Managing end-use recycling outcomes in Alberta

Beverage Container Management Board (BCMB)

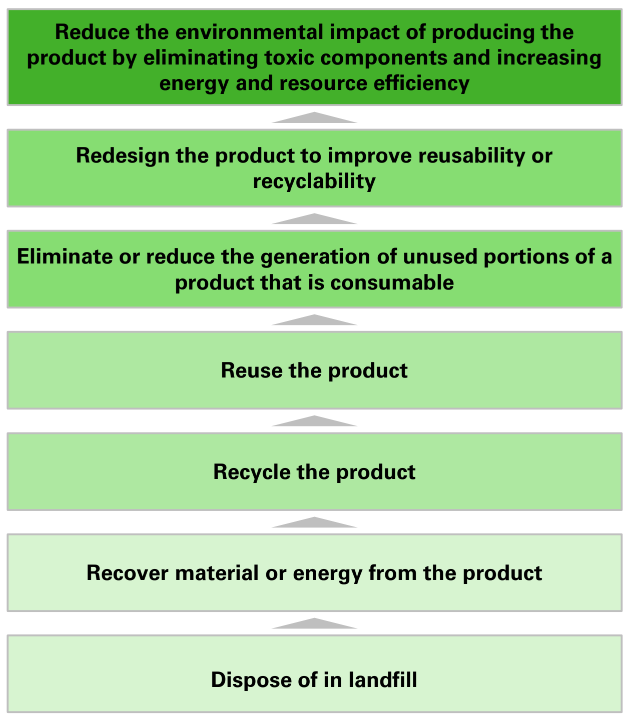
KPMG, December 2017

Table of contents

1. Introduction

Alberta has a long history of collecting and recycling beverage containers. In 1993, the Government of Alberta consolidated a number of pieces of legislation into the Environmental Protection and Enhancement Act, which led to the evolution of the regulation underpinning the beverage container program, as it is current in force today. Part of the program's mandate is to manage collection optimization and reduce the system wide environmental footprint. To this point, the Alberta Beverage Container Recycling Corporation (ABCRC) and the Beverage Container Management Board (BCMB) have a sound understanding of collection performance. With an overall collection rate of 86.2% in 2016[1], Alberta is amongst the better performers in the country.

This report aims to look beyond the process of beverage container collection, by considering end-use recycling outcomes. What happens to the beverage containers once they have been collected by the collection system agent? Generally speaking, the following outcomes apply, presented in order of preference[2]:



Already, the BCMB has indicated that certain end-use processes are not considered satisfactory in the Alberta context, including incineration, thermochemical decomposition at elevated temperatures in the absence of oxygen, and disposal (into landfills or bodies of water). This reports builds on this notion, and means to provide the BCMB with the tools to better understand current and projected end-uses and build these into its criteria for approving containers.

The objectives of this report are to:

- Provide suggestions for performance indicators to assess end-use recycling outcomes under the Alberta beverage container recycling program (section 2);
- Provide an understanding of the current end-use recycling outcomes under the Alberta program, as a means of identifying focus areas and room for improvement (section 3);
- Define a framework to manage and improve end-use recycling outcomes going forward (section 4).

[1] BCMB (2016). 2016 Annual Report

[2] CSA Group (2015). A Guideline for accountable management of end-of-life materials

2. Performance measurement: defining system-wide KPIs

In order to understand the success of a beverage container recycling program, it is key to establish meaningful metrics or key performance indicators (KPI) that provide the opportunity to track system performance and intervene when objectives are not being achieved. In this section we provide an overview of common KPIs applied by recycling programs to assess system-wide performance, as well as an indication of how different jurisdictions in Canada perform against respective KPIs. The goal of this section is:

- To provide suggestions for KPIs (or performance standards) to assess system wide performance in the Alberta context;
- To establish performance benchmarks across different KPIs where possible, as a reference for BCMB to define "good practice".

In creating an understanding of programs' performance against KPIs we focus on Canadian beverage container recycling programs only. The reason for this focus, is to allow for a well-defined conceptual boundary and like-for-like comparisons, as the operating contexts and markets between recycling programs in Canada are relatively similar.

Looking at beverage container recycling programs internationally, the Alberta program is on par with many European counterparts and outperforms many of the states in the US, as measured in terms of collection rate (the most commonly applied indicator to define program success)[3]. Alberta's relatively high collection rate is primarily attributable to its deposit collection system, which is far more favorable than single-stream or curb side collection systems. Looking at the waste system more broadly, jurisdictions around the world are taking tentative steps towards innovative concepts that consider the entire value chain (beyond waste collection alone). Especially in Europe, an increasing number of jurisdictions are making efforts aimed at influencing the waste hierarchy with end-use recycling outcomes in mind[4]. As much as the momentum for end-use recycling is growing, programs that are designed entirely around end-use recycling outcomes aren't mainstream yet. Below we have presented a few examples of jurisdictions that are demonstrating leadership in different capacities, by considering the broader waste system.

- **Bottle-to-bottle recycling** (Switzerland): To a great extent PET bottles are not returned to the packaging market. Instead, they are used for energy recovery, landfill or are recycled to granulate to be used outside the food industry. To increase primary or closed-loop recycling compared to secondary recycling, PET-Recycling Schweiz (RPS) established a system in which now more than half of the collected PET goes into bottle-to-bottle recycling. A bottle-to-bottle recycling system considers the entire PET value-chain aimed at minimizing waste and optimizing the final product (R-PET) which has to be comparable to virgin material. A critical component of Switzerland's bottle-to-bottle recycling success, is the approach to bottle design. The RPS has established certain requirements for the design of a PET bottle based on the principle of system conformity. System conformity means that a PET bottle goes – without additional cost – through the whole value chain (collection, sorting, and recycling) and ends up as a new PET bottle product. To facilitate system conformity RPS has developed a specific checklist that covers all relevant points having an influence on quality criteria like closures, labels, barriers, materials such as aluminum, PVC and chemical additives[5].
  - In Alberta, PET bottles are pelletized and, depending on the quality of the resin, used for purposes other than new PET beverage containers. Looking at the other waste streams, only aluminum cans are subject to primary recycling. The cullet of (non-refillable) glass bottles is used for the production of fibreglass insulation (which is less environmental beneficial than using recycled glass to manufacture new bottles, but has a higher environmental benefit than using recycled glass as road aggregate), while the materials recovered

[3] CM Consulting (2016). Deposit systems for one-way for beverage containers: global overview

[4] European Environment Agency (2016). Circular Economy in Europe.

[5] Patrik Geisselhardt et al. PET bottle-to-bottle recycling key success factors – 6 years experience in Switzerland.

from aseptic containers are mainly used for tissue paper or building materials (refer to chapter 3 for further details).

- **Recycling rate** (Germany): Germany has one of the highest PET bottle recycling rates in the world. Of all the PET bottles sold into the market 93.5% is recycled, with one-way deposit PET bottles reaching a 97.9% recycling rate. Deposits are noted as the main reason for the high recycling rate, with most consumers using reverse vending machines to return PET bottles. 34% of the recycled material is used in manufacturing new PET bottles, resulting in PET bottles containing an average of 26% recycled plastics[6].
  - Although the BCMB has indicated that certain non-recycling end-use processes are not considered satisfactory in the Alberta context (i.e. incineration, thermochemical decomposition at elevated temperatures in the absence of oxygen, and disposal), the recycling rate is currently not actively tracked or reported as part of the annual progress reporting (refer to chapter 2 for the application of the indicator recycling rate across jurisdictions in Canada).
- **Recycled content** (California): In California, manufacturers are required to use at least 35% recycled content for glass food, drink, and beverage containers made, sold, or used in the state[7]. The Department of Conservation's Division of Recycling regulates and oversees the container minimum content mandates and receives annual reports about the amount of recycled material that is used. In 2015, a similar bill for plastic beverage containers was put forward – requiring manufacturers of PET plastic packaging to use at least 10% recycled PET (as measured by weight) in bottles. This bill has not yet been enacted.
  - In Alberta, the BCMB has not expressed requirements related to recycled content similar to California. Currently, the BCMB Registration Requirements for Non-Alcoholic Beverage Containers includes a static list of approved materials for the primary container, approved label material, closure material and additional components, without specifying the feedstock used.

The underlying concepts applied by these programs, are used as a reference as we define solutions for managing the end-use recycling performance in Alberta in Chapter 4.

Table 1 provides an overview of the KPIs to assess system-wide recycling performance. In sections 2.1 – 2.8 we discuss selected KPIs in greater detail. Please note that the information provided in these sections is based on publically available resources.

Table 1: Use of system performance KPIs across recycling programs

Key performance indicators (KPIs)		AB	BC (1)	BC (2)	SK (1)	SK (2)	MB (1)	MB (2)	ON (1)	ON (2)	QC (1)	QC (2)	NS	NL	NWT	NB	PEI
Collection (container units)	Collection rate in container units | total (%)																
	Collection rate in container units | by container type (%)					2						4					
	Number of containers collected | total																
	Number of containers collected | by container type																
	Number of containers collected | per capita																
Collection (weight)	Collection rate by weight | total (%)									3							
	Collection rate by weight | by material type (%)																
	Weight of containers collected | total (tonnes)					2				3							
	Weight of containers collected | by material type (tonnes)																
	Weight of containers collected | per capita (kg)					2				3							

[6] Recycling International (2016). Deposits boost Germany's PET bottle recycling rate.

[7] CalRecycle (2015). Glass Recycling.

Diversion	Weight diverted from landfill | total (tonnes)				1												
	Weight diverted from landfill | by material type (tonnes)																
Recycling	Recycling rate | by material / container type (%)																
	Number of containers recycled | by material/container type (tonnes)																
	Weight of containers recycled | by material/container type (tonnes)																
Avoided GHG emissions / energy consumption	Avoided GHG emissions | total (tCO2e)				1												
	Avoided GHG emissions | by material type (tCO2e)																
	Avoided energy consumption | total (GJ)				1												
	Avoided energy consumption | by material type (GJ)																
	Energy savings | by material type (%)																
Other	Avoided pollution | total (tonnes)																
	Avoided pollution | by material type (tonnes)																
	Distance travelled per container (meters)																

Table notes

	Program	Source
AB	Beverage Container Recycling Program (BCMB)	BCMB (2016). 2016 Annual Report ABCRC (2016). 2016 Sustainability Report
BC (1)	Return-it (Encorp Pacific)	Encorp Pacific (2016). 2016 Annual Report
BC (2)	BC Brewers Recycled Container Collection Council	BRCCC (2016). 2016 Annual Report to the Director
SK (1)	Beverage Container Collection and Recycling Program (SARCAN Recycling)	SARCAN (2017). 2016-2017 Annual Report
SK (2)	Multi-Material Recycling Program (Multi-Material Stewardship Western)	MMSW (2016). 2016 Annual Report
MB (1)	Recycle Everywhere Program (CBCRA)	CBCRA (2016). 2016 Annual Report
MB (2)	Packaging and Printed Paper Program Plan (MMSM)	MMSM (2016). 2016 Annual Report
ON (1)	Ontario Deposit Return Program (ODRP) / the Beer Store	The Beer Store (2016). 2016 Responsible Stewardship Report
ON (2)	Blue Box Program (Stewardship Ontario)	Stewardship Ontario (2016). 2016 Annual Report
QC (1)	Agreement Relating to the Consignment, Recovery, and Recycling of Non-Refillable Soft Drink Containers (Boissons Gazeuses Environment)	Boissons Gazeuses Environment (2016). Recovery statistics (access via: http://www.bge-quebec.com/en/recovery-statistics/)
QC (2)	RECYC-Quebec	Recyc Quebec (2016). 2015-2016 Annual Report
NS	Beverage Container Deposit-Refund Program (Divert NS)	Divert Ns (2017). 2016-2017 Annual Report
NL	Used Beverage Container Recycling Program (Multi-Materials Stewardship Board)	MMSB (2017). 2016-2017 Annual Report
NWT	Beverage Container Program (Department of Environment and Natural Resources)	Government of Northwest Territories (2016). Waste reduction and recovery program 2015-2016 Annual Report
NB	Beverage Container Recovery Program (Encorp Atlantic, Rayan Industries)	Government of New Brunswick. Beverage Container Program (access via: http://www2.gnb.ca/content/gnb/en/services/services_renderer.3975.Beverage_Container_Program.html)
PEI	Beverage Container Management System (PEI Department of Environment, Energy, And Forestry)	Government of Prince Edward Island. Beverage Container Program (access via: https://www.princeedwardisland.ca/en/information/communities-land-and-environment/beverage-container-program)

1	From beverage containers, electronics and paint combined
2	From packaging and paper products combined
3	From packaging and paper products combined
4	By refillable / nonrefillable containers

2.1 Collection rate

2.1.1 Definition of indicator

The collection rate (or "recovery rate" in some jurisdictions) measures the amount of material collected for recycling compared to the amount of beverage container material placed on the market (or sold). The collection rate can either be expressed in:

- Collection by container units: number of containers collected (either in absolute or relative terms, i.e. the number of containers collected for recycling in a given jurisdiction versus the number of containers sold in a given jurisdiction); or
- Collection by weight: weight of containers collected (either in absolute or relative terms, i.e. the estimated weight of containers collected for recycling in a given jurisdiction versus the estimated weight of containers sold in a given jurisdiction).

2.1.2 Application of indicator (in Canada)

Collection rate is the most commonly applied KPI for measuring program performance. The vast majority of jurisdictions in Canada track and report their collection rate, with a number of programs reporting their collection rates by material streams / container types in addition to aggregated or total rates. For example, total recovery rates range from 94% in the Northwest Territories (all beverages except milk) to 61.1% in Newfoundland and Labrador (see table 2). It is noted that measuring the collection rate varies in complexity between deposit-return systems and multi-material collection systems (e.g. Manitoba, Ontario, Quebec), where performance measurement under a deposit-return system is less complicated since the refund provides an opportunity to track sales and collection on a unit basis.

Table 2. Collection rate in container units (%)

	AB	BC (1)	BC (2)	SK	MB (1)	MB (2)	ON (1)	ON (2)	QC	NS	NL	NWT	NB	PEI
Aluminum	91	92.2	90.5	94	61	62.8[8]	79.6	79	76.4	91.6	64	98	80.1	84.9
Glass (refillable)	98.4		94.3[5] 82.7[6]		99		97.5							
Glass (nonrefillible)	93.7	88.7		84	55	77.7	89	82	71	83.3	62.2	92	72.4	70.7
Plastics	91[1] 79.1[2]	73.9		83		68.2		53	78.4	80.8	65.4	98	71.2	81
Other plastics										53.3	37.5		57.4	
Bi-metal	75.4	85.3			55					93.2	52.9	105		
Polycoat (Gable Top / Tetra Pak)	74.1[3] 69.9[4]	59.4		50[7]	19			25		57.2	44.7	69		44
Bag-in-a-box & pouches	42.9													
Total collection rate	86.2	78	90.6	86.2	70	73	88.1	78	76.6	80.8	61.6	94	76.4	79.9

Table notes

Program		Year	Notes
AB	Beverage Container Recycling Program (BCMB)	2016	(1) ≥ 1 liter; (2) < 1 liter; (3) Tetra Pak; (4) Gable Top
BC (1)	Return-it (Encorp Pacific)	2016	
BC (2)	BC Brewers Recycled Container Collection Council	2016	(5) ISB; (6) proprietary glass bottle
SK	Beverage Container Collection and Recycling Program (SARCAN Recycling)	2016	(7) juice boxes
MB (1)	Recycle Everywhere Program (CBCRA)	2014 (total collection rate = 2016)	

MB (2)	Packaging and Printed Paper Program Plan (MMSM)	2015	Collection rate by weight (8) Aluminum food and beverage cans
ON (1)	The Beer Store	2016	
ON (2)	Ontario Deposit Return Program (ODRP)	2016	
QC	Agreement Relating to the Consignment, Recovery, and Recycling of Non-Refillable Soft Drink Containers (Boissons Gazeuses Environment)	2016	
NS	Beverage Container Deposit-Refund Program (Divert NS)	2014 (total collection rate = 2016)	
NL	Used Beverage Container Recycling Program (Multi-Materials Stewardship Board)	2014	
NWT	Beverage Container Program (Department of Environment and Natural Resources)	2016	
NB	Beverage Container Recovery Program (Encorp Atlantic, Rayan Industries)	2015	
PEI	Beverage Container Management System (PEI Department of Environment, Energy, And Forestry)	2015	

2.1.3 Indicator assessment

- The collection rate is a good indicator of program success in relation to consumer awareness and collection optimization. There are some challenges with the accuracy of the number, when unapproved containers are sold, or foreign beverage containers are introduced into the system (which affects the denominator). However, considering the corresponding volume and the measures already in place to mitigate the risk of unapproved containers, the effect of this is considered limited.
- The collection rate is a helpful indicator to understand the recycling potential for a specific beverage container. It is noted that, in order to allow for better recycling outcomes, recycling pathways benefit from large container volumes. The smaller the collection program, expressed through the collection rate KPI, the less likely re-processors are able to achieve economies of scale and justify capital intensive investments to drive the recycling performance up (this difference is clearly notable with Tetra Pak / Gable Top on the one hand and plastics on the other hand. Tetra Pak / Gable Top has relatively small collection volumes, whereas plastics has large collection volumes – each providing different opportunities to seek out further process improvements). Measuring and managing the collection rate, therefore indirectly provides an opportunity to influence end-use recycling outcomes.
- The collection rate provides an indication of the recycling potential, but does not reflect the actual amounts of material recycled. It doesn't separate out beverage containers disposed of in landfill or incinerated, or rejected due to process loss (see recycling rate). It therefore is a useful indicator to understand the performance for the very first step in the recycling process, but is less useful if the goal is to measure end-use recycling outcomes of programs.

2.2 Recycling rate

2.2.1 Definition of indicator

The recycling rate measures the amount of beverage container material recycled compared to the amount of beverage container material placed on the market, or collected. The recycling rate adjusts for materials rejected due to process loss, and materials disposed of in landfill or incinerated due to contamination or the absence of a market for the processed materials. The recycling rate can either be expressed in:

- Recycling by container units: number of containers recycled (either in absolute or relative terms, i.e. the number of containers recycled in a given jurisdiction versus the number of containers sold / collected in a given jurisdiction); or
- Recycling by weight: weight of containers recycled (either in absolute or relative terms, i.e. the estimated weight of containers recycled in a given jurisdiction versus the estimated weight of containers sold / collected in a given jurisdiction).

It is noted that measuring the recycling rate in terms of container units, only really lends itself to instances where containers are being re-used (e.g. refillable bottles such as beer bottles). In all other instances, beverage containers will likely be ground or melted and turned into a different product (e.g. plastic pellets, aluminum coils or glass cullets) for which the amount can only be expressed in terms of weight (in tonnes). Furthermore, it is noted that the recycling rate lends itself as a system performance measure, however when assessing the recycling performance of a re-processor the "processing efficiency rate" may be more informative. The processing efficiency rate measures the amount of beverage container material received by an individual recycler that is used in the recycling process (excluding energy-from-waste) compared to the amount of material shipped to the recycler. This provides an indication of the extent to which a re-processer is able to turn collected materials into useful products, and its tolerance towards (potential) contamination.

2.2.2 Application of indicator (in Canada)

A limited number of jurisdictions measure program performance using the KPI recycling rate. There appears no consistent method for disclosing recycling performance. Alberta, Ontario, BC, Northwest Territories and Saskatchewan each disclose their systems' recycling performance using different measures:

- Alberta: description of the recycling rates by material stream, providing an approximation of the percentage of containers recycled. The metric doesn't appear to be actively tracked.
- Ontario (Beer Store / Ontario Deposit Return Program): measurement of containers re-used / recycled across material streams in absolute terms and by weight.
- BC (BC Brewers Recycled Container Collection Council): measurement of recycling rate by material stream.
- Northwest Territories (Beverage Container Program): measurement of recycling rate by material stream.
- Saskatchewan (SARCAN): measurement of aggregated recycling rate across all material streams.

Of these programs, BC is most explicit in managing recycling rates using a dedicated target ("100% of collected materials for re-use or to recycling commodity markets").

Table 3. Recycling performance

Program	Measurement	Performance
AB (ABCRC)	Recycling rate by material stream	- Aluminum: 95 - 99% of weight shipped is recycled, with the remainder being moisture and contaminants - Plastics: 80+% recycled with less than 20% being sub-standard material or contaminants - Glass: 95% recycled with 5% waste including caps, corks and dust - Tetra-brik: 80% by weight recycled - Gable top: 80% by weight recycled - Drink pouches / Bag-in-a-box: 100% energy recovery
BC (BC Brewers Recycled Container Collection Council)	Recycling rate by material stream	- Aluminum: 100% processed for metal recovery - Refillable glass bottles: 99% of material shipped send to brewers for reuse, 1% of material shipped sent directly to a glass recycler for recycling by BDL
SK (SARCAN Recycling)	Total recycling rate (across all material streams)	- 86% of returnable beverage containers is turned in for recycling
ON (The Beer Store)	Containers re-used / recycled across material streams in absolute terms and by weight	- Glass bottle re-use by brewers (tonnes): 185,677 - Coloured glass recycled into new products (tonnes): 32,531 - Clear glass recycled into new clear glass bottles: 16, 331 - Aluminum cans recycled into new aluminum (tonnes): 10,258
ON (Ontario Deposit Return Program)	Containers re-used / recycled across material streams in absolute terms and by weight	- Coloured glass recycled into new products (tonnes): 67,671 - Clear glass recycled into new clear glass bottles: 41,084 - Aluminum cans recycled into new aluminum (tonnes): 1,493 - PET products recycled into felted automotive products & other plastic products (tonnes): 1,023
NWT (Beverage Container Program)	Recycling rate by material stream	- Aluminum: 97% recycled by weight - Refillable glass: refilled an average of 15 times - Plastic: 80% recycled by weight - Multi-material (aseptic and polycoat containers): 80% recycled by weight - Multi-material (bi-metal containers): 95% recycled by weight

2.2.3 Indicator assessment

- The recycling rate is a more informative performance indicator as it measures the entire recycling process, from collection to final disposition. It demonstrates what is actually recycled (i.e. not disposed of in landfill / incinerated), as opposed to the amount of containers collected. Beverage containers processed at recycling facilities typically experience some degree of yield loss (e.g. labels, caps, glue remaining on bottles after sorting) and contamination (which may result in materials disposed of in landfill). As an example, in deposit-return programs (like Alberta) there is usually a yield loss of 5% on paper in Tetra Pak containers used for tissues, as paper can't be separated entirely from the polyethylene layers. Some of these losses are recycled as a plastic with a contaminant, which can be sold as a by-product, but some are disposed of in landfill. Program performance is more compromised in curbside collection programs, with the glass recycling industry reporting losses of 20 to 60% from commingled glass, and the aluminum sector reporting losses of 2 to 11% for aluminum cans collected curbside[8]. The recycling rate measure accounts for these "losses" providing a more accurate assessment of system performance.
- Determining the recycling rate can be challenging. The recycling rate indicator relies on credible information being provided by re-processors on the amount of beverage container recycled, disposed of in landfill and/or incinerated (or used as fuel). This requires re-processors to track respective data, which may be complicated in instances where multiple material streams are mixed as part of the same recycling process (e.g. PET, HDPE and other plastics are typically mixed, therefore it is hard to determine the recycling rate for these container types separately). Also, in order to have a sound understanding of the recycling rate, one may have to look beyond the primary processor – requiring further "data mining" or sound assumptions:

Material category	Ease of determining recycling rate	Explanation
Tetra Pak / Gable Top	Medium	Recycling rate may be more challenging to determine, as the primary processor (Paper Tigers) serves as a collection and transport agent only. Containers are sold to various manufacturers of paper tissues and building material. To understand the recycling rate respective parties (multiple) must be engaged. Also at this point in the process it won't be practically feasible to separate out Alberta beverage containers – therefore the recycling rate for Alberta beverage containers will be the equivalent of the gross recycling rate (across all materials received) realized by the manufacturers.
Plastics (PET, HDPE, others)	High	Recycling rate is relatively easy to determine, as information on the different beverage container uses (i.e. recycling, landfill, incineration) for the most part can be provided by the ABCRC customer (Merlin Plastics).
Aluminum	High	Recycling rate is relatively easy to determine, as information on the different beverage container uses (i.e. recycling, landfill, incineration) for the most part can be provided by the ABCRC customer (Novelis).
Glass	High	Recycling rate is relatively easy to determine, as information on the different beverage container uses (i.e. recycling, landfill, incineration) for the most part can be provided by the ABCRC customer (Vitreous).

2.3 Waste diversion

2.3.1 Definition of indicator

Waste diversion is a measure to determine the amount of beverage containers diverted from landfill. Diversion can either be expressed in:

- Diversion rate: relative measure for determining the amount of material collected for recycling minus any material sent for disposal, compared to the amount of beverage container material placed on the market; or
- Diversion by weight: absolute measure for determining weight (in tonnes) of beverage containers diverted from landfill.

[8] Resource Recycling (2011). Recovery Questions.

2.3.2 Application of indicator (in Canada)

Diversion is used in many jurisdictions as a secondary KPI – as opposed to a measure that appears to be actively managed using targets. Exceptions are:

- Newfoundland and Labrador: target for waste diversion in the province (50%); and
- Ontario (Ontario Deposit Return Program): goal to "increase glass diversion from landfill".

It is noted that diversion is most often expressed in absolute terms (diversion by weight), with BC (Encorp Pacific) being most elaborate by providing the weight diverted from landfill for each material type.

Table 4. Waste diversion

	AB	BC (1)	BC (2)	SK	ON (1)	ON (2)	NWT
Total weight diverted from landfill (tonnes)	97,605	92,910	25,653	20,338[1]	246,046	111,271	1,327

Table notes

AB	Beverage Container Recycling Program (BCMB)
BC (1)	Return-it (Encorp Pacific)
BC (2)	BC Brewers Recycled Container Collection Council
SK	Beverage Container Collection and Recycling Program (SARCAN Recycling)
MB	Recycle Everywhere Program (CBCRA)
ON (1)	The Beer Store
ON (2)	Ontario Deposit Return Program (ODRP)
NWT	Beverage Container Program (Department of Environment and Natural Resources)
1	From beverage containers, electronics and paint combined

2.3.3 Indicator assessment

Diversion is a meaningful indicator to understand the amount of beverage container material not being disposed of in landfill. If used as a relative measure (diversion rate) it provides an indication of the end-use recycling performance of systems. The challenge is, that the value of the indicator is highly dependent on the assessment scope. That is, materials may be disposed of in landfill in different stages in the recycling process. For the waste diversion to provide an accurate understanding of the end-use recycling performance, the entire recycling process must be considered.

2.4 Contamination rate

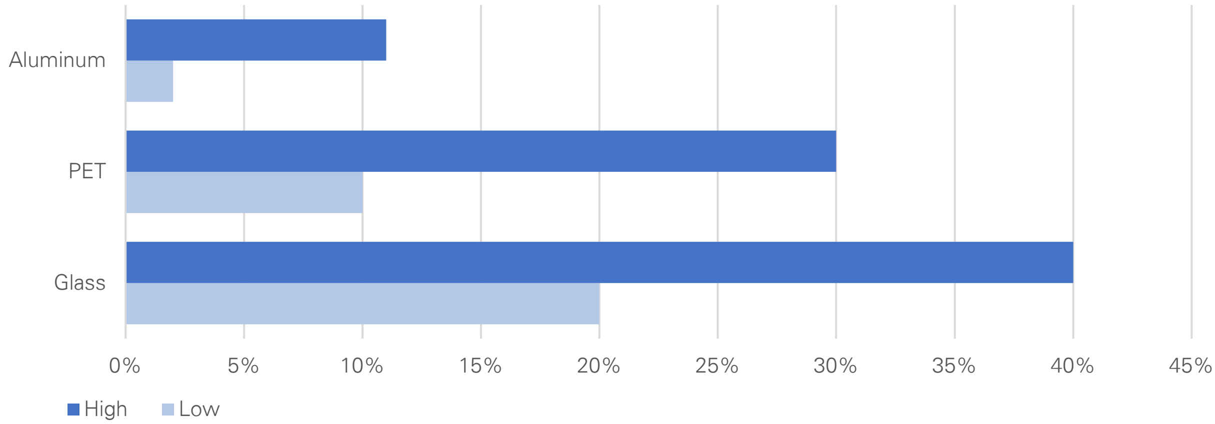
2.4.1 Definition of indicator

Contamination rate is a measure to determine the amount of "foreign" materials in a material stream shipped to a recycler. Contamination in recycling can happen when non-recyclable items are mixed in with recyclables (e.g. leftover liquids, dirt, coloured containers, PVC labels on PET bottles) or when recyclable items are sorted improperly before they are shipped for recycling (more likely in multi-material collection systems such as those in Manitoba, Ontario and Quebec).

2.4.2 Application of indicator (in Canada)

None of the jurisdictions in Canada use contamination rate as a KPI to assess and understand system performance. The problem of contamination is widely acknowledged – including higher costs to recyclers, increased equipment downtime, lower yield rates and higher volumes of material being sent to landfill – but processes for active tracking and measurement of contamination appear poorly defined. There have been efforts to understand the contamination rates by material streams across Canada (see table 5) for all jurisdictions combined. These results, however, indicate contamination rates of material collected in multi-material collection systems. Compared to deposit-return systems (i.e. Alberta), multi-material collection systems tend to generate more contamination from the introduction of a larger variety of materials (e.g. combination of paints, oil containers, electronics and beverage containers) – therefore this comparable isn't entirely valid for Alberta's recycling system.

Table 5: Typical contamination rates from multi-material collection (by weight – excluding weight of glue, caps and labels) [9]



Textbox 1: case study (UK)[10]

The European Union (EU) has set policy goals to improve the quality and quantity of recycling as part of the commitment towards "European recycling society". This is articulated in the EU *Waste Framework Directive Requirements for Separate Collection* (Article 11) which states: "*Member States shall take measures to promote high quality recycling and, to this end, shall set up separate collections of waste where technically, environmentally and economically practicable and appropriate to meet the necessary quality standards for the relevant recycling sectors.*" In an effort to operationalize this policy commitment UK-based Resource Association (a professional advocacy body for the reprocessing and recycling industries) has developed quality specifications (ReQIP) for recyclable materials, indicating the acceptable level of contamination for the material if it is to be reprocessed. With these quality specifications Resource Association aims to increase the likelihood that materials that are collected can be reprocessed into the same or a similar product. As a reference, please find below the quality specifications:

Mixed glass (bottles and jars)	**Contamination limit: 0 – 1 %** - End-users want bottles and jars as whole as possible. - The 1% contamination level is for non-glass material (such as aluminum, plastics and steel containers), organics (paper labels and corks) and general refuse). - Unacceptable contaminants include: hazardous or toxic material, and laboratory glass, chemical containers, needles, syringes etc. - Critical contaminants include: ceramics, stone & porcelain, plus Pyrex, vision ware glass pans & microwave plates. Contamination levels for the likes of ceramics are typically 500g to 1,500g/tonne of glass (or 0.15%). Critical contaminants should be avoided and eliminated wherever possible. - For colour mixing re-processors want: 1.5% (colour) in Clear Cullet; <20% Clear & <10% Amber in Green Cullet; <10% Clear & Green in Amber Cullet. - Cullet re-processors downgrade or reject material that contains: general rubbish, foodstuffs, metal, organic material, paper and plastics.
Aluminum cans	**Contamination limit: 3%** - Manufacturers want zero contamination. - As far as aluminum aerosols & foil are concerned the contamination level must be less than 2%. Additional criteria include a moisture level maximum tolerance of 4%.
Plastic bottles	**Contamination limit: 0 – 6%** - Re-processors want zero contamination, but will accept 1% residual food waste on packaging by weight, and < 6% PTT (of which < 20% is black Trays). - In mixed plastic bottles, re-processors are looking for a minimum 35% to 38% clear PET, a minimum 25% to 38% Natural/Coloured HDPE, with a maximum of 18% other plastic bottles.

[9] CM Consulting (2016). Who Pays What. An analysis of beverage container collection and costs in Canada.

[10] Resource Association. Recycling Quality Specifications, access via: http://www.resourceassociation.com/recycling-quality-specifications/

2.4.3 Indicator assessment

- Contamination rate isn't an indicator to demonstrate system performance post-recycling, it is an indicator that affects and informs the potential recycling rate and diversion rate, as well as the quality (or purity) of end-products. The lower the contamination rate the more likely that the recycling rate will excel and the quality of end-products is guaranteed (e.g. A-grade clear PET pellets). Measuring and managing the contamination rate therefore provides opportunities to influence the system performance downstream.
- Rather than being applied as a performance indicator to understand system outcomes, contamination rates or thresholds may be used as an "input" indicator to define the tolerance level across different material streams. For example, as illustrated by the UK case study (see textbox 1), programs may want to establish certain contamination limits within which recycling is achievable, and incineration and disposal to landfill can be kept to a minimum. No similar prescriptive measures were found for jurisdictions in Canada. It is noted that contamination rates or threshold may be expressed in different ways: (i) as a percentage, in terms of the relative amount of a contaminant – such as applied in the UK, or (ii) as a knock-out criterion, for example rather than stating that an *x* percentage of contaminants is accepted, the recycling pathway has zero tolerance to a specific contaminant (e.g. PVC labels on PET bottles are highly problematic, and ideally not accepted into the recycling pathway).

2.5 Value of processed materials

2.5.1 Definition of indicator

The *value of processed materials* is a proxy to estimate the dollar value of the materials that are being recycled and commoditized. The value can be determined by multiplying the amount of processed materials with the commodity price of for example clear plastic pellets, aluminum coils or glass cullet (e.g. the average price for aluminum and plastic in 2016 was CAD 0.76 and CAD 0.13 per pound respectively).

An alternative way to express the value of processed materials, is estimating the weight of processed materials by grades. That is, some processed materials have different quality grades (e.g. with plastics) – whereby the highest grade material usually carries the best properties to allow for recycling over-and-over again. The challenge here, however, is that not all streams apply different quality grades (e.g. glass and aluminum), also it might be challenging to isolate the weight by grades for the beverage containers coming from the Alberta collection system specifically.

2.5.2 Application of indicator (in Canada)

Generally speaking, the value of processed materials is one of the revenue line items for a recycler or steward (often expressed as "sale of processed containers"), among other revenue streams such as container recycling fees and unredeemed deposits. The indicator "value of processed materials" therefore tends to feature in recycler's annual performance reports.

2.5.3 Indicator assessment

- The benefit of using the indicator "value of processed materials" is, that it provides some insight in the quality (or purity) of the material. Quality is critical as it provides an indication for the amount of times that the material can be recycled over and over again and therefore continues to contribute to avoiding the use of virgin materials over a continued period of time. For example, low value products like white and brown paper mix from Tetra Pak and dark PET from plastics, will likely have very few subsequent uses (e.g. a black bottle will likely have only one more use after it being processed into black pellets, as opposed to clear pellets that are being recycled over-and-over again). Beverage containers that contribute to low value processed materials, therefore may want to be minimized entry into beverage container recycling programs.
- The downside of the indicator is, that the value is influenced by other factors such as commodity price. Also, if not expressed in relative terms, it most importantly is a financial proxy to determine the line item "sale of processed containers" as opposed to a proxy to determine the quality or purity of the processed material.

2.6 Environmental benefits (avoided GHG emissions / energy consumption)

2.6.1 Definition of indicator

The avoided GHG emissions or energy use indicator calculates the GHG or energy savings by comparing the emissions associated with an alternative scenario (e.g. recycling) with the emissions associated with the baseline scenario (e.g. landfill). The most commonly applied method for determining avoided GHG emissions (or energy use), is the US EPA's Waste Reduction Model (WARM). WARM takes a life-cycle approach to estimating GHG or energy savings by considering the energy use and associated emissions from raw material extraction and manufacture, waste management (i.e. collection and processing of beverage containers), transportation (from curb to landfill, combustor or material recovery facility) and process non-energy sources (e.g. methane release from landfill) across 54 different materials. WARM has a dedicated tool (publically available on https://www.epa.gov/warm/versions-waste-reduction-model-warm#WARM Tool V14) that recycling programs or stewards may use, that asks for a number of inputs, including but not limited to:

- The amount of beverage containers (in tonnes) recycled, landfilled or combusted;
- Distance travelled between curb and landfill, combustor or material recovery facility;
- Recycled content ("current mix" based on US statistic, or 100% virgin);
- Presence of landfill gas control system and methane recovery.

It is noted that the WARM tool applies US emission factors (e.g. US grid factors for determination of emissions from electricity consumption during recycling process) and assumptions (e.g. recycle content of standard containers).

The most commonly applied method for demonstrating avoided emissions is comparing the program wide emissions from recycling to the program wide emissions if the equivalent amount of beverage containers were disposed of in landfill. There also are alternative ways to disclose avoided emissions, one of which is to show avoided emissions as a percentage of total emissions associated with the product. For example, this would allow you to say that the total emissions associated with beverage containers are reduced by 30% as a result of recycling. This method is less commonly applied.

2.6.2 Application of indicator (in Canada)

The indicator "avoided energy consumption or GHG emissions" is fairly common across jurisdictions, and is used as a means to demonstrate the environmental benefits (i.e. reduced environmental burden) of programs. For example, recycling process for aluminum requires 95% less energy than making a new can from virgin ore[11]. BC (alcoholic and non-alcoholic), Saskatchewan, Northwest Territories, Manitoba and Ontario (alcoholic) each report their avoided emissions, with BC (non-alcoholic: Encorp Pacific) providing most detail by also accounting for the emissions associated with the recycling process itself from transporting materials as well as heating and powering process equipment. Most programs use the Environmental Protection Agency for the estimation of GHG emissions.

Table 6. Environmental benefits

	AB	BC (1)	BC (2)	SK	MB	ON	NWT
Avoided GHG emissions (tCO2e)	0.116 (per household)	101,915	88,112	52,083	25,686	203,555	2,621
Avoided energy use (GJ)			854,716	Equivalent of powering 7,273 homes		2,670,360	

Table notes

AB	Beverage Container Recycling Program (BCMB)
BC (1)	Return-it (Encorp Pacific)
BC (2)	BC Brewers Recycled Container Collection Council

[11] The International Aluminium Institute (2016). Access via: http://recycling.world-aluminium.org/review/sustainability/

SK	Beverage Container Collection and Recycling Program (SARCAN Recycling)
MB	Recycle Everywhere Program (CBCRA)
ON	Ontario Deposit Return Program (ODRP) / the Beer Store
NWT	Beverage Container Program (Department of Environment and Natural Resources)
1	From beverage containers, electronics and paint combined

2.6.3 Indicator assessment

Avoided energy consumption / GHG emissions is a good indicator to demonstrate program success in terms of contribution to managing the overall environmental footprint. The strengths of the indicator are: (i) it provides a holistic and comprehensive understanding of the environmental footprint of the recycling program by considering all relevant stages in a container's life cycle, and (ii) it provides a good opportunity to directly assess the implications of different waste management options (re-use, recycling, landfill, incineration). The challenge with this indicator is that it requires a certain level of understanding of various input variables (e.g. weight of materials by incineration, landfill, recycling / emission factors for different emission sources / assumptions around recycled content of containers).

2.7 Environmental benefits (distance travelled per container)

2.7.1 Definition of indicator

Distance traveled per container is a proxy to assess the average unit-distance a container travels from the depot to its end-user. End-user can be defined in different ways, for example: processing plant (e.g. compacting of plastic containers and preparing for shipping), recycler (e.g. pelletizing of plastic containers) or customer of processed material (e.g. production of shampoo or detergent bottles). Depending on the choice of end-user the indicator is more, or less representative for the total environmental footprint of transportation across the recycling system.

2.7.2 Application of indicator (in Canada)

The indicator "distance travelled per container" is only applied by the BCMB. Other jurisdictions make note of the logistical performance of the system in qualitative terms, or at the high level (e.g. Encorp Pacific, BC, notes that on a weighted basis, 81% of the kilometers a container travels will be in a compacted state keeping the GHG emissions at a minimum).

2.7.3 Indicator assessment

The indicator "distance travelled per container" provides a good opportunity to acknowledge the broader environmental footprint of the recycling process. As indicated by the various ABCRC customers engaged as part of this study, energy use and emissions from transport makes up a significant (if not, the most significant) part of the environmental impact of a typical recycling process. For example, a typical aluminum can is transported from a depot to a facility that produces aluminum ingot, to a facility that rolls the ingot into aluminum coils, to the end-user of aluminum coils (producer of aluminum cans), and back again to the ingot facility for the use of scrap. By leveraging opportunities such as compacting of containers to increase the number of containers per truck, and understanding the geographical location of different players in the process, the performance against the indicator can be improved. The limitation of this indicator though, is that it only addresses a portion of total energy use and related emissions and therefore is not as comprehensive as the avoided emissions indicator (see 2.6).

2.8 Environmental benefits (life cycle analysis)

2.8.1 Definition of method

Life cycle analyses (LCAs) capture the environmental impact from the extraction of raw materials through to the end-of-life of the beverage container. The method differs from the avoided emissions / energy use indicator, as it typically looks at the broader environmental impacts in every stage of a container's life cycle (e.g. energy consumption, waterborne waste, GHG emissions, solid waste). Different types of impact are added together using normalization criteria to come to overall impact ratings.

2.8.2 Application of indicator (in Canada)

None of the jurisdictions in Canada quantify the life cycle impacts of the beverage containers passing through their program. This is considered a very cumbersome analysis, requiring a considerable amount of data (and the development of assumptions) across the various stages of a beverage container life cycle. LCA's are typically conducted by the scientific community and supported by industry associations and knowledge institutions. It is noted that the results of such studies typically vary and general conclusions are difficult to draw. Generally speaking, there is no conclusive evidence to prove aluminum, glass or PET as environmentally preferable or detrimental materials (table 7). Most importantly, the environmental impact of each material depends heavily on the collection and recycling rates of each material, container weights, sizes and recycled content – where high recycling rates, light weight of materials, and larger bottles will lessen the environmental impact of each material.

Table 7. Conclusions from various life cycle analyses

	Study 1	Study 2	Study 3	Study 4	Study 5
Materials studied	- PET - HDPE - PP - PS - Aluminum - Steel - Glass - Cardboard	- Carton - Glass - PET - HDPE - Aluminum cans	- Glass (0.75 L) - Aluminum (0.33 L) - PET (0.5 and 2 L)	- Glass - PET	- PET - Aluminum - Refillable Glass
General conclusions	In order of preference: - PET - PS - HDPE - PP - Cardboard - Steel cans - Glass containers - Aluminum cans	In order of preference: - Carton - HDPE - PET - Aluminum cans - Glass	In order of preference: - PET (2 L) - PET (0.5 L) - Aluminum - Glass	In order of preference: - PET - Glass (glass can be more environmentally benign with 80% reuse rate)	In order of preference: - Refillable glass - Aluminum - PET

Table notes

Study 1	Huang, Chien-Chung, and Hwong-Wen Ma. "A Multidimensional Environmental Evaluation of Packaging Materials." Science of the Total Environment 324 (2004): 161-72. Science Direct, 31 Oct. 2003.
Study 2	Azapagic, Adisa. "LCM in the Packaging Sector." Towards Life Cycle Sustainability Management. By Haruna Gujba. New York: Springer (2011). 381-89.
Study 3	Amienyo, David, Haruna Gujba, Heinz Stichnothe, and Adisa Azapagic. "Life cycle environmental impacts of carbonated soft drinks. "The International Journal of Life Cycle Assessment" Springer, 3 (July 2012).
Study 4	Vellini, M.; and Savioli, M.; "Energy and Environmental Analysis of Glass Container Production and Recycling." Energy 34 (2008): 2137-143.
Study 5	Bersimis S, Georgakellos D. A probabilistic framework for the evaluation of products' environmental performance using life cycle approach and Principal Component Analysis. J. Cleaner Production. 42: 103- 115. (2013).

2.8.3 Method assessment

LCAs provide the most holistic and comprehensive understanding of the environmental impacts of a beverage container recycling program. They provide an opportunity to compare the environmental impact between containers on a like-for-like basis, and inform decision-making accordingly. The challenge though is, that they are highly cumbersome to conduct and hard to interpret. Associated costs would outweigh the benefits of applying the LCA method as input for a program-wide KPI that is being tracked and measured periodically. In addition, in the absence of a standard LCA methodology across all containers, differences in assumptions could create significant differences in LCA outcomes that would make it difficult to identify what the actual differences are.

2.9 Conclusion

Following the assessment of the implementation of system KPIs across recycling programs and their relative merits and limitations (looking at aspects such as relevance, ease of use, access to credible data) we recommend the following for monitoring the end-use recycling performance of the beverage container program in Alberta (see table 7). We envision an important role for the ABCRC (on behalf of BCMB) to collect respective data either directly or through the participating recyclers (i.e. ABCRC customers):

Table 8. Overview of recommended KPIs

	KPI	Rationale	Reporting requirements
Primary	Recycling rate by weight | total and by material stream (%)	Recycling rate compares the amount of beverage containers (by weight) that is recycled to the amount of beverage containers that is collected through the program. A high recycling rate implies minimum loss to the recycling stream, and therefore provides an indication of the end-use recycling performance of a program.	• Weight of beverage containers processed into a useful material, by material type; • Weight of beverage containers collected in the Alberta market, by material type. This information needs to be obtained through the ABCRC customers and possibly further downstream (e.g. for Tetra Pak / Gable Top).
	Collection rate by weight | total and by material stream (%)[12]	Collection rate compares the amount of beverage containers (by weight) that is collected to the amount of beverage containers that are sold through the program. It is suggested to measure the collection rate in terms of weight (as opposed to container counts) to allow for a consistent unit of measurement across the recycling process (processed materials are all expressed in terms of weight).	• Weight of beverage containers collected in the Alberta market, by material type; • Weight of beverage containers sold in the Alberta market, by material type.
	Program loss by weight | total and by material stream (%)	Program loss combines the weight of beverage containers not collected and the amount not recovered through recycling into a single number, and expresses it as a percentage of the total weight sold into the market. A low program loss indicates maximum program efficiency looking at collection and recycling outcomes combined.	• Weight of beverage containers not collected in the Alberta market + weight of beverage containers not recovered through recycling, by material type; • Weight of beverage containers sold in the Alberta market, by material type.
Secondary	Avoided GHG emissions (tCO_2e)	Avoided GHG emissions quantifies the GHG savings across the life cycle of a beverage container by comparing different waste processing options (landfill, incineration, recycling). It is the most accurate and comprehensive	Suggested to apply a method consistent with the EPA Waste Reduction Model (WARM), and provide for localized emission factors and assumptions where possible.

[12] It is noted that the collection rate KPI used by BCMB is currently being expressed in terms of units, and the existing systems and processes are supportive of measuring this KPI. It is at BCMB's discretion if the collection rate by weight would replace the existing measure, or would be an additional KPI. The significant advantage posed by a weight based KPI is to measure overall system effectiveness, which is more difficult when sales and collections are in units and recycling is by weight.

		(in terms of scope) measure to assess environmental performance of a program (outside LCAs which are highly cumbersome).	At a minimum this indicators requires an understanding of the amount of beverage containers (by weight) recycled, disposed of in landfill or incinerated.

In terms of creating an understanding of how other jurisdictions perform against these KPIs as a means to define "good-practice" (which could be used to define system standard or targets), we note the following:

- Only the KPI "collection rate" is currently widely applied and used (relatively) consistently across programs. Therefore, only this KPI lends itself for comparison between recycling programs and the development of a "minimum standard". We note that the North West Territories have the highest collection rate, however the absence of system verification may compromise the credibility of reported data.
- The KPI "recycling rate" is applied inconsistently across programs. Therefore there is limited evidence to establish a "good-practice" benchmark. For this indicator it is recommended that Alberta looks at its own historical performance as a (minimum) baseline to track progress against (section 3).
- The KPI "program loss" is a newly proposed KPI that is unique to the Alberta system and demonstrates the innovative approach to measuring and managing end-use recycling outcomes. As such, there is no comparative data available from other jurisdictions.
- The KPI "avoided GHG emissions" is used more broadly. However, since this KPI is expressed in absolute terms (tCO_2e), it doesn't serve as a useful benchmark to compare Alberta's performance against.

Taken together, the recommendation is to not put static standards or targets in place – which will be arbitrary to set based on the analysis above. Alternatively, it is suggested to build on the knowledge of the current performance within the Alberta system, and aim for continuous improvement across the KPIs accordingly. In chapter 4 we lay out an approach for the BCMB to apply to encourage such improvement.

3. Current-state assessment: understanding Alberta's end-use recycling performance

To understand the extent to which Alberta's beverage container recycling program demonstrates room for improvement, we need to establish an understanding of the current performance. In this section we provide an overview of the current end-use recycling performance of the four dominant material streams in Alberta, looking at recycling rate (to what extent are beverage containers processed into materials that have a use), the quality of the processed materials and sources of contamination. The information presented on the four material streams presented below, represents >99% of all materials sold by the ABCRC.

Note, the information presented below was gathered through interviews and record review and was not subjected to audit procedures to determine its reliability.

3.1 Tetra Pak / Gable Top

3.1.1 General information

The following general characteristics apply to the Tetra Pak / Gable Top material stream:

- Primary ABCRC customer: The Paper Tigers Inc.
- Role of entity: To collect and transport Tetra Pak and Gable Top containers and sell to manufacturers of tissue paper and building materials. The Paper Tigers Inc. is not involved in processing of the materials beyond compacting.
- Containers purchased by weight (in 2016):

Material	Weight (kg)	% of total weight across all material streams
Gable 0-1L	40,750,438	2%
Gable Over 1L	28,040,371	1%
Gable Over 1L Compacted	1,135,791	0.1%
Tetra 0-1L	91,718,973	5%
Tetra Over 1L	874,740	0.04%
Tetra Brik 0-1L Compacted	4,313,269	0.2%

3.1.2 Recycling performance

The recycling performance measures the amount of beverage container material received by an individual recycler that is used in the recycling process (excluding energy-from-waste) compared to the amount of material shipped to the recycler. It is noted that Tetra Pak and Gable Top containers consist of different key materials (paperboard, polyethylene, aluminum), therefore the recycling rate is specified per material type.

The following applies to recycling rate for Tetra Pak and Gable Top containers based on input provided by the ABCRC customer.

Container composition	Recycling rate	Explanation
When used for tissue production		
Paperboard (74% of Tetra Pak by weight / material composition varies for Gable Top)	+/- 95%	• Paperboard is the useful material in beverage containers. • On average 95% of paperboard is being recycled and used for tissue production, with some variability in fibre yield between tissue manufacturers depending on equipment, material processing time and solutions being used. The remaining 5% is either recycled as a plastic with a contaminant (fibre), or being sent to landfill. The 5% fibre yield loss is the result of paperboard being trapped between polyethylene lining and the inability to separate the fibre up to a 100% precision. Opportunities to reduce yield loss are minimal, due to absence of economies of scale (not economically viable to increase yield due to relatively low volumes).
Polyethylene (22% of Tetra Pak by weight / material composition varies for Gable Top)	Variable	• Polyethylene is considered a contaminant / by-product since it has no use in tissue production. • Material is either recycled in plastic stream with a contaminant (fibre) which can be sold as a by-product (e.g. cement additive, panel boards, roofing sheets, tiles), disposed of in landfill or incinerated. The exact ratio depends on the tissue manufacturer, with the likelihood of materials being disposed of in landfill being higher, if volumes of marketable polyethylene are low.
Aluminum (4% of Tetra Pak by weight / Gable Top containers contain no aluminum)	Variable	• Aluminum is considered a contaminant / by-product since it has no use in tissue production. • Material is either recycled in aluminum stream which can be sold as a by-product (e.g. cement additive, panel boards, roofing sheets, tiles), disposed of in landfill or incinerated. The exact ratio depends on the tissue manufacturer, with the likelihood of materials being disposed of in landfill being higher, if volumes of marketable aluminum are low.
When used for building materials production		
Whole container (either Tetra Pak or Gable Top)	100%	• Whole container is used in the production of building materials. As opposed to tissue production, non-fibre material from pulp production can also be utilized in whole carton recycling. The process does not require any added glue, water or chemicals as heat is used as the bonding agent.

3.1.3 Contamination

Contaminants may affect the recyclability of material streams, have the ability to degrade the quality of processed material or create other challenges for recyclers (e.g. market size of processed materials). Contaminants should be kept to a minimum or avoided altogether. The following contaminants are noted for Tetra Pak and Gable Top containers based on input provided by the ABCRC customer. The colour coding indicates the impact on quality/purity and recyclability (green = no impact, yellow = low to medium impact, red = medium to high impact).

Contaminants	Impact on quality / purity	Impact on recyclability
Aluminum lining	**No** • Doesn't compromise the quality (purity) of the fibre stream • Relatively easy to separate from fibre.	**Variable** • Successfully separated material is recycled as part of aluminum stream (by-product), disposed of in landfill or incinerated.

	• Not intended as primary use: the more aluminum in a container, the less useful material for tissue production.	
Polyethylene lining (plastics)	**No** • Doesn't compromise the quality (purity) of the fibre stream • Relatively easy to separate from fibre. • Not intended as primary use: the more polyethylene in a container, the less useful material for tissue production.	**Variable** • Successfully separated material is recycled as part of plastics stream (by-product), disposed of in landfill or incinerated.
Plastic caps	**No** • Doesn't compromise the quality (purity) of the fibre stream • Relatively easy to separate from fibre.	**No** • Successfully separated material is recycled as part of plastics stream (by-product)
Brown paperboard (kraft)	**Yes** • Compromises the quality (purity) of the fibre stream • Problematic to separate from white paperboard. • Fibre needs to meet certain quality standards in order to be eligible for use in tissue production. If fibre contains high proportions of brown paper (or kraft) the quality is compromised. Batches with high proportions of brown-paper are still accepted by tissue manufacturers, however at a lower price.	**Yes (low)** • In the event of a brown paper surplus with the tissue manufacturer, there is an increased chance that respective batches are disposed of in landfill by the tissue manufacturer.
Residues (excess liquid above certain proportion)	**No** • Doesn't compromise the quality (purity) of the fibre stream • Relatively easy to separate from useful material (through washing).	**No**

3.2 Plastics

3.2.1 General information

The following general characteristics apply to the plastics material stream:

- ABCRC customer: Merlin Plastics Inc.
- Role of entity: To collect and process plastic beverage containers into useful materials (pellets).
- Containers purchased by weight (in 2016):

Material	Weight (kg)	% of total weight across all material streams
PET 0-1L	401,170,318	21%

PET 0-1L Compacted	43,032,540	2%
PET Over 1L	46,518,870	2%
PET Over 1L Compacted	2,072,234	0.1%
HDPE Over 1L	59,050,566	3%
HDPE Over 1L Compacted	1,498,849	0.1%
Plastics (Other) 0-1L	86,722,730	4%
Plastics (Other) Over 1L	10,461,307	1%
Drink Pouches	4,666,338	0.2%
Bag-in-a-Box	533,004	0.03%

3.2.2 Recycling performance

The recycling performance measures the amount of beverage container material received by an individual recycler that is used in the recycling process (excluding energy-from-waste) compared to the amount of material shipped to the recycler. The following applies to recycling rate for different plastic container types based on input provided by the ABCRC customer.

Type of container	Recycling rate	Explanation
HDPE	+/- 100%	• Close to 100% of HDPE is pelletized and sold as a useful product, subject to contamination (see below)
PET	+/- 100%	• Close to 100% of PET is pelletized and sold as a useful product, subject to contamination (see below)
Other plastics	+/- 100%	• Close to 100% of other plastics are pelletized and sold as a useful product, subject to contamination (see below)
Drink pouches	0%	• Currently there is no recycling method for drink pouches, due to container material composition (multi-laminate). All drink pouches are incinerated (i.e. used as fuel). • Technology to pelletize (i.e. recycle) drink pouches is currently in the development stage. It is expected that the respective technology will be in use by Merlin Plastics by the end of 2018.
Bag-in-a-box	0%	• Currently there is no recycling method for bag-in-a-box containers, due to container material composition (multi-laminate). All bag-in-a-box containers are incinerated (i.e. used as fuel). • Technology to pelletize (i.e. recycle) bag-in-a-box containers is currently in the development stage. It is expected that the respective technology will be in use by Merlin Plastics by the end of 2018.

As noted drink pouches and bag-in-a-box containers currently present challenges in the waste system, as the reprocessor of plastic containers (Merlin Plastics) has no method that supports recycling of respective containers. Merlin Plastics is working on a technology that would allow for recycling going forward, in the interim BCMB may:

- Allow continued incineration of both approved and new drink pouches and bag-in-a-box containers;
- Allow incineration of approved drink pouches and bag-in-a-box containers, and discontinue approval of incineration of new containers. Manufacturers of new containers must either find a reprocessor that has capacity to recycle respective containers, or discontinue selling respective containers into the Alberta market.

The re-approval process for these containers would need to consider the amount of containers currently being collected and processed (0.23% of total amount of containers collected by weight), lack of current recycling options, the expected development of future recycling processes (potentially by 2018), the existing volume of products sold and their respective weight. The re-approval process does not guarantee a specific outcome but provides the information to allow BCMB to drive continuous improvement across all types of container, regardless of when they first entered the Alberta market at a rate that is appropriate for the Alberta market.

3.2.3 Contamination

Contaminants may affect the recyclability of material streams, have the ability to degrade the quality of processed material or create other challenges for recyclers (e.g. market size of processed materials). Contaminants should be kept to a minimum or avoided altogether. The following contaminants are noted for plastic containers based on input provided by the ABCRC customer. The colour coding indicates the impact on quality/purity and recyclability (green = no impact, yellow = low to medium impact, red = medium to high impact).

Contaminants	Impact on quality / purity	Impact on recyclability
Multi-layer containers (e.g. multi-laminated plastic based containers which include a combination of plastic resins (e.g. PET and polypropylene), or multi-laminated containers which include a combination of plastic and either metalized foil/wax and or paper (e.g. drink pouches))	**Yes** • Compromises the quality (purity) of the PET stream when polypropylene or polyethylene are mixed in (low grade product) • Problematic to separate.	**Variable** • If successfully separated, material is recycled as part of PET stream (low grade) • In the event of drink pouches and bag-in-a-box container, material is 100% incinerated.
PVC (labels) in PET stream and vice versa	**Yes** • Compromises the quality (purity) of the PET stream (low grade product) • Problematic to separate (optical sorters don't detect PVC labels properly).	**Yes (low)** • If successfully separated, PVC is pelletized and sold as part of PVC stream (low grade). • If not separated, batch may be disposed of in landfill if concentration of PVC is too high. This is considered a one-off, as the intent is to find an end-use for all materials (by re-running batches after quality testing). Also, the weight of materials disposed of in landfill would be minimal compared to the total container weight.
Coloured PET bottles	**No** • Doesn't compromise the quality (purity) of the clear or green PET stream • Relatively easy to separate. • Problem is that coloured (dark) PET bottles are a low quality material in itself: - The market for coloured PET is small (limited "end-use" opportunities); - The likelihood of coloured PET bottles being recycled multiple times is small. In most instances coloured bottles will only find 1 more use (e.g. black carpet).	**No** • Successfully separated material is recycled as part of the coloured PET bottles stream (low grade)

Aluminum (e.g. seals, sleeves, lids)	**Yes** • Compromises the quality (purity) of the plastics stream • Instances where aluminum is not adequately separated (especially foil lids).	**No** • Successfully separated material is recycled as part of the metal stream (low grade)
Paper labels	**No** • Doesn't compromise the quality (purity) of the plastics stream • Relatively easy to separate.	**Yes** • Successfully separated material is 100% incinerated (burned-off)
Additives (e.g. fillers, stiffeners, ash)	**Yes** (subject to concentration) • Compromises the quality (purity) of the plastics stream or complicates the recycling process, if thresholds are being exceeded. Thresholds vary per additive type.	**No** • Additives are recycled as part of plastics stream
Clear bottles with paint / ink / print	**Yes** • Compromises the quality (purity) of the clear plastics stream • Problematic to separate (optical sorters don't detect clear bottles with print / ink / paint)	**No** • Bottles are recycled as part of plastics stream (low grade)

3.3 Aluminum

3.3.1 General information

The following general characteristics apply to the aluminum material stream:

- ABCRC customer: Novelis
- Role of entity: To collect and process plastic beverage containers into useful materials (aluminum coil).
- Containers purchased by weight (in 2016):

Material	Weight (kg)	% of total weight across all material streams
Aluminum 0-1L	848,276,905	44%
Aluminum 0-1L Compacted	94,284,707	5%

3.3.2 Recycling performance

The recycling performance measures the amount of beverage container material received by an individual recycler that is used in the recycling process (excluding energy-from-waste) compared to the amount of material shipped to the recycler. The following applies to recycling rate for aluminum cans based on input provided by the ABCRC customer.

Type of container	Recycling rate	Explanation
Aluminum cans	100%	• 100% of aluminum cans are used for the production of Alloy 3104 and sold as a useful product (aluminum coil), subject to contamination (see below).

3.3.3 Contamination

Contaminants may affect the recyclability of material streams, have the ability to degrade the quality of processed material or create other challenges for recyclers (e.g. market size of processed materials). Contaminants should be kept to a minimum or avoided altogether. The following contaminants are noted for aluminum cans based on input provided by the ABCRC customer. The colour coding indicates the impact on quality/purity and recyclability (green = no impact, yellow = low to medium impact, red = medium to high impact).

Contaminants	Impact on quality / purity	Impact on recyclability
Colouring (e.g. paint, ink)	**No** • Doesn't compromise the quality (purity) of the aluminum stream • Relatively easy to separate by burning-off paint / ink (i.e. delackering process).	**No** • Not considered part of the container weight. Paints and inks are burned-off in the process (presence of paint or ink doesn't affect the recyclability of the aluminum stream).
Residues (e.g. straws, wood, paper)	**No** • Doesn't compromise the quality (purity) of the aluminum stream • Relatively easy to separate from useful material (through screening) and residues are found to be minimal in deposit systems.	**No** • Not considered part of the container (residues are materials foreign to the container that are found in batches due to unsuccessful pre-processing). Trash is separated and disposed of in landfill.
Plastic sleeves (e.g. from craft brewery containers)	**Potential** • Could compromise the quality (purity) of the aluminum stream or complicate the recycling process - volumes are currently too low to assess if plastic sleeves present a material risk to the aluminum stream. • The impact of plastic sleeves is most likely felt in the recycling process itself (through down-time caused by spark flames or smoke from burning plastics) as opposed to quality loss.	**Yes** • Successfully separated plastic sleeves are disposed of in landfill, remaining sleeves are burned-off (i.e. incinerated) in the process (presence of plastic sleeves in current volumes doesn't affect the recyclability of the aluminum stream).

3.4 Glass

3.4.1 General information

The following general characteristics apply to the glass material stream:

- ABCRC customer: Vitreous Glass
- Role of entity: To collect and process plastic beverage containers into useful materials (glass cullet).
- Containers purchased by weight (in 2016):

Material	Weight (kg)	% of total weight across all material streams
Glass 0-1L	168,230,845	9%
Glass Over 1L	7,018,518	0.4%
Ceramics	2,073	0.0001%

3.4.2 Recycling performance

The recycling performance measures the amount of beverage container material received by an individual recycler that is used in the recycling process (excluding energy-from-waste) compared to the amount of material shipped to the recycler. The following applies to recycling rate for glass bottles based on input provided by the ABCRC customer.

Type of container	Recycling rate	Explanation
Glass bottle	+/- 97.5%	• Vitreous glass processing plant achieved a 2.45% waste ratio in FY2017, of which 1.6% went to landfill and 0.86% went to compost. Landfill stream consists of non-glass material such as labels, caps, neck rings, and other contamination not associated with containers (e.g. cardboard, plastic). Compost stream consists of glass dust fines and fine organic material.
Ceramics	0%	• Currently there is no recycling method for ceramic containers. If separated during the screening process, ceramics are disposed of in landfill. If not separated, they create a source of contamination for the glass cullet.

It is noted that based on the information provided by ABCRC, currently no clay or porcelain is being sold to the re-processors. However, if clay or porcelain containers were to be approved and send to Vitreous Glass for processing purposes, there currently is no method in place for recycling or repurposing respective containers. Clay or porcelain would therefore be a source of landfill.

3.4.3 Contamination

Contaminants may affect the recyclability of material streams, have the ability to degrade the quality of processed material or create other challenges for recyclers (e.g. market size of processed materials). Contaminants should be kept to a minimum or avoided altogether. The following contaminants are noted for glass bottles based on input provided by the ABCRC customer. The colour coding indicates the impact on quality/purity and recyclability (green = no impact, yellow = low to medium impact, red = medium to high impact).

Contaminants	Impact on quality / purity	Impact on recyclability
Multi-material products (i.e. non-glass)	**Yes** • Could compromise the quality (purity) of the glass stream • System is designed to separate non-glass materials (e.g. labels, neck rims) from classic bottles relatively easily through screening, but can't guarantee separation up to a 100% precision for all containers. • If contaminants are found in glass cullet this could upset the customer process (e.g. source of crusting, off-gassing or little explosions when turning glass cullet into glassfibre).	**Yes (low)** • If not separated from glass cullet, there is a very small chance that customers will dispose contaminated batch in landfill. The likelihood of this happening is slim, as there is a financial incentive to recover all plant cullet. • If successfully separated and removed from the glass stream, non-glass material is either disposed of in landfill or composted.
Painted on/screened on labels	**Yes** • Compromises the quality (purity) of the glass stream above certain threshold (i.e. 0.16% by weight). • Painted on / screened on labels (e.g. Corona bottles) are problematic to separate.	**Yes (low)** • If not separated from glass cullet, there is a very small chance that customers will dispose contaminated batch in landfill. The likelihood of this happening is slim, as there is a financial incentive to recover all plant cullet. Also, the weight of materials disposed

		of in landfill would be minimal compared to the total container weight. • If successfully separated and removed from the glass stream, organic material is composted.
Hazardous materials (e.g. LED screens on bottles, heavy metals, lead crystal)	**Yes** • Could compromise the quality (purity) of the glass stream • System (i.e. hand picking) can't guarantee separation of all hazardous materials up to a 100% precision. • If hazardous materials are found in glass cullet this could upset the customer process (e.g. source of crusting, off-gassing or little explosions when turning glass cullet into glasfibre).	**Yes** • Hazardous materials aren't recycled on site and can not be disposed of in landfill (subject to electronics treatment process).
Concentration of amber glass	**Yes** • Compromises the quality (purity) of the glass stream above certain threshold • If a batch exceeds 12% in amber glass, it could upset the customer process (from high iron content).	**Yes (low)** • In the event of excessive amber in batches, there is a very small chance that customers will dispose contaminated batch in landfill. The likelihood of this happening is slim, as there is a financial incentive to recover all plant cullet.
Ceramic containers	**Yes** • Compromises the quality (purity) of the glass stream • Ceramic items are problematic to locate and separate. • If ceramics is found in glass cullet this could upset the customer process (e.g. source of crusting, off-gassing or little explosions when turning glass cullet into glasfibre).	**Yes** • If not separated from glass cullet, there is a very small chance that customers will dispose contaminated batch in landfill. The likelihood of this happening is slim, as there is a financial incentive to recover all plant cullet. • If successfully separated and removed from the glass stream, ceramics are disposed of in landfill.
Colour balance	**Yes** • Compromises the quality (purity) of the glass stream subject to colour imbalance • Vitreous needs to balance the colour of the glass cullet to meet customer specifications. Current specifications are: Flint (clear) = 40-60%; Green = 30-50%, Amber (brown) = 4-12%. The likelihood of imbalance caused by a single container is low, unless the container comes in very large quantities (e.g. if Molson Coors would change their containers to amber only, this could upset the balance).	**Yes (low)** • In the unlikely event of colour imbalance, there is a very small chance that customers will dispose contaminated batch in landfill. The likelihood of this happening is slim, as there is a financial incentive to recover all plant cullet.

3.5 Conclusion

Based on the information provided by the ABCRC customers we note the following recycling performance across the different material streams:

Material		Recycling rate (by weight)		
		Low (<50%)	Medium (50 – 80%)	High (>80%)
Tetra Pak / Gable Top (used for tissue paper)	Paperboard			**+/- 95%**
	Polyethylene		**Variable**	
	Aluminum		**Variable**	
Tetra Pak / Gable Top (used for building materials)				**100%**
HDPE				**+/- 100%**
PET				**+/- 100%**
Other plastics				**+/- 100%**
Drink pouches		**0%**		
Bag-in-a-box		**0%**		
Aluminum cans				**+/- 100%**
Glass bottles				**+/- 97.5%**
Ceramics		**0%**		

Taking the perspective of the beverage container design, based on the information provided by the ABCRC customers the following design considerations may help improve the above recycling rate, or (more importantly in many instances) could enhance the quality of the processed materials:

Container component	Tetra Pak / Gable Top	Plastic	Aluminum	Glass
Materials (primary container)	• Reduce the amount of non-fibre materials in beverage container (when processed material is used for tissue paper), while acknowledging the properties of aseptic containers. • Eliminate brown paperboard (kraft) from Tetra Pak containers.	• Eliminate multi-plastic / multi-laminate containers. • Eliminate PVC containers (low grade product / small market).		• Avoid using non-glass material • Eliminate use of ceramics / ceramics containers
Materials (subcom-ponent)		• Eliminate use of PVC labels on PET containers. • Avoid using non-plastic materials (e.g. aluminum seals, sleeves or lids / paper labels).	• Avoid using plastic sleeves on aluminum cans.	• Avoid using painted on/screened on labels • Eliminate use of hazardous materials
Colouring		• Avoid coloured PET bottles (small market / short lifespan). • Avoid using paint / ink / print on clear bottles.		• Consider colour when expecting large sales volumes (preferably not amber)

Additives		• Keep additives below accepted thresholds.		
Assembly / mixing	• Enhance ability to separate paperboard from polyethylene lining (increase fibre yield).			

As indicated by the analysis performed in chapter 2 and 3, there still is room for improvement in the Alberta system to enhance end-use recycling outcomes, measured in terms of overall recycling rates, the quality of processed materials and broader environmental impacts. There are different ways for addressing this gap, which can follow either of two approaches:

- Drive system-wide improvements by establishing prescriptive measures: this approach intends to prescribe in detail how the outcome should be achieved, by creating exact expectations around variables that each have the ability to affect the outcome, for example: prescribing the use of specific recycling technologies to be applied by reprocessors, prescribing engagement with specific reprocessors (by ABCRC) only, prescribing maximum tolerable contamination rates caused by beverage containers.
- Drive system-wide improvements by taking an outcome-focused approach: this approach takes sound end-use recycling outcomes as a starting-point and doesn't pose limitations on the options for achieving this, as is the case with the alternative approach. It provides for considerably more flexibility and tends to be more agnostic by design.

We recommend following the second-approach to drive continuous system improvement and address current gaps. In chapter 4 we provide a customized framework that allows the BCMB to manage and improve system performance, consistent with this approach.

4. Performance management: defining a framework to manage future end-use recycling performance

In the previous two chapters we have established an understanding of common KPIs to assess system-wide performance, the performance of Canadian recycling programs against these KPIs, and the end-use recycling performance of the Alberta system looking at recycling rate and quality of processed materials across the four key material streams. In this chapter we provide a framework (see table 9) that allows the BCMB to manage and improve the end-use recycling outcomes of the Alberta system going forward, and realize progress against selected KPIs.

4.1 Introducing the framework

The framework is focused on the design of a beverage container. That is, by creating certain expectations in relation to new (and existing) beverage container design it is possible to enhance the recycling rate and quality of processed materials. The framework is built on the simple premise that beverage containers that are compatible with the existing recycling pathway, generate better end-use recycling outcomes. The general idea is that every beverage container manufacturer that is seeking approval for a container in the Alberta market, assesses the "performance" of the proposed beverage container against the framework criteria. The result of this assessment is a well-informed understanding of the compatibility of the beverage container with the recycling pathway, as a means to inform the decision whether or not the container should be accepted entry into the Alberta market.

The framework builds on the following principles:

- The **registrant is responsible** for demonstrating a container's performance against the framework. That is, the onus is on the registrant to prove that the beverage container is compatible with the existing recycling pathway and minimizes broader environmental impacts.
- The framework is **agnostic in nature**, and can be applied across materials and containers. That is, the framework is fully flexible and does not preclude certain materials or containers from being assessed.
- The framework is **timeless**, and doesn't require updating as recycling methods evolve. That is, the framework doesn't include criteria, values or thresholds that may make the framework irrelevant over time. For instance, as recycling methods evolve, registrants would need to reflect the changing contaminant thresholds, acceptable materials etc., in their self-assessments. I.e. the onus is on the registrant to demonstrate that their proposed container is consistent with the existing and evolving contaminant pathways and to confirm their assumptions with existing or emerging recyclers.
- The framework is **holistic**, and considers containers' compatibility with recycling pathways as well as broader environmental impacts. That is, the framework considers the full environmental impact associated with beverage containers from material extraction to recycling.
- The framework intends to "**reward" best practice**. That is, the framework sets clear expectations of preferred outcomes for registrants to follow.
- The framework is **intuitive and clear**, and can be readily applied by registrants. That is, the framework builds on common industry language and principles, to avoid confusion and inconsistent application of the framework.
- The framework can be **applied to new and approved beverage containers**. That is, the framework provides an opportunity to set expectations for new containers entering the market, and can be used to assess already approved containers (subject to grace period).

It is noted that the framework has been tested using a series of sample beverage containers, to understand its completeness, comprehensiveness and practical use.

Table 9. Registrant self-assessment framework

Criteria	Description	Rationale	Registrant self-assessment rating		
BASE MATERIAL(S)					
Materials (primary container)	Define material(s) used for container.	• Certain materials may not be recyclable considering current recycling methods, therefore being disposed of in landfill or incinerated. • Certain (composite) materials or a combination of materials may contaminate the material stream. • Certain materials may have no / limited markets or use.	Will flow into existing recycling pathways. No contamination of existing systems. Sufficient market for processed materials	May require adjustment of existing recycling pathways or pre-processing. Minor (non-critical) contamination of existing systems possible Small market for processed materials	Incompatible with existing recycling pathways Potentially significant contamination of existing systems possible No market for processed materials
SUBCOMPONENTS					
Materials (subcomponents)	Define material(s) used for subcomponents (e.g. closures, lids, seals, inserts, tamper resistance, labels and sleeves).	• The use of sub-components that are non-compatible may contaminate the material stream.	Will flow into existing recycling pathways. No contamination of existing systems.	May require adjustment of existing recycling pathways or pre-processing. Minor (non-critical) contamination of existing systems possible	Incompatible with existing recycling pathways Potentially significant contamination of existing systems possible.
Colouring	Define colour of primary container and/or use of colourants (e.g. ink) if applicable.	• Use of colourants for visual effects may contaminate the material stream. • Certain coloured materials may have no / limited markets or use.	No contamination of existing systems. High marketability of processed materials	Minor (non-critical) contamination of existing systems possible Limited marketability of processed materials	Potentially significant contamination of existing systems possible. No market for processed materials
Additives	Define type and concentration of additives used in primary container.	• Type and concentration of additives used to enhance the properties of the container may contaminate the material stream.	No contamination of existing systems Additives are easy to remove / dilute	Minor (non-critical) contamination of existing systems possible. Additives are relatively hard to remove / dilute	Potentially significant contamination of existing systems possible. Additives can not be removed / diluted
Toxicity	Define use and concentration of hazardous substances.	• Hazardous substances or high toxicity possess a risk to human health.	No hazardous chemicals No contamination of existing systems. No health risk	No hazardous chemicals. Minor (non-critical) contamination of existing systems possible. No health risk	Hazardous chemicals Potentially significant contamination of existing systems possible. Potential / proven health risk
Assembly / mixing	Define method used for assembling different components (e.g. applied, glued) or mixing of multi-materials.	• Inability to separate different components or materials may contaminate the material stream or impede the ability to separate useful material.	Will flow into existing recycling pathways. No contamination of existing systems.	May require adjustment of existing recycling pathways or pre-processing. Minor (non-critical) contamination of existing systems possible	Incompatible with existing recycling pathways. Potentially significant contamination of existing systems possible.

Criteria	Description	Rationale	Registrant self-assessment rating		
Residues	Define how container design may affect ease of emptying residues.	• Inability to empty residues of the contents of containers may contaminate the material stream.	Will flow into existing recycling pathways. No contamination of existing systems.	May require adjustment of existing recycling pathways or pre-processing. Minor (non-critical) contamination of existing systems possible	Incompatible with existing recycling pathways. Potentially significant contamination of existing systems possible.
BROADER ENVIRONMENTAL IMPACT					
GHG emissions	Quantify the GHG emissions associated with the beverage container in accordance with EPA WARM methodology, accounting for regionally accurate data where possibly.	• Excessive GHG emissions from beverage container create a burden on the environment.	Beverage container leads to GHG savings	Beverage container is GHG neutral	Beverage container leads to GHG emissions
Feedstock used (primary container)	Define feedstock used for beverage container.	• Depending on the feedstock used, environmental impacts may vary as a consequence of extraction of raw materials and manufacturing of materials.	Container is made of 100% recycled content.	Container is made of a combination of recycled content and virgin feedstock.	Container is made of 100% virgin fossil-based feedstock, and LCA data is not available to support this as an environmentally equivalent option to containers containing recycled content.

4.2 How to apply the framework

4.2.1 Roles and responsibilities

The following stakeholders and corresponding roles and responsibilities are envisioned to allow for successful implementation of the self-assessment framework:

Stakeholder	Roles and responsibilities
Beverage container manufacturer	• It is the responsibility of the beverage container manufacturer to self-assess the beverage container against the framework criteria, and provide sufficient rationale to substantiate the rating. • The self-assessment needs to be conducted each time the beverage container manufacturer is seeking to register a new beverage container on the Alberta market, and is a standard feature of the registration process. • The self-assessment needs to be conducted by manufacturers of already approved beverage containers, subject to a 5-year grace period (i.e. per 2023). • Where a beverage container is approved on the basis of showing improvement over time, the beverage container manufacturer must substantiate the improvement within the specified 5-year timeframe.
Primary / secondary processing facility (recycler)	• The reprocessing facility / recycler may be engaged by the beverage container manufacturer to provide information to substantiate the self-assessment rating. • The reprocessing facility / recycler may be engaged by the ABCRC (on behalf of the BCMB) to confirm and verify the self-assessment rating provided for by the manufacturer (i.e. quality check).
BCMB	It is suggested that the BCMB administers the beverage container self-assessment as part of the regular registration process. That is:

	• The BCMB ensures that a self-assessment is completed by the beverage container manufacturer prior to acceptance of the beverage container into the Alberta market. • The BCMB collects the completed self-assessments and uses its discretion to determine if the beverage container is approved, approved subject to conditions or denied (with the assistance of ABCRC as required). • The BCMB holds the authority to revoke approved beverage containers, in the event where the "continuous improvement" requirements aren't met. • The BCMB tracks the success of the overall recycling program, by reporting annually against the KPIs defined in chapter 1 (with the assistance of ABCRC as required).

4.2.2 Performing the self-assessment: beverage container registrants

It is expected that registrants of beverage containers each assess the "performance" of their container against the criteria defined in the framework. The framework considers different ratings, that together provide an indication of the likelihood that the beverage container will be recycled in full considering existing recycling pathways. The following provides a definition of each of the ratings, to assist users of the framework. Furthermore, chapter 2 provides a number of examples of "ratings" for approved beverage containers, considering different beverage container features.

Rating	Explanation
Will flow into existing recycling pathway	The existing recycling pathway is capable of processing the container component into a high-value material. The entire recycling process must be considered; from collection, to primary processing (e.g. compacting of containers and preparing for shipping), to secondary processing (e.g. pelletizing of plastic containers).
May require adjustment of existing recycling pathways or pre-processing	The existing recycling pathway is capable of processing the container component into a useful material, subject to achievable adjustments in the process.
Incompatible with existing recycling pathways	The existing recycling pathway is not capable of processing the container component into a useful material.
No contamination of existing systems	The container or all its components is not a source of contamination: - Container component doesn't compromise the quality of the processed material (if not successfully separated / removed); - Container component is a high-grade material in itself (if successfully separated); - Container component does not upset the downstream recycling process (e.g. use of glass cullet for production of glassfibre)
Minor (non-critical) contamination of existing systems possible	The container or all its components is a source of contamination: - Container component compromises the quality of the processed material, but material is still marketable (if not successfully separated / removed); - Container component is a lower grade material in itself (if successfully separated); - Container component results in insignificant complications in the downstream recycling process (e.g. use of glass cullet for production of glassfibre).
Potentially significant contamination of existing systems possible	The container or all its components is a source of contamination: - Container component compromises the quality of the processed material, to the extent that the material is not marketable (if not successfully separated / removed); - Container component is the lowest grade material in itself (if successfully separated); - Container component significantly upsets the downstream recycling process (e.g. use of glass cullet for production of glassfibre).

No hazardous chemicals	The container does not contain hazardous chemicals or materials (e.g. heavy metal, batteries).
Hazardous chemicals	The container does contain hazardous chemicals or materials (e.g. heavy metal, batteries).
Additives are easy to remove / dilute	Type and concentration of additives is harmless and does not result in contamination of the material stream (e.g. readily soluble and/or can be burned-off easily in the recycling process).
Additives are relatively hard to remove / dilute	Type and concentration of additives is may result in acceptable level of contamination of the material stream.
Additives can not be removed / diluted	Type and concentration of additives may result in unacceptable level of contamination of the material stream (e.g. insoluble and/or can not be burned-off in the recycling process).
No health risk	The container does not present a health risk for users of the beverage container and exposure to the container does not present a health risk for those involved in the recycling process (e.g. pickers).
Potential / proven health risk	The container does/may present a health risk for users of the beverage container and exposure to the container does/may present a health risk for those involved in the recycling process (e.g. pickers).
High marketability of processed materials	The recycler faces no challenges in finding a market for the processed material.
Limited marketability of processed materials	The recycler faces challenges in finding a market for the processed material, due to the properties of the material and the corresponding market demand.
No market for processed materials	The recycler has no market for the processed materials.

It is expected that beverage container registrants substantiate the self-assessment ratings, by providing sufficient evidence across all relevant criteria. The following are examples of type of information that beverage container manufacturers can provide to satisfy the self-assessment process.

Criteria	Information / indicators
Materials (primary container)	• Specify materials contained in primary container • Quantify materials by weight (in absolute and relative terms) • Describe likely use of materials in recycling pathway (recycled, incinerated, disposed of in landfill, reused) • Describe likelihood of contamination of material streams • Describe ease of separation of multiple materials • Describe marketability of processed materials (i.e. end product of recycling)
Materials (subcomponents)	• Specify subcomponents and corresponding materials • Describe compatibility of subcomponents with primary container material • Describe likely use of subcomponent materials in recycling pathway (recycled, incinerated, disposed of in landfill, reused) • Describe likelihood of contamination of material streams • Describe ease of separation of subcomponents
Colouring	• Specify colour of beverage container (either primary colour of container or use of ink / paint) • Describe likelihood of contamination of material streams • Describe marketability of processed materials (i.e. end product of recycling)
Additives	• Specify and quantify type and concentration of additives used • Describe likelihood of contamination of material streams

	• Describe ease of removal / isolation (e.g. burned-off, water soluble below 80C)
Toxicity	• Specify and quantify use of toxic or persistent chemicals causing health risk • Describe likelihood of contamination of material streams • Describe ease of removal / isolation (e.g. burned-off, water soluble below 80C)
Assembly / mixing	• Describe method used for assembling different components (e.g. applied, glued, painted) • Describe ease of separation of multiple materials • Quantify possible yield loss from inability to separate materials • Describe likelihood of contamination of material streams
Residues	• Describe likelihood of residues after use of beverage container by customer • Describe ease of emptying container (e.g. cold water wash)
GHG emissions	• Quantify the GHG emissions associated with the beverage container in accordance with EPA WARM methodology, accounting for regionally accurate data where possible. Assume the total number of beverage containers expected to be introduced into the Alberta market.
Feedstock used	• Specify the feedstock used (virgin or recycled material) in the production of the primary container.

4.2.3 Integrity of self-assessment submissions and KPI reporting

Any program that publicly reports progress against KPIs runs an inherent risk of reporting inaccurate data to the public, whether as a result of unintentional errors or deliberate mis-reporting by participants in the program. The nature and extent of the activities required to reduce this risk to an acceptable level can vary widely and would normally be based on an assessment of the likelihood that the errors are significant enough to provide BCMB and the public with a false impression of the effectiveness of the program.

At the present time, no form of third party assurance is required over data submitted to support assessments of program effectiveness. Individual participants in the program are subject to financial audits which do provide some degree of comfort over their submissions. However, financial audits are not focused on the data that is of specific relevance to BCMB and are not designed for the purpose of determining whether this specific data is fairly stated.

The proposed BCMB registrant self-assessment framework and related KPIs described in this report incorporate a number of data points that BCMB will be reliant on in determining the appropriateness of container approvals and the effectiveness of recycling programs. The primary data points are shown in the table below.

Data relied on by BCMB	Comments
Registrant Self assessment	• The self-assessment is the basis of product approvals. • Information on container design, materials used, contaminants and compatibility with the Alberta recycling framework are the core elements of the self-assessment data. • Self-assessments are completed by beverage container manufacturers.
Container sales (by weight)	• As this data drives both collection rate and program loss KPIs it is critical to BCMB's assessment of program effectiveness. • This data should be provided by the ABCRC and may require a conversion from beverage container units to weight, depending on the type of information provided by manufacturers (refer to section 4.2.6 for proposed amendments to the CSA Operating Agreement to reflect data request).
Container collections (by weight)	• This data drives both collection rate and program loss KPIs. • This data should be provided by ABCRC and should reconcile with the amount of beverage containers sold to the ABCRC customers (consistent with section 2.1 of the existing CSA Operating Agreement).

Proportion of collected material recycled (by weight)	• This data drives both recycling rate and program loss KPIs. • This data should be provided by the relevant service providers (i.e. ABCRC customers or downstream processors – depending where in the chain materials are being recycled, incinerated or disposed of in landfill) to the ABCRC (refer to section 4.2.6 for proposed amendments to the CSA Operating Agreement to reflect data request). At a minimum, a service provider should consider the following steps to ensure data quality and demonstrate due diligence[13]: a) Maintain a record of all inbound and outbound materials on a monthly basis. b) Maintain, for at least five years or otherwise specified by law, commercial contracts, bills of lading, or other commercially accepted documentation for all transfers of materials into and out of its facility. c) Monitor the destinations of all outbound materials to final disposition. d) Maintain records of operational activities on a monthly basis, including: - the quantity (weight) and types of material reused; - the quantity (weight) and types of material recycled, including specification of type of processed material by weight (e.g. pellet, cullet, coil); - the quantity (weight) and type of material incinerated; - the quantity (weight) and type of material disposed of in landfill and the disposal method; - the quantity (weight) and type of material for further secondary processing, if final disposition (reuse, recycling, incineration, landfill) doesn't occur at the primary service provider facility.
Avoided GHG emissions (by tonnes CO_2e)	• This data is not closely related to other data sources and is related to a single KPI. There are multiple potential methodologies for calculating this data, of which the WARM methodology is recommended for use. • This KPI shall be calculated by the BCMB based on information provided by the ABCRC.

Amongst other recycling programs the level of third party verification differs. The method of verification differs also. In some cases (such as BC) an audit framework has been developed and implemented that applies to each of the regulated materials covered under the Recycling Regulation, covering data supporting KPIs as well as agreed targets for each stewardship program. In other cases, sector specific programs have developed, such as the Electronics Stewardship Standard incorporated in the Recycle Qualification Program (RQP) and managed by the Recycler Qualification Office (RQO) for end of life electronics. This program is now used across Canada to support recycling data and is focused on the specific topics that are critical to recycling programs (recycling rate data by material and tracking of each material to subsequent processors that are part of an approved recycling pathway). Linkage to other forms of verification, such as the ISO 14001 Environmental Management Systems standard, is sometimes considered as an option, but it is important to recognize that this standard, like all management systems standards, is focused on the internal processes of the users and does not include mechanisms for providing verification over data quantities.

In order to determine BCMB's third party verification needs it is first necessary to build an understanding of the reporting and credibility risk associated with existing data and proposed new data sources. The following recommendations are made for the development of a program that has appropriate rigor to address BCMB's risks:

1. Build an understanding of the risk of mis-reporting first and use this to help determine the scope and extent of third party verification that is desirable. This is best achieved by a small number of targeted pilot projects focused first on the key sources of data that are fundamental to the process (sales data, collections data, recycling rate data) then looking at the areas most likely to have data integrity issues (e.g. avoided GHG emissions).
2. Based on the developed understanding of risk, design a third party verification framework that can be applied to all potential types of data at a level of assurance and periodicity that is aligned with the associated risk of mis-reporting.

[13] CSA Group (2015). A Guideline for accountable management of end-of-life materials

3. Implement the framework on a risk-based timeline. This may result in different sub-sets of the data being subject to verification in different years, or all data of a specific type being subject to verification in a specific year.

The outputs from the above process are expected to identify at least some data where third party verification is preferable, on at least an intermittent basis. To the extent this conclusion is reached, the following comments apply to the development of a third party verification framework and the selection of auditors.

Third party verification framework

The third party verification framework selected should provide all of the key elements necessary to ensure consistent and reliable implementation, which include:

- A clear audit standard that will be upheld by the auditors
- Clear audit criteria, or a methodology for developing them
- An expected level of assurance
- An expected reporting format
- Guidance related to methodology (particularly in relation to managing data uncertainty)
- Competency requirements for auditors

Selection of auditor

Previous experience would indicate that there are both pros and cons to the selection of an auditor by BCMB – on the one hand this creates consistency across submissions, on the other hand manufacturers may be more comfortable with their own auditor for some data (particularly sales data) and the use of an existing auditor may be more efficient where they have the requisite non-financial audit skills. It is likely that manufacturers and recyclers would prefer to implement an audit program which would allow them to use their existing auditor for data that is more closely linked to existing financial audit processes and required on a more frequent basis (e.g. container sales data by manufacturers and recycling data by recyclers) which would require some degree of ongoing guidance and feedback by BCMB to ensure BCMB's needs are met by this process.

For data where consistency is critical and that is not closely coupled to existing financial audit processes (e.g. avoided GHG emissions) it is recommended that a single auditor be selected to audit data across submissions. Similarly for container self-assessments, it is likely that the most efficient form of verification is based on a single auditor reviewing self-assessments submitted to BCMB to assess the extent they are supportable by data prior to review of the self-assessment by BCMB.

Adaptation of the verification process in relation to identified errors.

As discussed above, the verification program should be matched to the risk of mis-reporting. When errors are identified in submissions (self-assessment data, collections data or recycling data) there are two necessary responses:

1. Address the specific mis-reporting issue – this might require requests for revised data and explanations of how the error occurred, targeted verification on specific data or broader verification on the full range of data being reported depending on the significance of the error.
2. Address the broader data quality issue – by re-evaluating the risk of mis-reporting and the extent of verification required within the overall program to ensure that there are sufficient checks in place to conclude that the overall data is reliable.

4.2.4 Evaluating the self-assessment results: BCMB

A completed self-assessment provides insight in the compatibility of a beverage container with the existing recycling pathway, the level of contamination and the broader environmental impacts. The result might be that some beverage container components do create a problem (red rating), while others only create a minor problem (yellow rating) or no problem at all (green rating). The question is, how does BCMB (with the assistance of ABCRC as required) aggregate the results to come to a conclusion? The following is suggested:

Framework component	Evaluation criteria
Base material(s)	• A red rating automatically disqualifies a beverage container from being approved; • A yellow rating is subject to the continuous improvement requirements as defined in section 4.2.5; • A green rating indicates container approval without provisions.
Subcomponents	• Any red rating automatically disqualifies a beverage container from being approved; • A yellow rating is subject to the continuous improvement requirements as defined in section 4.2.5, if the amount of beverage containers introduced into the Alberta market is *significant (e.g. ≥ 10 million beverage containers sold annually)*; • A yellow rating indicates container approval without provisions, if the amount of beverage containers introduced into the Alberta market is *insignificant (e.g. < 10 million beverage containers sold annually)*; • A green rating indicates container approval without provisions.
Broader environmental impact	• A red rating is subject to the continuous improvement requirements as defined in section 4.2.5; • A yellow rating indicates container approval without provisions; • A green rating indicates container approval without provisions.

As an example, based on the information provided by the ABCRC customers the following is noted to upset the recycling pathway considerably, and may trigger a red rating across material streams:

- Tetra Pak / Gable Top: presence / concentration of brown paperboard (kraft) in Tetra Pak containers
- Plastics: multi-plastic / multi-laminate containers
- Plastics: PVC containers
- Plastics: PVC labels on PET containers
- Plastics: Coloured PET bottles
- Glass: ceramics bottles
- Glass: use of "electronic" labels (e.g. LED labels).

4.2.5 Options for continuous improvement into the registration process

The framework provides opportunities to encourage performance improvement over time. It is suggested that, based on the considerations as defined in 4.2.4, certain expectations are created in relation to beverage containers that don't show a "green" rating across all criteria. For example, if labeling (as part of sub-components) is a minor (non-critical) source of contamination in the existing recycling process, it must be demonstrated that labeling is no longer a source of contamination within a 5 year timeframe. This can either be realized by adjusting the container design or through innovation in the recycling process. It is suggested that if the required improvement is not realized within the acceptable timeframe, BCMB holds the authority to revoke the approval. Similarly, as potential registrants provide self-assessments indicating the compatibility of their proposed containers with the Alberta recycling framework there is an expectation created within the approval process that subsequent monitoring data will demonstrate the accuracy of the self-assessment. In particular, demonstrating that actual performance meets or exceeds expected performance within the self-assessment for each of the key KPIs should be a key condition of approval.

It is suggested to apply a risk-based approach to the continuous improvement process, that is:

- New beverage containers: only those containers that demonstrated "yellow" ratings in their initial self-assessment registration, or were subject to change over the course of the 5 years, need to re-apply by completing the self-assessment again, and will be subject to a review by BCMB.
- Previously approved beverage containers: currently approximately 9,000 containers are registered in Alberta. To manage the corresponding administrative burden it is recommended that:
  - All manufacturers complete the self-assessment to create cross-system awareness about Alberta's beverage container recycling program direction, and the increased weight that is placed on beverage container design considerations.

- BCMB reviews the completed self-assessment for those containers with a "red" rating and reviews a representative sample of remaining self-assessments using a risk-based approach (e.g. focus on known high risk areas, e.g. beverage containers containing ceramics, PVC or lead crystal or coloured PET bottles).

4.2.6 By-law implications

We have performed an assessment of the extent to which the existing by-laws need to be amended to account for the proposed changes as discussed above. Based on this assessment it is recommended to update the Beverage Container Registration By-Law and the CSA Operating Agreement.

Beverage Container Registration By-Law

It is recommended to update Section 5 of The Beverage Container Registration By-Law to include the following:

- *Manufacturers are required to conduct an assessment of beverage containers proposed for or sold within Alberta prior to initial use of the container in Alberta and at least once every subsequent 5 years. The assessment shall be conducted in accordance with the BCMB registrant self-assessment framework.*
- *BCMB approval of beverage containers is subject to any conditions contained in the approval related to recycling performance and is valid for a maximum of 5 years.*
- *Manufacturers are required to provide sufficient information to the ABCRC (on behalf of the BCMB) in relation to the weight of beverage containers sold annually, by container category or container type.*
- *BCMB may request at its discretion that annual data submissions in relation to beverage containers sold (by weight) be supported by third party assurance.*
- *BCMB may request at its discretion that annual data submissions in relation to program KPIs (collection rate, recycling rate, program loss, avoided GHG emissions) be supported by third party assurance.*
- *Where third party assurance is requested, the method of assurance, the assurance criteria and the level of assurance to be provided shall be agreed in advance with BCMB.*
- *A manufacturer of an approved beverage container must demonstrate continuous improvement in relation to the framework requirements, as required.*

CSA Operating Agreement

It is recommended to update Section 2 of the CSA Operating Agreement to include the following:

- *The CSA shall provide the BCMB the following information on a quarterly basis:*
  - *The weight of beverage containers sold by material stream in metric tonnes, including information on the methodology applied to accurately determine the weight of containers sold.*

Furthermore, it is recommended to move sub-section 3.1.1 to Section 2, and amend as follows:

- *Weight of beverage containers reused, recycled, incinerated or disposed of in landfill, by material stream in metric tonnes.*

Finally, it is recommended to update Section 3.1.3 to include the following:

- *Confirmation that all contracts with third party recycling agents include the following contractual obligations:*
  - *The obligation to optimize recycling outcomes to the best of the agent's ability, measured in terms of overall recycling rate and the quality or properties of processed materials, and efforts to minimize broader environmental impacts associated with their operations.*

No changes to the CSA By-Law are suggested, as the By-Law implicitly addresses the amendments presented here in Section 20: "*The CSA shall provide the BCMB with such information relating to the CSA operations as specified in any By-laws or as may be requested by the BCMB from time to time*".

Collectively these recommended amendments mean to:

- Enhance Alberta recycling outcomes and provide greater program clarity to registrants based on the implementation of a structured framework for container approval and renewal.

- Ensure that the required information is available to the BCMB to allow for tracking of program performance against the proposed KPIs; and
- Place greater responsibility on the ABCRC to contract recycling agents that contribute to better environmental outcomes and system performance against the proposed KPIs.

5. Conclusion

The objective of this report was to provide the BCMB with the understanding and tools to manage and improve the end-use recycling outcome of the Alberta beverage container recycling program. The following is noted based on the analysis performed:

- BCMB may choose between a wide variety of indicators that each have the ability to provide insight in overall system performance. Following the assessment of the implementation of KPIs across recycling programs and their relative merits and limitations (looking at aspects such as relevance, ease of use, access to credible data) we recommend the following KPIs for monitoring the end-use recycling performance of the beverage container program in Alberta:
    - recycling rate,
    - collection rate;
    - program loss;
    - avoided GHG emissions.
- Alberta's beverage container recycling program already performs reasonably well in recycling collected materials. Depending on the type of container, the majority of containers (by weight) are being processed into a useful material (e.g. aluminum coil, glass cullet, paper fibre and plastic pallet). Opportunities to enhance the quality, purity and marketability of processed materials by addressing certain contamination concerns can be addressed through an updated registration process that is conducted on a rolling 5 year basis rather than as a one-time approval.
- To allow for continuous sound recycling performance, and to enhance the quality, purity and marketability of processed materials, we recommend that BCMB implement an agnostic cross-material framework for continuous registration of beverage containers. The framework creates expectations in relation to new and existing beverage container design in terms of compatibility with existing recycling pathways, and provides BCMB with key information to inform the container continuous approval process.

Appendix I: Literature used

- ABCRC (2016). 2016 Sustainability Report
- Amienyo, David, Haruna Gujba, Heinz Stichnothe, and Adisa Azapagic (2012). Life cycle environmental impacts of carbonated soft drinks. The International Journal of Life Cycle Assessment" Springer.
- Azapagic, Adisa (2011). LCM in the Packaging Sector. Towards Life Cycle Sustainability Management. Springer (2011). 381-89.
- BCMB (2016). 2016 Annual Report
- Bersimis S, Georgakellos D (2013). A probabilistic framework for the evaluation of products' environmental performance using life cycle approach and Principal Component Analysis. J. Cleaner Production. 42: 103- 115.
- BRCCC (2016). 2016 Annual Report to the Director
- Boissons Gazeuses Environment (2016). Recovery statistics (access via: http://www.bge-quebec.com/en/recovery-statistics/)
- CalRecycle (2015). Glass Recycling.
- CBCRA (2016). 2016 Annual Report
- CM Consulting (2016). Deposit systems for one-way for beverage containers: global overview
- CM Consulting (2016). Who Pays What. An analysis of beverage container collection and costs in Canada.
- CSA Group (2015). A Guideline for accountable management of end-of-life materials
- Divert Ns (2017). 2016-2017 Annual Report
- Encorp Pacific (2016). 2016 Annual Report
- European Environment Agency (2016). Circular Economy in Europe.
- Flexible Packaging Association (2009). Flexible Packaging – Less resources, less footprint, more value.
- Government of New Brunswick. Beverage Container Program (access via: http://www2.gnb.ca/content/gnb/en/services/services_renderer.3975.Beverage_Container_Program.html)
- Government of Northwest Territories (2016). Waste reduction and recovery program 2015-2016 Annual Report
- Government of Prince Edward Island. Beverage Container Program (access via: https://www.princeedwardisland.ca/en/information/communities-land-and-environment/beverage-container-program)
- Huang, Chien-Chung, and Hwong-Wen Ma (2004). A Multidimensional Environmental Evaluation of Packaging Materials. Science of the Total Environment 324 (2004): 161-72. Science Direct.
- MMSB (2017). 2016-2017 Annual Report
- MMSW (2016). 2016 Annual Report
- MMSM (2016). 2016 Annual Report
- Patrik Geisselhardt et al. PET bottle-to-bottle recycling key success factors – 6 years experience in Switzerland.
- Recyc Quebec (2016). 2015-2016 Annual Report
- Recycling International (2016). Deposits boost Germany's PET bottle recycling rate.
- Resource Recycling (2011). Recovery Questions.
- Resource Association. Recycling Quality Specifications, access via: http://www.resourceassociation.com/recycling-quality-specifications/
- SARCAN (2017). 2016-2017 Annual Report
- Stewardship Ontario (2016). 2016 Annual Report
- The Beer Store (2016). 2016 Responsible Stewardship Report
- The International Aluminium Institute (2016). Access via: http://recycling.world-aluminium.org/review/sustainability/
- Vellini, M.; and Savioli, M. (2008). Energy and Environmental Analysis of Glass Container Production and Recycling. Energy 34 (2008): 2137-143.

In addition KPMG held interviews with the following individuals:

- Trisha Dooley, Buyer (Novelis North America-Recycling)
- Kevin Andrews, General Manager (Merlin Plastics Supply Inc.)
- Santiago Fourcade, COO (The Paper Tigers, Inc.)
- Pat Cashion, President (Vitreous Glass Inc.)
- Darcy Forbes, General Manager (Vitreous Glass Inc.)