MORRISON HERSHFIELD

REPORT

Assessment of Economic and Environmental Impacts of Extended Producer Responsibility Programs Operating in BC in 2014

Presented to:

Ministry of Environment

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EXECUTIVE SUMMARY

British Columbia (BC) is leading the implementation of extended producer responsibility (EPR) programs in North America. BC has the largest number of EPR programs across all provinces in Canada (CCME 2014).

There are two key features of EPR policy:

1. To place the responsibility for end-of-life product management (physically and economically) on the producer, and
2. To influence producers to include environmental considerations in the design of their products.

EPR programs in BC are mandated by Recycling Regulation 449/2004, under the *Environmental Management Act*. It provides a single regulatory framework for EPR and establishes the government's requirements for environmental outcomes and program performance for producers to achieve and to report annually. Examples of performance measurement include reporting on recovery rates, the number and distribution of collection facilities, consumer awareness, financial reporting (where product eco-fees charged), and management of collected materials in relation to the pollution prevention hierarchy.

The BC Ministry of Environment (the Ministry) has been using this performance reporting format to measure the financial and environmental impacts attributed to implementation of EPR programs in BC. In 2012, Morrison Hershfield was commissioned by the Ministry and Metro Vancouver to assess economic and environmental impacts from BC's EPR programs. The project resulted in a report (Morrison Hershfield 2014: Assessment of Economic and Environmental Impacts of Extended Producer Responsibility Programs in BC), based on 2011 data.

This project is an update of the previous assessment using the most recent data (2014) from EPR programs operating in BC. As requested by the Ministry, the methodology that was used in the previous study was also used to quantify the economic and environmental impacts of EPR programs operating in BC in 2014.

This study provides an assessment of the economic and environmental impacts of EPR programs in BC, with the results presented by the designated EPR program material. The assessment is based on the recovered quantities of EPR program materials that can be credited to the regulation of EPR materials. This is determined by comparing the recovery rates achieved by the EPR programs in 2014 with those of a theoretical status quo scenario (if there had not been an EPR program). This approach was based on the assumption that collection systems for EPR product categories operating prior to the EPR program would have evolved through other policy mechanisms (e.g., solid waste management plans) in the absence of EPR legislation. As such, performance of EPR programs was evaluated against the status quo recovery scenario and not against a scenario in which 100% disposal was assumed.

Status quo scenarios for each EPR program material were developed based on available collection systems and estimated recovery rates, or alternative performance measure, prior to EPR program implementation. BC data was used where available and when missing, the study used data from other jurisdictions for specific EPR program materials (e.g., cell phones, pharmaceutical waste and paint and hazardous household waste). Many of the status quo scenario assumptions developed for the previous study remained valid for this study.

The study covers the following EPR material categories:

- Batteries
- Beverage Containers
- Electronic and Electrical Products
- Lamps and Lighting Equipment
- Packaging and Printed Paper (PPP)
- Paint and Household Hazardous Waste
- Pharmaceuticals
- Smoke Alarms

- Thermostats
- Tires
- Used Oil and Antifreeze Products

This study utilized information reported by each producer responsibility organization (PRO) on management methods used in 2014 other than recycling, specifically quantities of EPR products that were reused and processing residue sent to energy recovery or landfill disposal. This information was not available for the previous study.

Economic and environmental costs and benefits were examined using selected low (conservative), medium (average) and high (liberal) estimates to reflect data uncertainty. This executive summary presents the average estimates.

The following major economic and environmental findings are highlighted for the net quantities of EPR program materials recovered in 2014 compared to the status quo (no EPR programs):

- EPR programs were estimated to reduce mixed waste collection and landfilling costs by $32 million.
- A market value of $47 million was estimated for EPR materials that were recycled and sold to markets in 2014. Less than 5% of the total market value was estimated to be realized in BC markets. The majority of materials are destined for commodity markets. Although PROs are obliged to report on the final disposition of program materials, once managed as a commodity the materials are no longer traced.
- EPR programs were estimated to result in almost 2,300 jobs when losses from reduced mixed waste (garbage) collection and landfilling were taken into account. Over 900 jobs in BC can be credited to the EPR programs operating in the province in 2014.
- Approximately 160,000 tonnes of mixed waste were diverted from landfilling compared to the status quo. This equates to 17 % of BC's total mixed waste disposal from residential sources or 6% when compared to BC's total waste disposal in 2012 (Statistics Canada. 2012).
- The net reduction in greenhouse gas (GHG) emissions for 2014 that can be accredited to the EPR programs was over 200,000 tonnes carbon dioxide equivalent (CO_2e) (equivalent to taking over 42,000 cars off the roads for a year), with an energy saving of 3.2 million GJ (equivalent to the energy content of over 500,000 barrels of crude oil). The results reflect the net effect on GHG emissions and energy use when all direct and indirect impacts are considered over the life cycle of the materials recycled by EPR programs.
- Some EPR programs recover relatively small quantities of designated materials, but have significant benefits in reducing environmental contamination and environmental risk avoidance to water, land and air by keeping hazardous materials out of landfills, energy recovery facilities/incinerators and the environment. The benefits from greater control over the management of products were presented as qualitative comments for relevant EPR program materials.

Data suggests there are substantial environmental and financial benefits from EPR programs operating in BC in 2014.

1. INTRODUCTION

1.1 Background

British Columbia (BC) is leading the implementation of extended producer responsibility (EPR) programs in North America. BC has the largest number of EPR programs across all provinces in Canada (CCME 2014).

There are two key features of EPR policy:

1. To place the responsibility for end-of-life product management (physically and economically) on the producer, and
2. to influence producers to include environmental considerations in the design of their products.

EPR Definition:

Extended Producer Responsibility is an environmental policy approach in which a producer's responsibility, physical and/or financial, for a product is extended to the post-consumer stage of a product's life cycle.

Organization for Economic Co-operation and Development (OECD)

EPR programs in BC are mandated by Recycling Regulation 449/2004, under the *Environmental Management Act*, that provides a single, results-based framework for EPR with an emphasis on environmental outcomes and program performance. The results-based framework empowers producers to focus on developing effective collection and recycling management systems respecting the pollution prevention hierarchy. Producers determine how their programs are financed and managed.

1.2 Project Objectives

In accordance with the BC Recycling Regulation, each producer responsibility organization (PRO) is required to report annually on the performance of its EPR program in relation to its approved stewardship plan and stated performance measures. The Ministry of Environment (the Ministry) has been using this performance reporting to measure the economic and environmental impacts that can be attributed to implementation of EPR programs in BC. Since 2008, two primary reports have been developed in this regard. The economic impacts of BC's Recycling Regulation and associated EPR programs were assessed in 2008 by Gardner Pinfold Consulting. The study focused on financial impacts and greenhouse gas emissions. In 2012, Morrison Hershfield was commissioned to assess financial impacts from BC's EPR programs as well as wider environmental benefits from the programs. The project resulted in a 2014 report (Morrison Hershfield 2014: Assessment of Economic and Environmental Impacts of Extended Producer Responsibility Programs in BC), which was supported by an impact model to facilitate future reporting on the benefits of EPR programs.

This project aims to update the study completed in 2014 based on 2011 data, with data from EPR program 2014 annual reports. As requested by the Ministry, the same methodology used in the previous study has been used to quantify the economic and environmental impacts of EPR programs operating in BC in 2014. Since the last study, EPR programs additional product categories in the electronic and electrical product category and the packaging and printed paper (PPP) product category (Schedule 3 and Schedule 5 of Recycling Regulation 449/2004 respectively) were launched. As such, the study covers the following EPR material categories:

- Batteries
- Beverage Containers
- Electronic and Electrical Products
- Lamps and Lighting Equipment
- Packaging and Printed Paper (PPP)
- Paint and Household Hazardous Waste
- Pharmaceuticals
- Smoke Alarms
- Thermostats

- Tires
- Used Oil and Antifreeze Products

1.3 Study Approach

This study provides an assessment of the economic and environmental impacts of EPR programs in BC, with the results broken down by EPR program material. The assessment is based on the recovered quantities of EPR program materials that can be credited to the introduction of the EPR programs, determined by comparing the recovery rates achieved in 2014 with those of a status quo scenario (without an EPR program).

This approach was based on the assumption that collection systems for EPR product categories operating prior to the EPR program would have evolved through other policy mechanisms (e.g., solid waste management plans) in the absence of EPR legislation. As such, performance of EPR programs was evaluated against the assumed status quo recovery scenario and not against a scenario in which 100% disposal was assumed. This methodology was developed and used for the 2014 report based on 2011 operational data.

Status quo scenarios for each EPR program material were developed based on available collection systems and estimated recovery rates prior to EPR program implementation. BC data was used where available and when missing, the study used data from other jurisdictions for specific EPR program materials (e.g., cell phones, pharmaceutical waste and paint and hazardous household waste). Many of the status quo scenario assumptions were developed for the previous study and were still valid for this study. Status quo assumptions are summarized in Table 1. These are described in more detail for each of the EPR product categories (refer to specific sections of the report).

Table 1: Status Quo Recovery Rate Point in Time

EPR Program Material	Status Quo Description
Batteries	Lead Acid Batteries: Baseline recovery rate prior to EPR program implementation in 2010 as established by the Canadian Battery Association. Single use and rechargeable batteries: Quantity collected in Call2Recycle's voluntary program for rechargeable batteries prior to EPR program implementation in 2010.
Beverage Containers	Encorp and Brewers Distributor Limited (BDL) aluminum cans: Without government regulation establishing a deposit system for beverage containers, beverage containers would likely have been included in evolving curbside collection systems. Recovery rates of beverage containers collected at curbside with moderate capture rates (CM Consulting, 2002) have been assumed. BDL glass: BDL's deposit return program for glass pre-dated BC's regulated deposit system for beverage containers. The deposit system has remained the same and the EPR program has had minor impact on recovery rates.
Electronic or Electrical Products	Based on: • Recovery rates prior to EPR program implementation in 2007 used by PROs as their baseline (Canadian Electrical Stewardship Association and Major Appliance Recycling Roundtable), • Recovery rates in other jurisdictions without an EPR program (Canadian Wireless Telecommunications Association, Electronic Products Recycling Association), or

EPR Program Material	Status Quo Description
Lamps and Lighting Equipment	Based on estimated quantity of fluorescent lights collected from residential sources prior to EPR program implementation in 2010 as estimated by BC based processor Nu-Life Industries.
Packaging and Printed Paper	Based on recovery rates calculated from information provided in the Current System for Managing Packaging and Printed Paper in British Columbia (MMBC, 2012).
Paint and Household Hazardous Waste	Based on recovery rates in other jurisdictions without an EPR program.
Pharmaceutical Waste	Based on recovery rates in other jurisdictions without an EPR program
Smoke Alarms	Based on recovery rates prior to EPR program implementation in 2011 provided by Product Care Association.
Thermostats	Based on recovery rates prior to EPR program implementation in 2010 provided by Heating, Refrigeration, and Air Conditioning Institute of Canada.
Tires	Based on recovery rates prior to EPR program implementation in 2007 used as a baseline by Tire Stewardship BC.
Used Oil and Antifreeze Products	Based on recovery rates prior to EPR program implementation in 2003 used as a baseline by British Columbia Used Oil Management Association.

Some EPR programs report their performance using an alternate performance measure instead of calculating a recovery rate. Kilograms of recovered products per capita is used as a proxy in the study to represent the recovery rate in these cases.

The recovered quantities of materials that can be credited to the EPR programs were calculated by comparing the 2014 recovery with the recovery under the status quo scenario. This comparison was also done to quantify the net change between the EPR program and the status quo scenario in quantities disposed to landfill.

Performance data for EPR programs reporting in 2014 was based on annual reports by the PRO and interviews with the PRO. The input data used in this study are presented in Appendix A.

This study utilized information reported by PROs on management methods other than recycling, specifically quantities of EPR products that were reused and processing residue sent to energy recovery/incineration or landfill disposal. This information was not available for the previous study. Landfilling was assumed as the method of residual management in the status quo scenarios and for EPR program materials that were not collected by PROs.

The status quo baseline scenarios were developed to reflect the average waste management practices across the province.

Net recovered quantities accredited to EPR programs =
2014 EPR program recovery - status quo recovery

Net reduction of quantities landfilled accredited to EPR programs =
Landfilled under status quo scenario - Landfilled under EPR program

1.4 Measures

1.4.1 Rationale for the Selected Measures

The measures used in this study are the same as those used in the previous study. The measures were originally chosen based on relevance, comprehensiveness and availability. Where data was not available to quantify the measures, a description and assessment based on literature reviews were included based on available information.

EPR program operating costs are presented in the introductory description of each EPR program, where available. Program costs are only provided for programs where product eco-fees are charged. More details can be found in the financial reports provided by each PRO that charge eco-fees to cover the costs of operation. Developing estimates of the costs of a hypothetical status quo scenario was beyond the scope of this study.

1.4.2 Specific Measures Used in Study

The list below presents the measures that were used in the previous study as well as in this study to provide a comprehensive overview of EPR programs in BC. Measures were examined by using low, medium (average), and high estimates to reflect uncertainty in data and assumptions. The measures should be viewed as independent of each other when considering the effects of EPR programs.

When presenting impact results for each material category, if only one reference source was available, the low and high estimates of that particular measure will have the same value. For example, there was only one reference source for GHG emissions and energy savings factors for many of the recycled materials. As a result, these impact results show the same value for low and high estimates.

Economic Impacts:

- Cost avoidance from:
  - Avoided mixed waste collection costs, and
  - Avoided landfilling,
- Value of recovered material in end-markets in BC, Canada (out of province), North America (Canada or US) or outside North America, and
- Net number of jobs created in BC, Canada (out of province), North America (Canada or US) or outside North America.

Environmental Impacts:

- Net landfill space savings,
- Net reduction in greenhouse gas (GHG) emissions,
- Net energy savings from reduced need for extraction/processing of virgin materials for products, and
- Other environmental measures, such as reduction in environmental contamination, and environmental risk avoidance.

1.5 Methodology Used To Determine Net Impacts for Selected Measures

1.5.1 Economic Impacts

1.5.1.1 Avoided Mixed Waste Collection Costs

The reduced cost of garbage collection (or mixed waste) was quantified using representative per tonne collection costs for residential waste. A 2014 jurisdictional review of eleven BC municipalities (Morrison Hershfield, 2014) found combined curbside collection costs for mixed waste and organics collection ranged from $72 - $160 per year for collection of each waste stream, with an average of $104 per year per household.

In 2012 the residential sector of BC generated 947,542 tonnes of mixed waste for disposal (Stats Can 2012). Given that 1,831,476 total households generated this material (BC Stats) (with an average of 2.5 persons/household), each household generated 0.52 tonnes of waste (or 0.21 tonnes per capita).

In determining a representative mixed waste collection cost to use in this study, the annual collection cost per household was divided by the amount of waste generated per household per year, yielding collection costs for mixed waste ranging from a low of $139/tonne to a high of $309/tonne.

The household collection cost reflects the cost to collect and landfill waste. The avoided cost associated with reduced landfill disposal is identified separately (refer to section 1.5.1.1). In order to isolate the cost avoidance for reduced mixed waste collection, the landfilling cost (Table 2) was deducted from the garbage cost per household ($139 - $309). The estimated cost to collect waste was therefore estimated between $97 and $207 per tonne (with an average of $152 per tonne). Refer to Appendix B for all general factors and assumptions (i.e. not material specific) used in this study.

1.5.1.2 Avoided Landfilling Costs

The avoided landfilling cost aims to measure the savings achieved by diverting materials from landfill through EPR programs. The landfill costs used in this study represent the costs to build, operate and close a landfill, rather than the tipping fee that is ultimately charged by the landfill owner/operator. Tipping fees are often established to help cover the cost of other programs, such as recycling, composting, and public education, and may be elevated to encourage diversion activities. The same methodology was used for this study as was used in the previous study.

There are significant costs involved in siting and developing new landfills. Over the past decade, however, few new landfills have been sited in BC and other parts of Canada from which current data can be drawn. For this report, available cost estimates provided for the conceptual design of the landfill at Forceman Ridge in Terrace for the Regional District of Kitimat Stikine (RDKS) were used. Planning and design for this landfill are well advanced and accurate data was available, making these cost estimates a reasonable proxy. Table 2 presents the low and high estimates of avoided landfilling costs that were used in this study.

Table 2: Low and High Estimates of Avoided Landfilling Costs

Aspect	Low Estimate $ per tonne	High Estimate $ per tonne	Basis of Cost Estimate
Siting	$1	$1	RDKS has spent $695,000 on site selection, site investigation, conceptual design and consultation associated with their proposed landfill (RDKS, personal communication, 2016). This equates to a siting cost of approximately $1 per tonne.
Landfill management costs (operations)	$28	$88	The high estimate is based on the average operational costs at two landfills as recorded by the Regional District of North Okanagan at their landfills (RDNO personal communication 2015). The low estimate was developed by RDKS for estimated future operational costs for the proposed Forceman Ridge Landfill (RDKS, personal communication 2015).
Landfill development and closure	$13	$13	The estimated net capital cost of the Forceman Ridge landfill is equivalent to $13 per tonne when calculated based on the design capacity of the landfill.
Total Avoided Landfilling Costs	**$42**	**$102**	

In this study the quantities of EPR materials that were recycled by the EPR programs were used to calculate the avoided costs of disposal. The study assumed that all mixed waste was landfilled as this is considered to be the predominant waste management practice across the province. Only about 10% of BC's waste is managed through energy recovery, and as the cost of energy recovery reported in BC (approximately $60 after revenue for Metro Vancouver's waste-to-energy facility) falls within the identified range of landfilling costs (Table 2), waste to energy was not separately accounted for.

1.5.1.3 Value of Recovered Material in End-Markets

Recovered material commodity values were calculated by multiplying the tonnages of recycled materials by 2014 commodity prices. The study also attempted to identify where the value of the recovered materials was realized: BC, Canada (out of province), North America (Canada or US), or outside North America. Information on the destinations of the various recycled products was often not available. The market values assumed for each material are presented in Appendix C together with reference sources.

1.5.1.4 Net Number of Jobs Created

Jobs created as a result from an increase in recycling were quantified based on the net quantities of materials recycled under the EPR scenario compared to a status quo scenario with no EPR program.

To estimate the net number of jobs created, employment losses from reduced mixed waste collection and landfill management resulting from EPR programs were also accounted for. Employment loss estimates were based on the net reduction in landfill disposal quantities when compared to a status quo scenario with no EPR program.

The low, average and high estimates of jobs created were expressed as number of jobs per tonne recycled. Refer to Appendix C for the material-specific values and reference sources.

Where possible, jobs were separated into those created in BC, Canada (out of province), North America (Canada or US), or outside North America.

1.5.2 Environmental Impacts

1.5.2.1 Net Landfill Space Savings

Landfill space savings were calculated in cubic meters (m^3) by applying the bulk density factor unique for each material to the net tonnages of mixed waste avoided as a result of implementing specific EPR programs. These estimates reflect the estimated space saved in the landfill and do not take into account settlement or cover material (daily, interim and final).

The majority of the bulk densities came from the Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow - Development of a Methodology for Measurement of Residential Waste Diversion in Canada (Corporations Supporting Recycling (CSR), 2003). Refer to Appendix C for the material specific values and reference sources.

1.5.2.2 Net Reduction in Greenhouse Gas Emissions

The primary source for values associated with this measure was an ICF Consulting report (2005) that also formed the basis of the Waste Reduction Model (WARM) developed by Environment Canada. The GHG benefits were calculated for a specific material based on the net tonnages of recycled material resulting from a specific EPR program in comparison to the status quo scenario.

By using the ICF Consulting report (2005) values, the net GHG emissions were estimated as tonnes of carbon dioxide equivalent (CO_2e) based on the GHG emissions associated with recycling that material offset by emissions reductions associated with reduced raw material extraction and processing. This study uses GHG emission factors that include carbon sequestration, as well as GHG emissions generated during collection and recycling. For more details on the methodology, please refer to the ICF Consulting report (2005).

The results reflect the net effect on GHG emissions when all direct and indirect impacts are considered over the life cycle of the materials that are recycled by EPR programs.

Some PROs have calculated the GHG emissions per tonne of materials managed. This information was used when no ICF Consulting report (2005) data was available, but these results may not be comparable to the ICF Consulting report (2005) values, since the underlying assumptions and calculations were not made available by the PROs.

Refer to Appendix C for the material specific values and reference sources.

The following aspects were not included in the calculations:

- GHG emissions from disposal of materials not collected under the EPR programs. These were not considered since they would be disposed in the status quo scenario.
- GHG emissions from EPR materials collected by PROs that were sent for energy recovery or incineration as residue. The emissions vary depending on the type of energy being displaced in the local area (e.g., coal, natural gas, oil, hydro or nuclear sources). In almost all cases the location is not disclosed. In addition, the quantities sent for energy recovery are typically a small fraction of the total quantities collected.

1.5.2.3 Net Energy Savings

The reduced need for extraction/processing of virgin materials leads to energy savings which were quantified by utilizing published Canadian data (generally using the ICF Consulting report (2005) as a reference unless other sources were identified). The ICF Consulting report (2005) includes energy required for collection and recycling in the development of the material-specific energy factors. The energy factors were multiplied by the net number of tonnes recycled when the EPR program scenario is compared to the status quo scenario.

The results reflect the net effect on energy use when all direct and indirect impacts are considered over the life cycle of the materials that are recycled by EPR programs.

Refer to Appendix C for the material specific values and reference sources.

1.5.2.4 Other Environmental Measures

Where information was available, quantitative or qualitative measures of other environmental benefits from EPR programs were included. These included reduction in environmental contamination, and environmental risk avoidance to water, land and air.

2. EPR MATERIAL CATEGORIES INCLUDED IN PROGRAMS IN BC IN 2014

The following sections provide a brief summary of the EPR programs that existed in BC in 2014 and the associated economic and environmental impacts based on the quantities recovered through each program during 2014.

2.1 Batteries

EPR programs were introduced in 2010 for dry cell batteries and in 2011 for lead-acid batteries (LAB).

2.1.1 Description of EPR Program

Table 3 summarizes the EPR program for LAB and dry cell batteries Canadian Battery Association (CBA), Interstate Battery System of Canada (IBSC) and Call2Recycle in 2014.

Table 3: EPR Programs for LAB and Dry Cell Batteries (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
IBSC[1]	LAB	Financed by members of IBSC (no point-of-sale fee)	NA	>1,000 dealers accept residential and ICI LABs. Locations do not receive payment for collection services
Call2Recycle	Single use and rechargeable dry cell batteries weighing <5 kg	Financed by brand owners of batteries and products containing batteries at point of sale (no point-of-sale fee)	$1.8 million or $3,904/tonne	

Table 4 shows the recovery methods used by CBA, IBSC and Call2Recycle in 2014 for batteries. The end-markets for LAB have been assumed based on information from CBA.

[1] IBSC has withdrawn its plan and collapsed its program into CBA as of April 2016.

Table 4: Final Disposition for LAB and Dry Cell Batteries

Product	Processing Locations	End Use	End Market Locations
LAB: Electrolyte	Trail, and Richmond, BC	Sulphuric acid used in galvanizing or tanning	BC
LAB: Lead	Trail, Richmond, BC and US	Lead is used to manufacture new lead products	North American
Dry-cell batteries	The majority of batteries are sorted in BC by battery chemistry and sent to specialty processors in BC, Quebec, and the US	Metal is recovered for use in a variety of new products, such as batteries, cookware, appliances, hardware	North American

2.1.2 EPR Program Recovery Rates and Status Quo Scenario

Table 5 presents the 2014 recovery rates for LAB and dry cell batteries under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program.

Table 5: Recovery Rates of EPR Program for Lead Acid Batteries and Dry Cell Batteries in 2014 and Status Quo Scenario

Material	EPR 2014 Recovery	Status Quo Recovery	Basis of Status Quo
LAB	100% (lead and electrolyte)	93% (lead and electrolyte)	High commodity value for lead drives collection of LAB and electrolyte would be recovered as part of the process. A baseline recovery rate of 93% was established for 2011 prior to the EPR program
	70% (plastics)	25%	Lower recovery rate assumed due to the relatively low commodity value for plastic
Dry cell batteries	0.099 kg/capita (all battery types)	0.013 kg/capita	Based on 2008 quantity collected under Call2Recycle voluntary collection program for rechargeable batteries. Assumed limited collection of low value alkaline batteries prior to EPR program

2.1.3 Economic and Environmental Impacts

The economic and environmental impacts resulting from the EPR programs for batteries are presented in Table 6.

Table 6: Economic and Environmental Impacts of the EPR Programs for Batteries

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Avoided costs				
Avoided mixed waste collection costs	$million	$0.3	$0.5	$0.7
Avoided landfilling costs	$million	$0.1	$0.2	$0.3
Total avoided costs	**$million**	**$0.5**	**$0.7**	**$1.0**
Value of recovered material in end-markets				
BC	$million	$0.0	$0.0	$0.0
Out of province	$million	$0.0	$0.0	$0.0
North America (US or Canada)	$million	$1.2	$1.3	$1.4
Outside North America	$million	$0.0	$0.0	$0.0
Unknown	$million	$0.0	$0.0	$0.0
Total value of recovered material in end-markets	**$million**	**$1.2**	**$1.4**	**$1.5**
Net jobs creation				
BC	# jobs	14	19	24
Out of province	# jobs	0	0	0
North America (US or Canada)	# jobs	6	6	6
Outside North America	# jobs	0	0	0
Unknown	# jobs	0	0	0
Total number of jobs created	**# jobs**	**21**	**25**	**30**
Job loss due to reduced mixed waste collection and landfilling	# jobs	2	4	6
Net jobs created	**# jobs**	**16**	**17**	**18**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net landfill space savings	m^3	6,440	21,225	36,009
Net reduction in GHG emissions	tonnes CO_2e	3,337	3,337	3,337
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling	GJ	68,850	68,850	68,850
Energy savings in barrels of crude oil	# barrels of crude oil	11,117	11,117	11,117

2.1.3.1 Economic Impacts

Batteries contributed to reduced mixed waste collection costs and reduced landfilling costs of $0.5 - $1.0 million in 2014. The study did not attempt to quantify the avoided costs of pollution and environmental mitigation that would have been required if batteries had been disposed in landfills.

Compared to the status quo scenario, the EPR programs recovered additional materials with an estimated value of $1.2 - $1.5 million, with the majority of this market value realized in North America (Canada or US).

Economic Impacts:

- Reduced mixed waste collection and landfilling costs of $0.5 - $1.0 million
- End-market value of $1.2 - $1.5 million mainly in North America (Canada or US)
- Net job creation of 16 - 18 jobs with more than half of these in BC

The program had a net positive impact on job creation with 16 - 18 jobs. The majority of jobs are likely to be BC based where the processing take place.

2.1.3.2 Environmental Impacts

As shown in Table 6 the EPR programs for batteries saved approximately 6,400 - 36,000 m^3 in landfill space compared to the status quo scenario.

The net reduction in GHG emissions for 2011 that can be accredited to the EPR programs for batteries was over 3,300 tonnes CO_2e.

The net energy savings from reduced need for extraction/processing of virgin materials compared to energy needs in processing and recycling were 68,850 GJ. This compares to over 11,000 barrels of crude oil.

Environmental Impacts:

- Approximately 6,400 - 36,000 m^3 in landfill space savings
- Net GHG reductions of over 3,300 tonnes CO_2e
- Net energy savings of 68,850 GJ (equivalent to energy content of 11,000 barrels of crude oil)

The GHG and energy savings were based on the net quantities of recovered material when the 2014 program performance is compared to a status quo scenario.

Although not quantifiable, it should be noted that EPR programs for batteries assures safe material recovery and prevents contaminants (e.g., lead and cadmium) from entering the environment.

2.2 Beverage Containers

In 1971, the Litter Act came into effect, prohibiting littering and creating a deposit-refund system for beer and soft drinks. In 1998, the Beverage Container Stewardship Programme Regulation (B.C. Reg 406/97) expanded the scope of regulated beverage containers to include all ready-to-drink beverages with the exception of milk and milk substitutes. In 2004, this regulation was folded into BC's Recycling Regulation and continues to require these containers to be managed through a deposit-refund EPR program.

2.2.1 Description of EPR Program

Table 7 summarizes the EPR program for beverage containers delivered by Encorp and BDL in 2014.

Table 7: EPR Programs for Beverage Containers (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
Encorp Pacific Canada (Encorp)	Containers for non-alcoholic beverages and alcoholic beverage containers sold in non-refillable containers	Financed by unredeemed deposits and a visible Container Recycling Fee (CRF) charged to consumers	$90.6 million or $995/tonne	173 depots , where consumers, and retailers who accept returns from consumers, take their empty containers to collect the deposit refund
Brewers Distributor Limited (BDL)	Containers for alcoholic beverages sold in cans or refillable containers (glass)	Cost-recovery system funded by participating manufacturers and incorporated into the price of products	NA	1,135 redemption locations, including Liquor Distribution Branch (LDB) stores, licensee retail stores, LDB rural agency stores and some Encorp depots

Table 8 shows the recovery methods used by Encorp and BDL in 2014 for beverage containers. Neither of these PROs reported residue sent to energy recovery or landfill.

Table 8: Final Disposition for Beverage Containers

Product	Processing Locations	End Use	End Market Locations
Encorp: Aluminum	Prepared in BC for shipment to end markets	Used in new cans and other products	North America
Encorp: Plastic - PET and HDPE	Processed by Merlin Plastics in BC	Used in a variety of new products such as containers and strapping materials	BC 2% Canada (out of province) 5% North America (Canada or US) 91% Outside North America 2%
Encorp: Glass	Processed in BC	Used in a variety of new products including new bottles, fibreglass insulation, sandblasting materials, construction aggregates and landscaping use	BC 4.6% Alberta 17.9% US 77.5%
Encorp: Polycoat	Prepared in BC for shipment to end markets	The paper fibre, which makes up the majority of these containers (by weight), is used to make cardboard boxes and tissue paper	Aseptic drink boxes are shipped to Thailand, India or Japan Gable top cartons are shipped to Korea
Encorp: Bi-metal	Local metal recycler in BC	Used in construction re-bar	BC

Product	Processing Locations	End Use	End Market Locations
	Prepared in BC for shipment to end markets	Used in new cans and other products	Shipped to ALCOA in the US
BDL: Glass	Processed in BC	Up to 95% of collected glass bottles are refilled; remaining percentage (approximately 5%) is used in new bottles or fibreglass insulation	BC for fibreglass insulation US for new bottles

2.2.2 EPR Program Recovery Rates and Status Quo Scenario

Table 9 presents the 2014 recovery rates for beverage containers under the EPR program and the status quo scenario that formed the basis for calculating the net benefits of the EPR program.

Table 9: Recovery Rates of EPR Programs for Beverage Containers in 2014 and Status Quo Scenario

Material	EPR Reported 2014 Recovery Rate	Status Quo Recovery Rate	Basis of Status Quo
Encorp	Al: 84.2% PET: 76.5%, Glass: 91.1% Other plastics: 76.5% Steel: 63.6% Polycoat: 64.2%	Al: 27% PET: 14% Glass: 22% Other plastics: 14% Steel: 27% Polycoat:5%	Without government regulation establishing a deposit system for beverage containers, beverage containers would likely have been included in evolving curbside collection systems. Recovery rates of beverage containers collected at curbside with moderate capture rates (CM Consulting, 2002) have been assumed, on the basis that these materials, with the exception of polycoat, would have been accepted in most curbside collection programs
BDL: Aluminum cans	93%	27%	Without government regulation establishing a deposit system for beer cans, the cans would likely have been included in evolving curbside collection systems. Recovery rates of beverage containers collected at curbside with moderate capture rates (CM Consulting, 2002) have been assumed
BDL: Glass	95%	95%	BDL's deposit return program for glass pre-dated BC's regulated deposit system for beverage containers. The deposit system has remained the same and the EPR program has had no measurable impact on recovery rates

2.2.3 Economic and Environmental Impacts

The economic and environmental impacts resulting from the EPR programs for beverage containers are presented in Table 10.

Table 10: Economic and Environmental Impacts of the EPR Program for Beverage Containers

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
				$15.4
Avoided landfilling costs	$million	$3.1	$5.4	$7.6
Total avoided costs	**$million**	**$10.4**	**$16.7**	**$23.0**
Value of recovered material in end-markets				
				$0.2
Out of province	$million	$0.1	$0.4	$0.6
North America (US or Canada)	$million	$8.6	$10.9	$13.2
Outside North America	$million	$0.2	$0.2	$0.3
Unknown	$million	$9.1	$9.9	$10.8
Total value of recovered material in end-markets	**$million**	**$18.0**	**$21.6**	**$25.1**
Net job creation				
Out of province	# jobs	55	93	131
North America (US or Canada)	# jobs	293	525	757
Outside North America	# jobs	11	20	30
Unknown	# jobs	26	77	128
Total number of jobs created	**# jobs**	**401**	**742**	**1,083**
Job loss due to reduced landfilling	# jobs	55	101	146
Net job created	**# jobs**	**346**	**641**	**937**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net reduction in GHG emissions	tonnes CO_2e	93,467	93,538	93,609
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling			1,611,571	1,611,571
Energy savings in barrels of crude oil	# barrels of crude oil	260,225	260,225	260,225

2.2.3.1 Economic Impacts

The EPR programs for beverage containers reduced mixed waste collection and landfilling costs by an estimated $10.4 - $23.0 million.

Compared to the status quo scenario, the EPR program recovered additional materials with an estimated value of $18.0 to $25.1 million; almost half of this value was realized in North American markets (either in Canada or US). Approximately 50% of the market value was realized by markets in locations that were not identified. BC realizes little (<1%) of the market value of the recycled materials.

The collection of beverage containers through drop-off facilities, such as those used by Encorp and BDL for beverage containers, protects the quality of the glass for recycling compared to commingled collection at curbside.

Economic Impacts:

- Reduced mixed waste collection and landfilling costs by an estimated $10.4 - $23.0 million
- End-market value of $18.0 - 25.1 million with almost half realized in North America
- Market value of glass is improved by the EPR program
- Net job creation of 346 - 937 jobs with 16-36 jobs in BC

The EPR programs had a net positive impact on job creation with an estimated 346 - 937 jobs created, primarily in North America (either in Canada or US). This calculation takes into account job losses from the reduction in mixed waste collection and landfilling. The EPR programs created a net total of 16 - 36 jobs in BC.

2.2.3.2 Environmental Impacts

The EPR programs for beverage containers saved approximately 115,000 - 367,000 m^3 in landfill space compared to the status quo scenario.

The net reduction in GHG emissions for 2014, as a result of the EPR programs for beverage containers, was approximately 93,500 - 93,600 tonnes CO_2e due to recycling rather than landfilling these products.

The net energy savings from the reduced need for extraction/processing of virgin materials compared to energy needs for processing and recycling were 1.6 million GJ. This is equivalent to over 260,000 barrels of crude oil.

Since no emission or energy savings factors were available for the reuse of glass bottles or aluminum kegs, the estimates for GHG reductions and energy savings are conservative.

Environmental Impacts:

- Approximately 115,00 - 367,000 m^3 in landfill space savings
- Net GHG reduction of 93,500 - 93,600 tonnes CO_2e
- Net energy savings of 1.6 million GJ. (over 260,000 barrels of crude oil)
- 9.5 million fewer beverage containers were discarded as litter

Having a deposit-refund system for beverage containers encourages the recovery of the containers and reduces litter associated with the packaging. A literature review conducted by the Container Recycling Institute in 2005 found that states in the US with bottle bills had a 69% - 84% decrease in beverage container litter (Anielski Management Inc. 2007). Using a CM Consulting estimate of the avoided beverage container litter per tonne of recycled material (in 2002), the net number of containers that were avoided as litter as result of the EPR programs for beverage containers compared to the status quo scenario was calculated. Approximately 9.5 million beverage containers were estimated to be collected rather than littered in BC as result of the EPR program.

2.3 Electronic or Electrical Products

BC saw its first EPR program for electronics in 2007 and more product categories, with other EPR programs targeting electrical products implemented since then. Since the last study using 2011 data major appliances, outdoor power equipment, and an extensive list of Phase V electronics have been included. Phase V encompasses an expansive array of products, many of which have not been incorporated into any other Canadian stewardship programs to date.

2.3.1 Description of EPR Program

Table 11 summarizes the EPR programs for electronic or electrical products delivered by each of the PROs responsible for these products in 2014. Program costs are provided for programs where product eco-fees are charged.

Table 11: EPR Programs for Electronic or Electrical Products (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
(CBA)	Vending coolers, etc.	Financed by		
Canadian Electrical Stewardship Association (CESA)	Portable electrical appliances and power tools designed for use in homes	Financed by eco-fees applied at the point of sale on products sold in BC	$2.7 million or $748/tonne	176 collection sites (including retailers, other businesses, public agencies, municipalities)
Canadian Wireless Telecommunications Association (CWTA)	Cell Phones			Return-to-retail model via participating retail drop-off locations
Electronic Products Recycling Association (EPRA)	Portable and non-portable electronics	Financed by an Environmental Handling Fee (EHF) remitted by the producers. Fees are be made visible as eco-fees	$22.3 million or $1,083 /tonne	174 collection depots operated by Encorp
General Electric Canada (Healthcare) (GECH)	Electronic and electrical product > 200 kg		$14,000 $/tonne not determined	Using existing take-back program to collect products from customer locations
Major Appliance Recycling Roundtable (MARR)	Large Appliances such as refrigerators, freezers, clothes washer, etc.	Financed by program fee remitted by the producers. Fee may or may not be passed on to consumer at point of sale	$0.45 million or $16/tonne	245 collection sites (including retailers, municipalities, private collectors or processors and via utility bounty programs)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
Shaw Communications Inc.	Modems, Routers, Set-top boxes, Personal Video Recorders, Remotes, etc.	Self-financed by corporation	-	Methods include equipment picked up by a Shaw during visit; or equipment is dropped-off at Shaw retail locations
TELUS Communications Company	Telecommunication equipment (cordless phones, obsolete network infrastructure equipment, etc.)		-	10 collection facilities, and option for costumer to mail back products

Table 12 shows the recovery methods used by all the PROs responsible for electronic and electrical products in 2014.

Table 12: Final Disposition for Electronic and Electrical Products

Product	Processing Locations	End Use	End Market Locations
		sent for landfill disposal	
CESA products	Products are sent to the main processors: eCycle in Aidrie, AB, or Chilliwack BC, GEEP in Edmonton AB, and FCM in Delta, BC and Montreal, QC.	Recycling, with a small proportion (paper based material and heating oil) sent to energy recovery (0.8%) and landfill disposal (0.9%)	The majority of recovered commodities from CESA products reach end-fate within North America

Product	Processing Locations	End Use	End Market Locations
EPRA products	Products are sent to three processors: eCycle Solutions (Chilliwack, BC), GEEP (Edmonton, AB), and FCM Recycling (Delta, BC). Recycling into new products takes place at unknown locations.	Sent to down-stream recyclers (90.37%), energy recovery (3.24%) and landfill disposal (3.23%). Products with unknown fate (3.15%) were assumed to be landfilled.	North American markets, however cannot be verified
GECH products	Products are either resold in Canada without refurbishment or refurbished and re-sold in U.S. locations.	Reuse	North America
MARR major appliances	Processing in US (15%) and remaining portion in BC.	Recycling	Outside North America. Specific location dependent on material
OPEIC Outdoor Power Equipment	No information available.	Recycling of metals, landfilling of plastic shredder residue	No information available
Shaw products	Approximately 30% of materials are processed and recycled within BC. The remaining amount is processed out of province.	Recycling	Unknown markets
TELUS products	Approximately 20% of materials are processed in BC (batteries) and 80% is transferred to direct processor or multi-step processor in North America.	Recycling	Unknown markets

2.3.2 EPR Program Recovery Rates and Status Quo Scenario

Table 13 presents the 2014 recovery rates for electronic or electrical products under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program. Neither CBA nor OPEIC confirmed the recovered tonnages of EPR materials in 2014 and these were never included in the impact calculations. As outlined in OPEIC's Stewardship Plan, the setting of absolute collection rates targets will take place following the first 18 months of the program. With a program start in April, 2014, they were unable to report on the target for 2014.

Table 13: Recovery Rates of EPR program for Electronic or Electrical Products in 2014 and Status Quo Scenarios

Material	EPR 2014 Recovery (kg/capita)	Status Quo Recovery (kg/capita)	Basis of Status Quo
CBA products	ND	ND	ND
CESA products	0.792	0.023	CESA believes that a small portion of the products (approximately 100 tonnes per year) would have been collected by individual retailers prior to the EPR program start. Although CESA suggested that a large proportion of discarded microwaves would have been recycled even without the EPR program, they were unable to estimate this quantity. The study based the status quo recovery rate on 100 tonnes divided by BC's population in 2011.
	0.007	0.007	No baseline data on the recovery prior to the EPR program was available for BC. Before the EPR program there were several cell phone dealers in BC with voluntary recycling programs in place. A baseline collection rate of 0.013 kg/capita was recorded in Ontario before its Phase 2 Waste Electrical and Electronic Equipment (WEEE) Program that included cell phones and pagers, suggesting that the voluntary collection programs being operated by the service providers were collecting this amount before the introduction of the EPR program in Ontario (Glenda Gies, personal communication, 2013). Since this recovery rate is higher than the one recorded by the EPR programs in 2014, we assumed that the EPR program has had negligible effect on the recovery rate.
EPRA products	4.9	0.6	In the Genuine Wealth Assessment of Alberta's stewardship programs, it estimated that at the most 1,670 tonnes of electronic/electrical products would have been recovered in 1999 prior to the EPR program (Anielski Management Inc., 2007). With a population of 2,819,423 in 1999 (Alberta Municipal Affairs, 2013) this equates to 0.6 kg/capita which was assumed as the status quo recovery rate.
	0.0002 kg/capita (all reused)	0.00005 kg/capita (all reused)	In the first year of operation (2012) the PRO only collected 1 device (>200 kg) collected from BC. This is assumed to be representative of a status quo scenario since the program was new.
MARR major appliances	98%	90%	Based on System Study by MARR (Ecoinspire, 2013) the market-driven collection and recycling system for end-of-life appliances typically achieve a collection rate of over 90%.

Material	EPR 2014 Recovery (kg/capita)	Status Quo Recovery (kg/capita)	Basis of Status Quo
OPEIC Outdoor Power Equipment	ND	ND	ND
Shaw products	0.17	0.15	Shaw commenced the EPR program in 2012. During the six months of the first year of operation, Shaw reported that 340.6 tonnes were recovered. When extrapolated to account for a full year this equates to 0.15 kg/capita based on 2012 BC population. This is assumed to be representative of a status quo scenario since the program was new.
TELUS products	0.09	0.003	TELUS has been recycling products since 2005. TELUS commenced the EPR program in 2010. Telus recycled 15.0 tonnes of products in 2010. This equates to 0.003 kg/capita based on 2010 BC population. This is assumed to be representative of a status quo scenario since the program was new.

2.3.3 Economic and Environmental Impacts

The economic and environmental impacts resulting from the EPR programs for electronic and electrical products are presented Table 14. Recovered quantities from OPEIC and CBA were not provided and could not be included in the impact calculation.

Table 14: Economic and Environmental Impacts of the EPR program for Electronic and Electrical Products

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Avoided costs				
Avoided mixed waste collection costs	$million	$2.4	$3.8	$5.2
Avoided landfilling costs	$million	$1.1	$1.8	$2.6
Total avoided costs	**$million**	**$3.5**	**$5.7**	**$7.8**
Value of recovered material in end-markets				
BC	$million	$0.0	$0.0	$0.0
Out of province	$million	$0.0	$0.0	$0.0
North America (US or Canada)	$million	$12.4	$14.2	$16.0
Outside North America	$million	$0.0	$0.0	$0.0
Unknown	$million	$0.0	$0.0	$0.0
Total value of recovered material in end-markets	**$million**	**$12.4**	**$14.2**	**$16.0**
Net job creation				
BC	# jobs	429	542	656
Out of province	# jobs	231	292	353
North America (US or Canada)	# jobs	26	33	40
Outside North America	# jobs	0	0	0
Unknown	# jobs	291	368	445

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Job loss due to reduced landfilling	# jobs	19	34	49
Net job created	**# jobs**	**959**	**1,202**	**1,445**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net reduction in GHG emissions	tonnes CO_2e	29,461	34,434	39,408
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling			515,143	532,965
Energy savings in barrels of crude oil	# barrels of crude oil	80,304	83,181	86,059

2.3.3.1 Economic Impacts

As shown in Table 14, the program reduced the costs associated with mixed waste collection and landfilling by $3.5 - $7.8 million.

CESA, EPRA and MARR were the only PROs responsible for electronic and electrical products that provided quantities of various recovered component materials. Based on this information, the EPR programs recovered additional materials with an estimated value of $12.4 - 16.0 million. The majority of this value is thought to be realized in North America (Canada or US).

Economic Impacts:

- Reduced mixed waste collection and landfilling costs of $3.5 - $7.8 million
- Market value of $12.4 - $16.0 million with a majority captured in North America (Canada or US)
- Net job creation of 959 - 1,445 jobs

Plastics from electronics and small appliances were assumed to have very low value, because they are often treated with fire retardants, dark in colour, and made from unidentified or mixed resin types (EBA and Cascadia, 2012). Dark-coloured plastics and plastics containing fire retardant additives can be recycled, but they have limited applications, such as non-potable plumbing and irrigation pipe. These plastics have a market value of less than $0.01 per kg. Light-coloured plastics from small appliances, not treated with fire retardants, have a larger range of applications, and sold for up to $0.036 per kg (2012 information), primarily to overseas markets, where demand for lower-grade plastics is higher (and processing costs are lower) than in North America (EBA and Cascadia, 2012).

When job losses relating to reduced landfilling were accounted for, the programs still had a significant positive impact on job creation (959 - 1,445 jobs created). Over a third of these jobs were expected to be created in BC. The break-down in recycling jobs should be used with caution since it is largely unclear how many jobs are created from the processing of e-waste compared to the recycling of the component material into new products.

2.3.3.2 Environmental Impacts

The EPR programs for electronic and electrical products saved approximately 50,000 - 140,000 m^3 of landfill space compared to the status quo scenario.

The net reduction in GHG emissions that can be accredited to the EPR programs in 2014 was approximately 29,500 - 39,000 tonnes CO_2e.

The net energy savings from reduced need for extraction/processing of virgin materials for products and avoided

Environmental Impacts:

- 50,000 - 140,000 m^3 of landfill space saved
- Net GHG reduction of 29,500 - 39,000 tonnes CO_2e
- Net energy savings of 500,000 - 530,000 GJ (equivalent to over 85,000 barrels of crude oil)

landfilling were approximately 500,000 - 530,000 GJ. These energy savings equate to up to over 85,000 barrels of crude oil.

One of the key environmental benefits of the e-waste EPR programs is the reduction in the landfilling of hazardous materials, such as cadmium and lead, which is commonly found in e-waste. Based on limited information, this study was unable to estimate the amount of hazardous materials that were recovered via recycling.

2.4 Lamps and Lighting Equipment

An EPR program was introduced in June 2010 in BC for residential use compact fluorescent lamps (CFL) and fluorescent tubes, and in 2012 the program was expanded to include all lamps and lighting fixtures from both the residential and commercial sectors.

2.4.1 Description of EPR Program

Table 15 summarizes the EPR program for lamps and lighting equipment delivered by Product Care Association (Product Care) in 2014.

Table 15: EPR Program for Lamps and Lighting Equipment (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
Product Care				451 locations accept

Table 16 shows the recovery methods used by Product Care for 2014 lamps and lighting equipment.

Table 16: Final Disposition for Lamps and Lighting Equipment

Product	Processing locations	End Use	End Market Locations
	The majority is used within	Recovered for use in a	
Aluminum	Sent to BC metal recyclers	Recycling into new aluminum products	North America
Phosphor powder		Energy recovery and landfilling (unconfirmed quantities)	NA
Mercury	Mercury is sent to a specialized mercury processor in the US	Recycling (quantities unconfirmed)	North America

Product	Processing locations	End Use	End Market Locations
Porcelain and Plastic (from lamps)	Out of province	Used for energy recovery (quantities unconfirmed)	NA

2.4.2 EPR Program Recovery Rates and Status Quo Scenario

Table 17 presents the 2014 recovery rates for lamps and lighting equipment under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program.

Table 17: Recovery Rates of EPR program for Lamps and Lighting Equipment in 2014 and Status Quo Scenario

Material	EPR 2014 Recovery	Status Quo Recovery	Basis of Status Quo
			Recovery was very limited and two processors
	0.06 kg/capita (aluminum)	0.001 kg/capita (aluminum)	glass and aluminum.

2.4.3 Economic and Environmental Impacts

All the economic and environmental impact results resulting from the EPR program for lamps and lighting are presented in Table 18.

Table 18: Economic and Environmental Impacts of the EPR Program for Lamps and Lighting Equipment

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
				$0.2
Avoided landfilling costs	$million	$0.0	$0.1	$0.1
Total avoided costs	**$million**	**$0.1**	**$0.2**	**$0.3**
Value of recovered material in end-markets				
				$0.0
Out of province	$million	$0.0	$0.0	$0.0
North America (US or Canada)	$million	$0.5	$0.5	$0.6
Outside North America	$million	$0.0	$0.0	$0.0

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Total value of recovered material in end-markets	**$million**	**$0.5**	**$0.5**	**$0.6**
Net job creation				
				15
Out of province	# jobs	1	1	1
North America (US or Canada)	# jobs	0	0	0
Outside North America	# jobs	0	0	0
Unknown	# jobs	1	4	7
Total number of jobs created	**# jobs**	**7**	**15**	**23**
Job loss due to reduced landfilling	# jobs	1	1	2
Net job created	**# jobs**	**6**	**14**	**21**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net reduction in GHG emissions	tonnes CO_2e	1,745	1,745	1,745
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling			23,603	23,603
Energy savings in barrels of crude oil	# barrels of crude oil	3,811	3,811	3,811

2.4.3.1 Economic Impacts

The EPR program for lamps and lighting equipment reduced the mixed waste collection and landfilling costs by $0.1 - $0.3 million. The study did not attempt to quantify the avoided costs of pollution and environmental mitigation that would have been required if these lamp materials had been disposed in landfills.

Compared to the status quo scenario, the EPR program recovered additional materials with the estimated value of $0.5 - $0.6 million in 2014. The value is most likely realized in North American markets (either Canada or US).

The EPR program created a net total of 6 - 21 jobs based on material quantities recovered in 2014, with approximately half of these in BC. The job creation factors for the component materials from lights (e.g., glass and aluminum) were mainly determined by studying the impacts from recycling from curbside collection. Products containing aluminum and glass that are typically collected via curbside collection are likely to be recovered through less labour-demanding processes than those involved in the recycling of glass or aluminum from lamps. Therefore, this estimate can be considered conservative. No job impact studies were found specifically for the recovery of lamps.

Economic Impacts:

- Reduced the mixed waste and landfilling costs of $0.1 - $0.3 million, which does not consider avoided pollution reduction costs
- Market value of $0.5 - $0.6 million within North American markets
- Job creation of 6-21 jobs based on standards recycling factors for recovered materials (not lamp specific)

2.4.3.2 Environmental Impacts

The net reduction in landfill space was estimated to be approximately 850 - 1,700 m^3. The net reduction in GHG emissions for 2014 that can be accredited to the EPR program was over 1,700 tonnes CO_2e.

The net energy savings from a reduced need for extraction/processing of virgin materials for products and avoided landfilling were approximately 23,600 GJ. This equates to the energy content of over 3,800 barrels of crude oil.

One of the key benefits of this program is the removal of mercury from municipal solid waste management systems. Mercury is a toxic heavy metal that can bio-accumulate in the environment.

Environmental Impacts:

- Net reduction in landfill space was estimated to 850 - 1,700 m^3
- Net GHG reduction of over 1,700 tonnes CO_2e
- Net energy savings of 23,600 GJ (or over 3,800 barrels of crude oil)
- Up to 27 kg mercury was safely managed and recovered thanks to the EPR program

Mercury in the air eventually settles into water or onto land where it can be washed into water. Once it is deposited, certain microorganisms can change it into methylmercury, a highly toxic form that builds up in fish, shellfish and animals that eat fish. Fish and shellfish are the main sources of methylmercury exposure to humans (US EPA, 2013).

A fluorescent tube contains 8 - 12 mg of mercury bound into the phosphorous powder coating on the bulb glass (Kelleher Environmental, 2007). In 2014 fluorescent tubes from the EPR program in BC contained 18 - 27 kg of mercury that was safely managed and recovered.

2.5 Packaging and Printed Paper

The Recycling Regulation was amended in May 2011 to include packaging and printed paper from households and streetscapes, under Schedule 5. Multi-Material British Columbia (MMBC) the PRO for packaging producers launched an EPR program in BC on May 19, 2014.

2.5.1 Description of EPR Program

Table 19 summarizes the EPR program for PPP delivered by MMBC in 2014.

Table 19: EPR Programs for PPP (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
MMBC	Packaging and printed paper (PPP)	Financed by producers who supply PPP into the residential sector	$45.9 million or $394.50/ tonne (partial year from May 19 to December 31, 2014)	1.24 M households received curbside or multi-family collection service (a total of 3,106,000 BC residents served), and 180 drop-off depots

Table 20 shows the recovery methods used by MMBC for PPP collected in 2014. MMBC's processing and material marketed is provided through a services agreement with Green by Nature EPR. MMBC's processing and end use locations are sourced from MMBC's annual report, with the following exception. While MMBC reported that its plastics are sold to BC markets, it was understood that MMBC's BC market is Merlin Plastics. As Encorp sends all of its plastic beverage containers to Merlin Plastics and Encorp reports out-of-province markets for plastics, these same out-of-province markets were assumed for MMBC's plastics.

The end uses cited are those described in the Current System for Managing Packaging and Printed Paper in British Columbia (MMBC, 2012). They do not necessarily reflect the current MMBC end uses, which they were not willing to provide.

Table 20: Final Disposition for Packaging and Printed Paper

Product	Processing Locations	End Use	End Market Locations
Glass	Processed in BC	Used in a variety of new products including fibreglass insulation, sandblasting materials, construction aggregate	BC
Metals	Prepared in BC for shipment to end markets	Aluminum is used for new can sheet Steel is used for re-bar, rolled sheet and other steel applications	Aluminum in Ontario Steel in BC or shipped to the US
Plastics	Processed by Merlin Plastics (BC)	HDPE and PET are used in a variety of new products such as containers and strapping materials End uses of other plastics not identified	Assumed markets (based on information from Encorp for same processor) BC 2%, Canada (out of province) 5% North America (Canada or US) 91% Outside North America 2%
Paper and Fibres	Prepared in BC for shipment to end markets	Cardboard is used for cardboard, tissue, paperboard Mixed paper is used for cardboard, roofing paper, drywall paper, etc.	Majority exported overseas Small portion remaining in BC or shipped to US
Residual (fines, non-PPP)	-	Landfill disposal	-

2.5.2 EPR Program Recovery Rates and Status Quo Scenario

Table 21 presents the 2014 recovery rates for PPP under the EPR program and the status quo scenario that formed the basis for calculating the net benefits of the EPR program.

As MMBC did not provide recovery rates by material and the overall program recovery rate is calculated using PPP supplied by MMBC's members, the kg of material collected per capita was used to represent material-specific recovery rates. In 2014 MMBC served a population of 3,106,000 in BC. For example a total of 14,907 tonnes of glass was recycled in 2014, which equate to 4.8 kg/capita when dividing by the population served (of 3,106,000).

The status quo recovery rates were calculated on a kg per capita basis using the quantity of PPP collected and the number of households served (equivalent to 4,288,603 residents) as described in the Current System for Managing

Packaging and Printed Paper in British Columbia (MMBC, 2012). The difference in households served by MMBC represents the net difference between municipalities that were providing curbside collection of PPP as of November 19, 2012, but declined the collection incentive offered by MMBC, and municipalities that were providing only garbage collection as of November 19, 2012, but accepted MMBC's offer of a collection incentive or for which MMBC awarded a collection contract.

In order to compare performance, the EPR program and the status quo scenario were both based on the population served by MMBC in 2014 (3,106,000 population).

The status quo recovery rate for glass is significantly lower than that of the EPR program. This may be explained by the circumstances of the study Current System for Managing Packaging and Printed Paper in British Columbia (MMBC, 2012), specifically:

- The Current System study data were compiled using a single survey of municipalities and processing contractors with limited opportunity for data validation (while MMBC's data are based on monthly samples of inbound PPP designed to be statistically valid by sourcing from all types of collection systems - curbside, multi-family and depot - and from all geographic areas across the province).
- The composition and relative proportion of PPP in the Current System report is based on outbound shipments to end-markets.
- For the estimate of status quo recovery rates, data on outbound shipments plus the quantity of residue (allocated by outbound composition) were used as a proxy for the composition of inbound collected materials.
- However, this approach may be misrepresentative for glass because:
    - The amount of glass captured during processing by the pre-MMBC system was negligible with only 0.8 kg/capita of glass reported as shipped to end-markets; and
    - The 2.3 kg/capita of residue identified in the Current System Report may be under-reported.

As such, the amount of glass that appears to have been collected in the pre-MMBC is likely understated.

The composition of the residue in collected PPP in both the EPR program and the status quo scenario was based on recorded residue from PPP processing at a material recovery facility (Kelleher Environmental, 2011).

Table 21: Recovery Rates of EPR Program for PPP in 2014 and Status Quo Scenario

Material	EPR Program 2014 Recovery Rate	Status Quo Recovery Rate	Basis of Status Quo
Plastics	5.9 kg/capita	3.0 kg/capita	Current System for Managing Packaging and Printed Paper in British Columbia (MMBC, 2012)
Aluminum	0.8 kg/capita	0.4 kg/capita	Current System for Managing Packaging and Printed Paper in British Columbia (MMBC, 2012)
Steel and tin	0.9 kg/capita	0.4 kg/capita	Current System for Managing Packaging and Printed Paper in British Columbia (MMBC, 2012)
Cardboard, newsprint and other paper (fibres)	41.6 kg/capita	42.2 kg/capita	Current System for Managing Packaging and Printed Paper in British Columbia (MMBC, 2012)

2.5.3 Economic and Environmental Impacts

The economic and environmental impacts resulting from the EPR programs for PPP are presented in Table 22.

In the 2014 annual report MMBC did not provide a break-down of commingled paper-based packaging that contained liquid when sold, aluminum, steel and plastic containers (13 % of PPP materials collected in 2014). The break-down of each material (paper, steel, aluminum and plastics) in this mixture was calculated using the following data sources:

- MMBC's Current System for Managing Packaging and Printed Paper in British Columbia Report Table 6.5 (MMBC 2012) for the proportion of all papers, steel, aluminum and plastics; and
- Waste Diversion Ontario's Blue Box Tonnage Highlights from the 2014 Datacall for the proportion of paper-based packaging used to contain liquids (i.e. gabletop and aseptic cartons) as a percentage of total papers (WDO 2015).

Table 22: Economic and Environmental Impacts of the EPR Programs for PPP

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Avoided costs				
	$million	$2.7	$1.5	$5.7
Avoided landfilling costs	$million	$1.2	$0.8	$2.8
Total avoided costs	**$million**	**$3.8**	**$2.3**	**$8.5**
Value of recovered material in end-markets				
BC	$million	$0.1	$0.4	$0.7
Out of province	$million	$0.0	$0.1	$0.3
North America (US or Canada)	$million	$2.8	$5.4	$7.9
Outside North America	$million	$0.1	$0.2	$0.3
Unknown	$million	$0.0	$0.0	$0.0
Total value of recovered material in end-markets	**$million**	**$3.0**	**$6.1**	**$9.2**
Net job creation				
BC	# jobs	75	125	174
Out of province	# jobs	6.4	16	25
North America (US or Canada)	# jobs	60	116	172
Outside North America	# jobs	7.2	8.3	9.3
Unknown	# jobs	0	0	0
Total number of jobs created	**# jobs**	**148**	**265**	**381**
Job loss due to reduced landfilling	# jobs	20	37	54
Net job created	**# jobs**	**128**	**228**	**327**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net reduction in GHG emissions	tonnes CO_2e	33,663	34,486	35,310
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling	GJ	712,754	718,114	723,474
Energy savings in barrels of crude oil	# barrels of crude oil	115,090	115,956	116,821

2.5.3.1 Economic Impacts

The EPR program for PPP was estimated to reduce mixed waste collection and landfilling costs by $3.8 - $8.5 million.

In comparison to the status quo scenario, the EPR program is recovering additional materials with an estimated value of $3.0 - $9.2 million. Almost 75% of the market value is realized in North America (Canada or US markets). Less than 8% is realized in BC markets.

Economic Impacts:

- Reduced mixed waste collection and landfilling costs by $3.8 - $8.5 million
- Net market value of $3.0 - $9.2 million
- Net job creation of 128 - 327 jobs

The EPR program for PPP was estimated to have a positive net impact on job creation with an increase of 128 - 327 jobs. The estimate for jobs created in BC (75 - 174 jobs) is conservative as this estimate excludes jobs associated with preparing PPP for end markets (processing of the collected products). As a break-down between jobs associated with processing and those associated with re-manufacturing into new products was not available, both types of job creation were attributed to the locations of end markets.

2.5.3.2 Environmental Impacts

The EPR program for PPP saved approximately 70,000 - 300,000 m^3 of landfill space compared to the status quo scenario.

The net reduction in GHG emissions from the EPR program was estimated at approximately 34,000 - 35,000 tonnes CO_2e. The energy savings were approximately 710,000 - 720,000 GJ, which is equivalent to the energy content of approximately 116,000 barrels of crude oil.

Environmental Impacts:

- Approximately 70,000 - 300,000 m^3 of landfill space saved
- Net GHG reduction of 34,000 - 35,000 tonnes CO_2e
- Net energy savings of approximately 710,000 - 720,000 GJ (i.e. the energy content of 116,000 barrels of crude oil)

2.6 Paint and Household Hazardous Waste

Paint stewardship was mandated in BC in 1994 followed by flammable liquids, pesticides and gasoline in 1997.

2.6.1 Description of EPR Program

Table 23 summarizes the paint and Household Hazardous Waste (HHW) program delivered by Product Care in 2014.

Table 23: EPR Programs for Paint and Household Hazardous Waste (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
		in BC. Fees can be		212 collection depots accept

Table 24 shows the recovery methods used by Product Care for paint and HHW.

Table 24: Final Disposition for Paint and Household Hazardous Waste

Product	Processing locations	End Use	End Market Locations
		Recycled into latex paint or	BC (14%) and outside North
Alkyd (oil based) paint, flammables, pesticides and gasoline	Energy recovery in the US	Used as an alternative fuel source for energy recovery since there is no reuse or recycling option available	North America
Paint and HHW containers: metal	Consolidated at plant in Surrey and sent to processors out of province	Metal cans are recycled as scrap metal	Outside North America
Paint and HHW containers: plastics	Consolidated at plant in Surrey and sent to processors out of province	96% of the polypropylene containers are recycled, 4% managed as energy recovery in 2014	Outside North America

2.6.2 PR Program Recovery Rates and Status Quo Scenario

Table 25 presents the 2014 recovery rates for paint and HHW under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program.

Because of the toxicity of HHW, it is appropriate to assume local government collection programs would be operating in the absence of EPR programs for HHW, in part to protect drinking water and in part to keep the materials out of landfills to reduce the cost of managing landfill leachate.

Table 25: Recovery Rates of EPR Program for Paint and Hazardous Household Waste in 2014 and Status Quo Scenario

Material	EPR 2014 Recovery (kg/capita)	Status Quo Recovery (kg/capita)	Basis of Status Quo
Non-aerosol paint, paint aerosols, flammable liquids (including gasoline) and pesticides	0.672	0.506	Based on the total recovered quantities (calculated as kg per capita) of the EPR product categories collected in 2005 by the Ontario municipal hazardous or special waste collection program. The collection included paint, solvents and pesticides. This was prior to the introduction of an EPR program and is assumed to represent the status quo scenario.
HDPE (container)	0.066	0.049	The recovery rate (kg/capita) for container material would have improved between the status quo scenario and the EPR situation as much as that of the contents of the containers (25% improvement as shown for Ontario municipal hazardous or special waste collection program). The same assumption was made for steel containers.
Other plastic (container)	0.025	0.019	
Steel (container)	0.161	0.121	

2.6.3 Economic and Environmental Impacts

The economic and environmental impacts resulting from the EPR programs for paint and HHW are presented in Table 26.

Table 26: Economic and Environmental Impacts of the EPR Program for Paint and Hazardous Household Waste

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Avoided costs				
Avoided mixed waste collection costs	$million	$0.2	$0.2	$0.3
Avoided landfilling costs	$million	$0.1	$0.1	$0.2
Total avoided costs	**$million**	**$0.2**	**$0.4**	**$0.5**
Value of recovered material in end-markets				
BC	$million	$0.0	$0.0	$0.0
Out of province	$million	$0.0	$0.0	$0.0
North America (US or Canada)	$million	$0.0	$0.0	$0.0
Outside North America	$million	$0.1	$0.1	$0.1
Unknown	$million	$0.0	$0.0	$0.0
Total value of recovered material in end-markets	**$million**	**$0.1**	**$0.1**	**$0.1**
Net job creation				
BC	# jobs	2	2	2
Out of province	# jobs	0	0	0
North America (US or Canada)	# jobs	9	9	9

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Unknown	# jobs	0	0	0
Total number of jobs created	**# jobs**	**13**	**14**	**15**
Job loss due to reduced landfilling	# jobs	1	2	3
Net job created	**# jobs**	**12**	**12**	**12**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net landfill space savings	m^3	2,863	4,706	6,549
Net reduction in GHG emissions	tonnes CO_2e	3,059	3,167	3,276
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling	GJ	13,494	13,494	13,494
Energy savings in barrels of crude oil	# barrels of crude oil	2,179	2,179	2,179

2.6.3.1 Economic Impacts

The EPR program for paint and HHW reduced the mixed waste collection and landfilling costs by $0.2 - $0.5 million.

The study did not attempt to quantify the avoided costs of pollution and environmental mitigation that would have been required if these paint and HHW materials had been disposed in landfills.

It should also be noted that much of paint and HHW would most likely have been disposed of in the environment or to the wastewater system and not in landfills (Tchobanoglous & Kreith, 2002). The EPR program would therefore also reduce the cost to manage these materials through the sanitary system. Since little data exist on the quantities that were illegally disposed of before the EPR program, all quantities that were not recovered were assumed to be landfilled.

Economic Impacts:

- Total avoided collection and landfilling costs of $0.2 - $0.5 million, which does not consider avoided pollution reduction costs
- Reduced municipal recovery costs of $9.35 million in 2014
- Low market value of recycled paint ($100,000)
- Net job creation of 12 jobs, although Product Care reports on higher numbers

If the EPR program was not in place it is likely that municipal collection programs would have recovered materials to keep them out of landfills. The cost of leftover paint management has been reported at US$8 per gallon on average (Product Stewardship Institute, 2009) (or CAN$3.0 per litre when adjusted for CPI). This cost estimate was assumed to be equivalent to the reduced collection costs in BC. The reduced municipal recovery costs are $9.35 million for the quantity of paint collected by Product Care (3,115,909 Litres collected).

The market value resulting from the net recycled products is approximately $100,000 with markets outside North America. The paint and HHW generally do not have any market value and were not reflected in the net market value. Depending on the colour of the recycled paint and the recycler the value of the paint could be a negative, positive, or cost neutral.

Few studies have looked at the job impacts from the recovery of paint and HHW. Based on the only published factor for job creation and losses in Ontario (AECOM, 2009b), the EPR program was estimated to have created 12 jobs when losses from reduced landfilling were accounted for. These figures appear low. In 2012 Product Care estimated that up to 27.5 staff are working with this EPR program although some are not exclusive to this EPR program.

2.6.3.2 Environmental Impacts

The net reduction in landfill space that resulted from the EPR program for paint and HHW was estimated at approximately 3,000 - 6,500 m^3.

A net reduction in GHG emissions was approximately 3,000 - 3,300 tonnes CO_2e based on the net quantities of recycled material. GHG emission factors were provided by Product Care for paint recycling or hazardous waste recovery, however the report with underlying assumptions was not made available.

Environmental Impacts:

- Net reduction in landfill space was estimated to 3,000 - 6,500 m^3
- Net GHG reduction of 3,000 - 3,300 tonnes CO_2e using published data
- Net energy savings of almost 13,500 GJ (or over 2,000 barrels of crude oil)

The net energy saving from reduced need for extraction/processing of virgin materials for products and avoided landfilling was almost 13,500 GJ, which equates to the energy content of over 2,000 barrels of crude oil. The estimate for energy saving should be considered low since it does not include those resulting from paint recycling or hazardous waste recovery.

Inadequate management of these EPR program materials can pose significant environmental hazards and a key environmental benefit associated with the EPR program is that it ensures environmentally responsible and safe management and recovery of the collected materials. The transport and processing of paint and HHW are undertaken in accordance to the requirements of all federal and provincial regulations.

2.7 Pharmaceutical Waste

In the 1990s, the provincial government expanded the scope of the *Post-Consumer Residual Stewardship Program Regulation* (now the Recycling Regulation) to include pharmaceutical products. The Recycling Regulation, passed in October 2004, required all brand-owners of pharmaceutical products sold in British Columbia to take responsibility for the safe management of their products (Health Canada, 2009).

2.7.1 Description of EPR Program

Table 27 summarizes the EPR program for pharmaceutical waste delivered by the Health Products Stewardship Association (HPSA) in 2014. Waste from pharmaceutical products consists of all unused or expired medications, including non-prescription drugs and natural health products as defined under the Food and Drugs Act (Canada).

Table 27: EPR Programs for Pharmaceutical Waste (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
HPSA	Pharmaceutical waste	Financed by members based on market share	NA	1,160 locations accept pharmaceutical waste in residential quantities

Table 28 shows the recovery methods used by HPSA in 2014 for pharmaceutical waste.

Table 28: Final Disposition for Pharmaceutical Waste

Product	Processing locations	End Use	End Market Locations
Pharmaceutical waste	All collected products were sent to Alberta for incineration.	Thermally destroyed by incineration.	-

2.7.2 EPR Program Recovery Rates and Status Quo Scenario

Table 29 presents the 2014 recovery rates for pharmaceutical waste under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program.

Table 29: Recovery Rate of EPR program for Pharmaceutical Waste in 2014 and Status Quo Scenario

Material	EPR 2014 Recovery	Status Quo Recovery	Basis of Status Quo

2.7.3 Economic and Environmental Impacts

The economic and environmental impact resulting from the EPR program for pharmaceutical waste are presented in Table 30.

Table 30: Economic and Environmental Impacts of the EPR program for Pharmaceutical Waste

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Avoided mixed waste collection costs				$3,690
Avoided landfilling costs	$	$749	$1,284	$1,818
Total avoided costs	**$**	**$2,478**	**$3,993**	**$5,509**
Value of recovered material in end-markets				
BC				$0
Out of province	$	$0	$0	$0
North America (US or Canada)	$	$0	$0	$0
Outside North America	$	$0	$0	$0
Unknown	$	$0	$0	$0
Total value of recovered material in end-markets	**$**	**$0**	**$0**	**$0**
Net job creation				
BC				0.1
Out of province	# jobs	0.0	0.0	0.0
North America (US or Canada)	# jobs	0.0	0.0	0.0
Outside North America	# jobs	0.0	0.0	0.0
Unknown	# jobs	0.0	0.0	0.0
Total number of jobs created	**# jobs**	**0.1**	**0.1**	**0.1**
Job loss due to reduced landfilling	# jobs	0.0	0.0	0.0
Net job created	**# jobs**	**0.0**	**0.1**	**0.1**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net reduction in GHG emissions	tonnes CO_2e	0	0	0
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling	GJ	0	0	0
Energy savings in barrels of crude oil	# barrels of crude oil	0	0	0

2.7.3.1 Economic Impacts

The EPR program for pharmaceutical waste did not reduce collection and landfilling costs in BC significantly (approximately $2,500 - $5,500) due to very low volumes disposed through the solid waste system. The study did not attempt to quantify the avoided costs of pollution and environmental mitigation that would have been required if the pharmaceutical waste had been disposed in landfills.

Economic Impacts:

- A small cost reduction ($2,500 - $5,500) associated with reduced collection landfilling
- No impact on job creation or losses

Since pharmaceutical waste collected by the EPR program is incinerated there are no end-market values to assess.

A very small impact on job creation was determined (<1 jobs in net total) since the tonnes of recovered products were assumed to be similar with or without the EPR program.

While it may appear that there are little economic benefits from the EPR program for pharmaceutical waste, this is only because the same metrics were used as for traditionally recoverable materials that have much higher volumes and often economic and environmental impacts. Pharmaceutical waste is recovered in very small volumes, but the potential harm to the environment can be substantial. The true measurement of economic benefits from recovering pharmaceutical waste should be the avoided costs of removing the contamination from pharmaceuticals in the waste and waste water streams. This is a new area of research and emerging treatment technologies are still under development. Consensus is that the most effective way to manage the environmental harm from pharmaceuticals is through up-front removal, which is what the EPR program is designed to do. Once high collection efficiencies are achieved, the avoided cost from developing expensive end-of-pipe technologies can be substantial.

2.7.3.2 Environmental Impacts

There was a minor reduction in landfill space (up to 18 m^3) resulting from the EPR program for pharmaceutical waste.

No published factors on GHG or energy impacts were found for pharmaceutical waste incineration compared to landfilling, and therefore GHG emissions and energy savings impacts were not calculated.

It may seem as if the EPR program for pharmaceutical waste has few environmental benefits. However, the program is aimed at ensuring safe collection and management of these potentially hazardous wastes. Its collection reduces the risk of pharmaceutical disposal to the MSW stream or what may be more common, into the wastewater treatment system.

Environmental Impacts:

- Minor reduction in landfill space (up to 18 m^3) when compared to without EPR
- No GHG or energy impacts could be determined
- The program guarantees safe management of pharmaceutical waste which can have significant environmental impacts if disposed of inappropriately

In a recent review of the current system in the US for pharmaceutical waste management at least eight chemicals found in pharmaceuticals were identified as acute hazardous waste (US EPA Office of Inspector General, 2012). In

the US, traces of pharmaceuticals have been recorded in surface, ground, and drinking water, which raised concerns about the potentially adverse environmental consequences of these contaminants and their effects on human health. Minute concentrations of some pharmaceuticals can have detrimental effects on aquatic species, such as hormonal imbalances leading to feminization and reproductive problems in fish populations. Studies have shown the detection of pharmaceutical compounds in treated wastewater effluent, streams, lakes, seawater, and groundwater, as well as in sediments and fish tissue (U.S EPA Office of Inspector General, 2012).

2.8 Smoke Alarms

In 2011 the first EPR program was introduced to collect and recycle smoke alarms in BC.

2.8.1 Description of EPR Program

Table 31 summarizes the smoke alarm EPR program delivered Product Care in 2014.

Table 31: EPR Programs for Smoke Alarms (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
			$176,828 or	

Table 32 shows the recovery methods used by Product Care in 2014 for smoke alarms. There were no available details on final recycled quantities. Product Care specified that a smoke alarm weighs approximately 0.2 - 0.4 kg, but were unable to provide estimated quantities of the different recovered component materials (metal, plastic, etc.) from the smoke alarms since the component material varies between alarm types.

Table 32: Final Disposition for Smoke Alarms

Product	Processing locations	End Use	End Market Locations
Non-radioactive components	Processed in New Mexico, US	Recycling of metal (steel, copper, aluminum), circuit boards and plastic	North America
Radioactive components	Processed in Albuquerque, US. Residual radioactive material is sent to fully licensed radioactive facilities for final storage	Final cell storage of radioactive material	-

2.8.2 EPR Program Recovery Rates and Status Quo Scenario

Table 33 presents the 2014 recovery rates for smoke alarms under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program.

Table 33: Recovery Rates of EPR program for Smoke Alarms in 2014 and Status Quo Scenario

Material	EPR 2014 Recovery	Status Quo Recovery	Basis of Status Quo

2.8.3 Economic and Environmental Impacts

The economic and environmental impact results resulting from the EPR program for smoke alarms are presented in Table 34.

Table 34: Economic and Environmental Impacts of the EPR program for Smoke Alarms

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Avoided costs				
Avoided mixed waste collection costs	$	$645	$1,010	$1,376
Avoided landfilling costs	$	$279	$479	$678
Total avoided costs	**$**	**$924**	**$1,489**	**$2,054**
Value of recovered material in end-markets				
BC	$million	$0	$0	$0
Out of province	$million	$0	$0	$0
North America (US or Canada)	$million	$0	$0	$0
Outside North America	$million	$0	$0	$0
Unknown	$million	$0	$0	$0
Total value of recovered material in end-markets	**$million**	**$0**	**$0**	**$0**
Net job creation				
BC	# jobs	0.0	0.0	0.0
Out of province	# jobs	0.0	0.0	0.0
North America (US or Canada)	# jobs	0.4	0.4	0.4
Outside North America	# jobs	0.0	0.0	0.0
Unknown	# jobs	0.0	0.0	0.0
Total number of jobs created	**# jobs**	**0.4**	**0.4**	**0.4**
Job loss due to reduced landfilling	# jobs	0.0	0.0	0.0
Net job created	**# jobs**	**0.4**	**0.4**	**0.4**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net landfill space savings	m^3	43	43	43
Net reduction in GHG emissions	tonnes CO_2e	2	6	11
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling	GJ	8	71	134
Energy savings in barrels of crude oil	# barrels of crude oil	1	11	22

2.8.3.1 Economic Impacts

The EPR program for smoke alarms only had a minor impact on reducing the mixed waste collection and landfilling costs. The total reduced costs were estimated between $900 and $2,000.

Economic Impacts:

- Minor cost reduction associated with avoided mixed waste collection and landfilling ($900 - $2,000). This does not consider avoided pollution reduction costs
- Market value of recycled materials not available but expected to be small
- Small impact on the net job creation (up to 0.4 FTE)

Cost estimates are low due to the relatively small quantities managed by the program. The costs relate purely to the reduction in landfill space requirement. The study did not attempt to quantify the avoided costs of pollution and environmental mitigation that would have been required if the smoke alarm materials had been disposed in landfills.

Due to lack of data on recycled component material, the value of recycled materials in end-markets could not be estimated. The value is considered insignificant to the BC economy because of the small quantities recovered through the program and their expected low market value.

It was assumed that a job creation factor for smoke alarm recovery is similar to those recorded for recovery of electronics. On this basis, the EPR program created 0.4 jobs.

2.8.3.2 Environmental Impacts

The net reduction in landfill space was estimated to be approximately 40 m^3 resulting from the EPR program for smoke alarms. The net reduction in GHG emissions for 2014 that can be accredited to the EPR program was 2 - 11 tonnes CO_2e. This is based on assuming emission factors similar to those for electronics.

Environmental Impacts:

- Net reduction in landfill space of 40 m^3
- Net GHG reductions of 2 - 11 tonnes CO_2e
- Net energy savings of 10 - 130 GJ (over 20 barrels of crude oil)
- Program guarantees safe processing of smoke alarms

The net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling were approximately 10 - 130 GJ (saving energy equivalent to over 20 barrels of crude oil).

The EPR program in place for smoke alarms appears to only have limited environmental benefits, beyond those achieved by ensuring proper management of hazardous materials. It is important to keep in mind that the program ensures that all recovered materials are managed according to the requirements of all relevant federal and provincial regulations. The inadequate management of these materials can pose hazards to human health and the environment.

Only processors that can demonstrate compliance with specific health, safety and environmental management standard are allowed to manage the smoke alarms from the EPR program in BC. The processors are also required to have a general radioactive materials license for source materials allowing them to handle the radioactive smoke alarms.

2.9 Thermostats

In 2010 an EPR program for thermostats was started in BC by Summerhill Impact under agreement with the Heating, Refrigeration, and Air Conditioning Institute of Canada (HRAI).

2.9.1 Description of EPR Program

The program was administered by Summerhill Impact up to November 30, 2015. On December 1, 2015 Summerhill Impact changed corporate names to Scout Environmental, a federally registered non-profit continuing to provide program collection and recycling services for HRAI. Table 35 summarizes the thermostat EPR program delivered Summerhill Impact l in 2014.

Table 35: EPR Programs for thermostats (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
Scout Environmental	Thermostats	Financed by manufacturers		343 locations accept residential and ICI thermostats

Table 36 shows the recovery methods used by Scout Environmental in 2014 for thermostats.

Table 36: Final Disposition for Thermostats

Product	Processing locations	End Use	End Market Locations
	Processed in BC or ON	Plastic components are	
Mercury	Processed in North America	Recycled for use in fluorescent lighting	North America
Glass	Processed in Ontario	Recycled into varying applications	Canada
Mixed metals (iron, nickel and aluminum)	Processed in BC or ON	Recycled through scrap metal market	North America

2.9.2 EPR Program Recovery Rates and Status Quo Scenario

Table 37 presents the 2014 recovery rates for thermostats under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program.

For 2014 only quantities of recovered plastics and metals were provided, which only represented a fraction of the total quantity of thermostat material collected. Scout Environmental was unable to provide an average weight per thermostat because thermostats vary significantly from model to model in terms of size, shape, and composition. Therefore, the recovery rate is expressed as units/capita as a proxy.

Table 37: Recovery Rates of EPR program for Thermostats in 2014 and Status Quo Scenario

Material	EPR 2014 Recovery	Assumed Status Quo Recovery	Basis of Status Quo
Thermostats	0.00076 units/capita	Nil	Thermostats were likely to be landfilled since they were cost prohibitive to collect and recover. Without an EPR program, some collection system could be in place by contractors, however negligible recovery was assumed from this. The information is based on interview with HRAI for the last study (Morrison Hershfield 2014).

2.9.3 Economic and Environmental Impacts

2.9.3.1 Economic Impacts

No financial benefits were determined for the EPR program for thermostats since an average unit weight for thermostats collected was unable to be confirmed.

A reduction in mixed waste collection and landfilling costs compared to status quo is likely. However insignificant tonnages are likely to be managed by the program.

Economic Impacts:

- No financial benefits or costs could be determined for the thermostat program

Thermostat constituents are hazardous to the environment, but the avoided costs of pollution and environmental mitigation (e.g., leachate treatment) that would potentially be required if the thermostats were landfilled could not be quantified.

2.9.3.2 Environmental Impacts

No environmental impacts could be determined for the EPR program for thermostats since an average unit weight for thermostats collected was unable to be confirmed.

Thermostats have historically contained mercury which can be toxic to the environment if the thermostat is broken. The EPR program ensures that safe recovery methods are in place for thermostats at the end of the product's life.

Environmental Impacts:

- No environmental impacts could be determined
- The program guarantees safe processing of thermostats

New thermostats that are sold within BC and that are part of the program are more environmentally responsible as they contain no mercury and reduce energy demands (as compared to older models).

The EPR program for thermostats may appear to have limited environmental benefits. However, it is important to keep in mind that, although the program only recovered relatively small quantities of material compared to many other EPR programs, it ensures that all recovered materials are managed according to the requirements of all relevant federal and provincial regulations. The inadequate management of these materials can pose significant environmental hazards.

2.10 Tires

The Ministry of Environment in BC operated a tire recycling program from 1991 to 2006 and in 2007 an industry-led EPR program was initiated to comply with the Recycling Regulation.

2.10.1 Description of EPR Program

Table 38 summarizes the EPR program for tires delivered by Tire Stewardship BC (TSBC) in 2014.

Table 38: EPR Programs for Tires (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
				Tires not left with the retailer

Table 39 shows the recovery methods used by TSBC in 2014 for tires.

Table 39: Final Disposition for Tires

Product	Processing locations	End Use	End Market Locations
	Processed and recycled in BC	77% of tires are recovered for use in a variety of new used as fuel supplement to	BC, Canada and US

2.10.2 EPR Program Recovery Rates and Status Quo Scenario

Table 40 presents the 2014 recovery rates for tires under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program.

All Canadian provinces have tire recovery programs. Therefore, recycling and recovery markets for tires is sensitive to commodity prices and this pricing varies by specific regional locations. For this reason it was not suitable to compare BC's recovery rates for tires to those of other jurisdictions in Canada.

Table 40: Recovery Rate of EPR Program for Tires in 2014 and Status Quo Scenario

Material	EPR 2014 Recovery	Status Quo Recovery	Basis of Status Quo
Tires	76%	63%	According to TSBC there was acceptable tire recycling and recovery taking place in BC prior to 2007 when the program was administered by government. Recovery rates of between 50% and 75% (e.g., truck tires and other tires in urban areas) were being achieved. A mid-point recovery rate of 63% was assumed.

2.10.3 Economic and Environmental Impacts

The economic and environmental impact resulting from the EPR program for tires are presented in Table 41.

Table 41: Economic and Environmental Impacts of the EPR Program for Tires

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Avoided costs				
Avoided mixed waste collection costs	$million	$1.4	$2.2	$3.0
Avoided landfilling costs	$million	$0.6	$1.0	$1.5
Total avoided costs	**$million**	**$2.0**	**$3.2**	**$4.4**
Value of recovered material in end-markets				
BC	$million	$0.6	$0.8	$0.9
Out of Province	$million	$0.0	$0.1	$0.1
North America (US or Canada)	$million	$0.8	$1.0	$1.1
Outside North America	$million	$0.0	$0.0	$0.0
Unknown	$million	$0.0	$0.0	$0.0
Total value of recovered material in end-markets	**$million**	**$1.5**	**$1.8**	**$2.1**
Net jobs creation				
BC	# jobs	77	77	77
Out of Province	# jobs	0	0	0
North America (US or Canada)	# jobs	0	0	0
Outside North America	# jobs	0	0	0
Unknown	# jobs	0	0	0
Total number of jobs created	**# jobs**	**77**	**77**	**77**
Job loss due to reduced mixed waste collection and landfilling	# jobs	11	19	28
Net jobs created	**# jobs**	**49**	**58**	**67**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net landfill space savings	m^3	13,443	26,887	40,330
Net reduction in GHG emissions	tonnes CO_2e	1,188	1,188	1,188
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling	GJ	118,276	118,276	118,276
Energy savings in barrels of crude oil	# barrels of crude oil	19,098	19,098	19,098

2.10.3.1 Economic Impacts

The program was estimated to reduce mixed waste collection and landfilling costs by $2.0 - $4.4 million.

The market value of the net quantities of rubber crumb used in the manufacturing of crumb-derived product was estimated at $1.5 - $2.1 million. Almost half of this value was realized in the local market in BC.

Economic Impacts:

- Reduced mixed waste collection and landfilling costs of $2.0 - $4.4 million
- Market value of $1.5 - $2.1 million
- Net job creation of 49 - 67 jobs

The recycling of tires is relatively labour intensive. Based on published factors for job creation in the US, the EPR program created 49 - 67 jobs, when job losses from the net reduced quantities of garbage that require collection and management were taken into account. All of these jobs are believed to have been created in BC.

2.10.3.2 Environmental Impacts

The EPR program for tires saved landfill space of approximately 13,000 - 40,000 m^3. This was based on the net reduction in landfilled quantities when the EPR program was compared to the status quo scenario.

Environmental Impacts:

- Landfill space savings of 13,000 - 40,000 m^3
- Net GHG reduction of over 1,000 tonnes CO_2e
- Net energy savings of over 100,000 GJ or almost 20,000 barrels of crude oil

The net reduction in GHG emissions for 2014 resulting from the EPR program was over 1,000 tonnes CO_2e. This was calculated by using the emission factor published in the End-of-Life Tire Management Life Cycle Assessment (Pembina Institute, 2007). This study referenced emission factors of almost all other materials (ICF, 2005), and was not used for tires because it was calculated specifically for tire retreading. Retreading can be argued to be a reuse activity and since it is not representative of the recovery methods used by TSBC. Therefore the emission factor for tire recovery published by Pembina Institute was selected. This factor was calculated by more suitably assuming that all tires are turned into crumbed rubber which replaces polypropylene plastic crumb for use in numerous applications. Emission factors for all the various end-uses of recovered tires (e.g., energy recovery) were not available. The emission factors can vary between different end-uses and is likely to produce a different GHG emissions result. The emissions factors vary depending on the type of energy being displaced in the local area (e.g., coal, natural gas, oil, hydro or nuclear sources).

The net energy saving from reduced need for extraction/processing of virgin materials for products and avoided landfilling was over 100,000 GJ, which equates to almost 20,000 barrels of crude oil.

Before the introduction of the EPR program for tires, municipalities and other responsible organizations often had to deal with scrap tire piles that can pose a significant environmental and human health liability. Liabilities include tire fires and potential for human health disease outbreaks caused by rodents and mosquitoes breeding in scrap tire piles.

However, BC does not have abandoned stock piles to manage. Therefore, TSBC does not spend any funds to collect and process abandoned tires.

2.11 Used Oil and Antifreeze Products

In 2003, BC introduced an EPR program for used oil, used oil filters and oil containers. The program was expanded to include antifreeze products in July 2011.

2.11.1 Description of EPR Program

Table 42 summarizes the used oil EPR program delivered by the British Columbia Used Oil Management Association (BCUOMA) in 2014.

Table 42: EPR Programs for Used Oil and Antifreeze Products (2014)

PRO	Products Collected	Financing Mechanism	Program Costs	Product Collection
	Used oil and	or may not be passed on to consumer at point of sale		residential and used oil and

Table 43 shows the recovery methods used by BCUOMA in 2014 for used oil and antifreeze products. BCUOMA did not report on any residue sent to energy recovery or landfill.

Table 43: Final Disposition for Tires

Product	Processing locations	End Use	End Market Locations
	Almost all of the used oil (98%) was processed in BC	lubricating oil or industrial	
Antifreeze	All antifreeze was processed in BC	Recycled into new antifreeze	BC
Plastic oil and antifreeze containers	All plastic was processed by Merlin Plastics in BC for sale to manufacturers in unknown locations	The plastic (mainly HDPE) is recycled into new oil containers, drainage tiles and parking curbs	Unknown
Oil filters	Steel is processed by BC-based processors and sold to unknown manufacturers	Steel (the majority by weight of the filter) is used to manufacture reinforcing steel. Paper content of filters (1% by weight) was sent to energy recovery.	Unknown

2.11.2 EPR Program Recovery Rates and Status Quo Scenario

Table 44 presents the 2014 recovery rates used oil and antifreeze products under the EPR program and the status quo scenarios which formed the basis for calculating the net benefits of the EPR program.

Table 44: Recovery Rates of the EPR Program for Used Oil and Antifreeze Products in 2014 and the Status Quo Scenario

Material	EPR 2014 Recovery	Status Quo Recovery	Basis of Status Quo
Used oil	73.9%	60%	Prior to the commencement of the EPR program in 2003, BCUOMA estimated that the recovery rate for used oil was 60% (BCUOMA, 2012)
Antifreeze	36.5%	25%	BCUOMA suggested that the recovery rate would be less than with the EPR program, but no actual status quo recovery rate was reported. A recovery rate of 25% was therefore assumed in lack of specific data
Containers (Used oil and antifreeze)	70.1%	12%	Prior to the commencement of the BCUOMA program in 2003, it was estimated that the recovery rate for used oil containers was 12% (BCUOMA, 2012)
Oil filters	85.4%	18%	Prior to the commencement of the BCUOMA program in 2003, it was estimated that the recovery rate for used oil filters was 18% (BCUOMA, 2012)

2.11.3 Economic and Environmental Impacts

The economic and environmental impacts resulting from the EPR program for used oil and antifreeze products are presented in Table 45.

Table 45: Economic and Environmental Impacts of the EPR Program for Used Oil and Antifreeze Products

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Avoided costs				
Avoided mixed waste collection costs	$million	$1.3	$2.1	$2.8
Avoided landfilling costs	$million	$0.6	$1.0	$1.4
Total avoided costs	**$million**	**$1.9**	**$3.0**	**$4.2**
Value of recovered material in end-markets				
BC	$million	$0.0	$0.0	$0.0
Out of province	$million	$0.0	$0.0	$0.0
North America (US or Canada)	$million	$0.0	$0.0	$0.0
Outside North America	$million	$0.0	$0.0	$0.0
Unknown	$million	$0.9	$1.0	$1.1
Total value of recovered material in end-markets	**$million**	**$0.9**	**$1.0**	**$1.1**
Net job creation				
BC	# jobs	104	114	124
Out of province	# jobs	0	0	0
North America (US or Canada)	# jobs	2	2	2
Outside North America	# jobs	0	0	0

Economic Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Total number of jobs created	**# jobs**	**105**	**116**	**126**
Job loss due to reduced landfilling	# jobs	10	18	27
Net job created	**# jobs**	**95**	**97**	**99**

Environmental Impacts	Unit of Measurement	Low Estimate	Average Estimate	High Estimate
Net reduction in GHG emissions	tonnes CO_2e	28,091	29,028	29,965
Net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling			111,580	111,580

2.11.3.1 Economic Impacts

The program reduced mixed waste collection and landfilling costs by $1.9 - $4.2 million. It should be noted that a portion of used oil and antifreeze, as liquids are unaccounted for and potentially lost to the environment due to improper consumer practices. However, data is not available on improper used oil and antifreeze product disposal. As a result, the study did not attempt to quantify the avoided costs of pollution and environmental mitigation due to the lack of data. Safe disposal was governed by the regulations for special waste and for the return of used lubricating oil before the EPR program was created under the Recycling Regulation.

Economic Impacts:

- Reduced mixed waste collection and landfilling costs of $1.9 - $4.2 million
- Market value of $0.9 - $1.1 million in unconfirmed market locations
- Net job creation of 95 - 99 jobs

The EPR program recovered additional materials with the estimated value of $0.9 - $1.1 million in unconfirmed market locations.

The majority of employment opportunities were likely created in BC. In 2014, the EPR program created 95 - 99 jobs.

2.11.3.2 Environmental Impacts

The EPR program for used oil and antifreeze product saved approximately 23,700 - 52,000 m^3 in landfill space compared to the status quo scenario.

The net reduction in GHG emissions for 2014 that can be accredited to the EPR program were approximately 28,000 - 30,000 tonnes eCO_2. This estimate was based on the net quantities of recycled material when the 2011 program performance is compared to a status quo scenario.

Environmental Impacts:

- 23,700 - 52,000 m^3 of avoided landfill space
- Net GHG reduction of 28,000 - 30,000 tonnes eCO_2
- Net energy savings of 112,000 GJ or over 18,000 barrels of crude oil
- Over $3.5 billion in savings from reduced water contamination

Conestoga-Rovers & Associates (CRA) completed a GHG study on behalf of BCUOMA in 2010. Since no GHG emissions for used oil were analysed by ICF in 2005, we used the emission factor calculated by CRA in this study.

The CRA study compared EPR program results against a status quo scenario that assumed that similar used oil quantities would be recovered and combusted, while all filters and used oil containers would have been landfilled. Although a slightly different alternative (status quo) scenario was used in this study, the results should still be applicable.

The net energy savings from reduced need for extraction/processing of virgin materials for products and avoided landfilling were approximately 112,000 GJ. This is likely an underestimate as no energy savings factors for re-refining of used oil or recycling of antifreeze were available. The calculated net energy saving based on available data equate to over 18,000 barrels of crude oil.

In the Genuine Wealth Assessment of Alberta's Stewardship Programs (Anielski Management Inc. 2007), the reduced cost of environmental liability was assessed in relation to the responsible recovery of used oil. The report stated that used oil can contaminate up to a million times its volume of water. In 2001, the cost of treating contaminated water was equivalent to $0.32 per litre in accordance to the Minnesota Pollution Control Agency. For BC's EPR program for used oil, this equates to over $3.5 billion in potential savings from reduced contamination compared to a status quo scenario in which responsible oil recovery was assumed.

Also, improper management of used oil can contaminate soil, which is particularly problematic in agricultural areas. In 2007, a typical clean-up cost in Alberta was $160 per tonne with actual costs varying depending on the degree of contamination (Anielski Management Inc., 2007). The current costs in BC for oil contamination clean-up was not determined, but referenced the Alberta estimate to illustrate the potential liability involved with improper material handling.

3. SUMMARY AND CONCLUSIONS

This study provides an assessment of the economic and environmental impacts of EPR programs in BC, with the results present by EPR programs. The assessment is based on the recovered quantities of EPR program materials that can be credited to the introduction of the EPR programs determined by comparing the recovery rates achieved by the EPR programs in 2014 with those of a status quo scenario (without an EPR program). This approach was based on the assumption that collection systems for EPR product categories operating prior to the EPR program would have evolved through other policy mechanisms (e.g., solid waste management plans) in the absence of EPR legislation. As such, performance of EPR programs was evaluated against the status quo recovery scenario and not against a scenario in which 100% disposal was assumed.

This methodology was developed and used for the previous study, which was based on 2011 operational data.

This study utilized information reported by PROs on management methods other than recycling, specifically quantities of EPR products that were reused and processing residue sent to energy recovery/incineration or landfill disposal. This information was not available for the previous study.

Table 46 presents the economic and environmental impacts associated with the materials designated under EPR programs. The results table is followed by a discussion on specific impacts.

Measures were examined by using low, medium (average), and high estimates to reflect uncertainty in data and assumptions. The table presents the medium (average) estimates of each parameter for each EPR program material. The table is followed by sections that highlight key findings, provide additional comments that explain the results, and general conclusions regarding net impacts associated with managing designated materials under EPR programs in 2014.

Table 46: Overview of Economic & Environmental Impact Results for each EPR Program Material

Parameter/ Measure	Economic impact																Environmental impacts			
	Avoided costs			Value of recovered material in end markets						Net jobs created										
	Avoided mixed waste collection costs	Avoided landfilling costs	Total avoided costs	BC	Out of Province	North America (US or Canada)	Outside North America	Unknown	Total Value	BC	Out of Province	North America (US or Canada)	Outside North America	Unknown	Total Jobs Created	Job loss due to reduced landfilling	Net Jobs Created	Net landfill space savings	Net reduction in GHG emissions	Net energy savings	Energy savings in barrels of crude oil
2014 EPR Materials:	$million	$million	$million	$million	$million	$million	$million	$million	$million	# jobs	# jobs	# jobs	# jobs	# jobs	# jobs	# jobs	# jobs	m^3	tonnes CO_2e	(000) GJ	#barrels
	$0.5	$0.2	$0.7	$0.0	$0.0	$1.3	$0.0	$0.0	$1.4	19	0	6	0	0	25	4	17	21,225	3,337	69	11,117
	$11.3	$5.4	$16.7	$0.2	$0.4	$10.9	$0.2	$9.9	$21.6	26	93	525	20	77	742	101	641	241,003	93,538	1,612	260,225
	$3.8	$1.8	$5.7	$0.0	$0.0	$14.2	$0.0	$0.0	$14.2	542	292	33	0	368	1,236	34	1,202	95,108	34,434	515	83,181
	$0.2	$0.1	$0.2	$0.0	$0.0	$0.5	$0.0	$0.0	$0.5	10	1	0	0	4	15	1	14	1,279	1,745	24	3,811
	$1.5	$0.8	$2.3	$0.4	$0.1	$5.4	$0.2	$0.0	$6.1	125	16	116	8	0	265	37	228	190,340	34,486	718	115,956
	$0.2	$0.1	$0.4	$0.0	$0.0	$0.0	$0.1	$0.0	$0.1	2	0	9	4	0	14	2	12	6,549	3,276	13	2,179
	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	0	0	0	0	0	0	0	0	9	0	0	0
	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	0	0	0	0	0	0	0	0	43	6	0	11
	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	$2.2	$1.0	$3.2	$0.8	$0.1	$1.0	$0.0	$0.0	$1.8	77	0	0	0	0	77	19	58	26,887	1,188	118	19,098
	$2.1	$1.0	$3.0	$0.0	$0.0	$0.0	$0.0	$1.0	$1.0	114	0	2	0	0	116	18	97	38,033	29,028	112	18,017
	$21.8	**$10.4**	**$32.2**	**$1.4**	**$0.6**	**$33.3**	**$0.5**	**$11.0**	**$46.7**	**915**	**402**	**691**	**32**	**449**	**2,490**	**217**	**2,269**	**620,476**	**200,931**	**3,181**	**513,596**

3.1 Economic Impacts

One of the objectives of the EPR policy is shifting of responsibility (physically and financially) to the obligated producer to eliminate or minimize externalities.

The following major findings are highlighted in terms of economic impacts for EPR program materials collected in 2014 in BC.

Economic Impacts:

- Reduced mixed waste collection and landfilling costs of approximately $32 million
- Commodity market value of $47 million
- Net job creation of almost 2,300 jobs of which over 900 jobs were in BC

The EPR programs operating in BC during 2014 were estimated to reduce mixed waste collection and landfilling costs by $32 million (medium estimate). The study did not attempt to quantify the avoided costs of pollution and environmental mitigation that would have been required if EPR materials had been disposed in landfills.

Of all the EPR product categories, the programs for beverage containers accounted for the largest quantities of recycled materials compared to the status quo, followed by PPP and electronic and electrical products (74,000 net tonnes, 27,000 net tonnes and 25,000 net tonnes respectively). The programs for beverage containers have also the largest savings in reduced mixed waste collection and landfilling costs (almost $17 million in total).

The market value of the net change in recycled material resulting from the 2014 EPR programs compared to the status quo scenarios was estimated at almost $47 million. The study also identified where the value of the recovered materials was realized: BC, Canada (out of province), North America (Canada or US), outside North America or not reported. Less than 5% of the total market value was estimated to be realized in BC markets. The majority of materials are realized in unknown markets.

Less quantifiable from an economic perspective, but nevertheless providing positive impacts, are additional impacts including the creation of jobs resulting from an increase in recycling compared to a status quo scenario with no EPR program. To estimate the net number of jobs created, employment losses from reduced mixed waste collection and landfill management resulting from EPR programs were also accounted for.

The employment benefits associated with recovery (reuse and recycling) in comparison to energy recovery or disposal to landfill have been highlighted by a number of studies. Although none of the available studies is directly comparable, they have consistently shown that per tonne of material processed, recycling provides approximately ten times more jobs than landfilling and energy recovery (Friends of the Earth, 2010).

Based on published factors for job impacts for various waste management, recycling and reuse activities, the EPR programs that operated in 2014 were estimated to result in almost 2,300 jobs when losses from reduced mixed waste collection and landfilling were taken into account. Where possible, jobs were separated into those created in BC, Canada (out of province), North America (Canada or US), or Outside North America. It was estimated that a total of over 900 in BC jobs can be credited to the EPR programs that were operational in 2014.

3.2 Environmental Impacts

The following major environmental findings are highlighted for 2014 EPR program materials. Each EPR program material section in this report provides information on the estimates of quantifiable impacts and, where available, quantitative environmental benefits such as reduction in litter, environmental contamination or environmental risk avoidance resulting from the EPR programs.

The EPR programs operating in 2014 saved landfill space of 620,000 m^3. The savings were estimated based on the net reduction in landfilled quantities when the EPR programs were compared to the status quo scenarios, using the density of each recovered material.

Since the density of landfilled materials in practice may be higher than those published for individual compacted materials, an alternative calculation, based on an average garbage density in a landfill of 0.7 tonnes per m^3 (Wiley& Sons, 2011), was used. The EPR programs in 2014 resulted in approximately 160,000 tonnes of EPR materials that avoided landfilling. Based on this quantity and the assumed garbage density, the total landfill space savings equate to approximately 110,000 m^3. The estimated landfill space savings should be regarded as indicative since there is much uncertainty in the actual density when different types of materials are landfilled.

Environmental Impacts:

- Landfill space savings of between 110,000 - 620,000 m^3 depending on assumed density once materials are landfilled
- Net GHG reduction of over 200,000 tonnes CO_2e (equal to removing over 42,000 cars from the roads for a year)
- Net energy savings of 3.2 million GJ (equivalent to over 500,000 barrels of crude oil)

To put the EPR results into context, BC's EPR programs in 2014 avoided disposal of 160,000 tonnes compared to the status quo scenarios. This equates to 17 % of BC's total mixed waste disposal from residential sources or 6% when comparing to BC's total waste disposal in 2012 (Statistics Canada, 2012).

The net reduction in GHG emissions for 2014 that can be credited to the EPR programs was over 200,000 tonnes CO_2e. This calculation is likely under-stated as emission factors were unavailable for some recovered materials. Assuming that the GHG emissions from one car per year is 4.75 tonnes CO_2e, the EPR programs achieved GHG reductions equal to removing over 42,000 cars from the roads for a year (US EPA, 2016).

The net energy savings resulting from the EPR programs operating in 2014 were 3.2 million GJ, which equates to the energy content of over 500,000 barrels of crude oil. This is likely an underestimate as energy savings factors for the recovery of many EPR program materials were not available.

There are several EPR programs such as used oil, anti-freeze products, electronic or electrical products, lamps and lighting equipment, paint, smoke alarms, thermostats and pharmaceutical waste, that recover relatively small quantities of materials, however bring the significant benefits of keeping hazardous materials out of landfills, incinerators and the environment. The benefits from greater control over the management of hazardous materials and the minimization of environmental risks associated with disposal were presented as qualitative comments for each EPR program material. Although the EPR programs that manage these product categories generally have high per-tonne operating costs and in most cases show relatively small quantitative benefits (e.g., avoided collection and landfilling cost, GHG and energy savings), they often result in many important but unquantified environmental benefits.

GHG emission reductions, energy savings and assuring safe management of hazardous materials are some of the substantial benefits resulting from the EPR programs that have not been monetized but yet represent additional unquantified economic benefits.

4. GLOSSARY AND LIST OF ABBREVIATIONS

BCUOMA	British Columbia Used Oil Management Association
BDL	Brewers Distributor Limited
CBA	Canadian Battery Association
CCME	Canadian Council of Ministers of Environment
CESA	Canadian Electrical Stewardship Association
CPI	Consumer Price Index
CWTA	Canadian Wireless Telecommunications Association
Depot	Facility where residents can drop off EPR program materials.
E-waste	Electronic waste (or e-waste) includes computers, entertainment electronics, mobile phones and other items that have reached the end of their useful life.
EPRA	Electronic Products Recycling Association
FTE	Full time equivalent
GECH	General Electric Canada (Healthcare)
HPSA	Health Product Stewardship Association
IBSC	Interstate Battery System of Canada Inc.
ICI	Industrial, commercial and institutional.
Life cycle assessment (LCA)	Method for the environmental assessment of products and services, covering their life cycle from raw material extraction to waste treatment.
MARR	Major Appliance Recycling Roundtable
Mixed waste / garbage	Is any material for which the generator has no further use, and which is managed at waste disposal sites.
MMBC	Multi Material British Columbia
ND	No Data available
Processing	Manual or mechanical alteration of the collected EPR program material for the purpose of resource recovery.

Producer responsibility organization (PRO)	A "producer responsibility organization", usually a not-for-profit organization or an industry association, is the entity designated by a producer or producers to act on their behalf to administer an extended producer responsibility or product stewardship program. In Canada, a PRO may also be referred to as a "stewardship organization," an "industry funding organization" or a "delegated administrative organization".
Recovery rate	The amount of product collected divided by the amount of product generated, expressed as a percentage.
TSBC	Tire Stewardship BC

5. REFERENCES STEWARSHIP PROGRAMS IN BC

EPR Material Category	Reference Sources
Batteries	• CBA's Annual Report 2014 • Personal communication with Colin McKean, CBA, February 2016. • Call2Recycle 2014 Annual report • Personal communication with Kristen Romilly, Call2Recycle, February 2016
Beverage containers	• Encorp Annual Report 2014 • Personal communication with Scott Fraser, Encorp, February 2016 • Brewers Distributor Limited Annual Report 2014 • Personal communication with Brian Zeiler-Kligman, BDL, February and March 2016
Electronics	• Personal communication with Barb Collins, Telus, February 2016
Lamps and Lighting Equipment	• BC Fluorescent Light Recycling Program Annual Report 2014 • Personal communication with Mark Kurschner and Mannie Cheung, Product Care, February 2016
Packaging and Printed Paper	• MMBC's annual report 2014 • Personal communication with Allen Langdon and Tamara Burns, February 2016
Paint and HHW	• BC Paint and Household Hazardous Waste 2014 Program Year Annual Report • Personal communication with Mark Kurschner and Mannie Cheung, Product Care, February 2016
Pharmaceuticals	• Pharmaceutical Annual Report 2014 • Personal communication with Ginette Vanasse, Health Products Stewardship Association, February 2016
Smoke alarms	• BC Smoke and CO Alarm Recycling Program Annual Report 2014 • Personal communication with Mark Kurschner and Mannie Cheung, Product Care, February 2016
Thermostats	• Switch the 'Stat Thermostat Recovery Program - Annual Report 2014 • Personal communication with Jennifer Court, Scout Environmental, February 2016
Tires	• TSBC-Annual Report 2014 • Personal communication with Rosemary Sutton, TSBC, February 2016

EPR Material Category	Reference Sources
Used oil, antifreeze, oil filters and oil and antifreeze containers	• BCUOMA Annual Report 2014 • Personal communication with David Lawes, BCUOMA, February 2016

6. OTHER REFERENCES

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APPENDIX A:
Input Data of Each PRO

EPR Program - Batteries

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Canadian Battery Association (CBA)				
Total Items Collected	Tonne	EPR PROGRAM	13,395	13,395,000 kg LABs recovered in 2014 by CBA members as per Annual report 2014.
Plastics (Other)	Tonne	EPR PROGRAM	1,507	Assumed the following break-down of the LAB (as calculated based on CBA Annual report 2011): 15% plastic, 60% lead, 25% electrolyte. 75% of plastic LAB casings recycled into new LAB casings. 25% goes to
Lead	Tonne	EPR PROGRAM	8,037	Assumed the following break-down of the LAB (as calculated based on CBA Annual report 2011): 15% plastic, 60% lead, 25% electrolyte.
Hazardous Waste	Tonne	EPR PROGRAM	3,349	Assumed the following break-down of the LAB (as calculated based on CBA Annual report 2011): 15% plastic, 60% lead, 25% electrolyte.
Interstate Battery System of Canada Inc. (IBSC)				
Total Items Collected	Tonne	EPR PROGRAM	3,660	Recovery for Interstate based on 2014 Annual Report minus waste batteries sold to Interstate by CBA members as per CBA Annual report 2014.
Plastics (Other)	Tonne	EPR PROGRAM	549	Recovery for Interstate based on 2014 Annual Report minus waste batteries sold to Interstate by CBA members as per CBA Annual report 2014.
Lead	Tonne	EPR PROGRAM	2,196	IBSC did not provide break down into component material in Annual report 2014. Assumed the following break-down of the LAB (as calculated based on CBA Annual report 2011): 15% plastic, 60% lead, 25%
Hazardous Waste	Tonne	EPR PROGRAM	915	IBSC did not provide break down into component material in Annual report 2014. Assumed the following break-down of the LAB (as calculated based on CBA Annual report 2011): 15% plastic, 60% lead, 25%
Call2Recycle				
Total Items Collected	Tonne	EPR PROGRAM	461	In the AR 2014: This comprises both single use and rechargeable batteries.
Batteries	Tonne	EPR PROGRAM	461	In the AR 2014: This comprises both single use and rechargeable batteries.

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
CBA				
Plastics (Other)	%	STATUS QUO	25	Lower recovery rate assumed due to the relatively low commodity value for plastic.
		EPR PROGRAM	70	As per PRO annual report 2014
Lead	%	STATUS QUO	93	High commodity value for lead drives collection of LAB and electrolyte would be recovered as part of the process. A baseline recovery rate of 93% was established for 2011 prior to the EPR program.
		EPR PROGRAM	100	Lead and Electrolytes
Hazardous Waste	%	STATUS QUO	93	High commodity value for lead drives collection of LAB and electrolyte would be recovered as part of the process. A baseline recovery rate of 93% was established for 2011 prior to the EPR program.
		EPR PROGRAM	100	As per PRO annual report 2014

IBSC				
Plastics (Other)	%	STATUS QUO	25	Lower recovery rate assumed due to the relatively low commodity value for plastic.
		EPR PROGRAM	70	As reported in CBA Annual report 2014 when the tonnages are combined with those of Interstate. Interstate's report confirms this.
Lead	%	STATUS QUO	93	High commodity value for lead drives collection of LAB and electrolyte would be recovered as part of the process. A baseline recovery rate of 93% was established for 2011 prior to the EPR program.
		EPR PROGRAM	100	As reported in CBA Annual report 2014 when the tonnages are combined with those of Interstate. Interstate's report confirms this.
Hazardous Waste	%	STATUS QUO	93	High commodity value for lead drives collection of LAB and electrolyte would be recovered as part of the process. A baseline recovery rate of 93% was established for 2011 prior to the EPR program.
		EPR PROGRAM	100	As reported in CBA Annual report 2014 when the tonnages are combined with those of Interstate. Interstate's report confirms this.
Call2Recycle				
Overall Recovery Rate	kg/capita	STATUS QUO	0	Based on 2008 quantity collected under Call2Recycle voluntary collection program for rechargeable batteries. Assumed limited collection of low value alkaline batteries prior to EPR program.
		EPR PROGRAM	0	Recovery rate was not provided as per the Recycling regulation. Kg/capita is a better reflection of the recovery rate.
Batteries	kg/capita	STATUS QUO	0.01	Based on 2008 quantity collected under Call2Recycle voluntary collection program for rechargeable batteries. Assumed limited collection of low value alkaline batteries prior to EPR program.
		EPR PROGRAM	0.10	Recovery rate was not provided as per the Recycling regulation. Kg/capita is a better reflection of the recovery rate.

RESIDUE SENT TO LANDFILL/ENERGYRECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
CBA				
Residue sent to residual management	Tonne		134	As per the Annual report 2014, 99% of lead in LABs recovered in smelting process. 1% of dross is privately
Residue sent to energy recovery/incineration	Tonne		502	Assumed the following break-down of the LAB (as calculated based on CBA Annual report 2011): 15% plastic, of which 25% goes to resource recovery (Annual
IBSC				
Residue sent to residual management	Tonne		0	No waste to landfill data reported by PRO
Residue sent to energy recovery/incineration	Tonne		0	No waste to energy data reported by PRO
Call2Recycle				
Residue sent to residual management	Tonne		0	No data on waste to landfill reported by PRO
Residue sent to energy recovery/incineration	Tonne		0	No data on waste to energy reported by PRO

PROGRAM OPERATING COSTS

ITEM NAME/DESCRIPTION	UNIT	ESTIMATES (LOW/HIGH	VALUE	REFERENCE NOTE
CBA	$million	NOTE APPLICABLE	0	No program operating cost provided
IBSC	$million	NOTE APPLICABLE	0	No operation cost provided
Call2Recycle	$million	NOTE APPLICABLE	1.8	BC expenses were $1,800,276 expenses as per communication with PRO Feb 12.

EPR Program - Beverage Container

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Encorp				
Total Items Collected	Tonne	EPR PROGRAM	91074	Estimated weight of all containers recovered (tonnes) as reported in Encorp Annual Report 2014
Glass	Tonne	EPR PROGRAM	72010	Estimated weight of glass containers recovered as reported in Encorp Annual Report 2014
PET	Tonne	EPR PROGRAM	11606	Estimated weight of Plastic containers recovered as reported in Encorp Annual Report 2014 (PET makes up
Plastics (Other)	Tonne	EPR PROGRAM	361	Sum of tonnes of other Plastic (Laminate Pouches and Plastic Bag-In Box) as reported in Encorp Annual Report
Aluminum	Tonne	EPR PROGRAM	4884	Estimated weight of Al containers recovered as reported in Encorp Annual Report 2014
Steel	Tonne	EPR PROGRAM	324	Sum of tonnes of other Steel (Bi-metal containers -two sizes) as reported in Encorp Annual Report 2014
Polycoat	Tonne	EPR PROGRAM	1889	Sum of tonnes of other Steel (Bi-metal containers -two sizes) as reported in Encorp Annual Report 2014
BDL				
Total Items Collected	Tonne	EPR PROGRAM	28711	As reported as Weight of Materials Diverted (tonnes) in Annual report 2014
Glass	Tonne	EPR PROGRAM	21806	As reported in Annual report 2014. Assuming that only 5% was recycled and 95% was reused.
Aluminum	Tonne	EPR PROGRAM	6905	As reported in Annual report 2014

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
ENCORP				
Glass	%	STATUS QUO	22	Reference Information not available
		EPR PROGRAM	91.1	As reported on page 44 of Annual report 2014
PET	%	STATUS QUO	14	Reference Information not available
		EPR PROGRAM	76.5	As reported on page 44 of Annual report 2014
HDPE	%	STATUS QUO	0	Reference Information not available
		EPR PROGRAM	0	As reported on page 44 of Annual report 2014
Plastics (Other)	%	STATUS QUO	14	Reference Information not available
		EPR PROGRAM	76.5	As reported on page 44 of Annual report 2014
Aluminum	%	STATUS QUO	27	Reference Information not available
		EPR PROGRAM	84.2	As reported on page 44 of Annual report 2014
Steel	%	STATUS QUO	27	Reference Information not available
		EPR PROGRAM	63.6	As reported on page 44 of Annual report 2014
Polycoat	%	STATUS QUO	5	Reference Information not available

		EPR PROGRAM	64.2	As reported on page 44 of Annual report 2014
BDL				
Glass	%	STATUS QUO	95	In the earliest report published by the BC Ministry of Environment on beverage containers (reporting period 1998-1999), it presented a recovery rate for BDL of 91.16%. This was used as the status quo assumption. Updated as 95% on April 1, 2016
		EPR PROGRAM	95	As reported for total refillables in 2014 Annual report
Aluminum	%	STATUS QUO	27	Curbsite recycling with moderate capture rate
		EPR PROGRAM	93	As reported for cans

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Encorp				
Residue sent to residual management	Tonne		0	No tonnage reported by PRO for Waste to landfill
Residue sent to Energy Recovery/Incineration	Tonne		0	No tonnage reported by PRO for Waste to energy
BDL				
Residue sent to residual management	Tonne		0	No Landfill Quantity reported by PRO
Residue sent to Energy Recovery/Incineration	Tonne		0	No WtE tonnage reported by PRO

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
Encorp				
Total Items Collected	Tonne	EPR PROGRAM	0	No reused material is reported by PRO
BDL				
Glass	Tonne	EPR PROGRAM	20716	As reported in Annual report 2014. Assuming that only 5% was recycled and 95% was reused.

PROGRAM OPERATING COSTS

PRO Name	UNIT	ESTIMATES (LOW/HIGH	VALUE	REFERENCE NOTE
BDL	$million	NOT APPLICABLE	90.6	As reported in Encorp Annual Report 2014
BDL	$million	NOT APPLICABLE	0	BDL were not willing to share any financial information for 2014

EPR Program - Electronics

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Canadian Wireless Telecommunications Association (CWTA)				
Total Items Collected	Number	EPR PROGRAM	134173	Number of cell phone devices collected (all initiatives) as per CWTA Annual Report 2014 (Includes Recycle My Cell initiatives and internal)
Electronics	Tonne	EPR PROGRAM	26.8	When we convert units to weight we assumed 0.2kg/device as per advice from CWTA
Call2Recycle				
Total Items Collected	Number	EPR PROGRAM	29594	When we convert units to weight we assumed 0.2kg/device as per advice from CWTA

Electronics	Tonne	EPR PROGRAM	5.9	When we convert units to weight we assumed 0.2kg/device as per advice from CWTA Dec 2012
Electronic Products Recycling Association (EPRA)				
Total Items Collected	Tonne	EPR PROGRAM	22271	Tonnes of electronic waste collected through in 2014 as per EPRA Annual Report 2014
Glass	%	EPR PROGRAM	34.2	% of material stream turned into cullet for use in glass production, including 0.67% for non-leaded and 33.53% for leaded glass = 34.20%
Plastics (Other)	%	EPR PROGRAM	18.1	18.10% plastics recycled.
Aluminum	%	EPR PROGRAM	1.0	1.01% of materials aluminium that is reclaimed as per Annual report 2014
Steel	%	EPR PROGRAM	26.4	20.49 % of material stream (ferrous metals) that is reclaimed as per Annual report 2014. Mixed metals (5.72%) and 0.17% for batteries since we have no material category for this. Mixed metals are primarily residual ferrous metal, copper, aluminum, and precious
Electronics	%	EPR PROGRAM	7.0	7.04% circuit boards reclaimed as per annual report
Hazardous Waste	%	EPR PROGRAM	0.0	0.02% of material is Ethylene Glycol which is reclaimed
Copper	%	EPR PROGRAM	5.7	1.51% of material stream is wires and cables. Assuming copper makes up the majority. 3.10% of stream was copper. 1.07% of stream is copper yokes = gives a total
Canadian Electrical Stewardship Association (CESA)				
Total Items Collected	Tonne	EPR PROGRAM	3672.27	Approximately 3,672,265 kg of CESA products collected in 2014 as per the Annual report 2014.
Glass	%	EPR PROGRAM	1.1	1.1% of total weight collected was glass according to Annual report 2014.
Plastics (Other)	%	EPR PROGRAM	14.8	14.8% of total weight collected was plastics according to Annual report 2014.
Aluminum	%	EPR PROGRAM	6	6.0% of total weight collected was aluminum according to Annual report 2014.
Steel	%	EPR PROGRAM	66.7	66.7% of total weight collected was ferrous steel according to Annual report 2014.
Electronics	%	EPR PROGRAM	0.9	0.9% of total weight collected was circuitboards according to Annual report 2014.
Batteries	%	EPR PROGRAM	1.2	1.2% (0.7% rechargable and 0.5% non-rechargeable) of total weight collected was batteries according to Annual report 2014.
Copper	%	EPR PROGRAM	7.6	3.2% of total weight collected was copper according to Annual report 2014. Also included 4.4% collected as wires and cables as we assumed that copper make up the majority of these.
General Electric Canada (Healthcare) (GECH)				
Total Items Collected	Number	EPR PROGRAM	4	Only 4 items were collected during 2014 as per GEHC Annual report 2014
Electronics	Tonne	EPR PROGRAM	0.8	All medical devices and systems collected and returned from B.C. (> 200 kilograms in weight) were re-sold and did not enter. The recycling stream as per GEHC Annual report 2014. No quantity specified. Assumed that each
Shaw Communications Inc.				
Total Items Collected	Tonne	EPR PROGRAM	766.19	Tonnes equipment recovered in BC as per Shaw Communications Inc. Annual report 2014

Electronics	Tonne	EPR PROGRAM	766.19	Tonnes equipment recovered in BC as per Shaw Communications Inc. Annual report 2014
TELUS Communications Company				
Total Items Collected	Tonne	EPR PROGRAM	412	Tonnes equipment recovered in BC as per Telus Annual report 2014
Electronics	Tonne	EPR PROGRAM	412	Tonnes equipment recovered in BC as per Telus Annual report 2014
Major Appliance Recycling Roundtable (MARR)				
Total Items Collected	Tonne	EPR PROGRAM	37566	Tonnes of major appliances were collected in 2014 as per Annual report 2014
Aluminum	Tonne	EPR PROGRAM	2103.14	Tonnes of major appliances were collected in 2014 as per Annual report 2014
Steel	Tonne	EPR PROGRAM	25998.75	69.2% Estimated Ferrous Metal Composition based on 2012 MARR System Report

RECOVERY RATES

CWTA				
Electronics	kg/capita	STATUS QUO	0.006	Estimated based on total tonnage collected and population (same as EPR Program RR)
		EPR PROGRAM	0.006	Estimated based on total tonnage collected and
Call2Recycle				
Electronics	kg/capita	STATUS QUO	0.001	Same as EPR
		EPR PROGRAM	0.001	Estimated using total tonnage and 2014 population
EPRA				
Overall Recovery Rate	kg/capita	STATUS QUO	0.6	In the Genuine Wealth Assessment of Alberta's stewardship programs, it estimated that at the most 1,670 tonnes of electronic/electrical products would have been recovered in 1999 prior to the EPR program (Anielski Management Inc., 2007). With a population of 2,819,423 in 1999 (Alberta Municipal Affairs, 2013) this equates to 0.6 kg/capita which was assumed as the
		EPR PROGRAM	4.9	As reported by PRO calculated as kg/capita
Glass	kg/capita	STATUS QUO	0.21	Based on % break down calculated per capita
		EPR PROGRAM	1.81	Based on % break down calculated per capita
Plastics (Other)	kg/capita	STATUS QUO	0.11	Based on % break down calculated per capita
		EPR PROGRAM	0.96	Based on % break down calculated per capita
Aluminum	kg/capita	STATUS QUO	0.01	Based on % break down calculated per capita
		EPR PROGRAM	0.05	Based on % break down calculated per capita
Steel	kg/capita	STATUS QUO	0.16	Based on % break down calculated per capita
		EPR PROGRAM	1.40	Based on % break down calculated per capita
Electronics	kg/capita	STATUS QUO	0.04	Based on % break down calculated per capita
		EPR PROGRAM	0.37	Based on % break down calculated per capita
Copper	kg/capita	STATUS QUO	0.03	Based on % break down calculated per capita
		EPR PROGRAM	0.30	Based on % break down calculated per capita

CESA				
Overall Recovery Rate	kg/capita	STATUS QUO	0.023	CESA believes that a small portion of the products (approximately 100 tonnes per year) would have been collected by individual retailers prior to the EPR program start. Although CESA suggested that a large proportion of discarded microwaves would have been recycled even without the EPR program, they were unable to estimate this quantity. The study based the status quo recovery rate on 100 tonnes divided by BC's population in 2011.
		EPR PROGRAM	0.792	Reporting on a recovery rate is not applicable per the currently approved product stewardship plan. Using kg/capita instead. Same methodology as in last study.
GECH				
Electronics	kg/capita	STATUS QUO	0.00005	In the first year of operation (2012) the PRO only collected 1 device (>200 kg) collected from BC. This is assume to be representative of a status quo scenario since the program was new.
		EPR PROGRAM	0.0002	As reported by PRO calculated as kg/capita
Shaw Communications Inc.				
Electronics	kg/capita	STATUS QUO	0.15	Recovery rate as per Shaw Communications Inc. Annual report 2014 was not in accordance to BC recycling regulation. Used kg/capita as a more accurate recovery
		EPR PROGRAM	0.17	Status Quo: Shaw commenced the EPR program in 2012. During the six months of the first year of operation, Shaw reported that 340.645 tonnes were recovered. When extrapolated to account for a full year this equates to 0.15 kg/capita based on 2012 BC population. This is assume to be representative of a status quo scenario since the program was new.
TELUS				
Electronics	kg/capita	STATUS QUO	0.0033	Status Quo: TELUS has been recovering our electronics for refurbishing for reuse or reselling for about 20 years now and has had a recycling process in place since 2005. TELUS developed our own BC Electronic Equipment Stewardship Plan in 2010 to adhere to the BC electronics recycling Regulation where we now formally report on our results. In 2010 they recycled 14.993 tonnes of products. Equates to 0.0033 kg/capita
		EPR PROGRAM	0.09	42.75% as per Telus Annual report 2014, however used kg/capita as a more accurate recovery rate in order to compare with Status Quo value.
MARR				
Aluminum	%	STATUS QUO	90	Based on System Study by MARR (Ecoinspire, 2013) the market-driven collection and recycling system for end-of-life appliances continues to achieve a collection rate
		EPR PROGRAM	98	98% of major appliances available to collect were captured. as reported in annual report 2014. We may want to calculate the kg/capita as an alternative

Steel	%	STATUS QUO	90	Based on System Study by MARR (Ecoinspire, 2013) the market-driven collection and recycling system for end-of-life appliances continues to achieve a collection rate
		EPR PROGRAM	98	98% of major appliances available to collect were captured. As reported in annual report 2014. We may want to calculate the kg/capita as an alternative

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
CWTA				
Residue sent to residual management	Tonne		0	NA
Residue sent to Energy Recovery/Incineration	Tonne		0	NA
Call2Recycle				
Residue sent to residual management	Tonne		0	NA
Residue sent to Energy Recovery/Incineration	Tonne		0	NA
EPRA				
Residue sent to residual management	%		4.33	68% of tonnes recovered (equals 126705.216) were Category 1 (printed papers), 2 (corrugated cardboard), 3B fibres (other paper packaging not containing liquids when sold). Without any further break-down we assumed the material category Other Paper. MMBC also reported on 13% belonging to commingled collection of paper, plastic, steel and aluminum containers. 2,659 tonnes of this was estimated as Other Paper (11%). The total Other Paper equals:
Residue sent to Energy Recovery/Incineration	%		3.24	3.23% of total weight collected was refuse to landfill according to Annual report 2014.
CESA				
Residue sent to residual management	%		0.8	0.8% of total weight collected was refuse to landfill according to Annual report 2014.
Residue sent to Energy Recovery/Incineration	%		0.9	0.9% of total weight collected was paper based material sent to energy recovery and 0.2% of collected materials as heating oil sent for energy recovery
GECH				
Residue sent to residual management	Tonne		0	NA
Residue sent to Energy Recovery/Incineration	Tonne		0	NA

Shaw Communications Inc.				
Residue sent to residual management	Tonne		0	NA
Residue sent to Energy Recovery/Incineration	Tonne		0	NA
TELUS				
Residue sent to residual management	Tonne		0	NA
MARR				
Residue sent to residual management	Tonne		9464.11	as per Annual report 2014, the remaining portion, including plastic, glass, rubber and foam, does not undergo further processing, and is currently sent to landfill as part of the shredder residue to serve as landfill cover. Without any details on recycled plastics,
Residue sent to Energy Recovery/Incineration	Tonne		0	NA

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	Level	VALUE	REFERENCE NOTE
GECH				
Electronics	Tonne	EPR PROGRAM	0.8	As per PRO annual report 2014

PROGRAM OPERATING COSTS

ITEM NAME/DESCRIPTION	UNIT	ESTIMATES (LOW/HIGH	VALUE	REFERENCE NOTE
CWTA	$million	NOT APPLICABLE	0	NA
Call2Recycle	$million	NOT APPLICABLE	0	Not available
EPRA	$million	NOT APPLICABLE	22.3	PRO annual report 2014
CESA	$million	NOT APPLICABLE	2.7	PRO annual report 2014
GECH	$million	NOT APPLICABLE	0.014	PRO annual report 2014
Shaw Communications Inc.	$million	NOT APPLICABLE	0	Not available
TELUS	$million	NOT APPLICABLE	0	Not available
MARR	$million	NOT APPLICABLE	0.45	Expenses as per Annual report 2014.

EPR Program - Lamps and Lighting Equipment

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				
Total Items Collected	Tonne	EPR PROGRAM	1022	Glass and Aluminum added to estimate total tonnage

Glass	Tonne	EPR PROGRAM	760	Estimated by processor according to PRO (email communication)
Aluminum	Tonne	EPR PROGRAM	262	262 tonnes Material Quantities recovered as per LightRecycle Annual Report 2014. Assuming all of the fixtures were aluminum since this makes up the

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				
Glass	kg/capita	STATUS QUO	0.002	Recovery was very limited and two processors existed. The BC based processor Nu-Life estimated that in 2003 only 1% of its total quantity of recovered lights came from residential sources (approximately 2.35 tonnes) (Nu-Life Industries personal communication, 2013). The other major processor in BC (Contact Environmental) was assumed to receive the same quantities. Residential sources made up 4.7 tonnes in 2003, or 0.5% of total collected quantities in 2014. This portion
		EPR PROGRAM	0.16	As reported by PRO calculated as kg/capita calculated as kg/capita
Aluminum	kg/capita	STATUS QUO	0.001	Refer to ref note for glass
		EPR PROGRAM	0.06	As reported by PRO calculated as kg/capita calculated as kg/capita

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				
Residue sent to residual management	Tonne		0	No waste to landfill tonnage reported by PRO
Residue sent to Energy Recovery/Incineration	Tonne		0	No waste to energy tonnage reported by PRO

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

Product Care Association				
ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
Total Items Collected	Tonne	EPR PROGRAM	0	No items reused

PROGRAM OPERATING COSTS

ITEM NAME/DESCRIPTION	UNIT	ESTIMATES (LOW/HIGH	VALUE	REFERENCE NOTE
Product Care	$million	NOT APPLICABLE	3.57	As per LightRecycle Annual Report 2014

EPR Program - Packaging and Printed Paper

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Multi Material BC (MMBC)				
Total Items Collected	Tonne	EPR PROGRAM	186332	The figures reflect 7.5 months of program operation ((116457/7.5)*12) = 186331.2 tonnes in 12 months of operation)
Glass	Tonne	EPR PROGRAM	14907	8% of tonnes recovered were glass according to MMBC
Plastics (Other)	Tonne	EPR PROGRAM	18390	1% of tonnes recovered (1863.312) was Category 4 film (polyethylene film packaging). MMBC also reported on 13% belonging to commingled collection of paper, plastic, steel and aluminum containers. 16,527tonnes of this (68%) was estimated as Other Plastics (Plastic packaging other than PS and film). The total Other Plastics equals: 1863.312 +16527= 19579.312
Aluminum	Tonne	EPR PROGRAM	2374	MMBC also reported on 13% belonging to commingled collection of paper, plastic, steel and aluminum containers. 2,374 tonnes of this (10%) was estimated as Al packaging based on MMBC Current system study
Steel	Tonne	EPR PROGRAM	2664	MMBC also reported on 13% belonging to commingled collection of paper, plastic, steel and aluminum containers. 2,664 tonnes of this (11%) was estimated as steel packaging based on MMBC Current system study
Paper (Other Paper)	Tonne	EPR PROGRAM	129364	68% of tonnes recovered (equals 126705.216) were Category 1 (printed papers), 2 (corrugated cardboard), 3B fibres (other paper packaging not containing liquids when sold). Without any further break-down we assumed the material category Other Paper. MMBC also reported on 13% belonging to commingled collection of paper, plastic, steel and aluminum containers. 2,659 tonnes of this was estimated as Other Paper (11%). The total Other Paper equals:

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
MMBC				
Overall Recovery Rate	kg/capita	STATUS QUO	46.8	Based on quantities in Current System report (MMBC
		EPR PROGRAM	54.0	Recovery Rate calculated as kg/capita based on MMBC annual report 2014
Glass	kg/capita	STATUS QUO	0.8	Based on quantities in Current System report (MMBC
		EPR PROGRAM	4.8	Recovery Rate calculated as kg/capita based on MMBC annual report 2014
Plastics (Other)	kg/capita	STATUS QUO	3.0	Based on quantities in Current System report (MMBC
		EPR PROGRAM	5.9	Recovery Rate calculated as kg/capita based on MMBC annual report 2014
Aluminum	kg/capita	STATUS QUO	0.4	Based on quantities in Current System report (MMBC
		EPR PROGRAM	0.9	Recovery Rate calculated as kg/capita based on MMBC annual report 2014
Steel	kg/capita	STATUS QUO	0.4	Based on quantities in Current System report (MMBC
		EPR PROGRAM	0.9	Recovery Rate calculated as kg/capita based on MMBC annual report 2014
Paper (Other Paper)	kg/capita	STATUS QUO	42.2	Based on quantities in Current System report (MMBC

		EPR PROGRAM	41.7	Recovery Rate calculated as kg/capita based on MMBC annual report 2014

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
MMBC				
Residue sent to residual management	Tonne		18633.1	In 2014, 7% of Non-PPP and Fines and the 3% of Other materials-PPP of total tonnes recovered were assumed to be landfilled. Most (maybe all) of the Non-PPP and all of the Fines and Other Materials would have been discarded as residue (Glenda Gies, 2016). This is a conservative approach since no further data was available. 10% of total quantities equals 18,633 tonnes. The reported categories were assumed to be residue.
Residue sent to Energy Recovery/Incineration	Tonne		0	No tonnage reported by PRO sent to energy recovery

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
MMBC				
Total Items Collected	Tonne	EPR PROGRAM	0	No reused materials reported by PRO

EPR Program - Paint and Household Hazardous Waste

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				
HDPE	Tonne	EPR PROGRAM	306	As tonnes of HDPE plastics collected in paint and HHW containers in 2014
Plastics (Other)	Tonne	EPR PROGRAM	116	As tonnes of PVC and PP plastic collected in paint and HHW containers in 2014 (52+64 tonnes respectively = 116 tonnes)
Steel	Tonne	EPR PROGRAM	748	As tonnes of metal (steel assumed) collected in paint and HHW containers in 2014
Paints	Tonne	EPR PROGRAM	3116	A total of 3,115,909 Litres collected (2,943,339 + 38,413+ 112,478+ 21,679) for Paint (non aerosol), Paint Aerosol, Flammable Liquids and Pesticides respectively as reported in Annual report 2014.

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				

HDPE	kg/capita	STATUS QUO	0.05	The recovery rate (kg/capita) for container material would have improved between the status quo scenario and the EPR situation as much as that of the contents of the containers (25% improvement as shown for Ontario municipal hazardous or special waste collection program). We assume the steel containers would have
		EPR PROGRAM	0.07	As reported by PRO calculated as kg/capita
Plastics (Other)	kg/capita	STATUS QUO	0.02	See reference note for SQ: HDPE
		EPR PROGRAM	0.03	See reference note for EPR: HDPE
Steel	kg/capita	STATUS QUO	0.12	As reported by PRO calculated as kg/capita
		EPR PROGRAM	0.16	See reference note for EPR: HDPE
Hazardous Waste	kg/capita	STATUS QUO	0.51	See reference note for SQ: HDPE
		EPR PROGRAM	0.67	As reported by PRO calculated as kg/capita

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				
Residue sent to residual management	Tonne		13	0.7% of latex paint was sent to landfill. This equated to 13,200 Litres in 2014 according to Product Care.
Residue sent to Energy Recovery/Incineration	Tonne		913	According to PRO, 912800 Litres was the total volumes sent to energy recovery in 2014

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
Product Care Association				
Total Items Collected	Tonne	EPR PROGRAM	0	Reused tonnage not reported

PROGRAM OPERATING COSTS

PRO Name	UNIT	Estimates(Low/High)	VALUE	REFERENCE NOTE
Product Care	$million	NOT APPLICABLE	7	As reported in Annual report 2014

EPR Program - Pharmaceutical Waste

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Health Product Stewardship Association				
Total Items Collected	Tonne	EPR PROGRAM	96.68	As reported in PHPSA's annual report for BC 2014. All sent for proper destruction by incineration

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Health Product Stewardship Association				

Overall Recovery Rate	kg/capita	STATUS QUO	0.017	Alberta, Saskatchewan and Ontario all reported recovery rates that are slightly lower than that recorded by BC's EPR program in 2014. The average between the three provinces is 0.017 kg/capita.
		EPR PROGRAM	0.021	As reported by PRO calculated as kg/capita

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Health Product Stewardship Association				
Residue sent to residual management	Tonne		0	No data on waste to landfill
Residue sent to Energy Recovery/Incineration	Tonne		96.7	As reported in PHPSA's annual report for BC 2014. All sent for proper destruction by incineration

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
Health Product Stewardship Association				
Total Items Collected	Tonne	EPR PROGRAM	0	No tonnage reused

PROGRAM OPERATING COSTS

PRO Name	UNIT	ESTIMATES (LOW/HIGH	VALUE	REFERENCE NOTE
Health Product Stewardship Association	$million	NOT APPLICABLE	0.37	Reference note to be entered here

EPR Program - Smoke Alarms

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				
Total Items Collected	Number	EPR PROGRAM	44253	The program collected approximately 44,253 units in 2014 as per the Annual report 2014.
Electronics	Tonne	EPR PROGRAM	13.3	Product Care: an alarm weighs approximately 0.2-0.4 kg. We took 0.3 kg as an average.
Batteries	Tonne	EPR PROGRAM	0	No reference available

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				

Electronics	kg/capita	STATUS QUO	0.00143	Approximately 50% of Product Care's current alarm collection quantities come from large volume end-users. Prior to the EPR program implementation Product Care believes that these volumes were still being recycled. The remaining proportion was assumed to be landfilled.
		EPR PROGRAM	0.00286	As reported by PRO calculated in kg/capita.

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Product Care Association				
Residue sent to residual management	Tonne		0	No tonnage data reported by PRO on waste to landfill
Residue sent to Energy Recovery/Incineration	Tonne		0	No tonnage data reported by PRO in waste to energy

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
Product Care Association				
Total Items Collected	Tonne	EPR PROGRAM	0	No material reused

PROGRAM OPERATING COSTS

PRO Name	UNIT	ESTIMATES (LOW/HIGH	VALUE	REFERENCE NOTE
Product Care	$million	NOT APPLICABLE	0.18	Program expenses 2014 as per the Annual report 2014.

EPR Program - Thermostat

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Scout Environmental				
Total Items Collected	Number	EPR PROGRAM	3515	A total of 3,515 collected as per Annual report 2014. Because thermostats vary quite significantly from model to model in terms of size, shape, and composition, the PRO cannot provide an average weight of a thermostat
Glass	Tonne	EPR PROGRAM	0.0058	Each vessel has approximately 1 gram of glass. In 2014 we recycled approximately 5.783 kg of glass Information as per personal communication with
HDPE	Tonne	EPR PROGRAM	0.1092	109.18 kilograms of plastics recycled as per Annual Report BC 2014,
Steel	Tonne	EPR PROGRAM	0.0808	In 2014, as per Annual Report BC 2014. This is not specific to mercury.

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Scout Environmental				
Overall Recovery Rate	units/capita	STATUS QUO	0.000000	Thermostats were likely to be landfilled since they were cost prohibitive to collect and recover. Without an EPR program, some collection system could be in place by contractors, however negligible recovery was assumed from this. The information is based on interview with HRAI for the last study (Morrison Hershfield 2014).
		EPR PROGRAM	0.000760	Units/capita was used since recovery rates in % or kg/capita could be used
Glass	units/capita	STATUS QUO	0.000000	Refer to reference note for overall SQ recovery rate
		EPR PROGRAM	0.000001	Units/capita was used since recovery rates in % or kg/capita could be used
HDPE	units/capita	STATUS QUO	0.000000	Refer to reference note for overall SQ recovery rate
		EPR PROGRAM	0.000024	Units/capita was used since recovery rates in % or kg/capita could be used
Steel	units/capita	STATUS QUO	0.000000	Refer to reference note for overall SQ recovery rate
		EPR PROGRAM	0.000017	Units/capita was used since recovery rates in % or kg/capita could be used

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Scout Environmental				
Residue sent to residual management	Tonne		0	No tonnage landfill data reported
Residue sent to Energy Recovery/Incineration	Tonne		0	No tonnage waste to energy data reported

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
Scout Environmental				
Total Items Collected	Tonne	EPR PROGRAM	0	No item reused

PROGRAM OPERATING COSTS

PRO Name	UNIT	Estimates(Low/High)	VALUE	REFERENCE NOTE
Scout Environmental	$million	Not Applicable	0	no cost provided

EPR Program - Tires

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Tire Stewardship BC (TSBC)				
Rubber	Tonne	EPR PROGRAM	31430	Total tonnes of tires recycled as per TSBC Annual Report 2014 across all types. Recycled portion is 77% of 40,818 tonnes (26271+13836+525+186= 40,818) collected.

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Tire Stewardship BC (TSBC)				
Rubber	%	STATUS QUO	63	According to TSBC there was tire recycling and recovery taking place in BC even before the EPR program with recovery rates of between 50% and 75% (e.g. truck tires and other tires in urban areas). A mid-point recovery rate of 63% was assumed.
		EPR PROGRAM	76	The 2014 "Recovery Rate," a by the BC Recycling Regulation, was 76% across all regulated tire types as per the Annual report 2014.

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Tire Stewardship BC (TSBC)				
Residue sent to residual management	Tonne		408	1% of quantities were sent to landfill disposal as per Annual report 2015
Residue sent to Energy Recovery/Incineration	Tonne		8980	22% of quantities were sent to energy recovery as per Annual report 2014

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
Tire Stewardship BC (TSBC)				
Total Items Collected	Tonne	EPR PROGRAM	0	No quantity provided by PRO on Reused Tires

EPR Program - Used Oil and Antifreeze Products

MATERIAL QUANTITIES COLLECTED

ITEM NAME/DESCRIPTION	UNIT	SCENARIO	VALUE	REFERENCE NOTE
BC Used Oil Management Association (BCUOMA)				
HDPE	Tonne	EPR PROGRAM	1.5	Quantities recovered as per BCUOMA Annual Report

Steel	Tonne	EPR PROGRAM	3.1	Calculated tonnes of steel for number of filters collected as per BCUOMA Annual Report 2014 based on the weight of steel per filter. This was provided by GHG report by CRA 2009 in which 2,683,843.32 kg steel was divided by 4,774,800 (no of filters collected in 2009 as reported). Each filter is assumed to have 0.56 kg steel.
Used Oil	Tonne	EPR PROGRAM	2.6	Antifreeze as per BCUOMA Annual Report 2014. Assuming same density as water as per advice from
Hazardous Waste	Litre	EPR PROGRAM	48054279	Litres collected as per BCUOMA Annual Report 2014. Assuming same density as water as per advice from

RECOVERY RATES

MATERIAL	UNIT	SCENARIO	VALUE	REFERENCE NOTE
BC Used Oil Management Association (BCUOMA)				
HDPE	%	STATUS QUO	12	Prior to the commencement of the BCUOMA program in 2003, it was estimated that the recovery rate for used oil containers was 12% (BCUOMA, 2012).
		EPR PROGRAM	70	as per BCUOMA 2014 Annual report
Steel	%	STATUS QUO	18	Prior to the commencement of the BCUOMA program in 2003, it was estimated that the recovery rate for used oil filters was 18% (BCUOMA, 2012).
		EPR PROGRAM	86	As per BCUOMA 2014 Annual report re recovery rates for oil filters
Used Oil	%	STATUS QUO	60	Prior to the commencement of the EPR program in 2003, BCUOMA estimated that the recovery rate for used oil was 60% (BCUOMA, 2012).
		EPR PROGRAM	74	As per BCUOMA 2014 Annual report
Hazardous Waste	%	STATUS QUO	25	Without having an actual estimate BCUOMA commented that the recovery rate would be less than with the EPR program. We assumed a recovery rate of 25%, however this is not supported by any reference.
		EPR PROGRAM	37	As per BCUOMA 2014 Annual report

RESIDUE SENT TO LANDFILL/ENERGY RECOVERY/INCINERATION

RESIDUAL MANAGEMENT	UNIT	SCENARIO	VALUE	REFERENCE NOTE
Tire Stewardship BC (TSBC)				
Residue sent to residual management	Tonne		0	No residue to landfill reported
Residue sent to Energy Recovery/Incineration	Tonne		0	No residue to energy recovery reported

QUANTITIES OF COLLECTED MATERIALS REUSED (I.E. NOT RECYCLED)

ITEM NAME/DESCRIPTION	UNIT	LEVEL	VALUE	REFERENCE NOTE
Tire Stewardship BC (TSBC)				
Total Items Collected	Tonne	EPR PROGRAM	0	No reused tonnage reported

PROGRAM OPERATING COSTS

ITEM NAME/DESCRIPTION	UNIT	ESTIMATES (LOW/HIGH	VALUE	REFERENCE NOTE
Tire Stewardship BC (TSBC)	$million	NOT APPLICABLE	12.3	The 2014 program costs were $12.32 million as per Annual report 2014

APPENDIX B:
General Factors and Assumptions Used

GENERAL FACTORS AND ASSUMPTIONS USED - NON-MATERIAL SPECIFIC				
MATERIAL NAME	**UNIT**	**ESTIMATE**	**VALUE**	**REFERENCE NOTE**
Garbage Collection Costs	$ per tonne	Low	$ 97	Refer to Study Report Section 1.5.1
		High	$ 207	Refer to Study Report Section 1.5.1
Total Avoided Landfilling Costs	$ per tonne	Low	$ 42	Refer to Study Report Section 1.5.1
		High	$ 102	Refer to Study Report Section 1.5.1
Compacted Garbage Density	tonnes/m3	Low	0.7	Solid Waste Technology and Management, John Wiley & Sons, Aug 2, 2011, edited by Thomas Christensen. 350-420 kg/m3. In a highly compacted landfill the density can exceed 1,000 kg/m3. 700kg/m3 was assumed to reflect that not all landfills are well compacted.
		High	0.7	Same as above
Job production estimate for every tonne of MSW collected destined for landfill	# per tonne MSW	Low	0.0006	0.56 jobs per 1,000 tons, Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the
		High	0.0013	Jobs impacts from disposal Collection = 1.17 FTE per 1,000 tons, Container Recycling Institute 2011, Returning to Work: Understanding the Domestic Jobs Impacts from Different Methods of Recycling Beverage containers. This was converted to per metric tonne.
Job production estimate for every tonne of waste landfilled	# per tonne MSW	Low	0.0001	Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
		High	0.0007	Direct, indirect and induced landfilling related jobs per 1000 tonnes as included in AECOM's Economic Benefits of Recycling in Ontario
Job production estimate for every tonne of waste sent to energy recovery	# per tonne MSW	Low	0.000110	0.1 jobs per 1,000 tons (incineration), Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
		High	0.000110	Same as above
Energy in 1 barrel of crude oil	GJ	Low	6.2	Statistics Canada: http://www.statcan.gc.ca/pub/57-601-x/2010004/appendix-appendice1-eng.htm
		High	6.2	Same as above

GHG emissions from one car per year	eCO2	Low	4.75	United States Environmental Protection Agency. 2016. GHG Equivalencies Calculator - Calculations and References
		High	4.5	Same as above

APPENDIX C:
Material Specific Factors Used

MATERIAL SPECIFIC FACTORS

MATERIAL NAME	UNIT	ESTIMATE	VALUE	REFERENCE NOTE
Bulk Density of Material				
Glass	m3/tonne	Low	0.85	Semi-crushed glass (manually) - CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
		High	1.69	Crushed glass (mechanically, bin)- CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
PET	m3/tonne	Low	3.27	PET bottles (flattened) -CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
		High	22.73	PET bottles (baled) - CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
HDPE	m3/tonne	Low	4.22	HDPE bottles (flattened) -CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
		High	25.64	HDPE bottles (baled)- CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
Plastics (Other)	m3/tonne	Low	4.22	Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
		High	25.64	Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
Aluminum	m3/tonne	Low	3.91	Aluminum cans: flattened and compacted - CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
		High	4.81	Aluminum cans: flattened and compacted - CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.

Steel	m3/tonne	Low	3.46	Ferrous cans: flattened - CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
		High	4.17	Ferrous cans: flattened - CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
Polycoat	m3/tonne	Low	2.09	RESIDENTIAL WASTE MATERIALS DENSITY STUDY, WDO, 2001: bagged fibre (ONP, OBB, OCC, fine paper, polycoat, magazines, glossy, junk mail) (packed, by hand, into weighing container)
		High	6.55	RESIDENTIAL WASTE MATERIALS DENSITY STUDY, WDO, 2001: bagged fibre (ONP, OBB, OCC, fine paper,polycoat, magazines, glossy, junk mail) (packed, by hand, into weighing container)
Cardboard	m3/tonne	Low	2.02	Compacted corrugated cardboard - CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
		High	3.21	Compacted boxboard - CSR 2003, Residential GAP – Manual on Generally Accepted Principles (GAP) for Calculating Municipal Solid Waste System Flow, Development of a Methodology for Measurement of Residential Waste Diversion in Canada, November 2003 Release.
Number of Jobs Created (Including Collection, Processing and Manufacturing) From Recycling				
Glass	# jobs/tonne diverted	Low	0.005	5.4 per 1000 tonnes of bluebox materials diverted as shown in Table 6-1, AECOM's Economic Benefits of Recycling in Ontario, 2009, unpublished
		High	0.013	Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
PET	# jobs/tonne diverted	Low	0.005	5.4 per 1000 tonnes of bluebox materials diverted as shown in Table 6-1, AECOM's Economic Benefits of Recycling in Ontario, 2009, unpublished
		High	0.015	Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
HDPE	# jobs/tonne diverted	Low	0.005	5.4 per 1000 tonnes of bluebox materials diverted as shown in Table 6-1, AECOM's Economic Benefits of Recycling in Ontario, 2009, unpublished
		High	0.015	Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Plastics (Other)	# jobs/tonne diverted	Low	0.005	5.4 per 1000 tonnes of bluebox materials diverted as shown in Table 6-1, AECOM's Economic Benefits of Recycling in Ontario, 2009, unpublished
		High	0.015	Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Aluminum	# jobs/tonne diverted	Low	0.005	5.4 per 1000 tonnes of bluebox materials diverted as shown in Table 6-1, AECOM's Economic Benefits of Recycling in Ontario, 2009, unpublished
		High	0.026	Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Steel	# jobs/tonne diverted	Low	0.005	5.4 per 1000 tonnes of bluebox materials diverted as shown in Table 6-1, AECOM's Economic Benefits of Recycling in Ontario, 2009, unpublished

		High	0.009	Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Polycoat	# jobs/tonne diverted	Low	0.005	5.4 per 1000 tonnes of bluebox materials diverted as shown in Table 6-1, AECOM's Economic Benefits of Recycling in Ontario, 2009, unpublished
		High	0.015	Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Cardboard	# jobs/tonne diverted	Low	0.005	5.4 per 1000 tonnes of bluebox materials diverted as shown in Table 6-1, AECOM's Economic Benefits of Recycling in Ontario, 2009, unpublished
		High	0.009	More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Number of Jobs Created from Reusing Collected Products (i.e. Not Recycled)				
Glass	# jobs/tonne	Low	0.012	Figure for reuse/ remanufacture of Glass: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
		High	0.012	Figure for reuse/ remanufacture of Glass: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
PET	# jobs/tonne	Low	0.026	Figure for reuse/ remanufacture of Plastics: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
		High	0.026	Figure for reuse/ remanufacture of Plastics: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
HDPE	# jobs/tonne	Low	0.026	Figure for reuse/ remanufacture of Plastics: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
		High	0.026	Figure for reuse/ remanufacture of Plastics: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Plastics (Other)	# jobs/tonne	Low	0.026	Figure for reuse/ remanufacture of Plastics: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
		High	0.026	Figure for reuse/ remanufacture of Plastics: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Aluminum	# jobs/tonne	Low	0.026	Figure for reuse/ remanufacture of Al: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
		High	0.026	Figure for reuse/ remanufacture of Al: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Steel	# jobs/tonne	Low	0.026	Figure for reuse/ remanufacture of ferrous metals: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
		High	0.026	Figure for reuse/ remanufacture of ferrous metals: Sound Resource Management, 2011, More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.
Polycoat	# jobs/tonne	Low	0.000	NA
		High	0.000	NA
Cardboard	# jobs/tonne	Low	0.000	NA
		High	0.000	NA
Value of Recovered Material in End-Markets				

Glass	$ per tonne	Low	$ -	Value of material is generally lower than cost of transport. From study: MMBC, Program Design Options Final, 2012
		High	$ 36	Highest price in range given by EBA, Cascadia, May 2012 in Study: Recycling Market Study. Adjusted with CPI.
PET	$ per tonne	Low	$ 282	No BC data available. $274 was the lowest price recorded by WDO during 2013 in the Price Sheet, Reclay StewardEdge 2013, as monthly selling price per tonne, Program Design Option Report, MMBC 2012. This was adjusted with CPI to 2014 $.
		High	$ 507	According to Encorp Annual report 2014, plastic was $0.23 per pound = $507.10 per tonne.
HDPE	$ per tonne	Low	$ 450	No BC data available. $437 was the lowest price recorded by WDO during 2013 in the Price Sheet, Reclay StewardEdge 2013, as monthly selling price per tonne, Program Design Option Report, MMBC 2012. This was adjusted with CPI to 2014 $.
		High	$ 507	According to Encorp Annual report 2014, plastic was $0.23 per pound = $507.10 per tonne.
Plastics (Other)	$ per tonne	Low	$ 30	No BC data available. $28 was the lowest price recorded by WDO during 2013 in the Price Sheet, Reclay StewardEdge 2013, as monthly selling price per tonne, Program Design Option Report, MMBC 2012. This was adjusted with CPI to 2014 $.
		High	$ 507	According to Encorp Annual report 2014, plastic was $0.23 per pound = $507.10 per tonne.
Aluminum	$ per tonne	Low	$ 1,852	pound.
		High	$ 2,203	0.9 USD/ lb from http://www.kitcometals.com. Assumes 1.11 USD to the Canadian dollar (Jan 2014)
Steel	$ per tonne	Low	$ 134	The price of steel containers has been in the range of $130 to $200 per tonne. From study: MMBC, Program Design Options Final, 2012. Adjusted with CPI.
		High	$ 206	The price of steel containers has been in the range of $130 to $200 per tonne. From study: MMBC, Program Design Options Final, 2012. Adjusted with CPI.
Polycoat	$ per tonne	Low	$ 64	No BC data available. $62 was the lowest price recorded by WDO during 2013 in the Price Sheet, Reclay StewardEdge 2013, as monthly selling price per tonne, Program Design Option Report, MMBC 2012. This was adjusted with CPI to 2014 $.
		High	$ 121	No BC data available. $118 was the highest price recorded by WDO during 2013 in the Price Sheet, Reclay StewardEdge 2013, as monthly selling price per tonne, Program Design Option Report, MMBC 2012. This was adjusted with CPI to 2014 $.
Cardboard	$ per tonne	Low	$ 105	No BC data available. $102 was the lowest price recorded by WDO during 2013 in the Price Sheet, Reclay StewardEdge 2013, as monthly selling price per tonne, Program Design Option Report, MMBC 2012. This was adjusted with CPI to 2014 $.
		High	$ 161	No BC data available. $156 was the highest price recorded by WDO during 2013 in the Price Sheet, Reclay StewardEdge 2013, as monthly selling price per tonne, Program Design Option Report, MMBC 2012. This was adjusted with CPI to 2014 $.
GHG Emissions from Recycling Compared to Landfilling (Including Carbon Sequestration)				
Glass	tonnes eCO2/tonne	Low	-0.1	Management Activities on GHG emissions: 2005 Update Final Report
		High	-0.1	Management Activities on GHG emissions: 2005 Update Final Report
PET	tonnes eCO2/tonne	Low	-3.6	Management Activities on GHG emissions: 2005 Update Final Report

		High	-3.6	Management Activities on GHG emissions: 2005 Update Final Report
HDPE	tonnes eCO2/tonne	Low	-2.3	Management Activities on GHG emissions: 2005 Update Final Report
		High	-2.3	Management Activities on GHG emissions: 2005 Update Final Report
Plastics (Other)	tonnes eCO2/tonne	Low	-1.8	Management Activities on GHG emissions: 2005 Update Final Report
		High	-1.8	Management Activities on GHG emissions: 2005 Update Final Report
Aluminum	tonnes eCO2/tonne	Low	-6.5	Management Activities on GHG emissions: 2005 Update Final Report
		High	-6.5	Management Activities on GHG emissions: 2005 Update Final Report
Steel	tonnes eCO2/tonne	Low	-1.2	Management Activities on GHG emissions: 2005 Update Final Report
		High	-1.9	Management Activities on GHG emissions: 2005 Update Final Report
Polycoat	tonnes eCO2/tonne	Low	-1.8	ICF 2005, Exhibit 4-1, Determination of the Impact of Waste Management Activities on GHG emissions: 2005 Update Final Report. Assumed to be covered in category Other Plastics.
		High	-1.8	ICF 2005, Exhibit 4-1, Determination of the Impact of Waste Management Activities on GHG emissions: 2005 Update Final Report. Assumed to be covered in category Other Plastics.
Cardboard	tonnes eCO2/tonne	Low	-3.3	Management Activities on GHG emissions: 2005 Update Final Report.
		High	-3.3	Management Activities on GHG emissions: 2005 Update Final Report.
Energy Impacts from Recycling Compared to Landfilling				
Glass	GJ/tonne recycled	Low	-1.5	Management Activities on GHG emissions: 2005 Update Final Report
		High	-1.5	Management Activities on GHG emissions: 2005 Update Final Report
PET	GJ/tonne recycled	Low	-85.2	Management Activities on GHG emissions: 2005 Update Final Report
		High	-85.2	Management Activities on GHG emissions: 2005 Update Final Report
HDPE	GJ/tonne recycled	Low	-64.3	Management Activities on GHG emissions: 2005 Update Final Report
		High	-64.3	Management Activities on GHG emissions: 2005 Update Final Report
Plastics (Other)	GJ/tonne recycled	Low	-52.1	Management Activities on GHG emissions: 2005 Update Final Report
		High	-52.1	Management Activities on GHG emissions: 2005 Update Final Report
Aluminum	GJ/tonne recycled	Low	-87.2	Management Activities on GHG emissions: 2005 Update Final Report
		High	-87.2	Management Activities on GHG emissions: 2005 Update Final Report

Steel	GJ/tonne recycled	Low	-12.5	Management Activities on GHG emissions: 2005 Update Final Report
		High	-12.5	Management Activities on GHG emissions: 2005 Update Final Report
Polycoat	GJ/tonne recycled	Low	0.0	Management Activities on GHG emissions: 2005 Update Final Report
		High	0.0	Management Activities on GHG emissions: 2005 Update Final Report
Cardboard	GJ/tonne recycled	Low	-8.6	Management Activities on GHG emissions: 2005 Update Final Report
		High	-8.6	Management Activities on GHG emissions: 2005 Update Final Report