects

- ❑ **Encorp Program:** This is a full deposit-refund program with 2007 revenue of \$59.6 million, the main sources of which were the following items:
 - **Unredeemed Deposits:** Encorp is paid a deposit on every container sold. Deposits unclaimed are used as revenue and run \$17-18 million per year.
 - **Sale of Collected Materials:** All the collected aluminum, plastic, glass, etc. is sold on the open market. Aluminum is the most valuable (fetching \$0.75 to 0.90 per pound), followed by plastic (about \$0.20 per pound); some, like glass, have no net market value. In 2007, the value of materials sold was about \$15.6 million.
 - **Container Recycling Fees:** When the revenue from unclaimed deposits and from sales of collected material are insufficient to cover the costs of recovering and recycling a specific container type, a non-refundable recycling fee is added to the container to make up for the shortfall. This amounted to about \$19.6 million in 2007.
 - **Other Fees:** Revenues from service provider contracts in 2007 generated about \$6.3 million.

To run the program, Encorp incurred direct expenses of about \$64 in 2007 including:

- ❑ **Handling fees:** \$43 million, paid to depots for collecting containers.
- ❑ **Depot operations:** \$359,000.
- ❑ **Transportation and processing fees:** \$20.6 million.
- ❑ **Other Expenses:** of \$7.2 million including general and administrative (\$3.4 million), consumer awareness (\$2.7 million), amortization and foreign exchange loss (\$1.1 million).

The operating loss was financed from accumulated reserves.

2. BEER CONTAINERS PROGRAM

Overview

Brewers Distributor Limited manages the handling of four types of containers¹⁷ for Canada's National Brewers:

- ❑ Aluminum beer cans.
- ❑ Import beer cans (new, small volume).
- ❑ Industry standard beer bottles refillables – returned to nearest brewery.
- ❑ Non-standard refillables (Sleeman clear; cider bottles).

Table 4 indicates that the bulk of beer containers are cans and Industry Standard Bottles, for which the recovery rates were 89.2% and 92.8%, respectively, in 2006, exceeding the target rate of 85%. Beer kegs are also recycled at a 99%+ rate.

¹⁷ Further details are available at <http://beerbottlerefund.com/>

Table 4
Sales, Returns and Recovery Rate for Beer Containers

Container Type	Sales (Million Dozens)	Returns (Million Dozens)	Recovery Rate
Cans	34.2	30.5	89.2%
Industry Standard Bottles	12.0	11.1	92.8%
Non-Industry Standard Bottles (Refillable)	3.52	3.55	100.9%

Source: Brewers Distributors Ltd., 2006 Annual Report

At the recovery rates achieved, the recycling activities divert over 50,000 tonnes of cans and bottles from landfill sites annually. Figure 3 provides an outline of how beer bottles are recycled. Brewers Distributor Ltd. (BDL) collects the empties when it delivers full product, thereby creating a closed loop system; that includes Liquor Distribution Board (LDB), private liquor stores, bars and restaurants. This allows BDL to economise on space utilization and transport costs.

Recent changes to the program include adding import cans (since 2006), although this contributes a very small volume of material. The more important change was the decision of the Liquor Distribution Board to terminate its responsibilities as product steward and turn them over to Brewers Distributors for beer containers and Encorp for other liquor containers.

The structure of the beer bottle return system is changing. Typically about 78% of consumers take returns back to LDB stores when they purchase new product. However there are about 230 LDB stores, a figure that has been dropping steadily, while the number of private stores – has grown to about 1,100 – up from 600-700 four to five years ago.

As a result, LDB, which used to take back 50% of beer containers, now receives about 21%. In response, BD is trying to add more 100% return bottle depots, locating them strategically by mapping population distribution using GIS mapping. Independent operators, many of which handle containers both for Brewers Distributor Ltd. and for Encorp, run the bottle depots.

Figure 3



Source: Brewers Distributing Limited, <http://beerbottlerefund.com/>

Employment

The estimated total employment associated with the recycling of beer containers is about 406 FTEs. This is composed of 2.5 FTEs in management and administration, 27 FTEs associated with transporting the containers, and about 30 FTEs in sorting and recycling operations. The latter includes crushing and bailing cans for transport to ALCOA in Tennessee by rail. No allowance is made for any railway employment impact, which is expected to be small. We have also estimated about 27 FTEs related to contract carriers transporting beer containers outside the lower mainland. Finally are the employment impacts of the over 90 bottle depots operating across the province, estimated to be about 320 FTEs (note that most of the depots handle the whole range of beverage containers – wine, liquor, soft drinks as well as beer containers so this is an apportioned estimate).

Financial Aspects

Under the beer container recycling system, the retail beer price includes a deposit that is returned to customers if bottles are returned to LDB or a Brewers depot. Unclaimed deposits provide a

revenue source for BD, over \$5 million in 2006/07. Brewers Distributors' other revenue source is the sale of used aluminum cans to ALCOA in Tennessee for re-manufacture into new cans. Based on a price of about \$1.98 per kg for used aluminum, this adds between \$9-10 million to BD revenue. BD pays a fee to LDB, the Depots and to Private Liquor retail stores for units returned for recycling.

3. **ELECTRONIC WASTE PROGRAM**

Overview

- ❑ **Summary of Initiative:** This program operates under the Recycling Regulation. It has been in operation since August 2007. Producers (brand-owners) and importers of designated products remit fees per unit sold to the stewardship agencies to cover the costs of collection and recycling of designated products. There are two electronics products stewardship organizations operating in BC: Electronics Stewardship Association of BC (ESABC) and The Western Canada Computer Industry Association (WCCIA).
- ❑ **Objectives:** The objectives of this program are to reduce electronic waste from the waste stream, and to shift the waste management costs from governments to producers.

Products Targeted

- ❑ **Designated Products:** Schedule 3 of the British Columbia (BC) *Recycling Regulation* outlines designated five types of electronics that are eligible for the recycling program:
 - Desktop computers and servers including Central Processing Units (CPUs), mouse, keyboards, cables and other components within the computer.
 - Computer monitors (with unbroken glass screens) including traditional Cathode Ray Tube (CRT) and flat panel display technologies.
 - Notebook computers including portable computers such as notebook, laptop and tablet PCs.
 - Desktop printers and fax machines including various printing technologies such as laser & LED (electrophotographic), ink jet, dot matrix, thermal, dye sublimation, etc. and “multi-function” or “all in one” devices that perform different tasks such as copy, scan, fax, print, etc.
 - Televisions (with unbroken glass screens) including display technologies, such as traditional Cathode Ray Tube (CRT), flat panel or rear projection.

Currently, the program excludes stereos, CD players, DVD players and cell phones and other electronic waste.

- ❑ **End-of-Life Product Issues:** E-waste contains significant amounts of toxic or hazardous materials including mercury, lead, cadmium, beryllium, chromium, antimony, brominated flame-retardants and polyvinyl chlorides which cause concern for the safety of ground and surface water sources and human and ecosystem health if inadequately disposed of in landfills.

Key Responsibilities

Producers are responsible for developing Product Stewardship Plans for the designated products in the Schedule. Each of the two stewardship agencies has an approved plan. These plans include all financial arrangements for funding the program, details for collection, processing and

recycling of the information, and reporting to the Ministry of Environment. Importers are subject to the same requirements.

Program Details

- ❑ **Collection:** The Electronic Stewardship Association of BC program contracts Encorp to handle 60% of their collection (50 out of 83 depots), transportation and processing activities. The Salvation Army operates approximately 35% (30 out of 83 depots) of the remaining collection activities, with the remainder of the depots (3) operated by municipalities. In both these instances, Encorp collects material from Salvation Army and municipal depots.

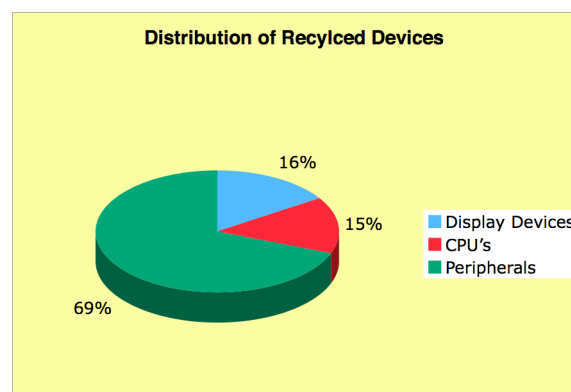
Electronics Stewardship Association of British Columbia (ESABC)

The ESABC started operating on August 1, 2007, while the WCCIA started up on November 1, 2007. During the intervening period, the ESABC partnered with Encorp to provide collection and transportation services and proceeded to sign up stores to contracts for recycling eligible electronic products. Starting from 517 companies, as of August 1, by the end of 2007 there were 1,271 companies registered with the ESABC program, submitting reports and 864 remitting fees. This earlier start has turned out to limit opportunities for the WCCIA to sign up electronics retail stores within their program, which is required for them to receive payment for any electronic waste collected.

According to the Electronic Stewardship Association of BC 2007 Annual Report, ESABC is the largest stewardship program of its kind in Canada, collecting over 2,684 metric tonnes of material in its first five months of operation. It expects this figure to grow to about 6,000 tonnes annually. Figure 4 shows the distribution of this material across recycled electronics devices.

At an annual rate this equates into an estimated 173,000 electronic products being diverted from British Columbia landfills by ESABC in 2007. This was accomplished through ESABC's more than 1,270 registered members and 73 Encorp Return-It™ Electronics Collection Sites. For 2007, the e-waste handled by Encorp as a result of the electronic regulation and subsequent program initiated by ESABC was 11% of total Encorp volume of waste handled (all wastes combined).

Figure 4
Distribution of Recycled Devices



ESABC has three approved primary processors:

- ❑ e-Cycle Solutions, headquartered in Airdrie, Alberta and operating a collection facility in Chilliwack, BC.
- ❑ SIMS Recycling Solutions, Brampton, Ontario.
- ❑ Teck Cominco, Trail, BC.

In terms of impacts in BC, we focus our attention on Teck Cominco and e-Cycle, since they are located in BC.

Teck Cominco

In 2007, Teck Cominco handled 4,485 tonnes of e-waste. Encorp, functioning as the service agent for the ESABC, contributed 1,066 tonnes or about 23.7% of the total. About another 381 tonnes was from another processor but originated in BC (by Teck Cominco's estimates). In total BC e-waste (direct and indirect) was 1,447 tonnes or a little over 32% of the total e-waste handled by Teck Cominco. The revenues generated by the tipping fee charged by Teck Cominco are regarded as proprietary information.

Teck Cominco's interest in electronics recycling started in 2004 as e-waste became known as a societal problem. The Trail operation was looking for business opportunities independent of the metal price cycle. Their interest developed prior to the new recycling regulation and before any e-waste programs started up in Canada.

Teck Cominco does generate some sales of re-refined lead but it is still at a very low level in terms of overall revenues. They expect it will begin to make an appreciable contribution once the collected volumes of e-waste increase. To put it in perspective, the 1,447 tonnes of BC e-waste Cominco handled in 2007 contained 57 tonnes of lead, which contributed to 0.07% of their 76,300 tonnes of lead production in that year. The situation is very similar for other metals such as cadmium, mercury, gold, silver, and copper.

So, in terms of recycling metals to replace use of virgin metals mined in BC, it is still very early to estimate impacts. However, directing these materials to responsible recyclers is the key to recovering and reusing these metals in BC. As the programs and public awareness grow in different provinces the amount of material processed and thus recovered will increase, so long as proper controls are exerted on illegal exporters to deter the offshore shipments of e-waste and other hazard bearing materials. The combination of program development and determent of exportation will help overall recoveries and can be expected to lead to an increase the amount of virgin ore replaced by recyclable metals.

Teck Cominco uses a slag fuming furnace to process bulk electronic scrap in which 100 percent of the input materials are recycled. The slag produced is sold in BC, Alberta and the United States, primarily as an input to the manufacturing of Portland cement, which requires a certain amount of iron. Cement companies use secondary materials that contain iron (i.e. slags, mill shavings) to supply this chemical requirement. The revenue generated does not cover the transportation costs, so it is not a net revenue generator for Teck Cominco.

The plastics smelted¹⁸ from the e-waste at Teck's processing facility are used to generate steam by replacing metallurgical coal. On a displacement basis, one tonne of plastic is nearly equivalent to one tonne of coal, although the mixed e-plastics contain a little less heat value than coal.

As well as e-waste, Teck also processes plastic separators that are part of vehicle lead-acid batteries that keep the cells from touching (very much like the plastic rings that hold a 6 pack of cans together). These plastic separators are contaminated with lead and are also processed by Teck Cominco. Taking into account the volume of separators processed in 2007 plus the e-plastics, 25% of the plastics processed were from e-waste.

Allowing for the part time involvement of some Teck employees the e-waste recycling process supports 13-14 FTEs. One new employee was hired at Teck to work with the e-waste process, and is joined on an as-required basis by a team of five people. In addition, a subcontractor to Teck who does the shredding of the whole e-waste components as feed preparation for the smelting operation has a crew of ten people in the e-waste processing plant.

e-Cycle Solutions

e-Cycle Solutions, an electronics waste processor for the ESABC, opened its BC recycling facility in Chilliwack in November 2007. Currently, this facility operates as a warehousing operation and the materials collected are shipped to e-Cycle's Airdrie, Alberta, recycling plant, where they account for about 25% of total volume. Current employment runs at about five FTEs and is expected to grow substantially when Ministry of Environment approval permits operation of a tear down line in Chilliwack.

Western Canada Computer Industry Association (WCCIA)

The WCCIA is a second electronics stewardship organization operating in BC in partnership with Genesis Recycling Ltd., RC Recycling Ltd., TechnoTrash Recycling Ltd. and 36ZeroWaste Group Inc. During its first quarter of operation, the WCCIA handled about 300 tonnes of electronic waste, over 50% (by weight) of which were monitors (see Table 5).

Table 5
WCCIA Electronics Stewardship Program
Devices Collected

	Units	Tonnes
Monitors	9947.0	162.9
TV's	695	19.3
CPU's	5266	50.7
Printers	5861	66.9
Total		299.8

Source: WCCIA First Quarter Report
(November 1, 2007 to January 31, 2008)

¹⁸ During the smelting process, the plastics decompose back into hydrocarbons within a pool of molten metal. There is very limited oxygen available so the plastics cannot actually "burn" in the traditional sense. At such high temperatures the carbon bonds are broken releasing heat energy and forming carbon and hydrogen. These molecules reform at the surface of the molten pool into carbon dioxide and water. Potentially harmful gases are destroyed without entering the atmosphere.

So far, this group is still attempting to overcome a market timing issue. An example of this issue is presented here: one company, Genesis Recycling Ltd. should receive materials from and be paid a processing fee by WCCIA. For the most part, this has not happened because WCCIA has only a very small revenue stream. As a result, this has had a strong negative effect on Genesis's recycling business, cutting their revenue by more than half, resulting in a drop in employment from about 18 to a current level of six persons. The story is very much the same for TechnoTrash. Although market timing has been an issue for the WCCIA and its processors, the affected processors do have the option of seeking business from the ESABC if they can meet its vendor qualification standards.

Employment

Estimated total employment generated by electronics recycling in BC is just over 123 FTEs.¹⁹ This is distributed across the stewardship organizations (4%), Collection Depots/Consolidation Warehouses (69%), Teck Cominco (11%), e-Cycle (10%) and transportation (5%) (percentages are rounded). For the 50 ESABC depots involved in this program, only 40 of them are dedicated electronic depots employing 2 FTEs each. They use 10 contractors for transportation of this material but they are not fully dedicated; the contractors handle other materials as well. The WCCIA conducts pick ups from 20-30 retail outlets. Their activities to date have not achieved a significant market share of the electronics recycling market and as noted their designated processors have reduced their employment levels as a consequence.

The requirement for recyclers to be audited has resulted in increased business for environmental consulting firms. In the first 6 months of operation they have spent \$35K on environmental auditing services. This cost is anticipated to increase for the second half of the first year of operations but will only be required to register new recyclers in the future and therefore is not considered to account for any future impact for consulting companies.

Encorp either sells the materials collected or pays to have it recycled, depending on the material (metals, plastics).

Financial Aspects

In 2007, the environmental handling fees for the ESABC were about \$12.8 million. Direct expenses included depot handling costs, \$634,000, payment to processors, \$1.7 million and transportation from depots to consolidation sites, and from consolidation to processors, almost \$500,000. Additional costs covered ESABC administration, \$281,000; consumer awareness programs \$731,000 and management fees to Encorp, about \$581,000. This left a surplus of about \$8.3 million to allocate to future programming costs.

4. TIRE STEWARDSHIP PROGRAM

Overview

- ❑ **Summary of Initiative:** On January 1, 2007 after 16 years, BC's Scrap Tire Recycling Program, FIRST (Financial Incentives for Recycling Scrap Tires) shifted from a government led program to an industry run program. Tire Stewardship BC is a not-for-profit organization formed to manage the scrap tire recycling program on behalf of tire retailers in the province.

¹⁹ Note that this is a gross estimate. Adjusting for the employment losses recorded by the processors working with the WCCIA, the total would fall to about 100.

Tire Stewardship BC membership is comprised of the Rubber Association of Canada, the Retail Council of Canada and Western Canada Tire Dealers Association.

- ❑ **Objectives:** The program aims to transform scrap tires from being an environmental problem to being a commodity, which is the basis of a sustainable industry for BC. The program's objectives are to: maximize the diversion of scrap tires from landfills; conform to the Ministry of Environment's pollution prevention hierarchy of Reduce, Reuse, Recycle, Recover and Residual Management; support new and existing tire processors and recyclers; ensure system cost-effectiveness; ensure the self-sufficiency of industry.

Products Targeted

- ❑ **Designated Products:** Categories of scrap tires included in the program include: Passenger and Light Truck (PLT) tires, Medium Truck (MT) and Farm Tires (FT), and skidder tires have recently been added.
- ❑ **End-of-Life Product Issues:** The end of life product issues associated with this product includes decreasing landfill capacity for used tires, and the associated safety hazard of stockpiling them.

Key Responsibilities

Producer associations volunteer time on the Tire Stewardship Board but do not have any physical or financial responsibilities for this program. Retailers collect tire levies from consumers and remit those funds to the Tire Stewardship Board. Retailers also collect used tires back from consumers; however, this is not mandatory. The Tire Stewardship Board is responsible for administration of financial aspects of the program (fee remittance), transportation arrangements and processing arrangements (payments and incentives).

Program Details

- ❑ **Product Collection:** The Tire Stewardship Board has agreements with processors to transport and process the materials. The annual recovery rate for all tire sizes collected is estimated to be close to 100%. Table 6 shows the volume of tires collected and processed for recycling by weight and number of units handled (in passenger tire equivalents), and the incentives paid at each stage. In 2007, for example, TSBC collected 40,000 tonnes of tires and paid out about \$4.1 million in transportation incentives; about 33,000 tonnes of tires entered the processing stream on attracting over \$7.2 million in incentive payments.

Table 6
Tire Recycling, Collection, Transportation and Processing, 2003 – 2007

	Transportation			Processing		
	Incentives (\$'000)	Volumes (tonnes)	Tires (‘000 PTEs)	Incentives (\$'000)	Volumes (tonnes)	Tires (‘000 PTEs)
2003	1,931	28,740	2,874	4,441	28,020	2,802
2004	2,221	31,590	3,159	4,777	28,900	2,890
2005	2,362	30,880	3,088	5,892	31,460	3,146
2006	2,442	33,000	3,300	7,084	35,000	3,500
2007	4,174	40,000	4,000	7,221	33,000	3,300

Note: The gap between transportation volume and processing volume reflects additions to crumb inventory (Processing volume less than Transportation volume) or drawings from the crumb inventory (Processing volumes exceeds Transportation volume) at the processor site.

Data for 2003-2006 are from the FIRST program; 2007 data from TSBC.

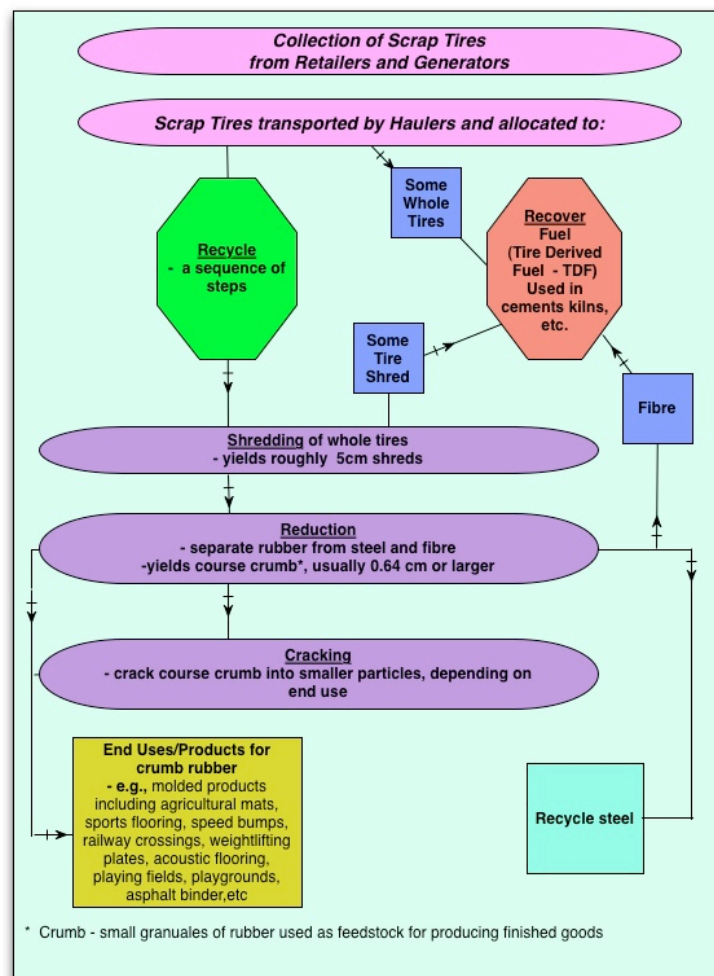
Source: Tire Stewardship BC.

Markets for Used Tires

Figure 5 shows that used tires end up either as:

- ☐ Crumb, which is used to manufacture other products; or
- ☐ Fuel, to replace other fuels (Tire Derived Fuel (TDF))

Figure 5



In 2007, 40,000 tonnes of scrap tires were collected in BC. All of the collections are coordinated and carried out by truckers working for Pacific Shredding or truckers on contract to the company. Pacific Shredding performs the initial shredding of the scrap tires, separating the nylon fibre and steel from the tires and producing a coarse crumb. The coarse crumb then goes to Western Rubber Products and Delta Fine Grind for further processing into various grades of fine crumb. On Vancouver Island, scrap tires are delivered to Island Tire Recycling²⁰ in Chemainus, where they are shredded and the shred is transported to Western Rubber on the Mainland for further processing.

The split of the scrap tires was about 26,400 tonnes to the product stream, and about 6,600 tonnes to the tire derived fuel stream (TDF). The 26,400 tonnes in the product stream breaks down into about 1,200 tonnes for the production blasting mats, 16,000 to 18,000 tonnes ends up as fine crumb, and 5,000 tonnes of nylon fibre and 5,000 tonnes of steel extracted from the whole scrap tires in the crumb manufacturing process.

²⁰ Western Rubber Products owns Pacific Shredding, Island Tire Recycling and Delta Fine Grind.

All the nylon fibre goes to Lafarge Cement, which burns it in their cement kiln. Western Rubber pays Lafarge \$30 per tonne to accept the fibre which would otherwise go to the landfill at a cost of \$70 per tonne.

The reclaimed steel is sold to a steel recycler in Vancouver for about \$60 per tonne not including freight. It makes up a very small percentage of total steel recycling. The recycler sells the steel to Schnitzer Steel in Washington State.

Lehigh Cement uses whole tires as fuel in its cement kiln at its Delta, BC plant. Coal is the main fuel but the Delta plant is permitted to burn used tires, waste oil and several other energy-rich, non-hazardous alternative fuels. The plant currently burns tires, with over 3.1 million burned to date. These recycled tires replace coal. On an annual basis, the annual volume or weight of tires burned varies. Lehigh has a 2008 target of 1.5 tonnes per hour. In 2007, Lehigh used almost 5,900 tonnes of used tires, up from a little over 3,200 tonnes in 2006. According to Lehigh, one tonne of tires replaces about 1.066 tonnes of coal. So, in 2007, the 5,900 tonnes of tires used as fuel replaced roughly 6,290 tonnes of coal. The price paid by Lehigh for coal, its primary fuel, is proprietary. However, considering that world coal prices have range between \$100 and \$200 per tonne over the last year, the TDF replaced coal that could have been valued in the \$630,000 to \$1.2 million range. TSBC's published incentive rate for burning of whole tires collected within BC is \$98.00 per tonne. In addition, Island Tire Recycling directs about 3,500 tonnes of shred to Catalyst Paper Corporation in Port Alberni for use as tire derived fuel to complement the company's use of biomass (bark and waste wood), which typically accounts about 90% of the mill's steam requirements.

Employment

The recycling of scrap tires generates employment of about 122 FTEs. The TSBC accounts for about 4% of the employment, trucking for about 30% and processing by Western Rubber Group Companies for about 66%.

Pacific Shredding started its own truck fleet in 1995 with a single truck and now operates 10 trucks and 22 trailers to service the interior of the province, with six independent contractors who service the Metro Vancouver area and two contractors servicing Vancouver Island. The transportation incentive paid by TSBC covers the full cost of collecting and hauling the scrap tires, which have already been sorted by the tire generator, to the Pacific Shredding in Vancouver and Island Tire Recycling.

The Western Rubber Group operates Western Rubber Products (WR), Pacific Shredding (PS), Delta Fine Grind (DFG) and Island Tire Recycling, located on Vancouver Island as separate companies. PS and WR/DFG operate from separate premises on Annacis Island, partly because they are independent industrial processes and partly as risk reduction policy in case of fire.

The processing incentive paid by TSBC was instrumental to the establishment of Pacific Shredding mainly because there are almost no markets for crumb in BC. Western Rubber has to sell most crumb into markets in US. Having incentives up front helps to make the whole system work. The increase in oil prices over the past several years has shrunk the market because of higher transportation costs, although this effect may now diminish with the recent sharp declines in petroleum prices.

Pacific Shredding produces 4-inch or 2-inch shred, the majority of which is then sold and delivered to WRP for granulating into fine crumb. About 70% of the course crumb rubber produced by WRP goes to DFG, while the other 30% is split between customers including Pro

Mat (close to 10%) and a variety of other uses (about 20%). WR employs two people on site making the Pasture Mat, a bedding product used for dairy cattle in dairy barns, for western Canada as result of a contract with Pro Mat Ltd., an Ontario company that originated the product.

In the past all of the DFG product has been sold outside BC. It is expected that the recently introduced manufacturing incentive will lead to the sale of about 30% DFG's output in BC mainly to Northwest Rubber Products Ltd.

North West Rubber Mats Ltd. is a manufacturer of sheet rubber products, using a type of crumb produced from buffings²¹ from truck tires that is vulcanized with catalysts and vulcanizing agents under pressure and heat. These products, including, for example, sheet rubber for use in horse box stalls and horse trailers, pick-up truck box and van liners and specialty matting and flooring are for use in recreational facilities shower/locker rooms, to name only a few.

North West manufactures its products in Abbotsford, the end markets for about 70% of their production is in the US and 30% in Canada, mainly Alberta and BC, although there are also international sales. The company has been hit hard by the slow down in the US economy and the sharp increase in the value of the Canadian dollar. Consequently its employment level is down sharply from its long-term stable peak of about 100 people.

Although North West has used some BC produced crumb, the bulk of its raw material input has been buffings collected from retread shops across the western half of North America. Now that North West is making use of the TSBC manufacturing incentive and thinking about expanding their BC manufacturing activity. This could lead to greater use of BC produced crumb and expanded local economic impacts from rubber recycling, so long as it is price competitive, since the current state of their markets demands careful attention to their input costs.

Financial Aspects

Levies called an Advance Disposal Fee are charged at point of sale per tire. This generated revenue of about \$14.8 million including about \$88,000 in interest in 2007. About two-thirds of the revenue, \$11.4 million, is paid out to the processors and haulers to collect, transport and recycle the scrap tires. About \$1.7 million is committed to program management and other stewardship commitments such as consumer education and awareness activities, and research and development. The \$1.8 million contributes to a Reserve Fund to cover possible costs from any possible wind-up of the organization and to ensure that funds are available to meet the potential incentives owing to processors for the whole tire and unsold product being held in inventory.

5. PAINT STEWARDSHIP PROGRAM AND SOLVENTS, FLAMMABLE LIQUIDS, GASOLINE AND PESTICIDES STEWARDSHIP PROGRAM

Overview

- ❑ **Summary of Initiative:** These two programs are administered by a single stewardship agency that deals with most types of household hazardous waste in BC. The agency is

²¹ Buffings are produced from recycled truck tire tread when the remainder of the worn-down tread is removed from the tire prior to retreading.

Product Care, and they operate a network of over 100 depots where consumers can drop used products off.

- ❑ **Objectives:** The objectives of these stewardship programs are to support pollution prevention principles by attempting to reduce the amount of hazardous waste that is disposed of in municipal landfills and storm-drains, and by promoting a shift in focus from treatment and disposal to recycling and reusing.

Products Targeted

- ❑ **Designated Products:** For the Paint Stewardship program, designated products include: interior and exterior latex, alkyd, enamel and oil-based consumer paints; porch, floor and deck paints; interior and exterior varnishes and urethanes; primers, undercoats and sealers; marine enamels; wood finishing oils, stains and shellac; latex driveway sealers; rust paint, decorative metal paints; fence, barn and swimming pool paints; empty paint containers; paint aerosols of all types, including automotive and industrial products.

For the Solvents etc. stewardship program, designated products include the following:

- The Solvents and Flammable Liquids category includes products with a flash point as tested by the ASTM D1310 Tag Open Cup Test Method of less than 61 degrees Celsius. Exceptions include: products in the paint category (see Post-Consumer Paint Stewardship Program); paint strippers containing methylene chloride; kerosene in containers larger than 9 litres; pharmaceutical products (see Medications Return Program); alcoholic beverages; cosmetic products, and products containing less than 50% water-miscible flammable liquid.
 - The Pesticide Product category includes products registered under the federal *Pesticide Control Products Act*.
 - The Gasoline Product category includes gasoline sold for use in spark ignition engines and returned in an approved Underwriters Laboratories of Canada container.
- ❑ **End-of-Life Product Issues:** End-of-life product issues of concern with these products include the improper disposal of paint into landfills and waterways, as well as the overall amount of household hazardous waste being stored by consumers.

Key Responsibilities

The manufacturers/brandowners pay eco-fees to Product Care, and these fees are either included (hidden) in the price for paint paid by consumers, or are identified as a visible "eco fee" at the point of purchase. Brandowners also develop and distribute educational material for retailers regarding their stewardship program. They also provide information regarding access to return collection facilities, as well as the environmental and economic benefits of participating in the stewardship program (this information is often developed by Product Care for the brandowners). The physical responsibilities of brandowners are to ensure the collection and management of used paint from the consumer through a network of collection sites. The Recycling Regulation requires that access to collection be convenient.

Product Care is a non-profit association established in response to provincial regulations requiring brand owners of paint and of solvents/flammable liquids, gasoline and pesticides to establish a collection program for consumers to return leftover products. The program is funded entirely by the eco fees remitted by Product Care's industry members, which are based on their unit sales in British Columbia. The eco fee is taxable, as it is considered to be a part of the price of regulated products. While the PST and GST are remitted to the government, no part of the eco fee itself is

remitted to the government. The Product Care Association fulfills the physical, economic and administrative responsibilities on behalf of their brand owner members.

Program Details

- ❑ **Product Collection:** There are 104 collection depots in the province for paint, and flammable liquids/solvents, pesticides and gasoline. There is no charge to drop off program products. Depots handle both paint and household hazardous waste (solvents, gasoline, flammables, etc.). Product Care has partnered with the Recycling Council of British Columbia in its province-wide materials exchange program, which matches parties who generate large quantities of leftover paint with parties who can re-use it. Product Care also operates a central bulking facility, which gives them greater control of waste paint; provides more opportunities for the research and development of diversion and disposal options; and is more cost effective than dealing with waste management companies.

It is hard to measure overall success rates by the amount of paint purchased and used because of the unknown amounts of old paint stored by individual households. However, Product Care reports that they recover over 5% of the new paint sold each year, and that the recovery rate increases by at least 8% each year (ideally, this would be 0% if everyone used up all that they purchased). Table 7 shows the collection of materials by Product Care in 2006, including 2.2 million litres of paint, 15,426 litres of paint aerosols, 58,516 litres of flammable liquids and gasoline and 10,716 litres of pesticides.

Table 7
Product Care Materials Recovery, 2006

	Paint (non aerosol)	Paint Aerosol Flammable	Liquids/Gasoline.	Pesticides
Sales (litres) ¹	36,673,940	913,171	4,351,252 ²	175,702
Recovery (litres)	2,164,437 ³	15,426	58,516 ⁴	10,716
Recovery (elc's) ⁵	6,727,968	134,978	159,840	38,578

Source: Product Care 2006 Annual Report

Notes:

1. Volumes reported as, Sales (litres), are estimates calculated by converting units reported using typical container volumes for each eco fee category.
2. Flammables Sales (litres) figure does not include gasoline. Gasoline sector members do not report sales volumes to Product Care.
3. Includes volume recovered via paint exchange program
4. Represents combined flammable liquids and gasoline collection volumes
5. elc means equivalent litre container, and is a measure of original container capacity, not contents.

- ❑ **Secondary Markets:** Table 8 shows the disposition of the hazardous materials collected by Product Care. Various secondary markets for the paint wastes exist such as: reusing post-consumer paint through paint exchanges (4.4%), recycling the used paint as a raw material in specialty concrete products (70.4%). Leftover latex paint is used as a raw material in the manufacturing of specialty concrete and cement products. A portion of oil-based paint collected is processed through a re-distillation system that recovered its components for use as raw material in the manufacturing of other products, such as asphalt. The scrap steel and plastic from paint containers are recycled into new industrial products. Product Care also recovers the propane repellent from the aerosols they collect. The remainder, 25.2% is used for energy recovery.

100% of flammable material and gasoline collected is used for energy recovery through fuel blending in applications such as incinerators and cement kilns. Pesticide material collected is incinerated.

Table 8
Disposition of Hazardous Materials Collected by Product Care, 2006

Method	Example	Paint	Flammables	Pesticides	Gasoline
Reused	Given to a consumer in original condition through “paint exchange”	4.40%	--	--	--
Recycled	Reprocessed as paint, used in concrete manufacture, cement manufacture, re-distillation	70.40%	--	--	--
Utilized for recovery of energy	Fuel blending	25.20%	100%	--	100%
Disposal	--	--		100%	
Incineration due to contamination					
Landfill	--	--	--	--	

Source: Product Care 2006 Annual Report

Product Care contracts with reputable service providers with a proven record of using established, approved and verifiable procedures for the final treatment and processing of residuals in compliance with all applicable environmental regulations. Product Care utilizes a due diligence and control system for environmental risk management. Note that in all cases, Product Care pays recyclers/waste disposal contractors to take the material.

Financial Aspects

The program is funded entirely by the eco fees remitted by Product Care's industry member based on their unit sales. The fees paid to Product Care are used for administration, to pay the depot system of collection and transportation, and to pay recyclers and disposal facilities, etc.

Program revenue for 2007 was slightly over \$6 million and has been growing at close to 5% annually over the last three years. About 87% of revenue or \$5.2 million was spent on collection, disposal, transportation and event advertising. Association and depot start-up costs, office, rent and travel, and technical, professional, management and communication account for the remaining expenses of about \$480,000. Allowing for investment and interest income, left a little more the \$350,000 contribution to the reserve fund currently running at \$10 million, most of which is allocated to as insurance to respond to environmental impairment liability exposures and director and officers liability exposures.

- ❑ **Secondary Markets:** Product Care’s program has developed a unique niche in the secondary market of specialty concrete, where most of the recycled paint gets processed as a raw material for concrete. The other products collected are bulked and shipped to approximately 10-15 approved contractors (recyclers or waste management contractors). These are all considered to be businesses that were in existence prior to the development of the stewardship plans. It is anticipated that the product supplied to these end markets is a small percentage of their overall volume.

Economic Impacts

Total employment generated by recycling paints, flammables including gasoline and pesticides is estimated at just over 73 FTEs based on information provided by Product Care. The collection Depots account for about 68% (50 FTEs). The rest is spread across Product Care administration (8%, 5 3/4 FTEs), Product Care consolidation plant (18%, 13 FTEs), and transportation (6%, about 4.5 FTEs).

6. USED LUBRICATING OIL, FILTERS, AND CONTAINERS STEWARDSHIP PROGRAM

Overview

- ❑ **Summary of Initiative:** The British Columbia Used Oil Management Association (BCUOMA), a not-for-profit association, administers the used oil, filter and container stewardship program under its stewardship plan approved by the Ministry of Environment. This program funding comes from the Environmental Handling Charge (EHC), a user-pay levy applied to all purchases of new oil products. A multi-stakeholder Board of Directors manages BCUOMA, with representatives from manufacturing, retailing, local government, Ministry of Environment, and the public.
- ❑ **Objectives:** The mission of the BCUOMA is to manage, on behalf of brand-owners, a cost-effective and environmentally sustainable program for the collection and recycling of used oil, used oil filters and used plastic oil containers. The main program objectives are: accountability to brand-owners; optimal recovery rates; informed and participating end-users; and environmentally responsible management of used oil materials.

Products Targeted

- ❑ Designated Products:
 - Oil – any petroleum or synthetic crankcase oil, engine oil, hydraulic fluid, transmission fluid, gear oil, heat transfer fluid or other fluid used for lubricating purposes in machinery or equipment.
 - Oil Filters – any spin-on or element oil filter used in hydraulic, transmission or internal combustion engine applications – includes diesel fuel filters but does not include gasoline fuel filters.
 - Oil Containers – any plastic container with a capacity of less than 30 litres that is manufactured to hold oil.
- ❑ **End-of-Life Product Issues:** End-of-life issues associated with these designated products include environmental contamination of surface water, ground water, and landfills.

Key Responsibilities

The BCUOMA administers the program, including the financial aspects. The program pays out incentives to collectors and processors for used lubricating oil. Target recovery rates are 70.5% for oil, 80.6% for filters, and 61.9% for oil containers.

Program Details

- ❑ **Product Collection:** There is a network of about 540 return collection facilities in BC that accept used oil materials from consumers. Consumers must bring the used oil materials to the depots. For large volumes of oil, BCUOMA pays registered collectors to pick up used oil materials from over 4,000 generators throughout BC, of which about 540 serve as Return Collection Facilities. BCUOMA registered Collectors are paid a Return Incentive (RI) by BCUOMA when they submit the required paperwork to show that the used oil materials have been delivered to a registered BCUOMA Processor. In turn, the Registered Collectors pay, depending on the quality, quantity and location of the used oil materials, some money to the generators.

BCUOMA allows the free market to work by registering all Collectors and Processors who meet the requirements for registration and allows them to compete with each other on the open market. Each registered Collector & Processor is paid a RI for the 11 different zones in the province for oil, filters and oil containers, as outlined on the website in the Manual for Collectors and Processors.

The volume of materials collected by the BCUOMA has been increasing over the past four years. For example, used oil collection has increased from 44 million litres in 2004 to 49 million litres in 2007 (Table 9). For 2007 the recovery rates for oil are estimated to be about 70%, down slightly from 71% in 2006; filters about 84%, up from 77% in 2006; and oil containers about 63%, up from 57% in 2006.

Table 9
BCUOMA Volume of Materials Collected, 2004 - 2007

	2007	2006	2005	2004
Used oil (litres)	49,012,147	47,554,996	47,740,794	44,119,202
Used oil filters (#)	5,234,673	4,729,007	4,925,339	4,721,232
Used oil containers(Kg)	1,386,406	1,254,001	1,241,032	1,055,969

Source: BCUOMA Annual Reports

Secondary Markets

Three companies, M&R Environmental, Enviro West and Hetherington Industries, provide the bulk of the collection and initial processing of used oil, filters and oil containers for the BCUOMA. M&R Environmental (<http://www.wepayforwasteoil.com/>) started operations in 2003 and has grown steadily since. M&R operates primarily in the lower mainland but also acquires used oil and plastic from the other two companies. The market expansion fostered by the used oil Stewardship program has contributed to its ability to grow into a \$10 million operation. Enviro West started operations in 2003 in BC, partly in response to the Stewardship program, partly in response to an assessment of business opportunities, and has participated in the used oil market growth. Enviro West operates out of Prince George and Kelowna. The company collects used oil, filters and plastic containers in the interior, on Vancouver Island and on the Sunshine Coast.

Hetherington Industries is a BC based company that deals with waste removal for wide range of waste materials including used oil, oil filters, and plastic oil containers on Vancouver Island.

Used Oil

In 2006, **M&R** helped its mainly lower mainland clients recover 11 million litres of used oil (including oil recovered from used oil filters). Used oil collections grew further to about 13 million litres over 2007/2008. During the last period, M&R sold about 13.5 million litres of processed used oil as fuel, 60% into Washington State and 40% into the lower mainland of BC. The used oil collected by Enviro West is processed in Kelowna and Prince George and sold as alternative fuel mainly to asphalt plants: about 7 million litres in Kelowna (25% of which is exported) and 4-5 million litres at Prince George (about 10% of which is exported). In 2007, Hetherington collected about 2.7 million litres of used oil, which they sold to M&R Environmental for processing and onward sale.

Oil Filters

The three companies collect and process used oil filters resulting in a diversion of about 1,110 tonnes annually, mostly steel from landfills in BC. M&R handled about 1.725 million filters over its 2007/08 accounting period. M&R extracts the residual used oil from the filters and adds it to used oil collected directly for processing. The steel from the filters is crushed, estimated at a little over 430 tonnes in 2007, up from about 365 tonnes in 2006, and sold to a steel recycler in the lower mainland, who in turn sells the steel to steels mills in Washington State. Enviro West filters are processed into ways: 230,000 kg from Prince George are shipped to Alberta for processing, while the 265,000 kg collected in Kelowna are processed in BC by NewAlta, based on exchange program between the two companies where Enviro West does filter processing for NewAlta in Alberta. Hetherington collects filters on Vancouver Island that yield about 13-15,000 kg per month of steel that is crushed and sold to Steel Pacific in Campbell River.

Plastics

In 2007, M&R had eight trucks in operation and collected about 454,000 kg of plastic oil bottles. This is estimated to be about 80% of the lower mainland market. After cleaning and grinding into flakes, this material is sold to Merlin Plastics. The Prince George operation of Enviro West collects about 60,000 kg from Prince George that is sent to Alberta for processing. Their Kelowna plant collects another 60,000 kg that is sold to Merlin Plastics for processing. On Vancouver Island, Hetherington Industries collects about 8,000 kg of plastic bottles per month that is also sold to M&R for further processing.

Financial Aspects

The Environmental Handling Charge (EHC), a user-pay levy applied to all purchases of new oil products, funds this program. According to the 2007 Annual Report, program revenue was about \$10.7 million, about 99% of which comes from the environmental handling charges. About 88% of total revenue, \$9.3 million is paid out as return incentives and infrastructure development incentives. Communications and public relations and other program expenses amount to about \$420,000, while administrative costs amount to a further \$420,000 leaving a \$461,000 contribution to the accumulated surplus of about \$1.8 million which provides a cash balance for working capital.

Employment Impacts

The employment generated by the collection and processing materials related to used oil recycling is about 103 FTEs, including about 3.25 FTEs at BCUOMA. The three companies—M&R Environmental, Enviro West and Hetherington Industries – are estimated to account for slightly over two-thirds of the employment²². About 85% of this employment is estimated to be attributable to the market development and organization provided by the BCUOMA. The specific features of the employment by the three companies includes:

- ❑ Prior to the oil stewardship program start-up in 2003, M & R Environmental operated three trucks with eight employees. By August 2005, they had grown to eight trucks and had 27 employees and reported an 8000% increase in their business. By mid-2008, M&R has increased to 40 employees. Most of the incremental growth is attributable to the expansion of business from the Stewardship program.
- ❑ Enviro West started operating in 2003 from two locations in BC, Prince George and Kelowna, partly in response to the Stewardship program and partly in response to other perceived business opportunities. From an initial employment level of six to eight persons in both locations, Enviro West has grown to 10 full-time employees in Prince George and 12 full-time in Kelowna.
- ❑ Hetherington serves Vancouver Island collecting used oil, filters and oil containers on behalf of BCUOMA. Six to seven of their total 14 employees are engaged in used oil recycling activities including three oil truck drivers, three other drivers who are not exclusive to used oil recycling, one driver hauling oil, filters and plastics after processing and one full time staff with part time assistance providing administrative back up. Hetherington estimates that about three of the jobs are incremental since it began serving BCUOMA.

7. MEDICATIONS RETURN PROGRAM

Overview

- ❑ **Summary of Initiative:** The program began in 1996 (formally called British Columbia EnviRx), and was initially a voluntary program. It is now a mandatory program and consumers return unused or outdated medications to participating retail outlets (pharmacies) for collection and disposal. The Residuals Management Group Ltd. administers the program with funding by the Post Consumer Pharmaceutical Stewardship Association.
- ❑ **Objectives:** The program's intentions are to divert leftover and/or unused medications from landfills and sewers, as well as to ensure safe and effective collection and disposal.

The program does not have a target recovery rate because medications are a consumable product. They do have awareness targets, because the success of their program largely depends on the consumers' level of awareness. Currently approximately 31% of BC residents are aware of the program, and only 24% of residents actually use the program. The program has seen a 5% annual increase in the collection rates and that is what the program plans for, however other factors come in to play such as a proposed ban by Metro Vancouver on placing used medications in the garbage, which will likely increase the awareness rate

²² Note that Merlin Plastics employment is accounted for under the Beverage Containers Stewardship discussion. Admittedly, some of the Merlin employment is attributable to the processing of plastic oil bottles, Used Oil employment may be slightly understated and Beverage Containers may be overstated to the same extent.

substantially. The program is planning for the awareness rate to go from 31% to at least 50% awareness if this ban is implemented.

Products Targeted

- ❑ **Designated Products:** As outlined in the *Recycling Regulation*, the program focuses on leftover and/or unused consumer medications as defined by the Drugs Directorate of Health Canada. The program excludes veterinary products, and medications from a hospital.
- ❑ **End-of-Life Product Issues:** Unused pharmaceuticals pose a significant health, safety and environmental hazard when improperly stored or disposed to the environment and can contaminate surface water or ground water.

Key Responsibilities

Manufacturer/brandowners finance the program. They are also required to develop and distribute consumer educational material to retailers regarding the safe use and storage of the products, as well as the safe storage and handling of the residuals and containers. The brandowners are also required to provide information pertaining to the location of collection facilities for their products. Their physical responsibilities are to ensure the collection and management of unused medications from the consumer through a convenient network of collection sites. Participating retailers are required to accept unused and expired medications from consumers. Over 90% of pharmacies in the province participate in the return program. The role of the consumers is to bring their unused or expired medications to their given retailer for collection.

The Residual Management Group Ltd. fulfills the administrative responsibilities of the brandowners on their behalf.

Program Details

- ❑ **Product Collection:** Approximately 75% of all retail pharmacies in BC collect residual medication from consumers. The residual medications are stored in 23 litre plastic containers provided by the program administrator, Residual Management Group Ltd. Once the container is full, the pharmacy contacts the Administrator who arranges for pick up within 7 days. The Administrator also consolidates and then sends the collected residual medications to a licensed incinerator for destruction. They send two shipments per year to an incinerator in Saskatchewan.

As of December 2006, 889 pharmacies participated in the program. At the end of the year 2007, 913 registered pharmacies representing 93.4% of licensed community pharmacies in B.C. were active in the program, up slightly from 92% in 2006. This represents a net gain of 24 collection sites from 2006 including 42 new locations, 10 closures and over 100 changes in ownership or pharmacy managers.

Total collections are increasing each year as awareness of the program expands. Collection reached 23,875 kilograms of medications in 2007, up from just over 18,000 kilograms in 2005. As shown in Table 10, collections tend to be concentrated in the areas of greatest population, Greater Vancouver, Vancouver Island and Fraser Valley, which accounted for 78% of the 19,995 kilograms collected in 2006.

Table 10
Pharmaceuticals Collection by Region, 2006

Region	Containers	Weight (kg)
Coastal B.C.	41	480
Fraser Valley	178	2,130
Greater Vancouver	698	8,117
Kootenays	47	593
Northern B.C.	97	1,135
Okanagan	197	2,108
Vancouver Island	451	5,432
Total	1,709	19,995

Source: Post Consumer Pharmaceutical Stewardship Association.

- ❑ **Secondary Markets:** There are no secondary markets because the medication is collected and transported for disposal through incineration. The incineration facilities already existed prior to this program, and this program only provides two shipments per year so this would be a very small proportion of incineration business. They regularly use courier services for transporting the collected pails to incineration facilities, but these courier services did not develop as a result of this program, and it is evident that the services they supply to this program are a very small portion of their courier business operations.

Financial Aspects

There are no product-specific fees for this program for the consumer. Manufacturers, who are invoiced by the stewardship organization based on their sales in BC, fund the program.

The program costs become an internalized cost for the pharmaceutical industry. For 2007, program revenue was \$325,000 and expenses were \$294,000. For 2006, program revenue was \$253,000, and expenses were \$256,000.

Employment

The Post-Consumer Pharmaceutical Stewardship Organisation has one individual who works 80% of a FTE as a result of this program.

The Residual Management Group Ltd. has one individual who works approximately 40% of FTE as a result of this program.

8. TREE PAINT STEWARDSHIP PROGRAM

Overview

- ❑ **Summary of Initiative:** Brand owners and distributors of industrial aerosol paint formed the Tree-Marking-Paint Stewardship Association (TSA) to manage industrial aerosol containers. Industrial aerosol paint is sold primarily in bulk to the forest industry or surveyors for the marking of trees, roads and other surfaces.

- ❑ **Objectives:** The TSA has a current target recovery rate of 45% of the containers sold. To achieve this, the operational strategy has three main parts:
 - Refurbish the automatic evacuator located in Campbell River.
 - Evaluate the establishment of a permanent depot in Prince George.
 - Working with the customers of the TSA brandowners to establish recovery programs.

Products Targeted

- ❑ **Designated Products:** Brand owners and distributors of industrial aerosol paint formed the Tree-Marking-Paint Stewardship Association to manage industrial aerosol containers. Industrial aerosol paint is sold primarily in bulk to the forest industry or surveyors for the marking of trees, roads and other surfaces. The TSA acts on behalf of brand owners of paint to establish a collection program for leftover paint products and waste.
- ❑ **End-of-Life Product Issues:** End-of-life product issues of concern with these products include the improper disposal of aerosol paint containers into landfills, as well as the overall amount of household hazardous waste being stored by industrial users.

Key Responsibilities

The TSA is charged with managing the collection and disposal of the paint residuals within an empty industrial aerosol container effectively and efficiently. The strategies used depend on the location and volume of aerosol containers requiring disposal: the main ones are the establishment and operation of return-collection facilities, and the provision of evacuators for on-site processing by companies with a sufficiently large volume.

Program Details

- ❑ **Product Collection:** The TSA operated 25 return-collection facilities in 2006 – one more than was operated in 2005. The brandowners within the TSA use either a hand operated processing equipment (e.g., the New Pig DRM266 evacuator) or an Aervoe-Pacific Model 1050 automatic evacuator located in Campbell River. Both systems are designed to puncture the container, vent the propellant and contain the solvent and residual paint within a 220-litre drum.

Increasingly, companies are evacuating their empty aerosol containers on site. The Aerosolve Model DRM266 aerosol puncturing system is currently the model of choice for companies processing containers on site.

The TSA purchased 10 new Aerosolve evacuators in 2006 to increase the number of companies processing the aerosol containers and to replace the older Aervoe hand-operated evacuators.

The Tree-Marking-Paint Stewardship Association (TSA) processed a total of 142,294 aerosol containers or an average of 34.5 per cent of the aerosol containers sold in 2006, very similar to the amount in 2005 (Table 11). The number of containers processed and the number of litres of paint recovered has declined steadily since 2002, reflecting in part the decline in the forest industry related to a variety of issues including the pine beetle.

The total volume of residual aerosol paint recovered by the TSA distributors in 2006 was estimated at 2,100 litres, which is estimated using the conversion rate of 200 litres of residual aerosol paint for every 7000 empty aerosol containers processed. This figure does not include

the volume of residual paint recovered by companies who are responsible for the management of residual aerosol paint generated on their operations.

Table 11
Containers Sold and Recovered, Paint Recovered, 2002- 2006

	Total Aerosol Paint Sold in BC	Containers Processed by Forest Companies	Containers Processed by Brand Owners	Per Cent Processed	Litres of Paint Recovered*
2006	411,915	67,555	74,739	34.5%	2,135
2005	418,955	70,378	76,373	35.0%	2,182
2004	381,109	71,420	84,597	40.9%	2,417
2003	378,066	32,998	123,113	41.3%	3,518
2002	440,375	49,254	124,263	39.4%	3,550

* Based on 200 litres per 7,000 containers, Brand Owners only; Forest Companies not included
Source: Tree Paint Stewardship Annual Reports

- ❑ **Secondary Markets:** There is no secondary market for the residual industrial aerosol paint. Instead, the residual aerosol paint recovered by brandowners in 2006 was managed by various transporters (NewAlta, Clean Harbours, Safety Clean) and was burned for energy recovery. Any remaining residual aerosol paint is stored at TSA depots until disposed by licensed transporters. The TSA has not operated any long-term containment or final treatment or processing facilities for industrial aerosol paint.

Financial Aspects

The program is funded entirely by the eco fees remitted by TSA industry members based on their unit sales. An industry eco-fee of \$0.10 per aerosol container is levied to cover the costs of the operation and administration of the program. Eco-fees for forest companies that use an aerosol evacuator are waived. Over the five years, 2002-2006, Eco Fees Revenue averaged about \$34,000 per year, of which about 35%, slightly less than \$12,000 was paid out for processing fees. Operating expenses averaged about \$15,000, leaving an operating surplus of about \$65,000 per year.

Economic Impacts

No information available but the impacts would be small.

VI. BROADER IMPACTS

The following sub-sections provide a brief overview of some of the considerations to reflect upon while interpreting results presented in the previous section.

1. AVOIDED COSTS TO LANDFILLS

Diverting waste away from landfills could potentially lead to savings on operating costs for the landfill. However, for most landfill operations, the ratio of fixed costs to variable costs is very high. The result is that reducing the waste stream through Stewardship programs would yield nominal operating cost savings on such items as fuel for machinery. In the Capital Regional District, for example, the landfill handled 170,000 tonnes in 2007. In their view, reducing the waste stream by a few thousand tonnes would have little impact on operating costs.

Looking at the capital costs of landfilling, the landfill operators contacted for this study agree that a cubic meter of air space in a landfill has a value. Moreover, they agree that reducing the waste stream deposited in a landfill will extend its life and lead to postponing, if not eliminating, the capital costs of expansion or investment in a new landfill. For example, a modern new landfill near Terrace, Foreman Ridge, is estimated to have a cost of \$55 per ton of municipal solid waste disposed. So, to the extent that the waste stream can be reduced, one can expect some cost savings. However, there were no current estimates of those savings. The most telling point made was that collectively the Stewardship programs do not handle a high volume of materials relative to the overall volume handled in landfills (approximately 121,000 tonnes of material managed through the product stewardship programs in 2007 compared with a total waste volume in BC of about 2.9 million tonnes in 2006,²³ suggesting that savings in this area will be modest.

The most important benefit of Stewardship has been to reduce the toxicity of material deposited in landfills. The benefit is a reduction in the costs of dealing with leachate contamination. If the problem required building a treatment plant for leachate, it would be expensive, running to the millions of dollars. An interesting observation in the case of the Capital Regional District (CRD) is that the biggest savings from Stewardship is estimated to come from reducing the volume of hazardous waste to be handled. The CRD solid waste authorities estimate that the hazardous waste stream is about 80% paint, 10% pesticide and 10% orphans. The first two items are handled by a Stewardship organization while it costs the CRD about \$500,000 per year to deal with the orphan items, which are not handled by a Stewardship organization.

2. GREENHOUSE GAS EMISSIONS ANALYSIS

Harvesting, extracting, and processing the raw materials used to manufacture new products is an energy-intensive activity. Reducing or nearly eliminating the need for these processes, therefore, achieves huge savings in energy. Recycling aluminum cans, for example, saves 95 percent of the energy required to make the same amount of aluminum from its virgin source, bauxite. The amount of energy saved differs by material, but almost all recycling processes achieve significant energy savings compared to production using virgin materials.

²³ This is the most recent province wide estimate from Statistics Canada, *Waste Management Industry Survey: Business and Government Sectors – 2006*.

To get some idea about the environmental benefits of the recycling facilitated by the stewardship programs in BC, we used the Waste Reduction Model (WARM)²⁴ created and supported by the US Environmental Protection Agency (EPA). This model calculates total GHG emissions of baseline and alternative waste management practices — source reduction, recycling, combustion, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE), metric tons of carbon dioxide equivalent (MTCO₂E), and energy units (million BTU²⁵) across a wide range of material types commonly found in municipal solid waste (MSW).²⁶

The analysis reported in the tables that follow compares allocating all of the materials handled by the Stewardship programs to landfill (the baseline) with the actual combination of recycling and landfilling of materials reported for 2007²⁷ (the alternative).

Carbon Equivalent Analysis

The baseline, which assumes that all materials are landfilled, exhibits GHG emissions of 1,917 MTCE (Table 12).

Table 12
GHG Emissions, Baseline Waste Management (MTCE): 1,917

Material	Tonnes Recycled	Tonnes Landfilled	Tonnes Combusted	Tonnes Composted	Total MTCE
Aluminum cans	0	13,104	0	N/A	136
Glass	0	77,728	0	N/A	806
Mixed paper (general)	0	3,760	0	N/A	357
Plastics	0	12,651	0	N/A	131
Personal computers	0	2,958	0	N/A	31
Tires	0	44,092	0	N/A	457

Under the Alternative Waste Management Scenario, where the amounts of materials recycled through the BC Stewardship organizations are modelled, the model estimates a reduction of 70,778 MTCE. The recycling of aluminium cans and tires accounts for about 82% of the reduction²⁸ (Table 13). The Total Change in GHG Emissions is a reduction of 72,695 MTCE.

²⁴ WARM Version 8, 8/06, available at http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html
The GHG emission factors in WARM were developed following a life-cycle assessment methodology using estimation techniques developed for national inventories of GHG emissions, as described in the EPA's report *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*.

²⁵ Converted to megajoules in this report.

²⁶ Note that WARM does not handle paints, flammables or pesticides in its calculations.

²⁷ Or 2006, if later data were not available.

²⁸ WARM defines recycling tires in this analysis as retreading and does not include other recycling activities (i.e. crumb rubber applications), so it is an approximation of the BC situation where about 80% of recycled tires are processed into crumb rubber.

Table 13
GHG Emissions, Alternative Waste Management (MTCE): -70,778 MTCE

Material	Tonnes Reduced	Tonnes Recycled	Tonnes Landfilled	Tonnes Combusted	Tonnes Composted	Total MTCE*
Aluminum Cans	0	11,049	2,055	0	N/A	-40,869
Glass	0	69,197	8,531	0	N/A	-5,155
Mixed paper (general)	N/A	2,027	1,733	0	N/A	-1,791
Plastics	N/A	9,122	3,529	0	N/A	-3,681
Personal Computers	0	2,958	0	0	N/A	-1,822
Tires	0	35,274	8,818	0	N/A	-17,460

Note: A negative value indicates an emission reduction; a positive value indicates an emission increase.

Carbon Dioxide Equivalent Analysis

The GHG Emissions from Baseline Waste Management is estimated at 7,030 MTCO₂E, distributed across the waste materials as shown in Table 14.

Table 14
GHG Emissions, Baseline Waste Management: 7,030 MTCO₂E

Material	Tonnes Recycled	Tonnes Landfilled	Tonnes Combusted	Tonnes Composted	Total MTCO ₂ E
Aluminum cans	0	13,104	0	N/A	498
Glass	0	77,728	0	N/A	2,954
LDPE	0	12,651	0	N/A	481
Mixed paper (general)	0	3,760	0	N/A	1,309
Personal computers	0	2,958	0	N/A	112
Tires	0	44,092	0	N/A	1,676

The estimated reduction in GHG Emissions under the Alternative Waste Management Scenario is 259,520 MTCO₂E, distributed across the materials as shown in Table 15. Again, aluminium and tires account for about 83% of the total reduction. The total reduction in GHG Emissions is 266,520 MTCO₂E.

Table 15
GHG Emissions, Alternative Waste Management: -259,520 MTCO₂E

Material	Tonnes Reduced	Tonnes Recycled	Tonnes Landfilled	Tonnes Combusted	Tonnes Composted	Total MTCO ₂ E*
Aluminum cans	0	11,049	2,055	0	N/A	-149,854
Glass	0	69,197	8,531	0	N/A	-18,903
LDPE	0	9,122	3,529	0	N/A	-13,496
Mixed paper (general)	N/A	2,027	1,733	0	N/A	-6,566
Personal computers	0	2,958	0	0	N/A	-6,681
Tires	0	35,274	8,818	0	N/A	-64,021

Note: A negative value indicates an emission reduction; a positive value indicates an emission increase.

Energy Analysis

WARM estimates energy use for Baseline Waste Management at 80,312 gigajoules, glass and tires are the major energy users (Table 16).

Table 16
Energy Use, Baseline Waste Management: 80,312 Gigajoules

Material	Tonnes Recycled	Tonnes Landfilled	Tonnes Combusted	Tonnes Composted	Gigajoules
Aluminum cans	0	13,104	0	N/A	6,911
Glass	0	77,728	0	N/A	40,994
LDPE	0	12,651	0	N/A	6672
Mixed paper (general)	0	3,760	0	N/A	921
Personal computers	0	2,958	0	N/A	1560
Tires	0	44,092	0	N/A	23,254

The estimated reduction in energy use from Alternative Waste Management Scenario 5,171,235 gigajoules, about 85% coming from recycling aluminium cans and tires (Table 17).

Table 17
Energy Use, Alternative Waste Management: -5,171,235 Gigajoules

Material	Tonnes Reduced	Tonnes Recycled	Tonnes Landfilled	Tonnes Combusted	Tonnes Composted	Gigajoules*
Aluminum cans	0	11,049	2,055	0	N/A	-2,405,185
Glass	0	69,197	8,531	0	N/A	-150,422
LDPE	0	9,122	3,529	0	N/A	-502,490
Mixed Paper (general)	N/A	2,027	1,733	0	N/A	-48,616
Personal Computers	0	2,958	0	0	N/A	-135,560
Tires	0	35,274	8,818	0	N/A	-1,928,962

Note: A negative value indicates an energy use reduction; a positive value indicates an energy use increase.

The total change in energy use by switching from the baseline to the alternative analysis is 5,255,969 gigajoules.

Based on the national average coefficients used in WARM, this is equivalent to:

- ☐ 72,950 Passenger cars removed from the roadway each year
- ☐ 858,913 Barrels of oil
- ☐ 39,830,817 Gallons of gasoline