Part 6: Economic and Environmental Benefits

Socio-Economic Benefits

The socio-economic benefits of beverage container recycling are numerous and widespread. Although they are sometimes difficult to quantify, these benefits must be considered if we are to understand the "full picture" of beverage container recovery in Canada. This section provides a brief overview of some of the indirect social and economic impacts of DRSs for beverage containers.

Job Creation

In 2011, the Container Recycling Institute (CRI) released a report entitled *Returning to Work: Understanding the Domestic Jobs Impacts from Different Methods of Recycling Beverage Containers.* Among other things, the report showed that DRSs create significantly more (11 to 38 times more) jobs than curbside recycling.[117]

One of the main reasons for this is the relatively greater amount of material throughput; the recovery rate for beverage containers in provinces with a DRS is 83%, compared to the average 49% in provinces with curbside recycling only. Consequently, DRSs require more workers to collect, sort, and transport the containers to materials recycling facilities (MRF) or secondary processors. In fact, ton for ton, DRSs require 1.5 to 4.0 times as many employees to carry out these tasks than curbside systems (depending on whether the curbside system is manual or automated).[118]

According to a recent economic impact study, Nova Scotia's DRS for beverage containers created approximately 700 jobs and $24.8 million in salaries and wages in 2016.[119] In Alberta, the Alberta Beverage Container Recycling Corporation (ABCRC) reports that its two processing facilities in Edmonton and Calgary employ 165 Albertans amounting to 138 full-time equivalent hours.[120] Jobs have also been created in Prince Edward Island, which reports that its DRS employs approximately 56 full and part-time people through the depot network.[121]

DRSs also create 'indirect' jobs – jobs created from businesses in the region that supply goods and services to the recycling business. For example, in addition to the 500 jobs directly attributable to recovering beverage containers, TBS's deposit-system and the ODRP created more than 300 jobs at external companies, such as Owens-Illinois. In Montreal, Owen Illinois' glass bottle factory employs over 320 people in highly skilled jobs.[122] Collectively, these employees are paid $31 million in wages and benefits annually.[123]

There are induced jobs that are created as a result of introducing a DRS. These jobs come from the purchases made by employees from the collection or processing business (the direct jobs), who spend their income on goods and services in the region.[124]

Contribution to GDP

The economic impact of beverage container deposit programs extends beyond job creation; these programs also play a key role in contributing to the wider economy. Gross Domestic Product (GDP) is the most common indicator used to measure economic activity.

An economic impact study of Nova Scotia's beverage container recycling program found that the program contributed over $32.7 million to the provincial economy in 2016, and over $496 million since the program began. It also generated $7.2 million in provincial revenue (in 2016).[125]

A similar study, released in June 2017, was undertaken in the U.S. to estimate the broader economic impact associated with Massachusetts Bottle Bill. The study found that Massachusetts deposit system contributes anywhere from USD$85 million to USD$151 million to the state's economy, including direct, indirect, and induced effects.[126]

Cost Savings for Municipalities

One of the main arguments used by opponents of DRS is that these systems harm municipalities by taking high-value recyclables like aluminum away from the municipal recycling streams. To support their argument, evidence is provided to show loss of material revenues as well as reduced industry contributions from EPR schemes for packaging where they exist. What opponents often fail to show are the cost savings that accrue to municipalities as a result of DRS, which can be significant. This includes savings resulting from the reduced or avoided costs of collection, treatment, and disposal by the municipal waste management system.

The primary driver of municipal waste management costs is the volume of collected waste and recyclables. This is due to the fact that the most expensive component of the municipal waste management system has to do with collection frequency, which is determined by the time it takes for garbage/recycling bins to fill up. Given their high volume to weight ratio, beverage containers cause bins to fill up quickly, and therefore demand more frequent collection. When beverage containers are collected via a deposit system, there is less material entering the municipal system, which means collection trucks fill up less quickly and do not need to leave collection rounds as frequently to go and unload their contents. The result is that collection trucks can serve more households in the same amount of time, which can translate into a reduction in the amount of vehicle and staff resources required to undertake collection work.

In addition to the impacts on collection costs, a DRS leads to savings on the costs of treatment/disposal of residual waste. Fewer beverage containers in residual waste means less material is sent to landfill, incineration, or other treatment. Less collected recyclables can also lead to a reduction in costs associated with sorting of collected materials, especially if municipalities collect recyclables in a mixed stream. Sorting material at a material recovery facility (MRF) is often a cost to municipalities (or their contractors), and if a DRS reduces the amount of recyclables collected, this reduces the tonnage on which such costs are incurred.

Cost savings from reduced litter clean-up are another benefit to municipalities that is often overlooked. It is important to note that estimating savings from litter reduction requires knowledge of the contribution of beverage packaging to total litter. This, in turn, depends on which metric is used. By piece count, beverage containers are only a small proportion of the entire litter stream, but when measured by volume, they are a significant contributor. Other factors to consider when estimating the cost savings on litter-clean up services are: estimated return rates (influenced by deposit level), ease of return (convenience), and whether litter is picked up by local authority contractors or is being left as uncollected litter.[127] There are also non-quantifiable benefits associated with litter reduction that should be monetized and included in the overall analysis of cost savings. This includes, for example, the value that people place on a litter-free environment, which can be measured by the amount people are "willing to pay" for reductions in litter.

Table 15 presents a compilation of 27 studies that examined the quantifiable costs and benefits to municipalities of implementing (or expanding) a DRS for beverage containers. It is noteworthy that although different in scope, location, author, and year, each study reports significant net savings to municipalities, even after lost material revenues are taken into account.

Table 15 Summary of Studies on Impact of Deposit Return Programs on Municipal Budgets

	Study Title, Author and Year	Summary of Findings
1	**Container Deposit Scheme – Consultation Regulation Impact Statement** ACT Government, Transport Canberra and City Services Directorate, 2017[128]	• The benefits transferred from the ACT Government in its capacity as a provider of municipal services to customers of those services are estimated to be $9.7M over the 20-year period.
2	**Consultation Regulation Impact Statement – New South Wales Container Deposit Scheme (NSW CDS)** NSW Environment Protection Authority, 2017[129]	• Avoided waste collection and transport costs: The benefits transferred from local government to customers are estimated to be $272M over a 20-year period.
3	**Costs and Impacts of a Deposit on Cans and Small Bottles in the Netherlands – Extended Summary** CE Delft, 2017[130]	• Cost savings on current collection systems: €5.5 to €8.0 million • Maximum reduction in costs of litter clean-up: Approx. €80 million (up to 3 eurocent per packaging) • Cost savings on emptying public litter bins: €3 to €10 million (0.10 to 0.37 eurocent per packaging)
4	**Deposit Return Evidence Summary** Zero Waste Scotland, 2017[131]	• Residual disposal savings: £2.6M to £6.2M • Recyclate savings costs: £2.8M to £3M (assuming no change in gate fees or material revenue) • Aggregated treatment and management costs savings: £5.3M to £9.2M

	Study Title, Author and Year	Summary of Findings
5	**Cost-Benefit Analysis of a Container Deposit Scheme** Sapere Research Group (prepared for the Auckland Council), 2017[132]	• Councils could expect to save $12.5M-$20.9M/year in collection costs ($2,645 to $4,424 per 1,000 pop.)[133] • Reduced litter collection and public space maintenance costs: $2.9M-$4.4M ($614 to $931 per 1,000 pop.) • Reduced landfill disposal costs: $1.3M-$3.7M ($275 to $866 per 1,000 pop.)
6	**Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services** Eunomia Research and Consulting Ltd. (Report Commissioned by Keep Britain Tidy, Campaign to Protect Rural England, Marine Conservation Society, Surfers Against Sewage, Reloop Platform, Melissa and Stephen Murdoch), 2017[134]	• Estimated net annual savings: £35M/year (£1.47/household) • Impact on collection costs: 'no change' to savings of £152,000/year (£1.65/household) • Impact on sorting costs: £800 to £220,000/year (£0.01 to £3.14/household) • Lost materials revenue: £58,000 to £160,000/year (£0.67 to £1.63/household) • Impact on residual waste treatment/disposal costs: estimated savings of £31,000 to £555,000/year (£0.54 to £4.55/household) • Savings on street cleaning costs: for more urban authorities, £25,000 to £50,000/year (£0.22 to £0.45/household). Rural authorities may see smaller savings.
7	**Massachusetts Container Deposit Return System – 2016 Employment and Economic Impacts in the Commonwealth** Container Recycling Institute, 2016[135]	• Absent the current bottle bill, cities and towns across the state would face an additional cost on the order of $20 million in collection, sorting, and disposal of containers currently managed under the system.
8	**Summary Review of the Impacts of Container Deposit Schemes on Kerbside Recycling and Local Government in Australia**[136] MRA Consulting Group (prepared for Container Deposit System Operators (CDSO)), 2016	• Reduced landfill gate fees: $10.1M/year ($5,465 per 1,000 pop.)[137] • Increased material value: $23M/year to $62M/year (NSW only) • Reduced collection costs: undetermined • Reduced litter collection costs: $59M/year ($31,922 per 1,000 pop.)
9	**The Incentive to Recycle: The Case for a Container Deposit System in New Zealand**[138] Envision New Zealand Ltd., 2015	• Refuse transport/ disposal savings: significant but undetermined • Refuse collection savings: $26.7M/year to $40.1M/year ($5,918 to $8,887 per 1,000 pop.)[139] • Reduced litter control costs: undetermined • Reduced kerbside collection costs: up to $19.26/household/year
10	**A Scottish Deposit Refund System**[140] Eunomia Research & Consulting (prepared for Zero Waste Scotland), 2015	Net annual savings (from reduced collection and disposal costs) of: • £5M for local authority kerbside services (£931 per 1,000 pop.)[141] • £7M for reduced litter (£1,303 per 1,000 pop.)
11	**Cost Benefit Study of a Tasmanian Container Deposit System**[142]	• From 2014/15 to 2034/35, a CDS would benefit local government by $28M NPV (Net Present

	Study Title, Author and Year	Summary of Findings
	Marsden Jacob Associates (prepared for the Department of Primary Industries, Parks, Water and the Environment (DPIPWE)), 2014	Value) ($54,139 per 1,000 pop.)[143] through the receipt of refunds on collected material & avoidance of some costs associated with existing kerbside recycling (undetermined).
12	**Cost-Benefit Analysis of a Recycling Refund System in Minnesota**[144] Reclay StewardEdge (prepared for Minnesota Pollution Control Agency (MPCA)), 2014	Estimated net annual savings for local governments: • $5.6M ($0.27/household/month) ($1,027 per 1,000 pop.)[145] • Undermined savings from reduced litter clean-up costs
13	**Executive Summary: Implementing a Deposit and Return Scheme in Catalonia – Economic Opportunities for Municipalities**[146] Retorna, 2014	• Reduced treatment costs: final treatment (€6,029,686, or €803 per 1,000 pop.)[147]; Waste Disposal Tax (€607,170, or €81 per 1,000 pop.); OFMSW (€565,042, €75 per 1,000 pop.) • Return of the waste disposal tax/collection fee: €1,105,523 (€147 per 1,000 pop.) • Reduced street cleaning costs: €13,175,737/year (€1,755 per 1,000 pop.) • Reduced beach cleaning costs: €580,481/year (€77 per 1,000 pop.)
14	**An Assessment of the Potential Financial Impacts of a Container Deposit System on Local Government in Tasmania**[148] Equilibrium (prepared for the Local Government Association of Tasmania), 2013	• Reduced collection costs: $257,000/year ($1.31/service/year) ($497 per 1,000 pop.)[149] • Reduced processing costs: $340,000/year ($1.73/service/year or $8.70/tonne) ($657 per 1,000 pop.), • Improved material value: $750,000/year ($1,450 per 1,000 pop.) • Net savings: $1.3M/year ($2,514 per 1,000 pop.), up to $26.8M ($51,819 per 1,000 pop.) over 20 years • Reduced litter management costs: $160,000/year
15	**Executive Summary: Report on the Temporary Implementation of a Deposit and Refund Scheme in Cadaques**[150] Retorna, 2013	• Reduced collection costs: €24,242/year (€8,536 per 1,000 pop.)[151] to €35,372/year (€12,455 per 1,000 pop.) • Reduction in compensation by Ecoembes: €1,240/year (€437per 1,000 pop.) to €1,766/year (€622 per 1,000 pop.) (This would be offset by the reduction in collection costs). • Reduced maintenance costs: €1,742/year (€613 per 1,000 pop.) to €2,420/year (€852 per 1,000 pop.) • Net savings: €23,000/year to €33,605/year (€8,099 to €11,833 per 1,000 pop.)
16	**Comparison of System Costs and Materials Recovery Rates: Implementation of Universal Single Stream Recycling With and Without**	• Estimated value of litter reduction: $815,000 to $1.2M ($1,301 to $1,917 per 1,000 pop.)[153] • Avoided disposal savings: $11.1M to $11.3M

	Study Title, Author and Year	Summary of Findings
	Beverage Container Deposits – Draft Report[152] DSM Environmental (prepared for Vermont Agency of Natural Resources), 2013	($17,730 to $18,050 per 1,000 pop.)
17	**The Impacts (Cost/Benefits) of the Introduction of a Container Deposit/Refund System (CDS) on recycling and councils**[154] Mike Ritchie & Associates (prepared for Local Government Association of NSW), 2012	• Recycling savings: $9 to $24/household • Potential savings for local governments: $23M/year to $62M/year ($3,010 to $8,115 per 1,000 pop.)[155]
18	**Understanding the Impacts of Expanding Vermont's Beverage Container Program**[156] CM Consulting (prepared for Vermont Public Research Interest Group (VPIRG)), 2012	• Increased material revenues: $2.3M ($3,674 per 1,000 pop.[157]) • Reduced garbage, recycling, and litter management costs: beyond the scope of this study, however, materials management in Vermont is estimated to cost $90/ton to $108/ton for disposal and $1,200/ton to $2,300/ton for litter collection.
19	**Examining the Cost of Introducing a Deposit Refund System in Spain**[158] Eunomia Research & Consulting (prepared for Retorna), 2012	• Total savings to municipality: €57M/year to €93M/year (€1,237 to €2,019 per 1,000 pop.[159]). 76% to 81% of these savings are derived from the reduction in costs associated with residual waste collection; ~20% come from reduced litter collection costs; and <1% come from reduced puntos limpios.
20	**Packaging Impacts Consultation Regulation Impact Statement**[160] Standing Council on Environment and Water 2011	Over 20 years, a CDS is estimated to result in: • Avoided collection, transport and recycling costs: $2.72 billion ($112,933 per 1,000 pop.[161]) • Other avoided costs (landfill and litter clean up): $247M ($10,255 per 1,000 pop.)
21	**Turning Rubbish into Community Money: The Benefits of a 10 cent Deposit on Drink Containers in Victoria**[162] Office of Colleen Hartland MLC, 2011	• Reduced recycling/MRF processing costs: $6,577,919 ($1,102 per 1,000 pop.[163]) • Reduced waste costs (landfill gate fee and levy): $5,070,851 ($850 per 1,000 pop.) • Reduced litter collection costs: $8.8M ($1,475 per 1,000 pop.) • Net savings: $32,625,183/year (($5,468 per 1,000 pop)
22	**Have We Got the Bottle? Implementing a Deposit Refund Scheme in the UK**[164] Eunomia Research & Consulting (prepared for the Campaign to Protect Rural England), 2010	'Complementary' DRS scenario: • Reduced recycling collection costs: £129M/year (£1,982 per 1,000 pop.[165]) • Reduced bringsite costs: £3M/year (£46 per 1,000 pop.) • Reduced Household Waste Recycling Centers (HWRC) costs: £1M/year (£15 per 1,000 pop.) • Reduced litter collection costs: £27M/year (£415 per 1,000 pop.) • Net savings: £159M/year (£2,443 per 1,000 pop.) (£7/household/year)

	Study Title, Author and Year	Summary of Findings
		'Parallel' DRS scenario: • Reduced collection, treatment and disposal costs:£143M/year (£2,198 per 1,000 pop.)
23	**Analysis of the Impact of an Expanded Bottle Bill on Municipal Refuse and Recycling Costs and Revenues**[166] DSM Environmental (prepared for Massachusetts Department of Environmental Protection (MassDEP)), 2009	• Avoided collection costs: $4,214,071/year to $5,033,112/year ($620 to $741 per 1,000 pop.[167]) • Avoided disposal costs: $482,372/year to $2,334,863/year ($71 to $344 per 1,000 pop.) • Reduced litter clean-up costs: $536,772 ($79 per 1,000 pop.) (distributed between state and local litter collection efforts; no data available on what this distribution is) • Net savings: $3,797,011/year to $6,468,544/year ($559 to $952 per 1,000 pop.)
24	**Analysis of Beverage Container Redemption System Options to Increase Municipal Recycling in Rhode Island**[168] DSM Environmental (prepared for Rhode Island Resource Recovery Corporation), 2009	• Reduction in municipal material revenues: $1.4M/year ($1,325 per 1,000 pop.[169]) statewide • Reduced litter collection costs: $267,500/year ($253 per 1,000 pop.) • Reduced disposal costs: $870,000/year ($824 per 1,000 pop.) • Reduced collection costs: $1.3M/year ($1,231 per 1,000 pop.) • Net savings: $1,037,500/year ($982 per 1,000 pop.)
25	**Beverage Container Investigation**[170] BDA Group (prepared for the EPHC Beverage Container Working Group), 2009	• Deposits collected by local government: $78M/year to $147M/year ($3,239 to $6,103 per 1,000 pop.[171]) • Kerbside savings: $24M/year to $25M/year ($996 to $1038 per 1,000 pop.) • Landfill cost savings: $13M/year to $17M/year ($540 to $706 per 1,000 pop.) • Landfill levy savings: $7M/year to $9M/year ($291 to $374 per 1,000 pop.) • Material values lost by local government: $47M/year to $48M/year ($1,951 to $1,993 per 1,000 pop.) • Net savings: $75M/year ($3,114 per 1,000 pop.) to $150M/year ($6,228 per 1,000 pop.), depending on level of deposit ($0.10 or $0.20/container)
26	**City of Toronto Staff Report: Amendments to Processing Fees Due to LCBO Deposit Return Program**[172] City of Toronto General Manager, Solid Waste Management Services (prepared for Public Works and Infrastructure Committee), 2008	The implementation of a DRS resulted in: • Reduced processing costs: $657,700 ($236 per 1,000 pop.[173]) in 2007 and $869,975 ($312 per 1,000 pop.) in 2008 • Reduced glass disposal costs: $490,000 ($176 per 1,000 pop.) in 2007 and $393,250 ($141 per 1,000

	Study Title, Author and Year	Summary of Findings
		pop.) in 2008 • Net savings: $447,989 ($161 per 1,000 pop.) in 2007 and $381,126 ($137 per 1,000 pop.) in 2008
27	**Economic & Environmental Benefits of a Deposit System for Beverage Containers in the State of Washington**[174] Jeffrey Morris (Sound Resource Management Group), Bill Smith (City of Tacoma), and Rick Hlavka (Green Solutions) (prepared for City of Tacoma Solid Waste Management), 2005	• Reduced garbage collection costs: $78,150 ($381 per 1,000 pop.[175]) • Reduced disposal costs: $150,500 ($734 per 1,000 pop.) • Reduced recycling collection costs: $69,400 ($338 per 1,000 pop.) • Reduced litter costs: $34,300 ($167 per 1,000 pop.) • Loss of market revenues for recycling programs: $68,300 (333 per 1,000 pop.) • Net savings: $264,050 ($1,287 per 1,000 pop.)

Charities and Community Organizations

Beverage container deposit programs play an important role in the fundraising efforts of many not-for-profit organizations (e.g. schools, community groups, youth groups) and charities.

In Ontario, for example, the *Returns for Leukemia* bottle drive has raised over $11 million dollars since the fundraiser began more than 10 years ago.[176] The fundraiser, which is a combined effort of The Beer Store and United Food and Commercial Workers Local 12R24, invites customers to donate all or a portion of their empty bottles (or cash), with 100% of the refunds going directly to the Leukemia and Lymphoma Society of Canada. The annual 'Returns for Roger Nielson House' bottle drive is another fundraiser organized by The Beer Store at its Eastern Ontario locations. In 2016, the program raised over $82,000 for Roger's House, a special palliative care facility for children.[177]

In Alberta, the 'Alberta Cans for Kids' program was established by the Alberta Bottle Depot Association (ABDA) as a way of raising money and awareness for foundations dedicated to providing medical needs for children (i.e. Ronald McDonald House, Stollery Children's Hospital Foundation, and Alberta Children's Hospital Foundation). Since November 2009, more than 200 bottle depots and their customers have been donating the proceeds from their returned recyclables to the program, for a total of over $500,000. The goal for this year's campaign is $150,000.[178]

In British Columbia, Encorp Pacific developed the Return-It School program, which encourages students, teachers, and parents to recycle and collect beverage containers. Participating schools keep all the deposit refunds earned from the Encorp containers they collect, which can be used for various school fundraising opportunities. In 2013, some schools collected more than $10,000.[179]

Supplemental Income for Low/No Income Individuals

In provinces that have them, many people rely on beverage container deposits as a means to earn or supplement their income. Most of these people are economically disadvantaged and, in many cases,

disengaged from the workforce. Without revenue from the deposits, many would have difficulty meeting their basic needs.

Environmental Benefits

Traditionally, the performance of beverage container recycling programs has been measured using operational and financial indicators, such as the number of containers collected for recycling. Today, more and more system operators are beginning to measure and report on the environmental impacts of their programs. This includes, for example, the amount of energy saved through the recycling of beverage containers or the amount of GHG emissions avoided. These indicators provide a more comprehensive picture of the overall impacts of beverage container recovery in Canada.

A recent study that assessed the benefits associated with Nova Scotia's DRS found that the landfill space saved by recycling beverage containers in 2016 was 7,660m^3. The 20-year cumulative total was estimated at 129,632m^3, which is equivalent to 52 Olympic-sized swimming pools. With landfill space at a premium these days, this is a particularly relevant indicator for measuring the environmental benefits of deposit programs. The study also found that recycling beverage containers in Nova Scotia saves 38,709 tonnes of GHG emissions each year, which is equivalent to removing more than 3,800 cars from the road. The amount of electricity saved by not having to produce new containers was estimated at 208 million kW in 2016, enough electricity to power 18,842 Nova Scotia homes.[180]

In British Columbia, Encorp reported that its activities in 2016 contributed to the reduction of about 101,900 tonnes of CO_2 equivalent being released into the atmosphere. Not surprisingly, half of these reductions (50,645 tonnes of CO_2) were achieved through the recovery and recycling of aluminum beverage containers, which were turned back into sheet stock for new cans. The recycling of glass containers resulted in 25,977 tonnes of CO2 reduced (25% of total reductions), while the recycling of plastic containers reduced CO2 emissions by 12,441 tonnes (12% of total reductions). In terms of energy savings, the recycling of aluminum cans offered the greatest savings at 93%, followed by plastic (86%) and bi-metal (82%).[181]

The environmental benefits of Ontario's Beer Store and ODRP programs are also well documented. In 2016, a total of 203,555 metric tonnes of CO_2e was avoided through the reuse and recycling of wine, spirit, and beer containers. It is worth noting that about 56% of these emission reductions are attributable to the recycling of aluminum cans. The two programs also resulted in 2.6 million GJ of avoided energy consumption. Almost half (47%) of these savings are the result of glass reuse.[182]

In addition to the above, Environment Canada and the U.S. Environmental Protection Agency (EPA) have undertaken extensive life-cycle analyses to measure the inputs and outputs, from cradle to grave, of recycling various materials. The results of these studies can be applied to beverage container diversion to quantify the environmental benefits associated with container recycling in each province. Results are summarized in Table 16. Note that in Quebec, the tonnes recycled are based on real 2016 numbers from Quebec's deposit program, and estimated numbers based on previous results for the curbside collection program.

Table 16 Environmental Benefits Realized from Recycling Beverage Containers in Canada (2016)

Province / Territory	Avoided emissions (MTCO2e)	Equivalent number of cars taken off the road	Total GJs saved	Avoided crude oil extraction (# of barrels)	Value of crude oil saved (based on $98.97/barrel) (avg price in 2014, US EIA)
BC	169,346	36,263	2,506,636	427,754	18,709,941
AB	181,313	38,825	2,936,477	501,105	21,918,346
SK	39,620	8,484	659,506	112,544	4,922,664
MB	14,801	3,169	409,606	69,899	3,057,369
ON	376,222	80,561	5,772,401	985,051	43,086,143
QC	272,751	58,405	4,162,659	710,351	31,070,768
NB	34,018	7,284	488,352	83,336	3,645,137
NS	35,940	7,696	631,451	107,756	4,713,254
NL	19,966	4,275	365,148	62,312	2,725,527
PEI	4,405	943	109,365	18,663	816,319
YT	136	29	3,005	513	22,433
NT	2,076	445	33,951	5,794	253,416
TOTAL	**1,150,593**	**246,380**	**18,078,558**	**3,085,078**	**134,941,317**

CM Consulting calculated the total avoided emissions (and equivalent cars off the road) by multiplying the tonnage recovered by container type with an emissions reduction factor for each material type. CM Consulting also calculated the total avoided energy used (and equivalent barrels of oil avoided) by multiplying the tonnage recovered by container type with an energy savings factor for each material type. See Table 17 for the results.

Table 17 Provincial and National Avoived Energy Used, by Material, 2016

Province	Aluminum	Steel	PET	HDPE	Glass Recycling	Glass Reuse	Total GJs saved
Energy Factor	**152.76**	**19.97**	**31.87**	**50.20**	**2.13**	**6.90**	
British Columbia	1,887,426	6,932	335,735	-	159,133	117,410	**2,506,636**
Alberta	1,985,116	7,998	640,334	-	131,591	171,438	**2,936,477**
Saskatchewan	475,308	379	112,125	-	21,083	50,611	**659,506**
Manitoba	225,627	-	121,361	-	1,358	61,261	**409,606**
Ontario	3,243,663	5,032	762,130	69,045	411,359	1,281,171	**5,772,401**
Quebec	2,503,712	-	594,305	-	285,003	779,638	**4,162,659**
New Brunswick	317,256	323	82,138	-	41,229	47,405	**488,352**
Nova Scotia	363,916	1,772	165,131	4,248	20,593	75,791	**631,451**
Newfoundland	133,889	91	69,272	-	14,259	147,638	**365,148**
Prince Edward Island	78,567	-	15,416	-	3,628	11,754	**109,365**
Yukon	-	-	-	-	65	2,940	**3,005**
Northwest Territories	26,275	240	4,207	-	1,001	2,229	**33,951**
TOTAL	**11,240,755**	**22,768**	**2,902,153**	**73,293**	**1,090,303**	**2,749,286**	**18,078,558**

Notes:

- All tonnage data are based on reported tonnes by program and container types.
- Refillable bottles tonnage is calculated as follows: average container weight of 263 grams multiplied by the number of units recovered. This number is then multiplied by 14/15, which represents an average of 15 individual trips per refillable bottle. For the remaining 15th trip (the last trip), it is assumed that the glass is being recycled.
- Energy saving factors were taken from the following report: Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions: 2005 Update—Final Report, Environment Canada & Natural Resources Canada, October 2005.
- Emissions reduction factors from https://www.epa.gov/warm/versions-waste-reductionmodel-warm#WARM%20Tool%20V14 accessed July 6, 2016.
- A typical passenger vehicle emits about 4.67 metric tons of $C0_2e$ per year <Source: www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references (accessed October 12, 2017).
- One barrel of crude oil is equal to about 6.1 GJ of energy (1 barrel of crude = 5.848 Mbtu = 6.17 GJ). <Source: www.oregon.gov/energy/cons/pages/industry/ecf.aspx>
- The price of Brent crude oil averaged USD$43.75/barrel in 2016. https://www.eia.gov/outlooks/steo/report/prices.phphttps://www.eia.gov/dnav/pet/pet_pri_spt_s1_a.htm

The calculations used to produce Table 16 and Table 17 are available in Appendix B of this report. To receive a copy of Appendix B and of all the associated supporting data for this section, please contact us at jason@cmconsultinginc.com.