Design Options and Cost

A DRS for the Future In Québec

Sarah Edwards
John Carhart
Mark Cordle

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Prepared by Eunomia Research & Consulting

Quality review by Sam Millette

Approved by

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Sarah Edwards

(Project Director)

Eunomia Research & Consulting Incorporated
33 Nassau Avenue
New York City
NY 11222

Tel: +1 646 256-6792

Web: www.eunomia.co.uk

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Executive Summary

Created in 1984, Québec's deposit return system (DRS) is regulated under the provisions of the *Environment Quality Act*, 1972. The program covers all single-use soft drink and beer containers, including plastic bottles, metal and bi-metal cans, and glass bottles. Other beverage containers, such as those used for water, sports drinks, and juice, are managed through curbside multi-material recycling programs ("collecte sélective"). Since the program began, the deposit on aluminum, glass, and plastic soft drink and beer cans has been $0.05. Beer cans and bottles larger than 450ml are subject to a $0.20 deposit. Beer bottles below 450ml are subject to a $0.05 deposit for can and $0.10 deposit on glass bottles.

On January 30, 2020, the Québec Government announced that the existing DRS would be expanded to include all "ready-to-drink" beverage containers with a capacity of 100 ml to 2L (e.g., flat and sparkling water, wine and spirits, juices and fruit-flavoured beverages, milk and milk substitutes, natural beverages, etc.), except for "bag-in-box" containers and flexible pouches. The future system also includes for increased and simplified deposit amounts of $0.25 for wine and spirits bottles and $0.10 for other containers.[i] Containers made of cardboard (i.e., multi-layer containers) are also expected to be included under the expanded system starting in 2024. The future system will also need to achieve a 75% recycling rate by 2025 and a 90% by 2030. To achieve this, consumer convenience and easy access to redemption points is key.

As part of its plan to modernize the province's DRS, the Government intends to have legislation drafted and enacted by December 2021. To help inform this process, Recyc-Québec tasked Eunomia with considering how a future system could be configured utilizing a range of return infrastructure to achieve a 90% return rate and to assess the cost of this future system. The analysis presented in this report follows on from that carried out by Houston Conseils as detailed in "*Deposit Modernisation – Mandate to Develop Deposit System Scenarios – Phase 1 Final Report".*

At the heart of Eunomia's standard approach to configuring and costing a future DRS is ensuring a high level of customer convenience. Systems that employ return-to-retail redemption are considered the gold standard of convenience as they provide consumers with a "one stop shop," which avoids extra trips and emissions. Our modelling approach therefore requires an understanding of where retailers are located and the size of those retailers, such that space limitations for the placement of RVMs and storage of material can be assessed. As part of the process, we consider locations that are likely to handle high volumes based on population density and the location of hotels, restaurants and cafés (HoReCa) to determine where additional return points will be needed to manage this material.

The proposed changes to the DRS in Québec will result in an estimated 4,990M total containers being included in the system by 2030 (an increase of 128% over the current system in 2020). In order to achieve the 90% collection for recycling target, the future system will need to be designed in a way that can accommodate not only more containers generated in households, but also containers consumed and discarded away-from-home, such as wines and spirits bottles from the HoReCa sector.

The return options considered as part of the modelling are included in Table 1.

Table 1: Advantages and Disadvantages of Different Return Infrastructure Options Considered

Return Infrastructure	Advantages and Disadvantages
Return in Retail through RVM	*Advantages* Consumers are able to return empty containers at the same time/location as they are purchasing new ones, avoiding extra trips and emissions. Consumers can return single use and refillables at the same location, reducing confusion and inconvenience. Containers are separated counted, verified, sorted into two fractions heavy (glass) and light (metals, plastics and multi-layer), and then crushed or compacted. Avoids expensive system-specific infrastructure as there is no need to secure additional sites, which could be difficult due to planning restrictions or reluctance by people to live near waste management facilities. Benefits for retailers, such as increased foot traffic (which can translate into increased sales) and an improved corporate image.[1] Deposit paid to redeemer immediately. Offers the highest level of consumer convenience. *Disadvantages* Space requirements costs associated with RVMs, material storage. Staff time and cost for servicing machines, managing deposit refunds, answering questions.

[1] Two large independents studies in Europe demonstrated that shoppers returning containers for their deposit spend mor than average. In Sweden spend was 52% more for customers returning containers, in Finland it was 15%. Survey of 8,500 shoppers at 70 supermarkets (Movement Research & Consulting), Survey of 8,500 shoppers at 71 supermarkets (TNS Gallup)

Kiosks	*Advantages* Potential for two or more retailers within close proximity to place a kiosk close by so that they can avoid having to accept in store returns. Containers are counted, verified, sorted, and then crushed or compacted. *Disadvantages* Requires someone to ensure the kiosks are operational at all times, difficult when not on a specific retailers land No one available to deal with redeemers' questions if the machines are not working if places on land not controlled by a single retailer Potential problems with securing a site due to planning restrictions or objections by land owners even if the proposed location is in a parking lot between existing retailers. Unable to accommodate refillables which could lead to containers being left in the kiosk and requiring separate collection Limits the number of people that can redeem at one time (kiosks are small, so there is the issue of where people would wait while others redeem their containers; this is an important consideration in the context of Québec's climate)
Bag drops	*Advantages* More time efficient for consumers as they are not required to feed containers into an RVM; they can drop off full bags of containers, both single use and refillable, without the need to sort *Disadvantages* Potential problems with securing a site due to planning restrictions or objections by land owners to have these facilities on their sites even if they are located in parking lots between existing retailers. Requires bins to be emptied on a regular basis to ensure that there is always space for consumers to redeem Potential for containers to be stolen and re-redeemed Containers not counted, verified or compacted therefore adding costs elsewhere in the system

Depots	*Advantages* Act as regional hubs through which the IC&I sector as well as groups like boy scouts, charities and schools can redeem high volumes of containers. Depots also count and verify containers through bulk processing machines. Depot operators could service local retail RVMs, kiosks and bag drops and even find new locations for bag drops to maximize units captured. *Disadvantages* Potential problems with securing a location due to planning/zoning restrictions or objections by residents who are concerned with living close to what could be classed as a waste management facility.

Data on retailer location, size and current returns was not shared by stakeholders and as such two approaches were taken to configure and cost a future system for Québec:

1) First a **geographical coverage approach** was taken whereby retailer data purchased from the North American Industry Classification System (NAICS) was plotted using GIS mapping and then the number of return points was determined by setting criteria for how far 90% of the population had to be from a return point in urban, semi urban and rural areas. Kiosks or bag drops replaced retailers where there were two or more retailers within the same 6-digit posts code. HoReCa location data was also purchased from NAICs and depots were placed to ensure no HoReCa was further than 30km from a depot in urban areas and 60km in a rural area.
2) Following to feedback from stakeholders a second future system was designed using a **volume-based approach with a greater reliance on depots**. Limited soft drink retail return data provided by Recyc-Québec and the projected return volume in 2030 was used to determine the number of retailers calculated to have sufficient volume to accommodate an RVM the remaining volume would flow through bag drops and 50 depots.

Future System 1 (geographical cover approach) (FS 1) and FS 2 (volume-based approach) was costed using Eunomia activity-based DRS model adapted to include Québec cost factors such as labor rates, fuel costs, geography. The outputs from the activity-based cost modeling demonstrated how expensive the kiosk option was and in order to better enable FS1 to be compared to FS2 a variant was modelled whereby the kiosk in FS1 were replaced with bag drop.

E.1.1 FS Configuration Comparison

Table 2 details the design key components of each future system (FS). FS 1 offers more return points that FS 2 and more of these points are in retail allowing for consumers to return when the shop providing a common stop approach to redemption. The current system is estimated to have 13,100 retailers obligated with 90% of the volume being returned through 3,935 retailers. While both these systems offer few potential return points they do provide more return options and more options for high volume return from the IC&I sector. FS 1 also measures the level of convenience provided by the return locations as a geographical coverage metric has been used to assess. This means that those living in urban areas for example are no further than 800m from a return point, this would allow redemption to be made without a car and should enable container to be redeemed when consumed "on-the-go". FS 2 with the greater number of depots will result in haulers servicing the IC&I sector having less distance to travel to return containers generated from these sectors.

Table 2: System Key Design Components

Key Consideration	Future System 1	Future System 1 (Variant – Excluding Kiosks)	Future System 2
Return Points	Total: 3,763 • 3,121 return in retail with RVM • 307 kiosks • 307 bag drops • 25 depots	Total: 3,763 • 3,121 return in retail with RVM • 614 bag drops • 25 depots	Total: 3,476 • 2,812 return in retail with RVM • 614 bag drops • 50 depots
Number of Conditioners for Light Fraction	5	5	5
Geographical Coverage	90% of population within: • 15km of a return point in rural (<55 ppl per sqkm) areas • 7km in semi urban (55<density<631 ppl per sqkm) areas • 800m in urban (>631 ppl per sq km) areas	90% of population within: • 15km of a return point in rural (<55 ppl per sq km) areas • 7km in semi urban (55<density<631 ppl per sq km) areas • 800m in urban (>631 ppl per sq km) areas	Could not be calculated as retailer volume by location data not provided
Logistics	The activity-based cost model includes to containers to be collected from return locations and transport either to conditioners, processors or depots for sorting, conditioning or recycling.		

E.1.2 FS Cost Comparison

Total Cost

A comparison of the FSs is provided in Table 3. Activity based costs are provided for the reception of containers, effectively the return points, RVM's in retail, kiosks and bag drops. The costs include the depreciation of capital assets as well as operating costs such as labour, property lease or space costs, electricity etc. FS 1 reception costs are significantly less than FS 1 – variant and FS 2 because it included kiosks which due to the capital, installation and servicing costs is significantly more expensive that return in retail as shown in Table 5. Transportation costs include the costs of collecting containers from the return points and transporting them to conditioners or depots prior to bulk transfer, as well as the transportation of containers from depots to conditioners or recyclers. Costs include the depreciation of tractors and trailers as well as maintenance and labour costs. Transportation costs are highest in FS 2 as there are more depots to collect from. Depots are predominately managing returns from the CI&I sector as well as material collected through bag drops. All of these units have to be counted and verified through bulk sorting equipment and separated into two fractions prior to transfer to the conditioner and recycler. Again, depot costs are higher under FS 2 because there are more depots. Conditioning costs are the same across the FS as the same number of containers have to be conditioned. The central administration costs for the system operator are also assumed to be the same across all FSs; these costs include for 11 staff plus office space, IT and education and communication. This cost modelling does not include any transitioning costs or costs, for example, associated with locating sites for depots or bag drops.

Table 3: Summary of FS Costs

Activity Cost Element	FS 1 Cost (CAD$ millions)	FS 1 Variant Cost (CAD$ millions)	FS 2 Cost (CAD$ millions)
Costs			
Reception	103.49	83.79	76.79
Transportation	36.74	39.90	40.78
Depot	35.37	42.39	49.04
Conditioning	38.32	38.32	38.32
Central Administration	1.9	1.9	1.9
Gross Cost	**215.84**	**206.3**	**206.84**
Income			
Material Revenues	-44.37	-44.37	-44.37
Unclaimed Deposits	-46.87	-46.87	-46.87
Total Net Cost	**124.62**	**115.07**	**115.61**

Source: Eunomia

The average cost of each of the systems on a per unit returned and placed on market perspective is provided in Table 4. The cost per unit differs my material type which is detailed in Table 6.

Table 4: Cost per Unit Returned and Placed on Market

	FS 1 (Canadian Cents)	FS 1 Variant (Canadian Cents)	FS 2 (Canadian Cents)
Unit Returned	2.77	2.56	2.57
Unit Placed on Market	2.50	2.31	2.32

Source: Eunomia

Cost by Return Point

The cost associated with returning a container through different return points is indicated in Table 5. The cost of managing a container through a RVM in a retail store versus a bag drop or kiosk is detailed in Table 5 for FS 1. The table details the gross and net costs as well as the cost per container collected through the different type of return point and the costs associated with the reception of the container, this is in effect the handling fee. As stated above, managing a container through kiosks is significantly higher than through a RVM in a retail store. The cost of the bag drop is also high overall because while the reception costs are low the cost of having to transport uncompacted containers and then separately, count, verify and sort adds cost. This is reflected in the handling fee. The handling fee for a retailer with an RVM should be $0.030 compared to a retailer that might consider a bag drop where the handling fee would be $0.014. The RVM in store, while more expensive from a reception perspective, significantly reduced down stream costs. The kiosks, in addition to being expensive due high capital costs and the need for more management to ensure they are always operation, have additional downside as detailed in Table 1, which is why a variant of FS 1 was modeled. Bag drop costs can be off set by charging the customer a convenience fee for choosing to use them. In Oregon this is $0.40 per bag. This revenue stream would reduce the bag drop cost to $0.0388 per container from $0.0438 in FS 1.

Table 5: Cost by Return Point Type (FS 1)

	Retail RVM (CAD$ millions)	Kiosk (CAD$ millions)	Depot RVM (CAD$ millions)	Bag Drop (CAD$ millions)
Gross Cost	105.92	35.50	0.89	33.13
Total Net Cost	60.90	25.01	0.51	22.64
Reception Cost (Handling Fee) (cents)	3.05	5.18	3.23	1.40
Cost per Container Collected (Cents)	2.75	4.84	2.74	4.38

Cost by Container Type

The difference in cost by container type is demonstrated in Table 6 for FS 1 (Variant). The cost of managing glass in the system is the highest due to its weight and a relatively low market value, compared to aluminum which is light, easily compacted compared to plastics, and provides significant revenue to the system from material sales.

Table 6: Cost by Container Type (FS 1 Variant)

	Plastic	Metal	Glass	Multi-Layer
Gross Cost (Millions)	72.91	66.16	54.75	17.33
Net Cost (Millions)	43.89	11.87	47.38	11.92
Net Cost Per Unit Placed On Market (Canadian Cents)	2.43	0.56	8.75	2.33

E.1.3 Curbside Costs

The future DRS will pull material currently being recycled through curbside into the DRS, and it will also have capture material that is disposed to landfill. Less material collected at the curbside could reduce collection costs if the volume is sufficient to enable route optimisation, and this potential benefit has not been calculated. Less material collected at the curbside will mean that less material is delivered to the MRF so reducing MRF tipping costs as well as reducing the amount of material disposed thus reducing landfill tipping costs. On the flip side, the curbside system will see a reduction in material revenues associated predominately with aluminum and PET, while a potential reduction in costs associated with the handling and onward recycling of glass. MRFs in Québec also receive the deposit if they can successfully separate out the deposit material. While it could be assumed that because the DRS is pulling material from the curbside the revenue from the deposits will decrease in the future system this is not actually the case. Because both the scope of containers and deposit increases in the future containers that currently do not have a deposit will have a deposit, and each container sorted through the MRF will be worth twice as much, so the possible revenue from deposits increases. The overarching impact is an approximate $19 million benefit as detailed in Table 7.

Table 7: Impact on Curbside Services

	Amount (CAD $) millions	Loss or Benefit
Reduction in Material revenue	7.3	Loss

Reduction in MRF Sorting Fees	14.59	Benefit
Reduction in Landfill Tipping Fees	8.10	Benefit
Increase in Deposits	2.80	Benefit
Total	18.16	Benefit

Source: Eunomia

E.2.0 Stakeholder Impact

A high-level overview of the FSs on stakeholders is set out in Table 8. The activity-based costing approach to calculating systems costs results in a potential handling fee to retailers with RVM's of $0.03, $0.01 more than currently under FS1. The overarching costs of the FS 1 with out the kiosks and FS 2 is comparable. FS 1 is designed to provide a level of access based on geographic coverage criteria that along with more options for high volume return to capture units from the IC&I provides more options for all consumers. Then impact on the curbside system is a benefit of $12.58 million.

Table 8: Overview of Impacts to Stakeholders

Stakeholder	Impact
Retailer	Both options include return in retail as well as options for retailers to be replaced with bag drop. Activity based costing used to model the future system indicates that the handling fee for a retailer with an RVM should be no less than $0.031 under FS 1, which is a whole cent more that current handling fees. The potential handling fees are less under FS 2 because more volume is going through fewer retailers but if set at this amount it would be suitable for retailers with less volume.
System Operator	Although the costs of both FSs are very similar, FS 1 offers slightly less risk as more containers are returned via return in retail (less risk in respect to securing locations for bag drop and depots).
Government	FS 1 has more return points than FS 2 and the geographical coverage approach provides security that return points will be located at a convenient distance from consumers' homes, which, along with a higher deposit could result in high returns. Both FSs are an improvement over the current system in that they facilitate better capture of large volume returns and volumes from IC&I. Neither system includes reverse logistics for beer from HoReCa, which could potentially lower the capture rate of this material. With that being said, FS 2 has depots more closely located to HoReCa, making it more convenient for haulers serving these

	establishments, which could potentially lead to higher capture rates.
Consumer	Although both FSs have fewer return points than current system, there are more options for return including bag drops and bulk return at depots. Under FS 1, return locations will be conveniently located to incentivize return when the deposit is increased.
HoReCa	The removal of reverse logistics for beer is potentially a concern for businesses in the HoReCa sector. An increase in the deposit and expansion of the system to include wines and spirits will likely incentivize haulers to make arrangements with HoReCa to separate out this material (with the deposit offsetting service costs). It is unlikely that HoReCa will receive any revenue for recycling, so the system could reduce service costs to these businesses.
Curbside Recycling	Some of the additional tonnage sent through the DRS system will be taken from the curbside recycling stream. As a result, there would be less material flowing into MRFs and being sold as baled commodities, as well as increase in the amount of deposits being reimbursed by the sorting centers. The change in MRF tipping fees is a decrease of $14.59 million per year, the change in material revenue would be a decrease of $7.3 million per year. The change in deposit revenue is an increase of $2.8 million per year.
Curbside Trash	Some material will also be taken from the curbside garbage stream, which will reduce the total disposal costs paid for the blue box system. The avoided landfill disposal costs under the expanded DRS system is a savings of $8.1 million per year.

E.3.0 Takeaways, Considerations and Recommendations

Takeaways

In order to reach a 90% return rate, it will be necessary to implement a mix of return options that make it easy and accessible for consumers to return containers that have been consumed both in and outside the home. At $115.07M and $115.61M, respectively, the net costs of FS 1 variant (excluding kiosks) and FS 2 are very similar. FS 1 provides less operational delivery risk as there is more return in retail and less reliance on the placing of infrastructure where none of the stakeholders have ownership or control. The number of return points under FS 1 is also closer to the number of retailers where 90% of the retail volume currently flows, providing a slightly greater level of confidence that the 90% return rate could be achieved, especially when combined with the geographical coverage targets and the range of different return point options. Return in retail provides the most cost-effective mechanisms for returns but it should be recognized that not all retail stores will have the space to return. This is where the placement of bag drops to serve more than one retailer especially in urban areas where there are small retailers in close proximity may be important. Bag drop costs can also be reduced by allowing the system operator to charge customers who use this return option to pay a convenience fee, user of a similar system in Oregon pay $0.40 per bag returned for the convenience. Recognising that in the future system there should be no cross subsidies between container types, the study calculates the cost of managing each container type (glass, plastics, metal and multi-layers) through the system, it also provides an indication of what the handling fee should be for retailers in the future.

Consideration and Recommendations

Many DRSs include allowances for certain retailers to be exempt from the requirements to take-back containers, either by limiting the number of containers that a consumer can return in one day, or allowing such stores to opt-out of the system altogether if they meet certain criteria. For example, in some markets, retailers whose annual revenues are below a certain threshold may be exempt from the obligation to refund the deposit. In other jurisdictions, DRS legislation may include exemptions for retailers that sell less than a certain number of units, or that are below a certain size (i.e., square footage). Exemptions based on retailer size are what is most commonly found in legislation. In order to enable the government to make an informed decision on this, the current system operators and stakeholders should provide retailer size and current return volume data to enable the cut off to be assessed. Without this data, the government could be forced to continue to require all retailers to be obligated, with retailers eligible for exclusion only if the system operator can demonstrate that the set geographical coverage target and 90% return target is met.

Eunomia was not asked to assess the cost and operational requirements of transitioning from the current system to the FS. This analysis and planning will be required to ensure a smooth transition, in which the anticipated significant influx of material at the beginning of the switch can be effectively captured and managed.

Contents

List of Tables and Figures

Glossary of Terms

Term	Definition
Bag Drop	A redemption route for deposit return systems in which consumers drop-off filled bags of empty beverage containers to a designated location. Beverage containers are later verified and counted and consumers are refunded their deposits through a digital account.
Transfer center with conditioner option	Party responsible for sorting mixed containers into individual commodities
Deposit	A sum of money required by law to be exchanged for a product in addition to the purchase price, in order to incentivize its return to the system.
Deposit Return System (DRS)	A system in which a beverage container is purchased at the point of sale for a set sum of money (deposit) in addition to the purchase price. This sum is returned when the empty beverage container is redeemed.
Handling Fee	Fee paid to parties providing redemption infrastructure calculated to cover the cost of receiving beverage containers from consumers and storing them prior to collection.
Conditioner	Parties that provide services that may include: counting, weighing, measuring, controlling, surveying and verifications. They may be responsible for scrap buying/selling, overseas shipping and brokering, and materials transformation.
Producer	Brand owners, manufacturers or distributers of beverage products. Produce products and place the items on the market. Producers sell their products to retailers, who sell them to consumers. These parties are also known as deposit initiators, as they are the originators of the deposit return process.
Producer Responsibility Organization (PRO)	Organization appointed by producers to manage the DRS program on their behalf.
Retailer	Sellers of beverages to consumers. These parties buy from producers and sell to consumers through a licensed establishment.
Reverse Vending Machine (RVM)	A machine through which beverage containers are returned, verified and compacted and deposits are automatically refunded. Used by consumers at redemption locations.

1.0 Introduction

Background

On January 30, 2020, the Québec Government announced that the current deposit return system (DRS) would be expanded to include all "ready-to-drink" beverage containers with a capacity of 100 ml to 2L (e.g., flat and sparkling water, wine and spirits, juices and fruit-flavoured beverages, milk and milk substitutes, natural beverages, etc.), except for "bag-in-box" containers and flexible pouches. As part of the plan, the Government will be implementing increased and simplified deposit amounts of $0.25 for wine and spirits bottles and $0.10 for other containers.[2] Containers made of cardboard (i.e., multi-layer containers) are also expected to be included under the expanded system, but at a later time. The Government anticipates that the new system, expected to be rolled out starting in fall 2022, will ultimately lead to an almost doubling of the number of beverage containers being used to about 4.5 billion a year, up from the current 2.4 billion.[3]

Unlike most other DRSs in North America, Québec's system is based on a return-to-retail (R2R) model, where retailers are legally obligated to take back empty containers from customers and issue deposit refunds. The province considers to utilize its existing networks of reverse vending machines (RVMs) in grocery stores for returns, plus other collection centres.[4]

In addition to expanding the program to new types of beverages, the Québec Government has also announced that recovery and recycling targets will be set. Specifically, businesses will need to ensure that 75% of deposit-bearing containers will be recovered and recycled by 2025, increasing to 90% by 2030. Failure to achieve these targets will result in penalties.[5]

Objective

Eunomia Research and Consulting was commissioned by Recyc-Québec to examine how a future DRS could be designed to collect for recycling 90% of single-use beverages included under an expanded system and to assess the potential cost of this system. As part of this work, it was asked to consider a range of redemption options including:

- Return-to-retail (R2R): a return option where empty containers can be redeemed at a redemption point that is co-located with a retail store. R2R can take several forms, including retailers with RVMs in-store, or kiosks incorporating RVMs that are located outside of the stores. It can also include redemption where customers present empty containers directly to a store employee who provides the deposit refund.
- Return-to-depot: a return option which involves a staffed or unstaffed facility accepting empty containers from both households and charities wanting to return in bulk as well as large volumes collected by private sector organizations (e.g., hotels, restaurants and cafes, schools, and event spaces, etc.)
- Bag drop: a return option in which consumers drop-off bags of empty containers to a designated stand-alone location (often a secure shipping container). Containers are later verified and counted, with the deposit being returned to consumers via an electronic transfer to their digital account for further transfer into their bank account.

To be clear, the objective is not to design the future DRS (this will be the responsibility of the future producer responsibility organization), but to present and assess the cost of various design options as well as the impact of each on a range of stakeholders, including the curbside collection system.

Structure

This report is split into the following sections:

- Modelling Considerations: Current system performance and convenience, and key considerations for the design of a future system.
- Future Systems: An overview of FS 1 and FS 2.
- Future Systems Cost: An overview of the costs of FS 1 and FS 2.
- Future Systems Comparison and Impact of Stakeholders: Comparison of key factors of each system and their impacts on stakeholders.
- Key Takeaways, Considerations, and Recommendations: Summary of report key takeaways and conclusions.

2.0 Modelling Considerations

The two primary factors impacting the performance of a DRS are: 1) the value of the deposit; and 2) the level of consumer convenience. For the purposes of this project, the deposit value has been set at $0.25 (wines and spirits) and $0.10 (all other beverages) and as such a key consideration for the modelling of a future system is to consider the level of convenience to enable 90%.

A convenient redemption system is one that is easy, accessible, and fair for all consumers. Convenience can be assessed by how easily a person can access a return point to recoup their deposit money. This can be measured in a number of ways, for example:

- Distance (km) or drive time (hours/minutes) to closest return point (with different measures for rural vs. urban areas).
- Number of return points per capita (return point to consumer ratio).

Other metrics to evaluate convenience include the percentage of the population that participates in the system. These metrics when calculated for Québec enable comparison with other jurisdictions.

2.1 Current System Performance and Convenience

Performance

In 2018, 68.59% of single use containers with a deposit were returned through the DRS system with a further 4.77% collected through curbside programs resulting in a total return rate of 73.36%. Table 9 provides an overview of the performance of the current program in 2018.

Table 9: Containers Sold and Returned in 2018 (billion units)

	Aluminum	Plastic	Glass	Total
Containers Sold				

Soft Drinks	844.7	229.1	22.5	1,096.3
Beer	1,042.4	-	138.4	1,180.8
Total	**1,887.1**	**229.1**	**160.9**	**2,277.1**
Containers Returned where Deposit Refunded				
DRS - Soft drinks	583.5	101.9	5.6	691
DRS - Beer	604.5	37.3	99.6	741.4
Curbside System	109.5	19.9	-	129.4
Sub-Total	**1,297.5**	**159.1**	**105.2**	**1,561.8**
Container Return Rate (%)	**68.76%**	**69.45%**	**65.38%**	**68.59%**
Curbside Recovery of Containers Not Returned for Deposit Refund	75.3	11.4	22.0	108.7
Total Containers Recovered	**1,372.8**	**170.5**	**127.2**	**1,670**
Total Rate of Recovery	**72.75%**	**74.42%**	**79.06%**	**73.36%**

Source: Houston Conseils[vi]

According to anonymized retailer return data[2] provided by Recyc-Québec,[vii] there are approximately 13,100 retailers that are obligated to accept empty containers of the same type they sell. The same data suggests that 90% of the soft drink containers recycled via the DRS are returned through approximately 3,935 retailers. Using the data from the table above, it was determined that 63% of

[2] Retail return data did not contain any locational information. Retailers were listed with a reference number only so it was not possible for Eunomia to assess the geographical coverage nor where high volume returns were taking place in order to evaluate alternative infrastructure needs.

soft drinks containers (all materials) are collected through retail the rest are collected through the curbside program.[3]

The 3,935 retailers responsible for collecting 90% of the 63% soft drink containers collected through retail locations can therefore be assumed to deliver a 57% return rate for soft drinks; this is a long way from 90%.

While limited returns data was available for soft drinks by retail point, absolutely no returns data by retailer was available for beer. Furthermore, it was not possible to determine the percentage of containers, specifically beer, that were collected from HoReCa versus through retail locations.

Convenience

As all retailers are obligated under the current program, the level of convenience is assumed to be high. Eunomia was not able to access retailer location data and therefore was unable to evaluate current convenience metrics such as average distance to return points or return point to consumer ratio.

Table 10 presents data on the level of convenience of Québec's DRS based on population per return point for the current system (2018) as well as under a future system (2030)[4], and offers a comparison to other jurisdictions. Based on a redemption network of 13,100 retailers, the number of consumers per return point in Québec's is currently comparable to Germany (653 vs. 636). Despite this, Québec's return rate is significantly lower than Germany's, probably because of Germany's higher deposit value, which is six times that of Québec's. If we only consider the 3,935 retailers that collect 90% of the containers recovered via the DRS, the population per return point increases to 3,049; by 2030, this number is expected to increase even further. In Oregon and Michigan, both of which have return rates close to 90%, there is one return point per 1,933 and 1,783 population, respectively. These jurisdictions are provided as a reference point, and demonstrates that it may be challenging to achieve 90% with a deposit of $0.10 unless there is a high level of convenience, this is further highlighted in a recently released report from Reloop "What We Waste"[viii].

Table 10: Population per Return Point in Québec and Other Jurisdictions

Jurisdiction	Number of Return Locations	Return Infrastructure	Deposit Value (CAD)	Population Per Return Point	Return Rate[5]
Québec (2018)					

[3] 69 divided by 1,096.3 x 100.
[4] Population 2018 – 8,754,571, Population 2030 – 8,962,000
[5] Excludes returns through the curbside system

All Retailers	13,100	Retail	$0.05 and $0.10	653	69%
Retailers Responsible for 90% of the Retail Returns	3,935	Retail	$0.05 and $0.10	3,049	N/A
Québec (2030)					
All Retailers	13,100	Retail	$0.10 and $0.25	683	Unknown
Retailers Responsible for 90% of the Retail Returns	2,812	Retail	$0.10 and $0.25	3,187	Unknown
Oregon (2018)	2,123	Retail, depot and bag drop	$0.12 (USD $0.10)	1,933	89%
Germany (2018)		Retail	$0.33	636	98%
Norway (2018)		Retail	$0.11–$0.45	355	90%
Michigan (2018)	5,600	Retail	$0.12 (USD $0.10)	1,783	89%
Alberta (2018)	221	Depot	$0.10	19,778	86%

2.2 Future System Key Considerations

Key considerations for the design of a future system are summarized below:

- **Volume and Weight**: It is expected that in 2030, sales of eligible single-use beverage containers into Québec will be 128% higher than current volumes. Sales volumes for 2017 (actual) and 2030 (projected) are shown in Table 11. As shown in the table, the introduction of wine and liquor bottles to the DRS results in a significant increase (358%) in the tonnage of materials sold into Québec by 2030.

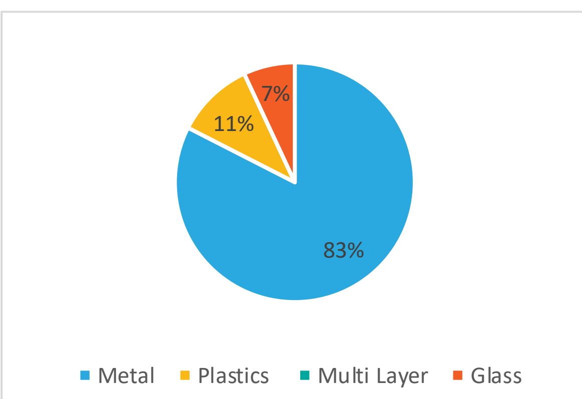
Table 11: Volume and Weight of Containers Assumed to be Sold in Québec by Material (2017 and 2030)

	2017		2030		% Increase in Number of Containers Sold	% Increase in Weight of Containers Sold
Material	Number of Containers Sold (millions of units)	Weight of Containers Sold (Tonnes)	Number of Containers Sold (millions of units)	Weight of Containers Sold (Tonnes)		
Metal	1,808	23,063	2,133	27,211	18%	18%
Plastic	231	6,914	1,804	54,009	681%	681%
Multi-Layer	0	0	511	15,340	N/A	N/A
Glass	152	31,920	541	186,794	256%	485%
Total	2,191	61,897	4,990	283,353	128%	358%

Source: Eunomia calculation using data from Recyc-Québec and Houston Conseils

- **Composition:** By 2030, it is very likely that the composition of beverage container material will change, and this, like volume, will have an impact on the return infrastructure and logistics. Figure 1 shows that by count, plastic beverage containers will make up a significantly larger proportion of the material stream than they do today (36% vs. 11%). However, when measured by weight, glass will make up the largest portion (66%) of material available for collection and processing, due to the addition of wine and liquor containers to the system.

Figure 1: Material Composition of Beverage Containers Sold in 2017 (left) and 2030 (right) by Unit



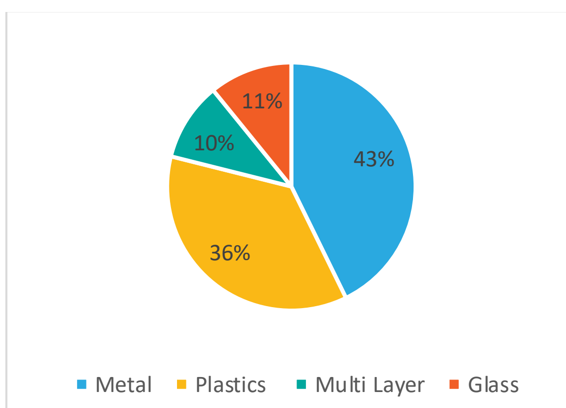
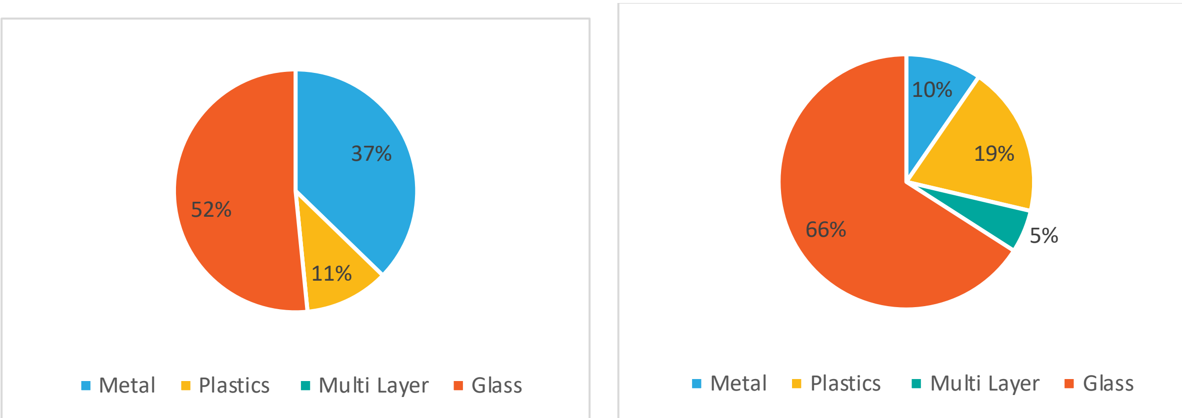


Figure 2: 2017 Material Composition of Beverage Containers Sold in 2017 (left) and 2030 (right) by Weight



- **At Home and Away-from-Home Consumption and Return**: To reach a 90% return rate, the future system must provide convenient return options for containers consumed both at and away-from-home (e.g., schools, hotels, public spaces, restaurants, concerts, parks, etc.). Under the current two operator system, beer containers are sometimes collected via reverse logistics.

  Unfortunately, data necessary to determine the percentage of containers consumed in the home versus away-from-home in Québec was not available. However, CM Consulting's latest "Who Pays What? An Analysis of Beverage Container Collection and Costs in Canada"[ix] report provides a summary of sources of data for away-from-home consumption, which includes the 2015 study carried out in Québec titled "Étude comparative des systèmes de récupération des contenants de boisson au Québec." This study provides data on away-from-home consumption for a number of different beverages for the years 2005 and 2010. The studies that include data for Canada are summarized in Appendix A.2.0.

  For the purposes of the modelling, we have applied the values presented in **Erreur ! Source du renvoi introuvable.**. It is assumed that the away-from-home values for glass beer, wine and spirt bottles is generated predominately by hotels, restaurants, and cafés (HoReCa) whereas for some soft drinks some of the volume will be consumed "on the go" as people are walking around cities or travelling in cars or on public transport. While it would have been beneficial for the modelling to know the split between volume consumed in HoReCa vs. on "on the go", no data was available.

Table 12: Percentage of Units Sold Assumed to be Consumed "At Home" and "Away-from-Home" in the Future System

Material	Metal	Plastic	Multi-Layer	Glass	Total

% Away-from-Home	17	40	5	21	23
% At Home	83	60	95	79	77

Source: Eunomia assumption

- **Refillables:** While refillables are not part of the design of a future system, consideration is needed as to how, from a consumer perspective, the DRS for single-use containers is linked to one for refillables where retailers will remain the primary return point.
- **Return and Processing Infrastructure:** To achieve a 90% return rate, the future system will have to:
  - Ensure convenience and flexibility for both households and haulers serving the commercial sector;
  - Allow for quick returns;
  - Allow consumers to access their deposit immediately or at a later point via electronic transfer;
  - Accommodate large-volume redeemers (e.g., haulers providing services to the HoReCa sector);
  - Be technology-focused and utilize modern RVMs with online connectivity. These systems allow real-time data to be transferred to a central system operator, which provides transparency on what is being returned and where. They also facilitate identification of potential fraudulent returns (e.g., containers sold outside the province, containers redeemed more than once), increase collection and logistical efficiencies, and allow for effective billing of producers. Under both future systems presented in this report, all units are verified and counted either through a RVM or a bulk counting machine in a depot.

Table 13 presents an overview of the different types of redemption systems utilized in DRSs and which are included in the FS design.

Table 13: Overview of DRS Return and Processing Infrastructure

Infrastructure	Description
Redemption Methods	
Return-in-Retail (Automated (RVMs) or Manual Collection)	 Although some continue to collect containers and refund deposits manually, most large retail stores have automated the process and use RVMs. Any retailer that sells a deposit-bearing beverage can opt-in to redeem and collect empty containers and return the deposit to the consumer.

Depots and Counting Centers	These centers are typically situated in retail spaces or in warehouses on the outskirts of a town. Depots process high volumes of returned containers, as returns delivered by haulers providing services to HoReCa. Depot users are required to have an online account and all bags or crates of containers returned must include a sticker with the account holder's details. The depot operator processes the containers using bulk counting machines, which removes any refillables that are rejected by the technology. After each unit is automatically verified and counted, it is split into two fractions: heavy (single use glass) and light (multi-layer, metal and plastic) where it is then crushed or compacted. The depots can also accommodate some RVMs for household return.  The depots act as hubs for material consolidation where direct delivery of glass to a recycler or the light faction to a conditioner is not efficient. Depots could be operated by the PRO or by the private sector under contract with the PRO to ensure that there is a consistency of service and operation to enable data transfer. Depots could be operated by local waste management companies and haulers and could service and consolidate material from local bag drops and potentially retailer RVMs but this would be the decision of the PRO.
Kiosk	 These facilities are stand-alone units and container RVMs. Kiosks offer no option for the return of refillables to be made at the same time as single use unless the kiosk is located on a retail parking lot.
Bag Drops	Consumers register for an online account and purchase special bags or stickers for bags that they fill with deposit containers. They drop-off full bags to unstaffed, standalone outlets and receive credit for deposit refunds to their accounts once bags are collected and containers are verified through the depots/counting centers.  
Additional Infrastructure	
Conditioners	All glass will either be delivered after pick up from an RVM to the recycler or bulked at the depot after being verified. The light faction needs to be sorted by commodity prior to being marketed.

3.0 Future Systems (FS)

Despite the fact that a DRS already operates in Québec, Eunomia did not have access to existing service and/or returns data to serve as a baseline to model each future system (FS). Therefore, the process of developing a FS and estimating costs of that system was iterative:

- **FS 1:** A **geographical coverage approach** was taken whereby retailer data (purchased from the North American Industry Classification System (NAICS)) was plotted using geographic information system (GIS) mapping. The number of return points was then determined by setting criteria for reasonable distances that 90% of the population could be from a return point in urban, semi-urban and rural areas. In cases where two or more retailers were located within the same 6-digit postal code, kiosks or bag drops were assumed to replace retailers. Data on the locations of hotels, restaurants, and cafes (HoReCa) was also purchased from NAICS to ensure that no HoReCa was further than 30km from a depot in urban areas and 60km in rural areas.
- **FS 2:** Based on feedback received from stakeholders, a second FS was designed using a **volume-based approach**. Soft drink retail return data provided by Recyc-Québec and projected return volumes for 2030 were used to determine the number of retailers that accept sufficient volumes of containers to accommodate a RVM. It was assumed that the remaining volume would flow through bag drops and 50 depots.

More detail on each of the FS modelling is contained in Section 0 and 3.2.

3.1 FS 1: Geographical Coverage Approach

Return Routes, Container Verification and Counting

As stated above, the two most important factors to achieving a high (at least 90%) return rate are the value of the deposit and the level of convenience, the latter of which can be measured by distance from or travel time to a return point.

Given that data on retailer locations was not provided by stakeholders, Eunomia purchased data (i.e., retail codes) from NAICS, which is presented in Appendix A.1.0. It's important to note that this dataset excludes gas stations or pharmacies that sell beverages.

While NAICS retail data for the US includes retailer size (square footage), this level of detail was not available in Canada. Therefore, in addition to data on retailer locations, Eunomia purchased data on store revenue and number of employees. Data on store size is important for modelling purposes as it allows small stores that have less room for RVMs or the storage of containers to be exempt from DRS take-back requirements.

Although it is better than no information at all, using data from NAICS is not ideal for a number of reasons. For example:

- The number of retailers based on NAICS data was less than the retail numbers provided by Recyc-Québec.[x]
- For some retailers the revenue was rolled up to a group level rather than being attributed to each single store.

- Data on number of employees was not listed for all retailers.

Plotting the NAICS data on GIS, our team modelled the retailer network considering distance from a return point and the percentage of the population within the modelled distance. The geographical coverage calculations considered where people live. For example, in dense urban areas it is more likely that people will not have a car or are less likely to use it and as such convenience to them would be the ability to walk to a return point. Conversely, in rural areas people must travel by car for most activities and as such are able to travel further distances in the same amount of time. Considering that Québec's population is centered in several urban areas, ensuring convenient access to return points in these areas is going to be critical to achieving 90%. To determine an appropriate number of retailer locations, Eunomia made assumptions regarding "reasonable" travel distances (considering 1km, 800m and 500m) and calculated the percentage of the population that would be within those distances of a retail store.

In addition to the urban areas, there are semi-urban areas where vehicles are likely to be the predominate mode of transport. However, compared to rural areas, these areas may have higher traffic congestion, which increases travel time. Again, we made an assumption regarding reasonable distance to a redemption point and then calculated the percentage of the population living within that distance.

Table 14 summarizes the outcome of this exercise and was used to determine the number of returns points under FS 1. Table 14 also shows the percentage of population located within each of the set areas and the total number of redemption points that this equates to.

Table 14: Percentage of Population Living Within a Set Distance to a Redemption Point

	Rural (<55 people per sq km)	Semi-Urban (55<density<631 people per sq km)	Urban (>631 people per sq km)	Total
Distance to Nearest Redemption Point	15km	7km	800m	
% of Population Living in Region	21%	26%	53%	
% of Population in each Region Living within Distance to a Redemption Point	90%	95%	90%	90%

Number of Redemption Points	567	450	3,513	4,530

Source: NAICS data, Eunomia

Eunomia then considered locations where either kiosks or bag drops could be established as points of return. It is generally assumed that bag drops or kiosks are located in the parking lots of very large retail stores, where retailers can oversee them. However, as data on retailer size was not available, we assumed that in cases where two or more retailers were located within the same 6-digit postcode area, that only one return location would be required, and this would be through either a kiosk or depot. Replace multiple retailers with one kiosk means the total number of return points will decrease on more than a one for one basis when substituting a kiosk/bag drop instead of having return in retail.

The impact of this assumption is shown in Table 15.

Table 15: Number of Redemption Points

	Rural (<55 people per sq km)	Semi-Urban (55<density<631 people per sq km)	Urban (>631 people per sq km)	Total
Number of Redemption Points prior to replacing 2 or more retailers in same postcode with bag drop or kiosks	567	450	3,513	4,530
Number of Bag Drops or Kiosks	64	41	510	614
Number of Return in Retail after retail locations in same post code substituted with bag drop or kiosk	338	377	2,406	3,121

Source: NAICS data, Eunomia

For the cost modelling we have assumed that of the 614 return points that could either be kiosk or bag drop locations, half are kiosk and half are bag drop. The reason for splitting these return points 50:50 is primarily to ascertain the cost difference between the two. All retail return points in the model have been modelled as having RVM's. All RVMs are processing in excess of 40,000 containers per month per RVM; based on discussions with RVM suppliers, this is considered to be a very viable volume, with volumes as low as 20,000 per month feasible on a RVM throughput lease models. It's also been assumed that all RVMs will count and verify each unit returned, sort the material into two fractions (i.e. heavy (glass) and light (multi-layer, plastics and metal), and compact or crush the containers to reduce space requirements.

To accommodate the estimated 23% of containers that will be consumed and discarded away-from-home (including those consumed "on the go" (mostly soft drinks) and in HoReCa establishments (more likely to be beers, wines and liquor)), a network of high-volume depots will be necessary to facilitate the bulk return of large volumes potentially in bags and cases. In addition to the NAICS retailer data, Eunomia purchased HoReCa and institutional locational data to understand where the out of home consumption would be taking place. The cost modelling assumed that depending on volumes, these businesses would either take their units to a depot themselves to redeem the deposit or contract with a local hauler that would offset the cost of the collection with the value of the deposit. Under this FS, it has been assumed that no IC&I location will be further than 30km from a depot in the urban areas, and in the rural area no more than 60km. Based on this assumption, Québec would need 25 depots. The depots would also accommodate some RVMs for residential returns.

As stated in Table 13, all depots would require the customer to have a digital account and to attach a unique customer label to their pre-filled bag or crate that would be scanned by the depot operator before dispensing the containers into a machine that would count, sort, separate, crush, and compact the containers in much the same way as RVMs. The depots will be used to consolidate material returned through retail RVM's where the distance and volume is insufficient to warrant direct delivery to a conditioner.

Table 16 details the number of units collected through each return route under this FS.

Table 16: Estimated Number of Containers (M) Returned in 2030, by Return Route (Based on 90% Return Rate)

	Retail RVM (M)	Kiosk (M)	Bag Drop (M)	Depot (M)	Total
Number of Containers Returned per Annum	2,218	517	517	1,243	4,494
Plastic	631	151	151	681	
Aluminium	1,066	256	356	406	
Glass	284	53	53	122	
Multi-Layer	236	57	57	34	
Number of return points.	3,121	307	307	25	

Source: Eunomia

The population per redemption point under Québec's FS compared to Oregon as well as the current system is shown in Table 17. The table shows that the population per redemption point in Québec is 24 % less than that in Oregon, which could present a risk to achieving the 90% target. Oregon was chosen as a comparison here because it is a state that has recently increased the scope of beverages covered as well as the deposit value to USD$0.10 (up from $0.05).

Table 17: Estimated Population per Redemption Point in 2030 (Based on 90% Return Rate), Québec vs. Oregon

Convenience Metric	FS 1	Current System (13,100 return points)	Current System (Retailers handling 90% of the volume, 3,935)	Oregon
Population per Return Point	2,390	683	2,278	1,933

Conditioning and Processing

The RVMs and depots will sort the empty containers into two fractions: heavy (glass) and light (multi-layer, metals, and plastics). In the case of a retailer RVM, the separated glass will either be collected and taken directly to the glass processor, or bulked at a depot before being transported to the processor (whichever is closest). The light fraction will be taken either directly or via bulk transfer at a depot to a conditioner where the material will be further sorted into individual fractions before being sold. To reduce travel distances, two large transfer center & conditioners (one close to Québec City and the other near Montreal) and three smaller transfer center & regional conditioners (near Val-D'or, Saguenay, and Amqui), have been costed in the model. The smaller conditioners are likely to be collocated at larger depots.

Table 18: Volume Conditioned through each Location Assuming 2030 Volumes at 90% Return Rate

Location	Number of Entities Serviced (hotels, restaurants, cafés, retailers)
Montreal	14 900
Québec City	3 800
Amqui	1 200
Saguenay	1 100

Val D'or	500

Source: Eunomia

Transportation

The cost model assumes:

- Household consumers transport their containers to a retail, kiosk, bag drop or depot location.
- IC&I premises either transport their own containers to a depot or contract with a hauler to collect and deliver containers to a depot with the deposit offsetting any waste and recycling service fees.
- Containers collected through RVMs are delivered directly to either the processor (glass) or conditioner (other) if sufficient volume can be collected and delivered in a working day. If not, material is bulked at depots before being transported.
- Collections from retailers to depots and conditioners are carried out in tractor trailer units
- Trailers without tractor units for storing containers at depots.

System Summary

The flow of material through the system, including material that is assumed to continue to be collected through the curbside system, is included in Table 19.

Table 19: Material Flows (Tonnes)

	Plastic	Aluminum	Glass	Carton	Total
Put on Market (Tonnes)	54,009	27,211	186,794	15,340	283,353
Collected through DRS (Tonnes)	38,338	25,306	176,521	11,505	261,669
Collected Through Curbside (Tonnes)	3,254	1,007	8,691	2,703	15,654
Collected Through Residual (Tonnes)	2,673	1,121	3,202	1,172	8,167
Littered (Tonnes)	228	30	146	76	480

3.2 FS 2: Volume Based Approach

Return Routes, Container Verification and Counting

This FS has been modelled based on volumes collected through existing retail stores to ascertain where volume is sufficient to warrant a RVM and then supplementing that with a bag drop and additional depots. Kiosks were excluded from this FS for the following reasons:

- Kiosks can not manage refillables and therefore do not allow for a single point of return for all containers. This is inconvenient for consumers, as it requires them to take refillables and single-use containers to different locations. Also, if a refillable container is rejected by a RVM, there is the potential for the consumer to leave the container within the kiosk requiring additional clearance and management.
- Because of how small they are, kiosks are not ideal in cold climates. If a consumer attends the kiosk and it is being used, they have to either wait in their car or outside in the cold.
- Kiosks that are not associated with a retail store require additional management to ensure they are always fully operational. Also, the fact that they are not staffed means there is no one for the consumer to directly engage with if they encounter a problem.

These factors result in a kiosk being a more expensive return route as detailed in Section 4.1.

Under this FS, an indication of the proportion of containers returned through existing stores was calculated by analyzing the information provided by Recyc-Québec[xi] on the number of soft drink containers returned through retail stores where the store was identified by a reference number and not by a location. Using this limited data, the percentage of total soft drinks returned through each retailer was calculated and this percentage was applied to the projected volume in 2030 (excluding bulk returns and HoReCa volumes). The next step was to assess which stores had a large enough volume to accommodate a RVM (approximately 20,000 containers/month). If a store had significant volume, its throughput was reduced based on the assumption that no store could accommodate more than 8 RVMs.

Under FS 2, the total number of bag drops is 614 which is the same as the combined number of kiosks and bag drops under FS 1; this is to ensure there is still coverage in the urban areas which is where the majority of these alternative return points will be located to replace small retailers that are in the same 6-digit postcode area.

A total of 50 depots are included under this option.

The total number of redemption points and the volume returned through each of them is set out in Table 20.

Table 20: Estimated Number of Containers (M) Returned by Return Route in 2030 (Based on 90% Return Rate)

	Retail RVM (M)	Bag Drop (M)	Depot (M)	Total
Number of Containers Returned per Annum	2,439	677	1,378	4,494
Plastic	701	195	720	

Aluminium	1,183	329	472	
Glass	292	81	138	
Multi-Layer	262	73	48	
Number of return points	2,812	614	50	3,476

Source: Eunomia

Conditioning, Processing and Transportation

The principles set out under FS 1 apply to FS 2 in respect to conditioning, processing and transportation.

System Summary

The waste flows under this FS are provided in Table 21. An infrastructure map cannot be provided for this FS because retail location data was not known. The waste flows are the same as in FS1, as the same targets are being met under each scenario.

Table 21: Material Flows (tons)

	Plastic	Aluminum	Glass	Multi-Layer	Total
Put on Market (t)	54,009	27,211	186,794	15,340	283,353
Collected through DRS (t)	38,338	25,306	176,521	11,505	251,669
Collected Through Curbside (t)	3,254	1,007	8,691	2,703	15,654
Collected Through Residual (t)	2,673	1,121	3,202	1,172	8,167
Littered (t)	228	30	146	76	480

Source Eunomia

4.0 Future System Cost

This section provides an overview of the costs of the two possible FSs detailed above. Eunomia's model for estimating future DRS costs and benefits model uses a bottom-up approach. Key elements of the cost model are summarized in Table 22 with further information provided in A.3.0. Appendix A.4.0 and Appendix A.5.0 provide a more detailed breakdown of the costs for the summary tables in Section 4.1 and Section 4.2.

Table 22: Activity Cost Elements

Activity Cost Element	Summary
Reception	This includes all costs related to the infrastructure necessary for a consumer or the IC&I sector to return containers as well as the time within retail stores managing and handling the material prior to collection, and time maintaining kiosks and bag drop.
RVM, Kiosk and Bag Drop	Cost for RVMs in retailers the cost includes the capital and installation costs depreciated over seven years, plus costs for refurbishments and replacement parts such as compactor units as well as bin costs. Retail space requirements are costed including instore, backroom, and additional storage prior to pick up. The labor costs are built up based on time necessary to empty bins, clean RVMs, process receipts, assist in the pick-up of containers. The kiosks and RVM capital cost is depreciated over seven years, there are costs for installation, maintenance, land costs, as well as labour time to assist in the pick up containers and general cleaning of the kiosk. Bag drop as with kiosks includes for the containers and technology plus labour time for the collection of containers during pick up.
Transport	This includes all costs related to the collection of containers from retailers, kiosks and bag drops and transportation to either a conditioner or a depot, as well as the costs to transport containers from a depot to a conditioner.
Pickup/ collection	These costs include the capital costs of the collection vehicles (depreciated over 9 years) plus maintenance, fuel, and labour costs (driver, as well as supervision and management). There is also an assumed level of profit for the serviced provider if the services are provided by the private sector.
Pickup at redemption location	This includes costs related to time spent at the retailer or depot to assist with loading of containers into the collection vehicle.
Transportation to the conditioner	This includes the cost of the vehicle, labour, fuel, etc. associated with transporting containers to the conditioners.
Depot	This includes all costs related to receiving, counting, sorting, and storing containers at depots.

Activity Cost Element	Summary
Reception and take back	This includes the capital costs and associated cost of borrowing for the bulk counting and verification machines, as well as the installation and maintenance of these machines amortized over five years. It also includes costs related to staff time spent receiving containers and processing them through the bulk counting machines, as well as managing the containers once they have been counted and sorted.
Depot transfer	This includes costs related to staff time spent loading containers into collection vehicles
Depot space	This is the lease costs for the property which includes space for the unloading trucks, storage, bulk return, office space, delivery bay.
Depot overhead	Overhead costs include supervision labour costs, fixed costs for equipment, and a small profit in the case of private depot management. Also includes the electricity costs, etc.
Depot counting	This includes the costs associated with counting containers at the smaller depots, based on throughput, capital, and counting machine operating costs.
Other Counting	This includes the costs associated with counting containers at the larger depots, based on throughput, capital, and counting machine operating costs.
Conditioning	This is based on a per tonne conditioning fee.
Central Administration	This includes resource costs for administration, marketing and communications costs, infrastructure such as IT set up and office space, and legal/accounting departments.

Source Eunomia

4.1 Future System 1: Geographical Coverage Approach

Total Cost

The total cost of FS1 as well as a break down by activity is provided in Table 23.

Table 23: Total System Cost Summary (FS 1)

Activity Cost Element	Cost M (CAD $)
Reception	
RVM and kiosk	68.57
RVM Space	9.31

Activity Cost Element	Cost M (CAD $)
RVM Labour	7.89
Bag Drop Labour	1.63
Bag Drop Space	4.30
Bins	11.79
Transportation	
Pickup/Collection	27.36
Pickup at Redemption Location	1.49
Transportation to the Conditioner	7.89
Depot	
Depot Reception & Takeback	5.68
Depot Transfer	0.23
Depot Space	2.59
Depot Overhead	8.16
Depot Counting	13.48
Other Counting	5.23
Conditioning	38.32
Central Administration	1.90
Gross Cost	215.84
Material Revenues	(44.37)
Unclaimed Deposit	(46.87)
Total Net Cost	124.62

Source: Eunomia

The average cost per container collected and cost per container placed on the market is shown in Table 24.

Table 24: Cost per Container Returned and Placed on the Market (FS 1)

	Cost (Canadian Cents)
Unit Returned	2.77
Unit Placed on Market	2.50

Source: Eunomia

Cost by Return Route

The costs associated with redeeming empty containers vary depending on the return route used. For example, containers that returned via retailer RVMs are crushed and compacted and therefore require less storage space and handling in retail locations; this, in turn, allows for more material to be transported in a collection vehicle, reducing transport costs. Capital costs associated with kiosks and bag drops will increase the costs of this return option. A comparison of the costs of managing containers returned via the different return routes under FS 1, based on the material flows set out in Table 19, are provided in Table 25. The table shows that the costs of managing containers returned through a kiosk or bag drop are significantly higher than those returned through a RVM at a retailer or depot. On average, the cost of managing a container returned via a kiosk is $0.0484 versus $0.0275 through a retailer RVM (a difference of 75%). The higher costs associated with kiosk returns are related to the kiosk and associated infrastructure, while for the bag drop they are related to managing uncompacted and uncrushed containers. The revenue streams available to offset the cost of service include material income from the sale of material as well as unclaimed deposits associated with the containers that are not returned.

Table 25: Cost of Managing Returned Containers through Different Return Routes (FS 1)

Activity Cost Element	Retail RVM (CAD$ millions)	Kiosk (CAD$ millions)	Depot RVM (CAD$ millions)	Bag Drop (CAD$ millions)
Reception				
RVM & Kiosks	49.42	18.91	0.24	0.00
RVM Space	5.29	4.00	0.02	0.00
RVM Labour	6.52	1.09	0.29	0.00
Bag Drop Labour	0.00	0.00	0.00	1.63
Bag Drop Space	0.00	0.00	0.00	4.30
Bins	5.24	2.74	0.01	1.13
Transportation				
Pickup/Collection	13.32	2.81	0.00	11.24
Pickup at Redemption Location	1.23	0.03	0.05	0.19
Transportation to the Conditioner	3.59	0.83	0.03	0.83
Depot				
Depot Reception & Takeback	0.17	0.04	0.00	1.64
Depot Transfer	0.12	0.03	0.00	0.03
Depot Space	0.55	0.13	0.01	0.51
Depot Overhead	1.73	0.40	0.02	1.59
Depot Counting	0.00	0.00	0.00	4.00
Other Counting	0.00	0.00	0.00	1.55
Conditioning	17.81	4.28	0.22	4.28
Central Administration	0.94	0.22	0.01	0.22
Gross Cost	**105.92**	**35.50**	**0.89**	**33.13**
Material Revenues	-21.90	-5.10	-0.18	-5.10
Unclaimed deposits	-23.13	-5.39	-0.19	-5.39

Total Net Cost	**60.90**	**25.01**	**0.51**	**22.64**
Cost of Container Return Point (Handling Fee) (cents)	**3.05**	**5.18**	**3.23**	**1.40**
Cost per Container Collected (Cents)	**2.75**	**4.84**	**2.74**	**4.38**

Source: Eunomia

The cost of handling a container through the different points is shown above as being $0.031 for a unit returned through an RVM versus $0.014 through a bag drop for example. This does not mean that it would cost less to put out more bag drops because bag drops create more costs in the system down stream. Retailers using RVMs should be given a higher fee because overall RVM's are the most cost effective mechanisms for returning a container, $0.0275 per container collected when the whole system cost is considered compared to $0.0438 for a container returned through a bag drop. The capital cost of kiosks makes this return option too expensive compared to the other options.

Cost by Container Type

While understanding the average cost of the system per container is helpful for comparing different return routes, it is important to understand what the different container types, glass, plastics and cans cost to the system to ensure when producers cover the cost of the system there is no cross subsidies between container types. The different properties of the container, weight, compact rate, value all impact on the cost of handling and the material revenue that can offset the cost. The cost of handling a glass container is $0.0812 per container placed on the market compared to $0.0088 for a metal container. The table below also includes a cost line to cover fraudulent activities, this could be double redemption through a bag drop or containers coming from outside of the province, this cost is an estimated. The gross cost of multi-layer is lower than what might be expected because it has a lower return rate (75% vs 90% for plastics) as such the model is allocating a lower proportion of the fixed and variable reception costs.

Table 26: Cost by Material Type under FS 1

	Total Cost ($ millions)				**Cost per Unit Placed on Market (Cents)**			
Item	**PET**	**Metal**	**Glass**	**Multi-Layer**	**PET**	**Metal**	**Glass**	**Multi-Layer**
Gross Cost	**77.74**	**73.13**	**51.34**	**18.48**	**4.31**	**3.43**	**9.48**	**3.61**
Revenues								
Material Revenues	-10.32	-32.18	-1.76	-0.11	-0.57	-1.51	-0.32	-0.02
Unclaimed Deposits	-18.70	-22.11	-5.61	-5.30	-1.04	-1.04	-1.04	-1.04
Total Net Cost	**48.72**	**18.85**	**43.97**	**13.06**	**2.70**	**0.88**	**8.12**	**2.55**

Source: Eunomia, note: the total gross cost in the table above appears around $5 million larger than in Table 25, this is because fraudulent deposits has been added as a separate line in this table, whereas it is combined in the unclaimed deposit line in Table 25.

4.1.1 FS 1 Variant

As demonstrated above, the costs of managing containers returned through a kiosk and/or bag drop are significantly higher than those of a retail or depot-based RVM. While bag drops provide an additional level of convenience in that they do not require customers to feed containers individually into a RVM, the kiosks do not. Given all of the disadvantages associated with kiosks, it was decided to rerun the model based on the assumption that all kiosks are replaced with bag drops. The results of this exercise are presented in Table 27, Table 29 and Table 30. The tables show that when kiosks are removed from the equation, the cost of FS 1 decreases by 8%.

Table 27: Total Cost of FS 1 (Excluding Kiosks)

Activity Cost Element		Cost (CAD$) Millions
Reception		
	RVM & Bag Drop	49.69
	RVM Space	5.31
	RVM Labour	6.73
	Bag Drop Labour	3.27
	Bag Drop Space	8.59
	Bins	10.20
Transportation		
	Pickup/Collection	30.36
	Pickup at Return Location	1.65
	Transportation to the Conditioner	7.89
Depot		
	Depot Reception & Takeback	7.28
	Depot Transfer	0.23
	Depot Space	2.59
	Depot Overhead	8.56
	Depot Counting	17.38
Other Counting		6.35
Conditioning		38.32
Central Administration		1.90
Gross Cost		206.30
Material Revenues		(44.37)
Unclaimed Deposits		(46.87)
Total Net Cost		115.07

Source: Eunomia

Table 28: Cost of Managing Returned Containers through Different Return Routes (FS 1 – Excluding Kiosk)

Activity Cost Element	Retail RVM ($ millions)	Depot RVM ($ millions)	Bag Drop ($ millions)
Reception			
RVM & Kiosks	49.42	0.24	0.00
RVM Space	5.29	0.01	0.00
RVM Labour	6.44	0.29	0.00
Bag Drop Labour	0.00	0.00	3.27
Bag Drop Space	0.00	0.00	8.59
Containers	5.24	0.01	2.27
Transportation			
Pickup/Collection	11.31	0.00	19.05
Pickup at Return Location	1.23	0.05	0.37
Transportation to the Conditioner	3.59	0.03	1.66
Depot			
Depot Reception & Takeback	0.17	0.00	3.28
Depot Transfer	0.12	0.00	0.05
Depot Space	0.48	0.01	0.88
Depot Overhead	1.58	0.02	2.92
Depot Counting	0.00	0.00	7.96
Other Counting	0.00	0.00	2.91
Conditioning	17.81	0.22	8.55
Central Administration	0.94	0.01	0.44
Gross Cost	**103.62**	**0.89**	**62.20**
Material Revenues	-21.90	-0.18	-10.20
Unclaimed deposits	-23.13	-0.19	-10.78
Total Net Cost	**58.60**	**0.51**	**41.22**
Cost of Container Return Point (Handling Fee) (cents)	**3.05**	**3.22**	**1.40**
Cost per Container Collected (Cents)	**2.64**	**2.72**	**3.99**

Source: Eunomia

Table 29: Cost per Container Returned and Placed on the Market under FS 1 (Excluding Kiosks)

	Cost (Canadian Cents)
Unit Returned	2.56
Unit Placed on Market	2.31

Source: Eunomia

Table 30: Cost by Material Type under FS 1 (Excluding Kiosks)

	Total Cost ($ millions)				Cost per Unit Placed on Market (Canadian cents)			
Item	PET	Metal	Glass	Multi-Layer	PET	Metal	Glass	Multi-Layer
Cost Element								
Central Administration	0.68	0.84	0.22	0.16	0.04	0.04	0.04	0.03
Reception and retailer, bag drop pick up	37.41	45.95	11.85	8.88	2.07	2.15	2.19	1.74
Transportation	7.07	3.70	25.80	1.68	0.39	0.17	4.77	0.33
Conditioner	21.75	11.39	0.00	5.18	1.21	0.53	0.00	1.01
Depot Counting and verification	4.38	2.29	16.01	1.04	0.24	0.11	2.96	0.20
Fraudulently Claimed Deposits	1.62	1.98	0.87	0.38	0.09	0.09	0.16	0.08
Gross Cost	**72.91**	**66.16**	**54.75**	**17.33**	**4.04**	**3.10**	**10.11**	**3.39**
Income								
Material Revenues	-10.32	-32.18	-1.76	-0.11	-0.57	-1.51	-0.32	-0.02
Unclaimed Deposits	-18.70	-22.11	-5.61	-5.30	-1.04	-1.04	-1.04	-1.04
Total Net Cost	**43.89**	**11.87**	**47.38**	**11.92**	**2.43**	**0.56**	**8.75**	**2.33**

Source: Eunomia, note: the total gross cost in the table above appears around $5 million larger than in Table 27, this is because fraudulent deposits has been added as a separate line in this table, whereas it is combined in the unclaimed deposit line in Table 27.

4.2 Future System 2: Volume Based Approach

Total Cost

The total cost of FS 2 as well as cost by activity is provided in Table 31. The net cost of this system is over $9M less than FS 1. If kiosks are removed (FS 1 variant), the net cost of FS 2 is $1M more.

Table 31: Total System Cost Summary (Million) (FS 2)

Activity Cost Element	Cost (CAD$) millions
Reception	
RVM	45.02
RVM Space	4.80
RVM Labour	6.87
Bag Drop Labour	3.27
Bag Drop Space	8.59

Bins	8.24
Transportation	
Pickup/Collection	31.25
Pickup at Redemption Location	1.64
Transportation to the Conditioner	7.89
Depot	
Depot Reception & Takeback	6.72
Depot Transfer	0.23
Depot Space	5.18
Depot Overhead	15.15
Depot Counting	15.72
Other Counting	6.04
Conditioning	38.32
Central Administration	1.90
Gross Cost	206.84
Material Revenues	(44.37)
Unclaimed Deposits	(46.87)
Total Net Cost	115.61

Source: Eunomia, Note costs may not add due to rounding

The average cost per container collected and placed on the market is shown in Table 32.

Table 32: Cost per Container Returned and Placed on the Market (FS 2)

	Cost (Canadian Cents)
Unit Returned	2.57
Unit Placed on Market	2.32

Source: Eunomia

Cost by Return Route

The cost of managing a container returned through each return route (excluding kiosks) in FS 2 is set out in Table 33. The cost for handling a unit through a retailer RVM under this scenario is less that under FS 1 because there are less retailers and more volume going through each. The bag drop cost increases because there is more units in the system that are not being compacted prior to transportation and that require counting and verifying at the depots.

Table 33: Costs of Managing Returned Containers through Different Return Routes (FS 2)

Activity Cost Element	Retail RVM (CAD$) millions	Depot RVM (CAD$) millions	Bag Drop (CAD$) millions
Reception			
RVM & Infrastructure	44.49	0.53	0.00
RVM Space	4.77	0.03	0.00
RVM Labour	6.30	0.58	0.00
Bag Drop Labour	0.00	0.00	3.27
Bag Drop Space	0.00	0.00	8.59
Bins	3.72	0.03	1.50
Transportation			
Pickup/Collection	14.79	0.00	16.46
Pickup at Redemption Location	1.34	0.05	0.25
Transportation to the Conditioner	3.94	0.06	1.09
Depot			
Depot Reception & Takeback	0.19	0.00	2.32
Depot Transfer	0.13	0.00	0.03
Depot Space	1.11	0.02	1.23
Depot Overhead	3.26	0.07	3.61
Depot Counting	0.00	0.00	5.28
Other Counting	0.00	0.00	2.03
Conditioning	19.77	0.38	5.49
Central Administration	1.03	0.02	0.29
Gross Cost	**104.84**	**1.77**	**51.44**
Material Revenues	-24.07	-0.37	-6.69
Deposit Balance	-25.43	-0.39	-7.06
Total Net Cost	**55.34**	**1.01**	**37.69**
Cost of Container Return Point (Handling Fee) (cents)	**2.49**	**3.26**	**2.01**
Cost per Container Collected (Cents)	**2.27**	**2.71**	**5.56**

Source: Eunomia

Cost by Container Type

The cost per container type under FS 2 is provided in Table 34.

Table 34: Cost by Material Type under FS 2

	Total Cost ($ millions)				Cost per Unit Placed on Market (Canadian cents)			
Item	Plastic	Metal	Glass	Multi-Layer	Plastic	Metal	Glass	Multi-Layer
Gross Cost	73.29	66.77	54.21	17.42	4.06	3.13	10.01	3.41

Income								
Material Revenues	-10.32	-32.18	-1.76	-0.11	-0.57	-1.51	-0.32	-0.02
Unclaimed Deposits	-18.70	-22.11	-5.61	-5.30	-1.04	-1.04	-1.04	-1.04
Total Net Cost	44.28	12.48	46.84	12.01	2.45	0.59	8.65	2.35

Source: Eunomia, note: the total gross cost in the table above appears around $5 million larger than in Table 31 this is because fraudulent deposits has been added as a separate line in this table, whereas it is combined in the unclaimed deposit line in Table 31

4.3 DRS Cost Overview

Kiosks are an expensive way to manage returned containers; when these are removed from the modelling, the cost of FS 1 is only slightly lower ($1M) than FS 2. When compared to retail collection, bag drops are also expensive. However, bag drops provide an additional level of convenience for consumers and therefore have been used in FS 1 to replace retailers located predominately in urban areas where retailers are in close proximity. In the Oregon DRS, consumers pay a convenience fee of $0.40 per bag returned through a bag drop to offset this additional cost. British Columbia has started to introduce a similar return option but are not charging a convenience fee. If a similar convenience fee is assumed in the FS, the cost of FS 1 decreases to $122 million, and FS 2 to $112 million.

4.4 Curbside Costs

The future DRS will divert material away from the curbside recycling system as well as from the garbage stream, as not all containers are currently being captured in the curbside recycling system.

Reclaimed Deposits Under Current System

Under the current deposit system, sorting centers do receive some in-scope containers. Sorting centers can reimburse these containers for their deposit value. Table 35 provides detail on the number of MRF-bound plastic and aluminum containers.

Table 35: MRF Bound Containers

	Deposit Containers Put on Market (2018) (millions)	% of POM containers which are inbound to Sorting Centers from Curbside Recycling Collection	Number of Containers Inbound to Sorting Centers
Plastic	229.1	13.7%	31.3
Aluminum	1,887.1	9.8%	184.8

Source: Houston Conseils

Of the containers which are included in inbound tonnage to the sorting centers, a percentage are successfully sorted and redeemed by the sorting center for their deposit value. Table 36 details this percentage.

Table 36: Number of Containers Redeemed by Sorting Centers

	Number of Containers Inbound to Sorting Centers (millions)	% of Inbound Containers which are Successfully Redeemed	Number of Containers Successfully Redeemed by Sorting Centers	Deposits Redeemed ($ CAD) million
Plastic	31.3	63.6%	19.9	1.0
Aluminum	184.8	59.5%	109.5	6.8
Total	216.1		129.4	7.8

Source: Houston Conseils

Table 37 shows the percentage of containers put on the market which are then redeemed by sorting centers.

Table 37: Percent of Containers Put on Market Redeemed Through Sorting Centers

	Number of Containers POM (millions)	Number of Containers Successfully Redeemed by Sorting Centers	% of POM Containers which are redeemed by Sorting Centers
Plastic	229.1	19.9	8.7%
Aluminum	1,887.1	109.5	5.8%
Total	2,116.2	128.9	6.1%

Source: Houston Conseils

Applying an average deposit of 5-cents to each of the redeemed containers for plastic, and a mix of 20-cents and 5-cents for the aluminum containers, based on return volumes of each container type, a total of $7.85M is redeemed in deposits. If extrapolated to the number of containers projected to be placed on the market in 2030, this would increase to $8.85M assuming similar return rates to 2018.

Reclaimed Deposits Under Future System

In the future systems, the scope of containers put under the DRS is expected to produce twice the volume of containers under deposit. Therefore, the put-on market of in scope containers will be greater than under the current scope. A comparison is shown in Table 38 below.

Table 38: Comparison of In-Scope Volumes

	Current Scope Put on Market (2019)	Expanded Scope Put on Market (2030 Projection)
Plastic	311	1,805
Aluminum	2,064	2,133
Total	2,375	3,938

Source: Houston Conseils

Under the future system, Eunomia calculates the estimated tonnage which flows into the DRS under the expanded scope, as well as the curbside recycling system and garbage streams in a system where the DRS is performing at 90% return rates.

The number of containers expected to be collected through the curbside Blue Box is shown in Table 39.

Table 39: Total Units Collected Through Curbside Blue Box Under Future Scenario

	Containers Collected Through Curbside Recycling (ex. Contamination) (millions)
Plastic	96.31
Aluminum	69.93

Source: Eunomia

If assuming the same percentage of in scope containers are collected as in 2018, as is illustrated in Table 39 above, then an expected number of containers reimbursed through the sorting systems can be estimated. Table 40 below shows this calculation and in addition, under the increased deposit of 10-cents per container, an estimated deposit revenue is also calculated.

Table 40: Containers Reimbursed Through Sorting Centers Under Future Scenario

	Containers Collected Through Curbside Blue Box (ex. Contamination) (million)	% of Collected Containers Successfully Reimbursed	# of Containers Successfully Reimbursed (million)	Deposit successfully Reimbursed ($ CAD) million

Plastic	96.31	63.6%	61.23	6.12
Aluminum	69.93	59.5%	41.44	4.49
Total	166.24		102.67	10.60

Source: Eunomia

The total reimbursement amount of $10.60 million under a DRS with a 90% return and higher deposit level is around $3.00 million more than if the current scope and deposit level were still implemented in 2030. This is due to the fact that as the scope expands, and the deposit level doubles, the decreased percentage of in-scope containers reimbursed through the curbside (6.1% under the current system versus 2.6% under the future system) is offset by increases in absolute volume, and deposit value per container.

Material Revenue

The amount of material revenue in the curbside recycling system will also change as a result of fewer tons being sent to the materials recovery systems via curbside collection.

The change tons expected to be collected through the curbside system, along with the material revenue lost is shown in Table 41.

Table 41: Change in Tonnages and Material Revenue

Material	Change in Outbound Tonnage	Change in Material Revenue ($ CAD) million
Plastic	-28,995	-3.75
Aluminum	-3,508	-4.34
Glass[6]	-83,834	0.84
Carton	-7,087	-0.06
Total	-123,384	-7.31

Source: Eunomia

MRF Sorting Fees

[6] Glass assumed to have negative value when collected through curbside

Because the DRS will take some recyclable material out of the MRF stream, MRFs will see a decline in the total tonnage sent for sorting. This means fewer tipping fees will be paid to the MRF. This change in tipping fees is shown in Table 42 below, assuming a tipping fee of $105/tonne.

Table 42: MRF Tipping Fee Reduction

Material	Reduction in Inbound Tonnage Sent to MRF (Tonnes)	Reduction in Tip Fees Under DRS ($ CAD) million
Total	138,959	14.59

Source: Eunomia

The DRS system will therefore result in a reduction of $14.59 million in MRF tipping fees.

Landfill Costs

In addition to removing some tonnage from the recycling. stream, the DRS will also remove some tonnage from the garbage stream as well. Less garbage will result in avoided disposal costs under the expanded DRS, as fewer tonnes will end up in landfill. The total avoided disposal is shown in Table 43 below, assuming a disposal cost of $100/tonne.

Table 43: Avoided Landfill Disposal Cost

Material	Change in Tonnage Sent to Landfill (Tonnes)	Avoided Disposal Costs ($ CAD) million
Total	80,977	8.10

Source: Eunomia

A total of $8.1 million is avoided in disposal costs under the expanded DRS.

Summary of Curbside Impacts

The overarching impact is 18.14 million as detailed in Table 44.

Table 44: Impact on Curbside Services

	Amount (CAD $) millions	Loss or Benefit
Material revenue	7.3	Loss
MRF Sorting Fees	14.59	Benefit
Landfill Tipping Fees	8.1	Benefit
Deposits	2.77	Benefit
Total	18.14	Benefit

Source: Eunomia

5.0 Future System Comparison and Impact on Stakeholders

The two design options presented in this report are just two of many possible configurations for the future system. Table 45 compares the variant of FS 1 (which excludes kiosks) with FS 2.

Table 45: Comparison of Possible Future Systems (FS 1 variant and FS 2)

Key Consideration	Current System	Future System 1 (Variant – Excluding Kiosks)	Future System 2
Cost	Not known in a comparable format	Gross cost: $206.05M Net cost: $114.82M	Gross cost: $206.60M Net cost: $115.37M
Return Points	~13,100 total retailers with 90% of volume processed through 3,935	Total: 3,763 • 3,121 return in retail • 614 bag drops • 25 depots More return points than FS 2 but slightly less than where 90% of the current volume is returned. Great options for bulk return, returns from IC&I should provide more ability to capture units from these sectors	Total: 3,476 • 2,812 return in retail • 614 bag drops • 50 depots Over 1,000 less return in retail points compared to current system with greater reliance on depots to process volume.
Number of Conditioners for Light Fraction	1	5	5
Geographical Coverage	Could not be calculated due to retail locational data not being available	90% of population within: • 15km of a return point in rural (<55 ppl per sq sqkm) areas • 7km in semi urban	Could not be calculated as retailer volume by location not provided

Key Consideration	Current System	Future System 1 (Variant – Excluding Kiosks)	Future System 2
		(55 ppl per sq km<density<631 ppl per sq km) areas • 800m in urban (>631 ppl per sqkm) areas	
Return Options for Consumers	Return in retail only through RVM or manual return	Good – options available for consumers who want to access deposit immediately as well as those that are happy to have the convenience of a bag drop at the cost of waiting to receive payment after units have been processed. More retail return points and a wider geographical coverage to ensure convenience.	Good – options available for consumers who want to access deposit immediately as well as those that are happy to have the convenience of a bag drop at the cost of waiting to receive payment after units have been processed.
Options to Capture HoReCa and Large Volume Returns	Beer via reverse logistics Recover may pick up empty soft drink containers from HoReCA as part of recycling program	Option for bulk return and returns from HoReCa Distance to travel to depot further than under FS 2	Option for bulk return and returns from HoReCa Distance to travel to depot less than FS 1 proving increased convenience
Fraud Mitigation	Some level of fraud protection for units returned through RVM, which currently is only for plastics and metals (not glass)	Both systems are technology focused, with all units individually counted and verified through RVMs or bulk counting and verification machines at depots.	
Deliverability Risk	N/A	This option is based on providing a certain level of geographical coverage, with that coverage being provided by retailers. The	This option is based on retailers that have been calculated to have sufficient volume for an RVM in the future.

Key Consideration	Current System	Future System 1 (Variant – Excluding Kiosks)	Future System 2
		assumption is that where two or more retailers are located within the same 6-digit postal code area, a bag drop would be established negating a retailer's need to accept returns. More bag drops are located in urban areas as there are more retailers in close proximity. There is always a risk to the system operator when depots and bag drops are added because there is a need to find and secure suitable locations which cannot be guaranteed and can take time. Oregon has found the expansion of their depots and bag drops to be problematic due to planning zoning restrictions as well as a reluctance by the public to live next to what is viewed as waste management facilities.	This option is more heavily reliant on placing of infrastructure whether depots or bag drop-in locations for which no stakeholder has ownership, creating a greater risk in delivery than FS 1.

Source: Eunomia

Stakeholder Impact

A high level overview of the FSs impact on stakeholders is set out in Table 46. The activity based costing approach to calculating systems costs results in a potential handling fee to retailers with RVM's of $0.03, $0.01 more than currently under FS1. The overarching costs of the FS 1 with out the kiosks and FS 2 is comparable. FS 1 is designed to provide a level of access based on geographic coverage criteria that along with more options for high volume return to capture units from the IC&I provides more options for all consumers. Due to the expanded scope and higher deposit, if the sorting centers separate out beverage containers the value of these containers will be greater than currently, while there will be a loss of material revenue their will be less sorting center fees as less material will need to be sorted, plus less material to landfill providing a net benefit.

Table 46: Overview of Impacts to Stakeholders

Stakeholder	Impact
Retailer	Both options include return in retail as well as options for retailers to be replaced with bag drop. Activity based costing used to model the future system indications that the handling fee for a retailer with an RVM should be no less than $0.031 under FS 1, this is a whole cent more that current handling fees. The potential handling fees are less under FS 2 because more volume is going through fewer retailers but if set at this amount it would be suitable for retailers with less volume.
System Operator	Although the costs of both FSs are very similar, FS 1 offers slightly less risk as more containers are returned via return in retail (less risk in respect to securing locations for bag drop and depots).
Government	FS 1 has more return points than FS 2 and the geographical coverage approach provides security that return points will be located at a convenient distance from consumers' homes, which, along with a higher deposit could result in high returns. Both FSs are an improvement over the current system in that they facilitate better capture of large volume returns and volumes from IC&I, neither system includes reverse logistics for beer from HoReCa, which could potentially lower the capture rate of this material. With that being said, FS 2 has depots more closely located to HoReCa, making it more convenient for haulers serving these establishments, which could potentially lead to higher capture rates.
Consumer	Although both FSs have less return points than current system, there are more options for return including bag drops and bulk return at depots. Under FS 1, return locations will be conveniently located to incentivize return when the deposit is increased.
HoReCa	The removal of reverse logistics for beer is potentially a concern for businesses in the HoReCa sector. An increase in the deposit and expansion of the system to include wines and spirits will likely incentivize haulers to make arrangements with HoReCa to separate out this material (with the deposit offsetting service costs). It is unlikely that HoReCa will receive any revenue for recycling, so the system could reduce service costs to these businesses.
Curbside	Some of the additional tonnage sent through the DRS system will be taken from the curbside recycling stream. As a result, there would be less material flowing

Recycling	into MRFs and being sold as baled commodities, as well as changes in the amount of deposits being reimbursed by the sorting centers. The overall change to the MRF tipping fees would be a decrease of $14.59 million per year, while the change in material revenue would also be a decrease of $7.3 million. The value of reimbursed deposits would increase by $3.8 million per year.
Curbside Trash	Some material will also be taken from the curbside garbage stream, which will reduce the total disposal costs paid for the blue box system. The avoided disposal costs would be $8.10million per year.

6.0 Key Takeaways, Considerations and Recommendations

Key Takeaways

In order to reach a 90% return rate, it will be necessary to implement a mix of return options that make it easy and accessible for consumers to return containers that have been consumed both in and outside the home. The least expensive return option is return in retail, where modern RVMs are used to collect and process empty containers. Due to their relatively high costs and operational challenges, kiosks are unlikely to play a significant role in a future system, while bag drops—although expensive—will likely replace small retailers in urban areas due to their added level of convenience. The costs of bag drop redemption can be reduced if the consumer is made to pay a "convenience fee", as is currently the case in Oregon. If such a fee were to be implemented, the cost of bag drop return would drop to $0.0388 per container from $0.0438 in FS 1, and in FS2, the cost would be $0.0506 cents per container, rather than $0.0556.

At $115.07M and $115.61M, respectively, the net cost of FS 1 variant (excluding kiosks) and FS 2 is very similar. FS 1 provides less operational delivery risk as there is more return in retail and less reliance on the placing of infrastructure where none of the stakeholders have ownership or control. The number of return points under FS 1 is also closer to the number of retailers where 90% of the retail volume currently flows provide a slightly greater level of confidence that the 90% return rate could be achieved, especially when combined with the geographical coverage targets and the range of different return point options.

The cost of managing different containers through the system difference based on the property of the container, glass has the highest cost due to is weight and low market value. Aluminium has the least costs because it is light can be easily compacted and as a high market value.

Considerations and Recommendations

The model does not include for any transitional costs, nor does it consider how the system will transition in a way that can accommodate a significant influx of containers in the short term. Directly prior to when the deposit changes and the scope increases, consumers may hoard containers such that they can claim the higher deposit value. If the infrastructure is not in place to accommodate this potential influx retailers may be inundated. Education and the provision potentially of some temporary facilities such as bag drops could help alleviate this. Over time, older RVMs will need to be replaced with new ones, and new RVMs will need to be installed at additional retailers where the placement of a RVM is now warranted due to significantly increased volumes. Both FS 1 and FS 2 include new depots, which, in addition to accepting returns provide a counting and verification function; locations for these facilities will need to be secured or private sector providers contracted with areas that provide the necessary levels of access to effectively service and capture volume from the HoReCa sector.

Many DRSs include allowances for certain retailers to be exempt from the requirements to take-back containers, either by limiting the number of containers that a consumer can return in one day, or allowing such stores to opt-out of the system altogether if they meet certain criteria. For example, in some markets, retailers whose annual revenues are below a certain threshold may be exempt from the obligation to refund the deposit. In other jurisdictions, DRS legislation may include exemptions for retailers that sell less than a certain number of units, or that are below a certain size (i.e. square footage). Exemptions based on retailer size are what is most commonly found in legislation. In order to enable the government to make an informed decision on this, the current system operators and stakeholders should provide retailer size and current return volume data to enable the cut off to be assessed. Without this data, the government could be forced to continue to require all retailers to be obligated with retailers only being able to be excluded if the system operator can demonstrate that the set geographical coverage target and 90% return target is met. There may also be a cost to the retailer for opting out which is the case for example in the Oregon DRS.

Considerations for Future Design

Québec benefits from several local recyclers for glass, PET and multi-layer. The FSs modelled assumed that containers in RVMs and bulk counting machines are separated into two fractions, light and heavy. These technologies could sort into more fractions. A separate fraction for PET for example could significantly reduce the transport and conditioning costs. The part of the system where further costs would be incurred would be at the retailer where there would be the need potentially of additional space. The future system operator may wish to investigate this option.

The activity-based cost model could easily be rerun based on current retailer location, size and return volumes to better understand what retailer sizes could be exempt whilst still maintaining a convenient return infrastructure.

APPENDICES

A.1.0 NAICs Codes for Retail Locations and Away from Home Consumption

SIC Codes Used

SIC Code	Description
5311	Department Stores
5399	Miscellaneous General Merchandise
5411	Grocery Stores
5451	Dairy Products Stores
5499	Miscellaneous Food Stores
5541	Gasoline Service Stations
5812	Eating Places
5813	Drinking Places
5921	Liquor Stores
7011	Hotels and Motels
7832	Motion Picture Theaters, Except Drive
7996	Amusement Parks
7997	Membership Sports and Recreation Clubs
7999	Amusement and Recreation, Nec
8062	General Medical and Surgical Hospitals
8211	Elementary and Secondary Schools

8221	Colleges and Universities
8222	Junior Colleges

A.2.0 At Home vs Away from Home Consumption

Table 47 summarizes the data included in from the 2020 “Who Pays What? An Analysis of Beverage Container Collection and Costs in Canada”[xii] report on the percentage of beverages consumed away from home.

Table 47: Data on Away from Home Consumption

Study Name	Away from Home Consumption
The Environmental and Economic Performance of Beverage Container Reuse and Recycling in British Columbia, Canada, prepared by Container Recycling Institute, August 2015 (not available to the public)	All beverage containers: 30-40%
IPSOS Study conducted in Ontario for CBCRA in 2012[xiii]	Glass: 28% Aluminum cans: 28% PET: 28% HDPE: 20% Gable top cartons: 10%
Beverage Packaging Environmental Council (BPEC) study, 2006[xiv]	*By container type:* Glass: 33% Aluminum: 24% Plastic: 42% *All beverage containers: 37%*
Mise en Marché et Récuperation des Contenants de Boisson au Québec prepared by Francois Lafortune [xv]	Milk containers: 5% (2005) Soft-drink containers: 17% Juice containers: 22% (2005) Wine/spirits containers: 22% (2005) Water bottles: 50% A survey of 1,500 found the following away from consumption: Beer: 13% Soft drink: 31% Jus: 39%

	Milk: 20% Water: 48% Wine and spirits: 9%

Source: Who Pays What? An Analysis of Beverage Container Collection and Costs in Canada, November 2020.

A.3.0 Activity based Costing Assumptions

Particular assumptions are constant across both scenarios mentioned in this report. For instance, inputs such as salaries and capital unit costs are fixed across FS1 and FS2.

A.3.1 Retailer Assumptions

The costs associated with RVMs are shown in A.3. Table 1.

A.3. Table 1 Purchase and Maintenance cost of RVM

Parameter	Value
Purchase Cost per Dual Stream Online RVM ($)	36,000
Installation Fee ($)	750.0
Loan Repayment Period	7
Annual Operating/maintenance Costs per RVM ($)	2,700

Renovation and replacement costs are shown in A.3. Table 2.

A.3. Table 2 Renovation

Parameter	Value
Lifetime of Compactor, containers	1,300,000
Cost of Replacement ($)	3,080
Renovation Cost (every 4 to 5 years)	6,545

The RVM space requirements are shown in A.3. Table 3.

A.3. Table 3 Space Requirements

Requirement	Value
RVM footprint, (m2)	1.3
Additional space for queuing, (m2)	2.0
Backroom storage space (m2)	3.0
Total space requirements, m2	6.3

Space Required (m2) per unit volume storage (m3)	0.9

The time required for various activities is shown in A.3. Table 4.

A.3. Table 4 Activity Based Labor

Activity	Value
Emptying bins, time per empty (mins)	5.0
Cleaning RVMs, time per machine (mins)	10.0
Processing Receipts, time per receipt processed (mins)	0.1
RVM Beverage Containers Returned per Customer (# of containers)	40.0
Time Needed per Pickup (mins)	30.0

RVM bin costs and replacement details are shown in A.3. Table 5.

A.3. Table 5 RVM Bin Cost

Parameter	Value
Purchase Cost, $	90.0
Washing Cost, $	1.5
Number of Bins Needed per RVM (e.g spares, replacements)	3.0
Number of Years before Replacement	3.0

A.3.2 Kiosk Assumptions

Kiosk purchase and maintenance costs are shown in A.3. Table 6.

A.3. Table 6 Purchase and Maintenance Costs

Capital Parameter	Value
Kiosk Infrastructure Cost ($)	150,000
Kiosk RVM Cost (per RVM) ($)	80,000.0
Installation Fee ($)	3,000.0
Loan Repayment Period ($)	7.0
Operating/Maintenance Costs per RVM ($)	2,700.0

Kiosk space requirements are shown in A.3. Table 7.

A.3. Table 7 Space Requirements

Kiosk Space	Space
Total space requirements, m2	60

A.3.3 Bag Drop Assumptions

The bag drop assumptions are shown in A.3. Table 8.

A.3. Table 8 Bag Drop Assumptions

Parameter	Value
Container width (ft)	8.0
Container length (ft)	20.0
Unloading space (ft)	8.0
Customer space (ft)	2.0
Infrastructure cost ($)	50,000.0
Labour hours required per day	1.0
Drop off hours per day	13.0
Max bags per customer per day	2.0
Beverage Containers per bag	80.0
Max bags per bag drop	200.0

A.3.4 Salaries

Annual salaries are shown in A.3. Table 9.

A.3. Table 9 Salaries

Staff Type	Annual Salary
Retail Staff ($)	30,347
Manual operator - Counting Centre ($)	36,816

IT / Database staff - Central Admin ($)	50,500
Customer services staff - Central Admin & Collections ($)	30,347

A.3.5 Transport

Annual salaries of collections staff are shown in A.3. Table 10.

A.3. Table 10 Resource Costs: Salaries

Parameter	Annual Salaries
Collections Driver	70,720
Collections Supervisor	84,864
Collections Manager	101,836

Costs of transportation are shown in A.3. Table 11.

A.3. Table 11 Resource Costs: Inputs

Parameter	Amount
Semi-Truck Purchase Cost	168,000
Fuel Cost, $ per litre	1.30
Profit Margin	10%
Contingency %	10%

Percent of collected containers needing further hauling is shown in A.3. Table 12.

A.3. Table 12 Further Haulage to Conditioner: Containers

Parameter	Amount
% of Collected Containers Needing Further Haulage	70%

Further hauling to conditioner distance and costs are shown in A.3. Table 13.

A.3. Table 13 Further Haulage to Conditioner: Travel

Parameter	Amount

Average Distance to Conditioner (km)	90.7
Cost per Km ($/km)	4.0

A.3.6 Counting

Total number of containers needed to be counted are shown in A.3. Table 14.

A.3. Table 14 Counting Containers

Parameter	Number
Containers Needing to be Counted	1,740,687,583

Capital costs are shown in A.3. Table 15.

A.3. Table 15 Capital Costs

Parameter	Amount
Counting Machine Cost per Machine	180,000
Installation Costs	30,800
Number of years to be annualised over	5.0
Cost of capital	5%
Number of Machines Needed	47.0

Operating costs are shown in A.3. Table 16.

A.3. Table 16 Operating Costs

Parameter	Amount
Space per Machine (m2)	50
Rent per m2 per Year ($)	83
Additional Space per Counting Center (m2) (office space)	2,000
Time Required for Daily Maintenance (hrs)	2.0
Maintenance Cost per Thousand Containers ($)	0.70

Power Consumption per Machine per Hour	14
Number of Staff per Counting Centre per Machine (support, operations, etc.)	1.5
Other supplies - server, network etc, per centre, $ per year	3,080

Machine logistics are shown in A.3. Table 17.

A.3. Table 17 Machine Logistics

Parameter	Amount
Beverage Containers per Minute per Machine	90
Number of Operating Days per Year	350

A.3.7 Local Depot Costs

Labor cost details are shown in A.3. Table 18.

A.3. Table 18 Labor

Parameter	Number
Supervision/Loading Staff FTE per Depot	3.0
Management Staff per Depot	1.0
Business Overheads %	15%
Profit	10%
Forklift Purchase Cost ($)	65,000

Time for unloading activities are shown in A.3. Table 19.

A.3. Table 19 Activities

Parameter	Time (Minutes)
Time to Unload RVM Material per Bin	1.0
Time to Unload Bags per Bag	2.0
Time to Unload Palettes per Palette	4.0

Space per depot is shown in A.3. Table 20.

A.3. Table 20 Space

Parameter	Amount
Space per Depot (m2)	1,256

A.3.8 Material Revenues

Material revenues per tonne of DRS material is shown in A.3. Table 21.

A.3. Table 21 Material Revenues

Products	Material Revenue (per tonne of material) (CAD $)
Glass	10.00
Plastic	216.00
Cans (Al.)	1,278.00
Beverage Cartons	10.00

A.3.9 Conditioning

Conditioning costs per tonne is shown in A.3. Table 22.

A.3. Table 22 Conditioning

Parameter	Cost (CAD $)
Conditioning Cost per Tonne	450.00

A.3.10 Collection Costs

Vehicle cost details are shown in A.3. Table 23.

A.3. Table 23 Vehicle Costs

Parameter	Cost (CAD $)
Semi-Truck Purchase Cost	168,000

Fuel Cost, CAD $ per litre	1.30
Profit Margin	10%
Contingency %	10%

A.4.0 Future System 1 – Assumptions and Cost Breakdown

A.4.1 Introduction

Future System 1 includes six different container return possibilities:

- In-Store RVM Return
- Kiosk Return
- Bag Drop Return
- Depot RVM Return
- Depot Bulk Return for Consumers
- Bulk return for restaurants, hotels, schools etc. to return their containers to depots.

This section of the appendix will illustrate the assumptions and methodology used to model the DRS costs of each of the return types in Future System 1.

A.4.2 DRS Return System Network

A.4.2.1 Return Points

The return points mentioned in section A.4.1 are further described in A.4. Table 1.

A.4. Table 1 Return Infrastructure Under FS1

Redemption Method	Description	Number of Locations	Rationale

Redemption Method	Description	Number of Locations	Rationale
Retail Stores (in Store RVM)	A retailer above a certain size which sells a deposit-initiated beverage may also install an RVM for the consumer to return their deposit	3,121	Enough retail locations installed with RVMs to ensure that the DRS meets geographical/convenience coverage for consumers
Kiosk	A self-standing structure, similar to a large shipping container, which contains an RVM for consumers to return their containers	307	Finding where a six digit postcode containers two or more retailers, who may then opt out of in-store return and install a kiosk instead.
Bag Drop	Shipping containers adapted to include hatches for consumers to deposit bags of containers, located in parking lots of large retailers or on patches of unused land	307	Finding where a six digit postcode containers two or more retailers, who may then opt out of in-store return and install a bag drop instead.
Depot	Depot facilities with RVMS which consumers can use to return containers	25	Any system depot will have an RVM installed.
	Depot facilities will also accept large bulk returns manually by consumers		Any system depot will have bulk return for consumers.
	The hotel, restaurant, entertainment, café and school sector will have their containers hauled to depots for return		Any system depot will accept HoReCa containers.

A.4.3 Retailer Cost and Handling Fee

The cost of collecting and sorting containers at retail outlets is borne by the retailers themselves and is reimbursed through handling fees.

Space Costs

Space is required for all retailers who take back containers through an RVM. This is an added cost for retailers under the DRS, therefore retailers should be reimbursed for these costs by the central system. The costs are shown in A.4. Table 2.

A.4. Table 2 RVM Space Costs

	RVMs	Floorspace Required per Retailer (m2)	Total Floorspace	Total Floorspace Costs (CAD $M)
RVM Space	4,685	7.8	36,545	5.29

RVM Infrastructure Costs

Each retailer will have to purchase and operate an RVM for consumers to take back their containers. The cost of purchasing RVMs has been annualized in this study, and combined with the operation and maintenance costs to produce a total annual RVM cost for retailers as shown in A.4. Table 3.

A.4. Table 3 RVM Infrastructure Costs

	Annualized Per Machine ($)	Total (CAD $M)
Capital & Operational Costs	9,051	42.4
Total Backroom Costs		0.2
Renovation Costs per RVM per Year	1,454	6.8
Total	10,506	42.4

RVM Labour Costs

In addition to infrastructure, operation and space costs for RVMs, retailers must also pay for the time required to manage and clean the RVMs within their store. These labour costs include:

- Time spent to empty the RVM bin
- Time spent to clean the RVM
- Time spent to process receipts
- Time spent by retailers to set out the return RVM containers for collection by haulers.

A.4. Table 4 below shows the total annual hours required for each of these processes.

A.4. Table 4 Labour Time Spent

	Total Hours

Total Time to Empty Bins	**156,074**
Cleaning RVMS	**244,395**
Processing Receipts	**46,208**
Setting Out Containers	**84,024**
Total Labour Hours	**530,700**

Total retailer handling costs are shown in A.4. Table 5.

A.4. Table 5 Total Retailer Handling Costs

	Total Cost ($M)
RVM & Infrastructure	49.5
RVM Space	5.3
RVM Labor	6.5
Container Costs	5.2
Setting Out Container Costs	1.23
Total Costs	67.7
Cost per Container Collected (handling fee)	3.05

A.4.4 Kiosk Costs

In some cases, kiosks will be constructed to take back containers in a shared location by multiple retailers, rather than having each of the retailers have their own in-store RVMs.

Space Costs

Kiosks require space for two RVMs, storage space for the containers, and space for the consumer to deposit their containers. The total floorspace needed is shown in A.4. Table 6 below, along with the total cost to lease the space.

A.4. Table 6 Kiosk Space Costs

	Number of Kiosks	Total Floorspace Needed (m2)	Total Floorspace Costs ($M)
RVM Space	307	18,420	4.00

Infrastructure Cost

The kiosks require an infrastructure cost not only for the RVMs they are supplied with, but also for the kiosk structure itself. A.4. Table 7 below shows the total infrastructure costs necessary for the construction of the kiosk network on an annual basis.

A.4. Table 7 Infrastructure Costs

	Total Annual Cost ($M)
Infrastructure & Operational Costs	17.9
Total Storage Space Costs	0.1
Total Renovation Costs	0.9
Total	**18.9**

Labour Costs

Similar to retail RVMs, the management of kiosks include cleaning, emptying bins and processing receipts as well, as shown in A.4. Table 8.

A.4. Table 8 Labour Hours

	Total Hours
Total Time to Empty Bins	31,818
Cleaning RVMS	32,030
Processing Receipts	10,764
Total Labour Hours	**74,613**

A.4.5 Bag Drop Costs

The approach taken to model the costs of the bag drop network is different from the retailers and kiosks, because bag drops are a fundamentally different operation which requires minimal labour and maintenance costs. The costs for bag drop are composed of three main areas:

- Infrastructure Costs
- Space Costs
- Labour costs for cleaning and emptying

Infrastructure Costs

Bag drops require the installation of a shipping container type of containment for customers to deposit their bags in, as well as outfitting with technology and electronics. A.4. Table 9 below shows the annualized cost of this infrastructure per bag drop, and the total amount needed for the network.

A.4. Table 9 Infrastructure Costs

	Total Bag Drops	Annualized Infrastructure Cost per Bag Drop	Total Annual Infrastructure Costs (CAD $M)
Infrastructure	307	8,642	2.7

Space Costs

The shipping container is 20 feet by 8 feet wide, with additional room for customers to stand, queue, and deposit their bags, and for the staff to unload bags from the container to be put on a collection vehicle. The leasing costs of having the bag drop are calculated accordingly for the square meterage the bag dop requires. Space costs are shown in A.4. Table 10.

A.4. Table 10 Space Costs

	Total Bag Drops	Total Space Needed per Bag Drop	Total Space Needed	Total Space Costs (CAD $M)
Space	307	25	7,530	1.6

Labor Costs

Labor costs for bag drops include unloading all the bags from the shipping container structure, often once per day, as well as general cleaning and maintaining of the bag drop container as well. The total hours required for the bag drop are shown in A.4. Table 11, with the total cost of labour as well.

A.4. Table 11 Bag Drop Labour Costs

	Total Hours	Total Costs (CAD $M)
Bag Drop Labour	112,055	1.6

A.4.6 Depot Costs

A significant portion of the return infrastructure in Future System 1 is the depot network. The depot network receives all HoReCa material, as well as has options for bulk return and some RVM returns. The depots also function as counting centers for containers which are not collected through an RVM. Therefore, the depots are large facilities with space for storing RVM material, housing container counting machines, and room for consumers to drop off their bulk returns.

Under FS1, there are a total of 25 depots in the network, which are further broken down as follows:

- 2 are main conditioners which are located in Montreal and Québec, in addition to counting and reception
- 3 are regional conditioners in addition to counting and reception
- 22 others are reception and counting only, with no conditioning function

Depot Reception Costs

The depots are able to accept containers for redemption in three ways:

- Through an RVM at the depot
- Through bulk manual return at the depot
- Through HoReCa return

Depots also handle the transfer of containers which have been returned via bag drop at bag drop locations, and RVM material from retailers.

The costs for the RVM reception are similar to those at a retailer, while the bulk manual return, bag drop, and HoReCa have costs mostly in transferring uncompacted material to a counting machine.

The hours necessary and cost of receiving each of these types of materials is shown in A.4. Table 12. Because RVM material is compacted and already been counted, the transfer costs associated with this material is much lower than the uncompacted material.

A.4. Table 12 Transfer/Takeback of Material

	Total Hours	Cost ($M)
RVM Compacted Material	12,258	0.2
Manual Material (HoReCa and Bulk Return)	345,477	5.5
Total	357,736	5.7

Space Costs

As with the other collection systems, space must be leased out for the depot facilities. The space must be big enough for a few counting machines, as well as for reception of containers. There also must be space for RVMs and RVM bin storage, although this is calculated separately and is shown in A.4. Table 13 below.

A.4. Table 13 Space Costs

	Total Space (m2)	Cost ($M)
Space for Counting, Storage	31,400	2.6
RVM Space	195	0.02
Total	31,595	2.6

Counting Costs

Each of the depots in the FS1 scenario have the capability to count uncompacted containers. This means the depots must be outfitted with counting machines and staffed with maintenance workers and operators. Annual operating and investment costs are shown in A.4. Table 14.

A.4. Table 14 Counting Costs

	Large Depot	Regional Depot	Small Depot	Total
Annual Operating Costs ($M)	3.3	1.1	12.0	16.4
Annualized Investment Costs ($M)	0.6	0.1	1.5	2.3
Total ($M)	3.9	1.3	13.5	18.7

A.4.7 Transportation and Collection Costs

Containers collected through retailers, kiosks and bag drops all must be collected by a hauler, which comes at a cost to the DRS system. Under FS1, the following parameters are determined by the model to cost the collection process. The collections per vehicle and total pickups are determined from the storage space of a retailer, kiosk, or bag drop, and their respective throughputs.

A.4. Table 15 Transportation and Collection Details

Parameter	Value
Storage Volume per Store (m3)	5
Total Pickups Required from Retailers	395,383
Pickups per Vehicle per Day	9
Average Round Length (km)	113

Volume per Pickup (m3)	7
Vehicle Days Required	43,721
Average time per Pickup (mins)	30

The parameters mentioned in A.4. Table 15 result in the average number of pickups per week from each of the collection methods, shown in A.4. Table 16 below.

A.4. Table 16 Average Pickups per Week

Return Point	Average Number of Pickups per Week
Retailers	0.7
Kiosks	1.6
Bag Drops	1.6

A.4.8 Central Administration Costs

Central administration costs are necessary for the management and marketing/communications of the deposit system. Costs include the set-up of offices and capital investment of IT infrastructure, as well as the costs of staff to manage the system. A.4. Table 17 below shows this breakdown of total annual costs.

A.4. Table 17 Annual Admin Costs

	Cost ($M)
Annual Investment Costs	0.2
On-going costs (marketing, admin etc.)	1.1
Staff Costs	0.6
Total	**1.9**

A.5.0 Future System 2 – Assumptions and Cost Breakdown

A.5.1.1 Introduction

Future System 2 includes 5 different container return possibilities:

- In-Store RVM Return
- Bag Drop Return
- Depot RVM Return
- Depot Bulk Return for Consumers
- Bulk return for restaurants, hotels, schools etc. to return their containers to depots.

This section of the appendix will illustrate the assumptions and methodology used to model the DRS costs of each of the return types in Future System 2.

A.5.2 DRS Return System Network

A.5.2.1 Return Points

Detail on each redemption method is provided in A.5. Table 1.

A.5. Table 1 Return Points

Redemption Method	Description	Number of Locations	Rationale
Retail Stores (in Store RVM)	A retailer above a certain size which sells a deposit-initiated beverage may also install an RVM for the consumer to return their deposit	2,812	Enough retail locations installed with RVMs to handle enough expected volume to justify installation of an RVM

Bag Drop	Shipping containers adapted to include hatches for consumers to deposit bags of containers, located in parking lots of large retailers or on patches of unused land	614	Finding where a six digit postcode containers two or more retailers, who may then opt out of in-store return and install a bag drop instead.
Depot	Depot facilities with RVMS which consumers can use to return containers	50	Any system depot will have an RVM installed.
	Depot facilities will also accept large bulk returns manually by consumers		Any system depot will have bulk return for consumers.
	The hotel, restaurant, entertainment, café and school sector will have their containers hauled to depots for return		Any system depot will accept HoReCa containers.

A.5.3 Retailer Cost and Handling Fee

The cost of collecting and sorting containers at retail outlets is borne by the retailers themselves and is reimbursed through handling fees.

Space Costs

Space is required for all retailers who take back containers through an RVM. This is an added cost for retailers under the DRS, therefore retailers should be reimbursed for these costs by the central system. Space costs are listed in A.5. Table 2.

A.5. Table 2 Space Costs

	RVMs	Floorspace Required per Retailer (m2)	Total Floorspace	Total Floorspace Costs ($M)
RVM Space	2,812	7.8	21,933	4.77

RVM Infrastructure Costs

Each retailer will have to purchase and operate an RVM for consumers to take back their containers. The cost of purchasing RVMs has been annualized in this study, and combined with the operation and maintenance costs to produce a total annual RVM cost for retailers. Infrastructure costs are listed in A.5. Table 3.

A.5. Table 3 Infrastructure Costs

	Annualized Per Machine ($)	Total ($M)
Capital & Operational Costs	9,051	38.2
Total Backroom Costs		0.2
Renovation Costs per RVM per Year	1,454	6.1
Total	10,506	44.5

RVM Labour Costs

In addition to infrastructure, operation and space costs for RVMs, retailers must also pay for the time required to manage and clean the RVMs within their store. These labor costs include:

- Time spent to empty the RVM bin
- Time spent to clean the RVM
- Time spent to process receipts
- Time spent by retailers to set out the return RVM containers for collection by haulers.

A.5. Table 4 below shows the total annual hours required for each of these processes.

A.5. Table 4 Annual Labour Hours

Task	Total Hours
Total Time to Empty Bins	160,932
Cleaning RVMS	219,904
Processing Receipts	50,802
Setting Out Containers	92,136
Total Labour Hours	523,773

A.5.4 Bag Drop Costs

The approach taken to model the costs of the bag drop network is different from the retailers and kiosks, because bag drops are a fundamentally different operation which requires minimal labour and maintenance costs. The costs for bag drop are composed of three main areas:

- Infrastructure Costs
- Space Costs
- Labour costs for cleaning and emptying

Infrastructure Costs

Bag drops require the installation of a shipping container type of containment for customers to deposit their bags in, as well as outfitting with technology and electronics. A.5. Table 4below shows the annualized cost of this infrastructure per bag drop, and the total amount needed for the network.

A.5. Table 5 Infrastructure Costs

	Total Bag Drops	Annualized Infrastructure Cost per Bag Drop	Total Annual Infrastructure Costs (CAD $M)
Infrastructure	614	8,642	5.3

Space Costs

The shipping container is 20 feet by 8 feet wide, with additional room for customers to stand, queue, and deposit their bags, and for the staff to unload bags from the container to be put on a collection vehicle. The leasing costs of having the bag drop are calculated accordingly for the square meterage the bag dop requires. Space costs are listed in A.5. Table 6.

A.5. Table 6 Space Costs

	Total Bag Drops	Total Space Needed per Bag Drop	Total Space Needed	Total Space Costs (CAD $M)
Value	614	25	15,059	3.3

Labour costs are listed in A.5. Table 7 below.

A.5. Table 7 Bag Drop Labour Costs

	Total Hours	Total Costs ($M)

Bag Drop Labour	224,110	3.27

Depot Reception Costs

The depots are able to accept containers for redemption in three ways:

- Through an RVM at the depot
- Through bulk manual return at the depot
- Through HORECA return

Depots also handle the transfer of containers which have been returned via bag drop at bag drop locations, and RVM material from retailers.

The costs for the RVM reception are similar to those at a retailer, while the bulk manual return, bag drop, and HORECA have costs mostly in transferring uncompacted material to a counting machine.

The hours necessary and cost of receiving each of these types of materials is shown in A.5 Table 8. Because RVM material is compacted and already been counted, the transfer costs associated with this material is much lower than the uncompacted material.

A.5 Table 8 Takeback and Transfer Hours under FS2

	Total Hours	Cost ($ CAD) million
RVM Compacted Material	10,911	0.2
Manual Material (Horeca and Bulk Return)	411,032	6.5

The total amount of depot space required under FS2 is shown in A.5 Table 9 below.

A.5 Table 9 Depot Space under FS2

	Total Space (m2)	Cost ($ CAD) million
RVM Space	62,800	5.2
Other Space (counting, floor space etc.)	391	0.0
Total	**63,191**	**5.2**

Counting Costs

Each of the depots in the FS2 scenario have the capability to count uncompacted containers. This means the depots must be outfitted with counting machines and staffed with maintenance workers and operators. Annual operating and investment costs are shown in A.5. Table 10 below.

A.5. Table 10 Counting Costs

	Large Depot	Regional Depot	Small Depot	Total (CAD $M)
Annual Operating Costs	4.0	1.1	14.0	19.1
Annualized Investment Costs	0.8	0.2	1.8	2.8
Total	4.8	1.3	15.8	21.9

The transportation and collection details for FS2 are shown in A.5 Table 11 below.

A.5 Table 11 Collection Details under FS2

Parameter	Value
Storage Volume per Store (m3)	5
Total Pickups Required from Retailers	436,210
Pickups per Vehicle per Day	9
Average Round Length (km)	118
Volume per Pickup (m3)	7
Vehicle Days Required	49,675
Average time per Pickup	30

The total pickups per day for each collection type are shown in Table 22 below

A.4. Table 22 Pickups per Week under FS2

	Number of Pickups per Week
Retailers	1.0
Kiosks	1.9
Bag Drops	1.1

Central Administration Costs

The Central Administration Costs are the same under FS2 as FS1.

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[x] Recyc-Québec, January 2021 "Québec Retailer Recovery data by materials ((actual system) 2013"

[xi] 2013 BGE anonymised retailer return volume data

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[xiii] Canadian Beverage Container Recycling Association, "Beverage Container Recovery in Ontario: Achieving Greater Performance and Sustainability - Draft CBCRA Industry Stewardship Plan for Submission to Waste Diversion Ontario", Waste Diversion Ontario, www.wdo.ca/files/9713/7935/8851/CBCRA_Beverage_Container_Draft_ISP.pdf, September 5, 2013.
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