Quantifying the Economic Value of Alberta's Recycling Programs

Now and Towards the Future

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Report for Recycling Council of Alberta

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Version Control Table

Version	Date	Author	Description
V1	03/27/19	Sarah Edwards	Client first draft
V2	04/22/19	Sarah Edwards	Draft final to client
Final	06/17/19	Sarah Edwards	Final complete
External Use	09/10/19	Sarah Edwards	Final for publication

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Executive Summary

The environmental benefits of recycling in terms of avoided tonnes to landfill and the replacement of primary raw material with secondary recycling material in products are well established. However, the contribution the sector makes to the economy in terms of employment (direct, indirect and induced jobs), tax, and overall Gross Value Added (GVA), which is the contribution the sector makes to Gross Domestic Product (GDP), is rarely considered, and to an even lesser extent calculated. Where such work has been carried out, the data demonstrates that as the management of waste moves up the waste hierarchy so does the economic benefit. Additional benefits are realized when recycled material is used by manufacturers in Alberta in the production of new products and packaging, which supports a local circular economy.

This study, which was commissioned by the Recycling Council of Alberta (RCA), utilizes primary and secondary data to initially establish the tonnage of material recycled in Alberta across the residential; industrial, commercial and institutional (ICI); and construction and demolition (C&D) sectors. It then calculates the following social and economic benefits realized in Alberta from this recycling activity:

- Job creation - direct, indirect[1] and induced[2];
- Wages;
- Recycling sector GVA[3] which contributes to Alberta's GDP[4];
- Provincial tax benefit; and
- Capital investment in the province.

It is important to not only understand the benefit of existing recycling programs but also identify the economic potential of diverting material that is currently going to landfill. As such, the study also includes an evaluation of the additional material that could be captured and economic benefits that would be delivered.

[1] Jobs created through activity associated with the direct functioning of the system (e.g., a recycling plant purchasing container processing equipment).
[2] For example, jobs created as a result of additional spending by workers at the recycling plant with their wages, as well as additional spending by equipment manufacturers with income received from sales to the recycling plant.
[3] Measure of value of goods and services
[4] Measure of value of goods and services

The study finally highlights where recyclable material is collected, processed and used in the manufacturing process within Alberta helping to contribute to a local circular economy. Expanding existing programs or implementing new programs for additional materials would further support the circular economy.

This is the first study to present a full picture of recycling activity in Alberta detailing programs and activities across the residential, ICI, and C&D sectors.

E.1.0 Economic Benefits from Existing Recycling Programs

E.1.1 Overview of Existing Programs

Recycling programs available to households and business are not recorded or tracked by the Alberta government and therefore responses to individual municipal surveys were used to collect data on the wide range of services being offered to residents. The information gathered through municipality surveys suggests that 75% of all households have access to curbside recycling services, and 44% to curbside organics diversion programs.

Recycling in the ICI sector is primarily confined to the collection of cardboard/boxboard except where municipalities have bylaws that require that the same level of service be provided to multi-family properties, businesses, and single-family properties, such as in the City of Calgary.

Service consistency across the province is provided by Alberta's stewardship programs, which are in place for the following materials:

- beverage containers (all ready-to-serve refillable and non-refillable);
- used oil, containers and filters;
- paint and paint containers;
- tires (except giant mining tires (tires over 39 inches)); and
- electronics (computers, printers, floor standing printers, laptops, monitors and televisions).

These programs are well established and strongly supported by Albertans. The beverage container program is the highest performing and lowest cost program in Canada[5] and the

[5] BCMB, 2017, Beverage Container Management Board Annual report https://www.bcmb.ab.ca/uploads/source/Annual_Reports/BCMB_2017_Annual_Report_Final_Web.pdf

programs for electronics, paint and tires also outperform the (interprovincial) average at a cost similar to or lower than the interprovincial average.[6]

The Delegated Administrative Organization[7] for beverage containers is the Beverage Container Management Board (BCMB). The Alberta Recycling Management Authority (Alberta Recycling) manages the programs for tires, electronics and paint, and took over management of the used oil program in October 2018.

An industry-initiated stewardship program is also in place for some agricultural sector wastes. Cleanfarms is a not-for-profit stewardship program that manages the collection, recycling and safe disposal of the following waste streams for its members:

- pesticide and fertilizer containers 23L or less;
- non-refillable bulk pesticide containers; and
- obsolete pesticide and animal health medication.

E.1.2 Tonnage Recycled

In order to calculate the overall economic benefit of current recycling activities, an understanding of the tonnage recycled by material and sector was determined. The 2018 Statistics Canada tonnage data derived from the Waste Management Industry Survey (WMIS) was used as the initial baseline and adjusted during the project period based on survey and interview data.

Table E 1 details the total tonnage determined as being recycled in Alberta by material stream. It is estimated that a total of 1.2M tonnes of material was diverted for recycling in 2018, 320,000 tonnes more than the tonnage reported by Statistics Canada for 2016. That equates to over 260 kg per capita.

Table E 1: Tonnage of Material Recycling in Alberta in 2018

	Statistics Canada 2016 WMIS Data	Revised Estimate	Beverage Container	Residential (Excl. Deposit)	ICI
Newsprint	76,200	60,600	0	49,200	11,400
Cardboard/Boxboard	104,700	104,800	0	44,100	60,700
Mixed Paper	78,600	87,600	0	56,100	31,400

[6] Benchmarking Alberta Recycling Stewardship Programs for Tires, Electronics and Paint, April 2018, Kelleher Environmental in association with SAMI Environmental

[7] https://www.alberta.ca/delegated-arrangements.aspx

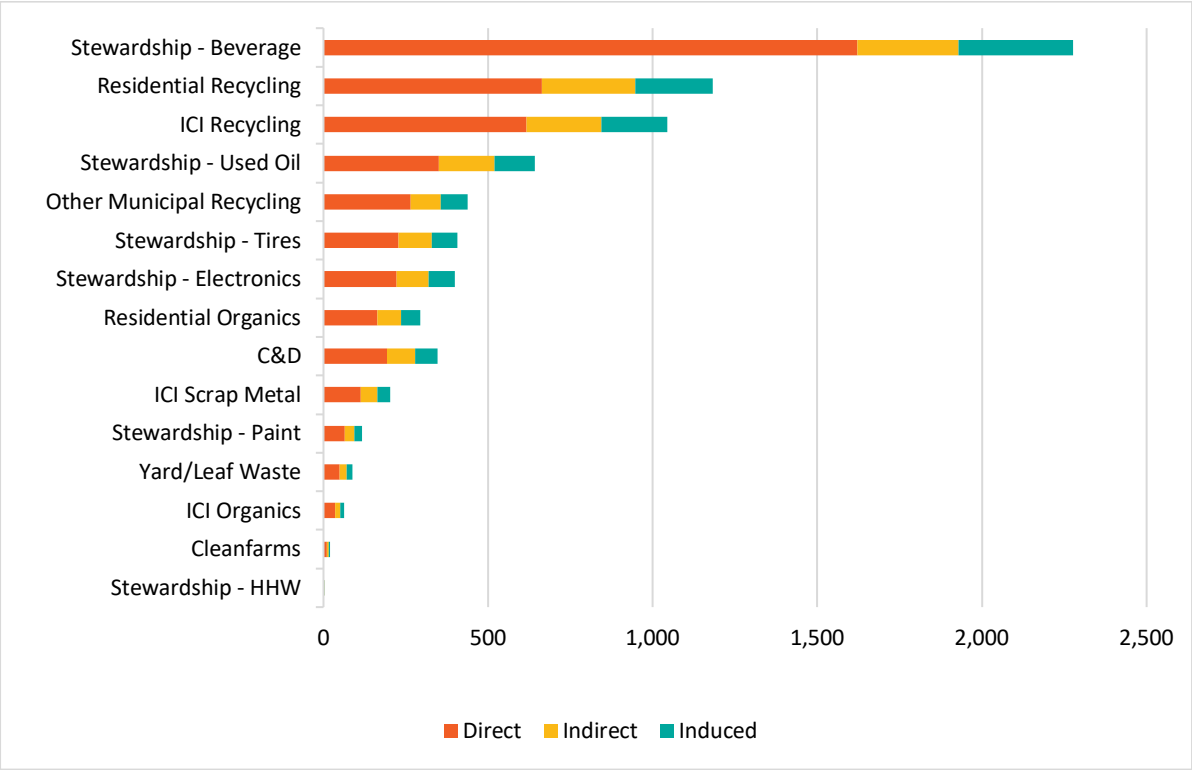
	Statistics Canada 2016 WMIS Data	Revised Estimate	Beverage Container	Residential (Excl. Deposit)	ICI
Ferrous Metals	33,300	33,600	370	13,300	20,000
Mixed Metals	23,100	23,000	0	19,200	13,800
Copper and Aluminum	16,100	29,000	12,900	9,600	6,400
White Goods	9,400	9,400	0	7,500	1,900
Electronics	8,200	12,000	0	8,200	3,800
Plastics	33,600	54,400	20,700	9,200	24,500
Tires	60,700	60,300	0	48,200	12,100
Construction and Demolition	70,200	115,000	0	34,500	80,600
Organics	239,400	319,300	0	235,500	83,800
Other Materials	13,700	18,300	4,580	12,400	1,400
Glass	64,300	117,600	57,100	9,100	51,400
Used Oil		103,400			
Used Paint (Latex Only)		1,800			
Total	**831,500**	**1,150,100**	**95,480**	**556,100**	**403,200**

Source: Statistics Canada and Eunomia primary research, totals may not add due to rounding

E.1.3 Employment

A total of 4,500 direct full time equivalent (FTE) jobs are created in the province as a result of existing recycling activities with a further 1,600 indirect and 1,400 induced jobs, for a total of 7,500. Figure E 2 summarizes the direct, indirect and induced jobs generated by material and shows that the beverage container program employs the most people in the province.

Figure E 2: Direct, Indirect and Induced Full Time Equivalent (FTE) Jobs by Waste Type

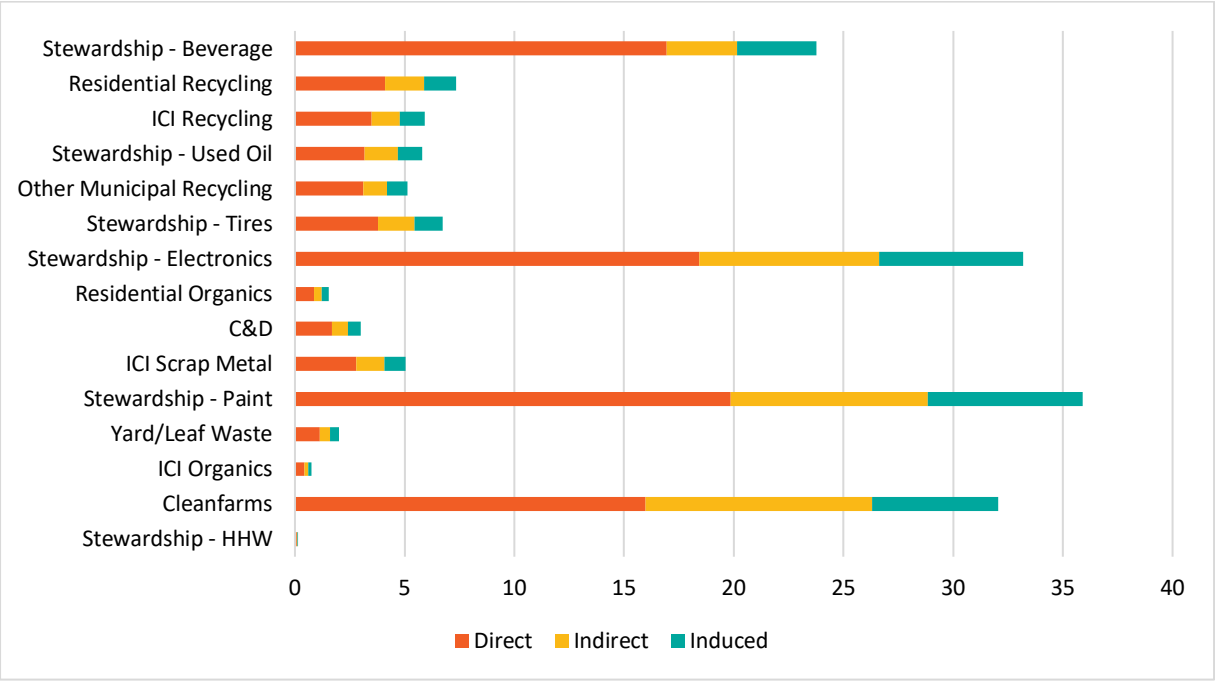


Source: Eunomia Calculation. Note: Stewardship – Used Oil includes oil, filters and containers.

Total jobs are important, but to ascertain the benefits from increased recycling in the future, an understanding of jobs per 1,000 tonnes of material recycled is more beneficial. Figure E 3 presents the data based on jobs per 1,000 tonnes of material processed and shows that the electronics and paint programs create the most jobs per 1,000 tonnes recycled. Responses from electronics processors suggest that the initial disassembly process is labor intensive, specifically for smaller processors. This reasoning is supported when the direct job intensity by material and activity is calculated as shown in Figure E 4. Notably, the waste streams with the highest direct job intensities have very different profiles:

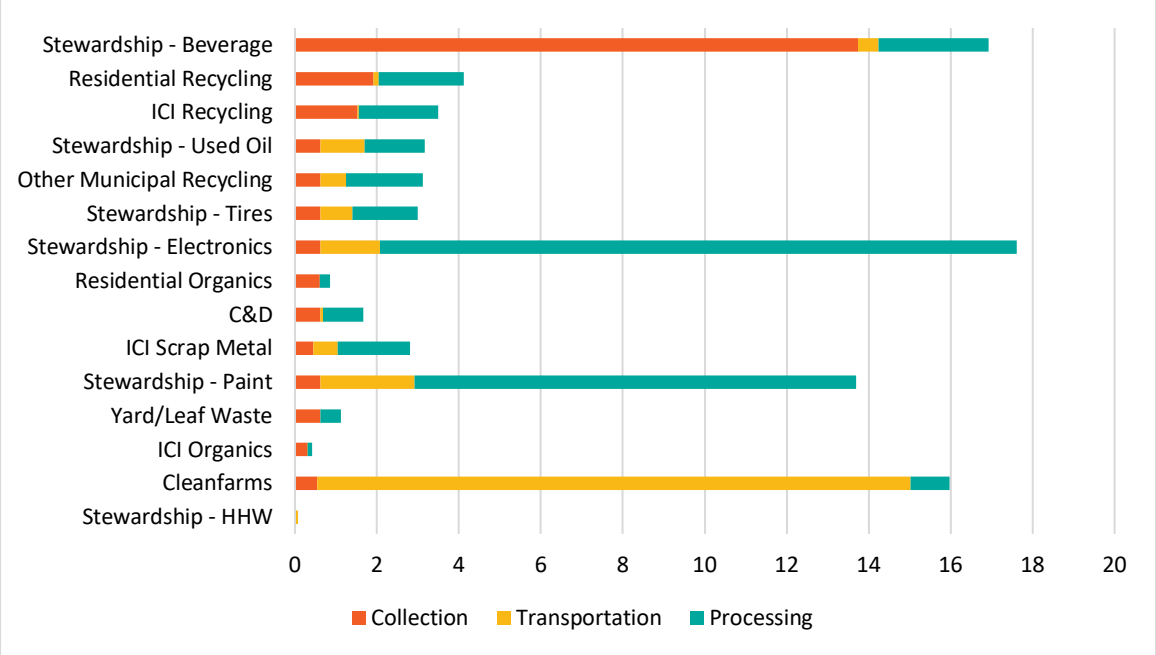
- The electronics and paint programs have labour-intensive processing operations;
- The beverage program has a very high collection job intensity at beverage depots due to the manual sorting of containers by depot staff.

Figure E 3: Job Intensity - Jobs per 1,000 Tonnes of Recycling Managed for by Waste Type



Source: Eunomia Calculation. Note: Stewardship – Used Oil includes oil, filters and containers.

Figure E 4: Direct Jobs in Collection, Transportation and Processing Per 1,000 Tonnes of Recycling Managed by Waste Type



Source: Eunomia Calculation. Note: Stewardship – Used Oil includes oil, filters and containers.

E.1.4 Material Value

The value of material recycled in Alberta each year equates to approximately $70M.

E.1.5 Tax

The contribution that recycling activities make to provincial tax receipts (taxes on labour, on production and on company income) each year is estimated to be in the region of $60M. Actual profit margins made were not disclosed, and actual corporate taxes paid depend on other company activities.

E.1.6 Gross Value Added (GVA)

The model created for this study uses the income approach to measuring GVA. The income approach to calculating GVA sums up all of the income earned by individuals or businesses involved in the production of goods and services. The main components of income-based GVA are:

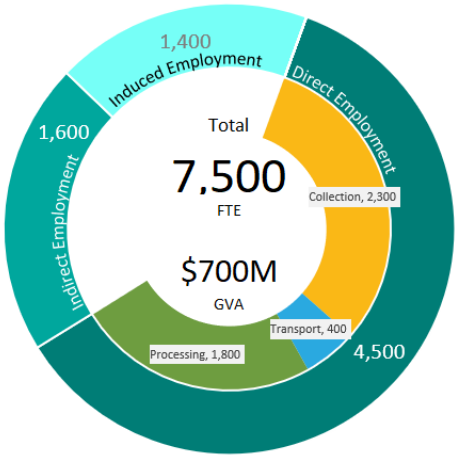
- compensation of employees;
- gross operating surplus (includes gross trading profit and surplus, mixed income, non-market capital consumption, rental income, less holding gains); and
- taxes (less subsidies) on production (but not on products)

Income-based GVA is a common approach to measuring the contribution of a sector to overall GDP of a region. The total GVA from the recycling sector in Alberta in 2018 was estimated at $700M.

E.1.7 Benefit Summary

Figure E 5 summarizes the total employment and GVA resulting from the recycling of 1.2M tonnes of waste. In addition, an estimated $40M of taxes are paid to the provincial government and the value of the secondary material produced is $80M.

Figure E 5: Total Jobs and GVA from Current Recycling Activities in Alberta



E.2.0 Future Potential

Recyclable waste is still being landfilled; this is a missed economic opportunity.

The steps to quantify this missed opportunity and to determine a future economic contribution were as follows:

1) Estimate the current diversion of a range of materials (dry recyclables; organics; C&D waste; electronics, etc.);
2) Estimate the economic benefits per tonne of material currently diverted;
3) Identify the best practices in other jurisdictions;
4) Estimate the potential diversion that would result if best practices from other jurisdictions were applied in Alberta,
5) Estimate the potential diversion if the CCME Phase 2 list of materials were diverted in Alberta;
6) Estimate the incremental diversion (potential future less current performance);
7) Apply the economic benefits per tonne to the incremental tonnes that would be diverted through more aggressive waste diversion policies.

Table E 6 summarizes the materials and recycling programs that could deliver additional economic benefits to Alberta. The table includes: the total additional tonnes; the direct, indirect and induced additional jobs that would be created; and the additional GVA, tax and material revenue.

Table E 6: Economic Benefits from Additional Recycling in Alberta

Material	Incremental Tonnes Diverted Through High Diversion Practices	Direct, Indirect and Induced Jobs (FTE)	Direct, Indirect and Induced GVA ($M/year)
PPP Residential	29,900	220	31.1
Organics Residential	173,000	270	52.2
PPP ICI	495,000	2,900	347.9
Organics ICI	155,000	120	23.2
C&D Recycling	300,000	900	147.2

Material	Incremental Tonnes Diverted Through High Diversion Practices	Direct, Indirect and Induced Jobs (FTE)	Direct, Indirect and Induced GVA ($M/year)
Electronics and Outdoor Power Equipment	12,500	320	34.4
Major Appliances	5,200	30	3.14
Mattresses	7,000	500	56.3
Textiles	16,900	150	15.9
Carpet	13,300	120	12.5
Agricultural Plastics - Grain Bags	875	5	1.3
Agricultural Plastics - Other Film and Twine	6,325	20	9.1
Used Oil Program – Additional Antifreeze and Antifreeze Containers	850	5	0.6
Tire Program – Aviation and Agricultural Tires	1,800	10	1.6
Furniture	25,000	220	23.5
Total	**1,243,000**	**5,790**	**759.96**

Source Eunomia calculations, numbers may not total due to rounding

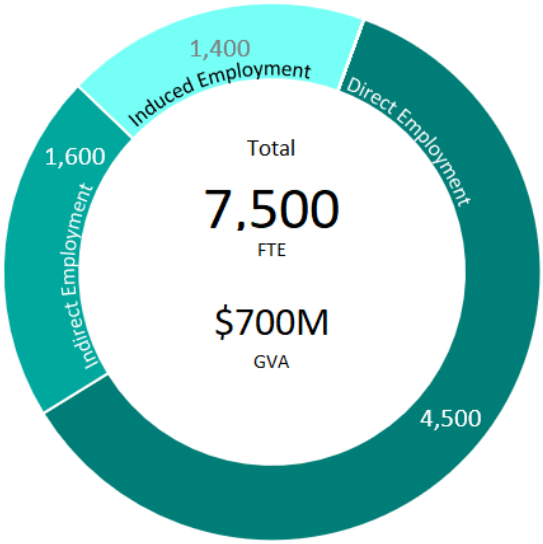
If programs were put in place to capture these additional materials, over 1.2M tonnes of additional material would be recycled resulting in 5,790 additional direct, indirect and induced jobs and almost $760M of GVA.

A comparison of current economic benefit versus the potential in the medium term if best practice policies and programs are implemented is shown in Figure E 7. There is a potential

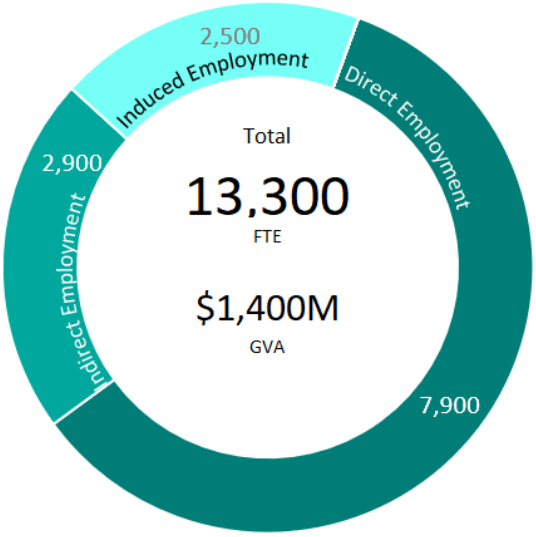
to double the GVA and create 76% more direct, indirect and induced jobs. The total tonnage of material that would be diverted from landfill would increase from 1.2M to 2.4M.

E 7: Comparison of Current versus Possible Future Economic Benefits Derived from Recycling

Current Economic Benefit from Recycling

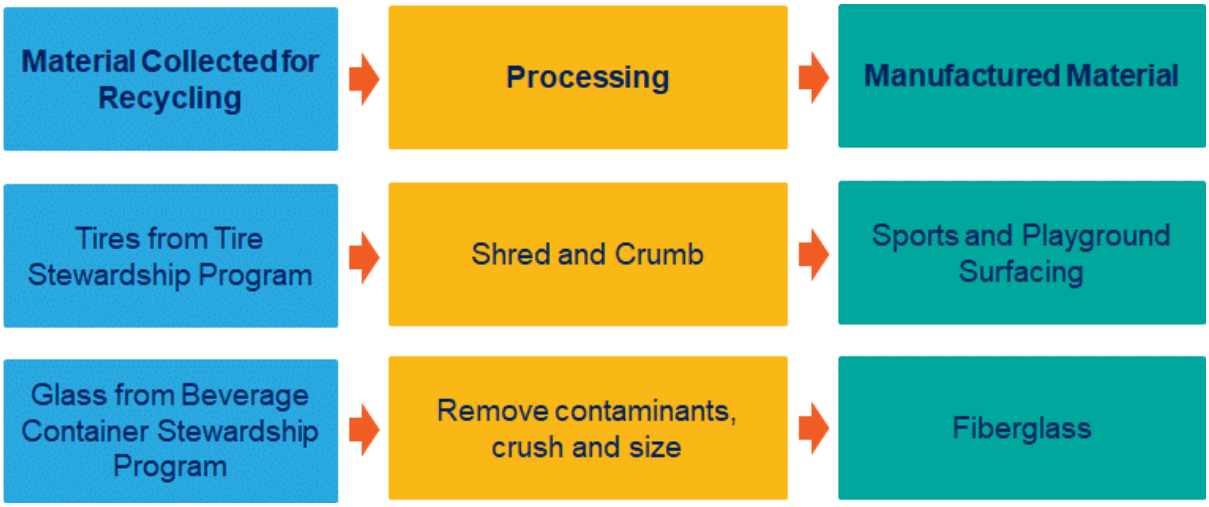


Potential Total Economic Benefit from Recycling



The above figures do not include the economic benefits derived from manufacturers using secondary material. Whilst in some case these jobs are likely to exist because secondary material would be replaced with primary material at a higher environmental cost, in other cases, processing and manufacturing is a direct result of the clean recyclable material being collected. Figure E 8 contains examples of where this is the case in Alberta. The study identified an additional 80 jobs in manufacturing from businesses using recycled product that was collected and processed in the province.

Figure E 8: Examples of Where Recyclables are Collected, Processed and Used in Manufacturing in Alberta



E.3.0 Recommendations

In developing this study, a number of key recommendations or next steps have been identified and included here for consideration:

- Data Management: This is the first study to attempt to present a holistic picture of the recycling sector in Alberta, in respect to both tonnes recycled and the economic benefits that the sector delivers to Alberta in terms of jobs and GVA. The biggest obstacle to understanding current activity was the absence of a reliable, centrally compiled and verified material data set. This data deficiency resulted in the study using primary data collected through surveys and interviews. Data was relatively forthcoming from the public sector but very little data could be gathered from the private sector, and private sector collectors in particular (even regarding services conducted on behalf of municipalities). It is recommended that a process be put in place to require all organizations to record and annually report key waste flow data that can be verified and used to update this study over time. Systems have tended to focus on requiring municipalities to enter data (often collecting it from their contractors) and on central recording of treatment capacities. However, as recycling efforts increase there is a greater need to improve the recording and understanding of commercial waste flows also. Ontario probably has one of the most comprehensive data collection and verification processes for curbside collected PPP, which is managed through the Resource Productivity and Recovery Authority

(RPRA)[8] (and formerly through Waste Diversion Ontario (WDO)).[9] The UK has Waste Data Flow,[10] which is an annual reporting requirement for municipalities that collates collection, processing and disposal data on residential, ICI and C&D wastes collected by municipalities. The UK's data collection and verification process is managed through its Environmental Protection Agency and is used as a mechanism for monitoring compliance with statutory recycling and landfill diversion targets. The ability to accurately monitor waste trends and track waste flows through the waste management system allows for the development and implementation of more effective policies and programs.

- Strategy: Projections of the potential economic benefits from investing and growing the recycling sector were based on Alberta putting in place a 5-10-year delivery strategy. This strategy should be based on a detailed cost benefit analysis to determine the most appropriate suite of polices and market instruments to capture the identified materials that are currently disposed. The policies and market instruments chosen should cost effectively deliver the optimum levels of diversion and recycling to help grow the Alberta economy and minimize environmental impact for future generations. They should also help establish markets for the material collected and ensure collection and processing can meet the specification, where possible, of local manufacturers. This strategy should consider short, medium- and long-term benefits of moving from current practice to a circular economy.

The study shows that although there is significant recycling activity in the province, specifically in the residential sector, significantly more can be done to increase the amount of material that is being captured through existing diversion programs and also to capture material currently being disposed of, and re-introduce the material to the circular economy. Programs that aim to capture this material for recycling will lead to increased economic and environmental prosperity for Albertans.

[8] Resource Productivity and Recovery Authority (www.rpra.ca)
[9] https://stewardshipontario.ca/reporting-deadlines/
[10] http://www.wastedataflow.org/home.aspx

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Definitions

Term	Definition
Anaerobic Digestion (AD)	Anaerobic Digestion, is the process by which organic matter such as animal or food waste is broken down to produce biogas and biofertilizer. This process happens in the absence of oxygen in a sealed, oxygen-free tank called an anaerobic digester. ... The word Anaerobic actually means 'in the absence of oxygen'.
Construction & Demolition (C&D)	Defined as waste material produced in the process of construction, renovation or demolition of structures.
Direct Impact	Jobs and GVA resulting from organizations managing and contracted to supply waste management activities (e.g. collection agent, material processor).
Gross Value Added (GVA)	The measure of the value of goods and services produced in an area, industry or sector of an economy.
Indirect Impact	Jobs and GVA generated as a result of the waste management sector using amounts of goods and services from other sectors, thereby generating employment and profit in these sectors (e.g. supply of recycling collection vehicles)
Induced Impact	The additional economic activity resulting from the direct and indirect economic impacts from recycling. This is the consequential economic impact created from, for example, workers spending their wages.
Industrial, Commercial & Institutional (ICI)	Waste generated from: • Hospitals • Hotels and motels • Office buildings • Multi-residential buildings • Restaurants • Retail shopping establishments

Term	Definition
	• Retail shopping complexes • Educational institutions • Large manufacturing establishments
Organic Waste	Waste types typically included as organic waste: • Grass and leaves • Garden debris and weeds • Tree pruning's and brush • Bones • Bread, muffins, cake, cookies, pies, and dough • Coffee grounds and tea bags • Eggs and egg shells • Fruit and vegetable peelings • Meat, chicken, and fish • Nut shells • Pasta and rice • Sauces and gravy • Solid dairy products • Table scraps and plate scrapings
Packaging and Paper Products (PPP)	Category of materials that includes traditional curbside recyclables, such as aluminum, glass, plastic, paperboard, newspapers, phone books, and office paper.
Residential Waste	Waste generated from households.
Sector	Generator of the waste; either residential, ICI or C&D

1.0 Introduction

In addition to the environmental benefits associated with reducing waste to landfill and replacing virgin material with recycled material in products, studies from across the globe have demonstrated how recycling contributes significantly to the economy through Gross Value Added (GVA), tax revenues and by providing jobs. Recycling also attracts inward investment to support the necessary infrastructure.

Recycling services in Alberta differ across the residential; industrial, commercial and institutional (ICI); and construction and demolition (C&D) sectors, and vary by material. Despite the high-level data published by Statistics Canada through the bi-annual Statistics Canada Waste Management Industry Survey (WMIS), there has never been a study to investigate the status of recycling across the province as a whole across all sectors – this study does that. Once the tonnage of recycling is identified the economic benefits are calculated both for the current level of recycling and for a future medium-term scenario based on extrapolating data from best practice programs in other jurisdictions.

The scope of the study includes the collection, transportation, intermediate transfer and processing of material currently recycled through the three sectors (residential, ICI and C&D), including material managed through the stewardship programs. These include:

- beverage containers (full scope included in Appendix A.1.0);
- lubricating oil, filters and oil containers (full details included in Appendix A.2.0);
- paint (full details included in Appendix A.3.0);
- tires (full details included in Appendix A.4.0);
- electronics including televisions, monitors, floor standing printers and computer equipment (full list provided in Appendix A.5.0); and
- pesticide and fertilizer containers 23L or less and non-refillable bulk pesticide containers collected from the agricultural sector.

The study also identifies end processing and manufacturing activities where they are carried out within the province in order to quantify the economic benefit of the recycling sector to the Alberta economy. Material processed out of the province provides economic benefits to the jurisdiction where those activities take place and as such are not included. A circular economy approach to materials management would strive to retain the economic benefits locally.

Using publicly available data supplemented by primary data gathered through surveys and telephone interviews, a province-wide picture has been established of:

- the type of recycling services provided in the province;
- the type of material captured by sector; and
- quantity of material recycled by sector (Section 0).

Calculated tonnage data, supplemented by primary and secondary data and assumptions, where necessary, is then used to determine:

- the number of direct, indirect and induced full time equivalent (FTE) jobs associated with the existing recycling activity;
- wages;
- tax benefit;
- material revenue generated; and
- GVA to the Alberta economy.

Finally, to ascertain the extent to which the recycling sector could contribute to the Alberta economy, materials that are recyclable and that are successfully being recycled in other jurisdictions – but not Alberta – are identified. Using waste composition studies from cities, towns and counties in Alberta as well as the performance from high diversion practice programs operating outside the province, the tonnage of additional recyclable material that could potentially be diverted in Alberta is calculated. Multiplying the estimated additional tonnage by the calculated economic benefits per 1,000 tonnes recycled by material type determines the additional economic value to the Alberta economy (Section 5.0). This calculation highlights Alberta's current missed economic opportunity by not maximizing the potential for waste diversion.

Section 6.0 highlights examples of where materials are collected, transported, processed and manufactured into end products within the province, thereby maximizing the potential to create local jobs from recycling.

This study does not monetize the environmental benefits delivered as a result of recycling; for example, it does not place a value on the avoided greenhouse gas (GHG) emissions as a result of not sending the recycled waste to landfill, nor does it calculate the reduced impact of litter, in terms of avoided clean-up costs on land and in the aquatic environment, avoided impact of plastics in the marine environment, and improved public amenity delivered through a cleaner environment, all of which are very real benefits resulting from high performing recycling programs.

2.0 Approach

This section summarizes the approach taken to:

1) Calculate the economic contribution of existing recycling activities to the Alberta economy (Section 2.1);
2) Assess the missed economic opportunity from recyclable material currently being disposed (Section 2.2).

2.1 Approach to Determining Economic Value of Recycling in 2018

In common with other studies, the economic impact of recycling is measured in terms of the contribution recycling activities make to:

- employment; and
- overall economic contribution, measured as GVA.

The 'income approach' was primarily used to calculate GVA in this study. By adding up the income of different actors in society, the calculated total GVA estimate was cross-checked against estimates of total expenditure and material revenues from waste management.

The total economic impact is comprised of the following:

1) 'Direct' impacts: includes the employment and value-added impacts (i.e. GVA) that are generated in the provincial economy directly from waste management activities (collection, processing, etc.).
2) 'Indirect' impacts: the economic impacts generated by the demand for goods and services from other sectors. They represent, for example, economic activity generated in the manufacturing and transportation sectors as a result of demand for materials and services by the waste management sector.
3) 'Induced' impacts: the additional, or "knock-off" economic activity stimulated by the spending of workers' salaries and wages earned as a result of the waste and recycling sector.

The estimation of economic impact is generally approached using type 1 (for indirect impacts) and type 2 (for direct, indirect and induced impacts) multipliers. These multipliers are specific to Alberta and to specific industry activities (each sector uses a specific combination of goods and services) and are calculated by Statistics Canada based upon a

detailed set of input-output tables detailing the interlinkages between sectors of the economy, published as the Industry Accounts Division of Statistics Canada, April 2018.[11]

Primary data has been used to estimate the capital investment and tax contributions.

The study goes further than some others in seeking to calculate and comment on the relative economic contributions made by:

1) the different operational components: collection, transportation, processing and end-product manufacturing; and
2) the different sources of recyclable material: stewardship programs, curbside collected material, or material that originates in the ICI and C&D sectors for example.

The project team consisting of representatives from Recycling Council of Alberta (RCA), Alberta Recycling Management Authority (Alberta Recycling), Beverage Container Management Board (BCMB), Solid Waste Association of North America, Northern Lights Chapter, and Cleanfarms worked collaboratively to gather and verify data collected, and agree on assumptions where data were not available, prior to the economic analysis taking place. This approach provided checks and balances throughout the project.

2.1.1 Data Collection

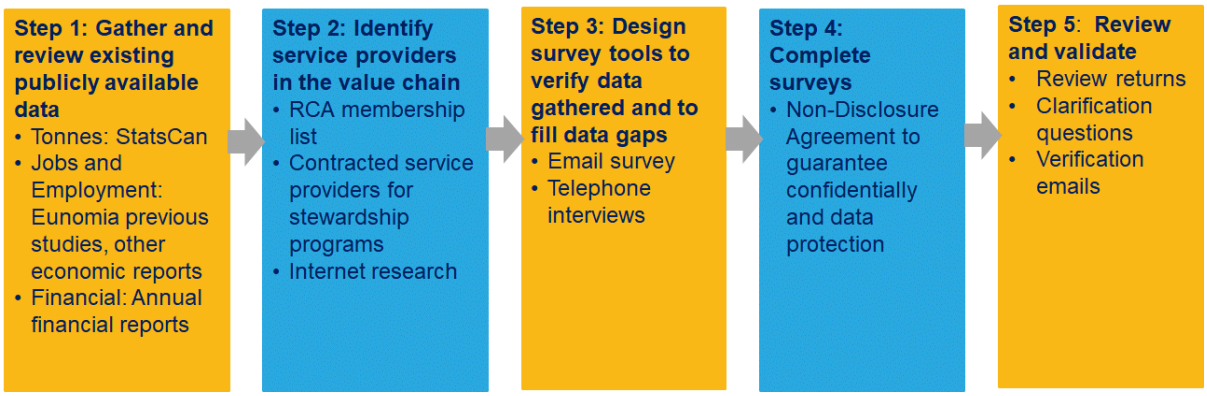
The key data required to carry out the economic analysis is set out in Figure 2-1.

Figure 2-1: Key Data Requirements

Figure 2-2 outlines the process taken to collect primary and secondary data. The data collection process was heavily reliant on primary research through surveys due to the absence of a provincial waste and recycling tonnage data reporting and management system. On this note, Ontario in particular has a mandatory annual data reporting system for municipal waste statistics, and therefore has excellent data verified by RPRA on which to base sound policy decisions and planning.

[11] https://www150.statcan.gc.ca/n1/en/catalogue/15F0046X2018001

Figure 2-2: Data Gathering Process



Step 1: Secondary Data Review

Table 2-1 summarizes the key secondary data sources that were used for the economic benefits study. Data collected through this process were supplemented through the surveying in step 3.

Table 2-1: Secondary Data Sources

Material Types	Secondary Data Source
Stewardship Materials	
Beverage Containers	Alberta Beverage Container Recycling Corporation 2017 Sustainability Report
Electronics	Alberta Recycling Annual Report 2017-18 Alberta Recycling Management Authority 2018/19 – 2020/21 Business Plan
Paint	Alberta Recycling Annual Report 2017-18 Alberta Recycling Management Authority 2018/19 – 2020/21 Business Plan
Tires	Alberta Recycling Annual Report 2017-18 Alberta Recycling Management Authority 2018/19 – 2020/21 Business Plan
Lubricating Oil, Filters and Oil Containers	Alberta Used Oil Management Association 2017 Annual Report

Material Types	Secondary Data Source
Agricultural Plastics (Currently Pesticide Containers Only)	Alberta Agricultural Waste Study 2013 Cleanfarms directly supplied data
Other Materials	
Municipality-collected Material	Statistics Canada WMIS[12] Website review Waste characterization reports: • City of Airdrie 2018 • City of Lethbridge • City of Luduc 2018 • Strathcona County2017 • City of Calgary 2014 • City of Edmonton 2016 • Spruce Grove 2016 • Rockyview County 2018, 2011
ICI Material	Statistics Canada WMIS City of Calgary Results of the Kelleher Environmental Waste Allocation Model and Waste Audits of Industrial, Commercial and Institutional Generators July 2014
C&D Material	Statistics Canada WMIS City of Calgary State of Construction and Demolition Waste Diversion in Calgary Report, November 2015 City of Calgary Construction and Demolition Waste Diversion Update 2016[13]
Textiles and Furniture	Other province/state benchmarks

[12] Statistics Canada, *Table 38-10-0034-01 Materials diverted, by type*, accessible via https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3810003401

[13] https://pub-calgary.escribemeetings.com/filestream.ashx?DocumentId=17284

Material Types	Secondary Data Source
General	State of Waste Management in Canada 2014, prepared for the Canadian Council of Ministers of the Environment

Step 2: Identify Service Providers

A project database was created of service providers involved in the following activities:

- **Collection** of material from the generator (e.g. households and business);
- **Processing/sorting** of collected materials (e.g. material recycling facilities, companies that break down electronics to their composite parts);
- **Transportation** of material from a depot to a sorting facility, or transportation from the sorting facility to the processor;
- **Processing/converting** a material into a product that can be used to manufacture a new product (e.g. producing PET (polyethylene terephthalate) pellets from baled PET); and
- **Manufacturing** a product from the output of the processing stages (e.g. turning PET pellets into recycled plastic furniture)

The database included:

- Waste management companies and other RCA members providing services within the waste sector – RCA provided the electronic version of its membership list which is publicly available through the RCA website;
- Municipalities;
- Private sector service providers;
- Stewardship programs' contracted service providers, collectors and processors; and
- Companies identified through internet research and discussion with stakeholders during the survey and interview process set out below.

Step 3: Design Survey

Email surveys were developed for public and private sector organizations. Questions were drafted to confirm, clarify or fill gaps identified through step 1 to collect as much investment, employment and tonnage data as possible. Standard surveys were provided to municipalities with a more customized approach used for the different private sector organizations where surveys were completed via telephone interviews. A copy of the municipal survey is included in Appendix A.6.0.

Step 4 and 5: Survey Completion and Clarification

The response rate from municipalities was good with the data provided covering 67% of the population in Alberta.

Table 2-2 to Table 2-5 summarize, for each sector and by material, the approach used for data collection. It also indicates the quality of the data received using a red/amber/green scale with:

- Red denoting little or no data available and/or poor data quality;
- Amber denoting sufficient information to draw conclusions if supplemented by secondary data; and
- Green denoting accurate data of good quality.

Table 2-2: Residential Primary Data Quality

Material	Activity	Service Provider	Primary Data Quality
Dry recyclables	Collection	Public sector (municipalities)	Response to survey covered 67% of Alberta's population
		Private sector	Declined to participate for confidentiality reasons
	Drop-off	Public sector (municipalities)	Response rate for smaller municipalities that are more reliant on drop-off facilities low
	Processing (materials recovery facility)	Public sector (municipalities)	Calgary and Edmonton MRF contractor data plus some smaller region data
		Private sector	Declined to participate for confidentiality reasons; some data gathered through municipal survey responses
	Transport	Private sector	Declined to participate for confidentiality reasons
Organics	Collection	Public sector	Response to survey covered 67% of Alberta's population

Material	Activity	Service Provider	Primary Data Quality
		Private sector (multifamily properties)	Declined to participate for confidentiality reasons; some data derived through municipal survey responses
	Drop-off	Public sector	Response to survey covered 67% of Alberta's population
	Processing	Public sector	Organics processing largely contracted out; a small amount of data provided by the private sector
		Private sector	Declined to participate for confidentiality reasons; some data derived through municipal survey responses
	Transport	Private sector	Declined to participate for confidentiality reasons
Other recyclables	Drop-off	Public sector	Data received on 15 different drop-off sites from a range of communities of different sizes
	Transport	Private sector	Declined to participate for confidentiality reasons
	Processing	Private sector	Declined to participate for confidentiality reasons

Source: Eunomia

Table 2-3: ICI Primary Data Quality

Material	Activity	Service Provider	Primary Data Quality
Dry recyclables	Collection	Private and public sector	Private declined to provide data; some data received through public sector responses
	Processing (materials recovery facility)	Private sector	Declined to participate for confidentiality reasons

Material	Activity	Service Provider	Primary Data Quality
	Transport	Private sector	Declined to participate for confidentiality reasons
Organic	Collection	Private sector (multifamily properties)	Declined to participate for confidentiality reasons; some data derived through municipal survey responses
		Private sector	Declined to participate for confidentiality reasons; some data derived through municipal survey responses
	Transport	Private sector	Declined to participate for confidentiality reasons
Mattresses	Collection and processing	Public sector	One company identified and provided data

Source: Eunomia

Table 2-4: C&D Primary Data Quality

Material	Activity	Service Provider	Primary Data Quality
Mixed C&D processing	Collecting	Public sector (regional waste management commissions)	Data collected through municipal survey responses where collected via drop-off sites; much C&D waste is self-hauled to processors
	Processing	Public sector (regional waste management commissions)	Some tonnage data provided by two C&D MRFs
Wood	Collecting	Private sector	No data obtained on collection
	Processing	Private sector	Data from two C&D MRFs
Drywall	Collecting	Private sector	No data on collection
	Processing	Private sector	Data from one C&D MRF

Material	Activity	Service Provider	Primary Data Quality
Asphalt	Collecting	Private sector	No data on collection
	Processing	Private sector	Data from one C&D MRF

Source: Eunomia

Table 2-5: Stewardship Programs Primary Data Quality

Material	Activity	Service Provider	Primary Data Quality
Beverage containers	Depot	Private	Good data captured through public reports and conversations with BCMB, ABCRC and ABCC
	Transport	Non-profit	Good data provided by ABCRC
		Private	Some data provided on refillable beer program but assumptions required to assess jobs impact associated with reverse logistics
	Sorting	Non- profit	Good data provided by ABCRC
	Processing	Private	Some data provided; requirement for some assumptions using known data from comparable programs and previous Eunomia analysis
Oil	Drop- off	Public	Good data provided by Alberta Recycling on tonnage; assumptions required to determine jobs impact resulting from management of used oil and related stewardship materials from municipal survey responses
		Private	Some data provided by Alberta Recycling on assumed jobs and investment
	Transport	Private	Responses received from only two registered collection and processing companies; published processing data determined through Eunomia's previous work
	Processing	Private	
Paint	Drop-off	Public	Aggregated tonnage data available through Alberta Recycling and employment data derived through municipal survey responses

Material	Activity	Service Provider	Primary Data Quality
		Private	Aggregated tonnage data available through Alberta Recycling
	Transport	Private	Declined to respond
	Processing	Private	Declined to respond
Tires	Drop-off	Public	Good data provided by Alberta Recycling on tonnage; some assumptions required to determine jobs impact resulting from management of tires
		Private	No data provided; assumed to be the same as at drop-off facility
	Transport	Private	Good data provided by the registered processing companies
	Processing	Private	
Electronics	Drop-off	Public	Tonnage data received through Alberta Recycling; assumptions required to determine jobs impact resulting from management of electronics
		Private	No data provided; assumed to be the same as at drop-off facility
	Transport	Private	Limited data received by two of the program's registered processing companies
	Processing	Private	

Source: Eunomia

2.1.2 Modelling, Assumptions and Extrapolation

The purpose of the modelling exercise was to calculate values for the following parameters:

- Tonnage:
  - An updated estimate of the total tonnage recycled (primarily using data from 2017) and associated kg per capita;
  - The tonnage of each material recycled and associated kg per capita;
  - Tonnage recycled by sector and through the stewardship programs and kg per capita.

- Jobs and wages:
    - Direct, indirect and induced employment and wages with the following activities for recycling as a whole plus for each sector and the stewardship programs;
    - Job intensities: the jobs per 1,000 tonnes of material collected/transported/processed were calculated from data collected, specific to each material and collection/management route;
    - The job intensities were then scaled up by the total tonnage of material flowing through the associated part of the system.
- Investment:
    - An estimate of total annual investment based upon data provided on annual capital spend or annual use of capital (amortization). Again, these are translated into an annual investment requirement per tonne of waste managed.
- GVA: and
- Tax.

The following sections provide information on how the model was developed, input data sources and assumptions, data extrapolation, and key calculations.

2.1.2.1 Model Development

A custom designed model was developed for the Alberta economic benefit analysis. Table 2-6 sets out each waste management activity component of the model for which tonnages, jobs, wages and investment were calculated. The level of granularity built into the model was necessary to enable the data to be extrapolated to determine the benefits of increasing recycling in the future. Care was taken to avoid double counting, specifically in respect to jobs and investment. For example, where jobs at municipal drop-off sites involved the employees spending a proportion of their time managing scrap metal as well as stewardship electronic material, the relative time they spent on each activity was estimated and then allocated accordingly.

Table 2-6: Waste Management Activities Included in the Study

Waste Management Activity	Description
Program Management Activities	
Stewardship Materials	Management of Alberta Recycling's programs (electronics, tires, paint, used oil and HHW), the beverage container recycling organizations (BCMB, ABCRC and Alberta Beverage Depot Association (ABDA)), and Cleanfarms

Waste Management Activity	Description
Municipal Recycling	Strategy, policy, contract management and communication activities associated with curbside and depot-based recycling services
Collection at Depot Sites	
Beverage Depots	217 independently owned bottle depots receive all beverage containers redeemed in Alberta
Drop-off Sites	Management and staffing of sites where residents can drop-off recycling, whether at small local sites, larger regional waste transfer locations or landfill sites, or eco-centers in towns and cities. These sites may also receive stewardship materials (apart from beverage containers).
Collection from the Curbside – Residential and Small ICI	
Curbside Collection – Packaging & Paper Products (PPP)	Curbside collection of PPP from residential homes and from communal recycling sites.
Curbside Collection – Mixed Organics Collection	Collection of mixed organics from the curbside and shared containers.
ICI Collections – Mixed Dry Recycling, Commercial Sectors	Collection of PPP from the commercial, small business sector
ICI Collections – Other Materials	Collection of mixed organics from the commercial, small business sector
ICI Collections – Organics	Collection of mixed organics from the commercial, small business sector
Intermediate/Local Transportation and Bulking	
Local Transportation of Drop-off Site Recycling	Material collected at smaller rural drop-off sites is often aggregated for sale at a central waste management location
Bulking of Tires	A proportion of tires collected are bulked for reload into 53’ trailers for transport from Calgary to Edmonton

Waste Management Activity	Description
Bulking of Other Materials	A proportion of collected dry recycling material and paper and card collected from depots is assumed to be bulked from regional centres
Collection/Transportation from Depots and Larger ICI Sites to Processors	
Collection from Beverage Depots	Collection organized by ABCRC to transport materials to their processing depots
Stewardship Material Collections from Depots	Collection of stewardship materials either directly funded by the relevant organization or covered via payments to processors
Paper and Cardboard/Boxboard	Bulk transportation/shipping of paper and card to central Alberta locations for onward sale
Plastics	Bulk transportation/shipping of plastics to central Alberta locations for onward sale
Glass to Aggregate	Transported for local use in aggregate
Scrap Metal Collection	Collection and transportation in the private sector via local dealers to end users (all located in Calgary or Edmonton)
Mattress Collection	Local collection and transportation by mattress processors
Waste to Windrow Compost Facilities (Small Facilities) and Aerated Static Pile	Organic waste collected at depots and landfills transported to local windrows/aerated static piles (though some of these are co-located with the drop-off/landfill site)
Waste to Anaerobic Digestion (AD) Facilities	Food and ICI organic waste transported to AD facilities
Sorter Processors	
Beverage Container Processor	Receipt and processing of beverage containers at ABCRC facilities
MRF – Local	Processing of mixed dry and drop-off site collected material for sale at regional facilities
MRF – Large	Receipt and processing of PPP

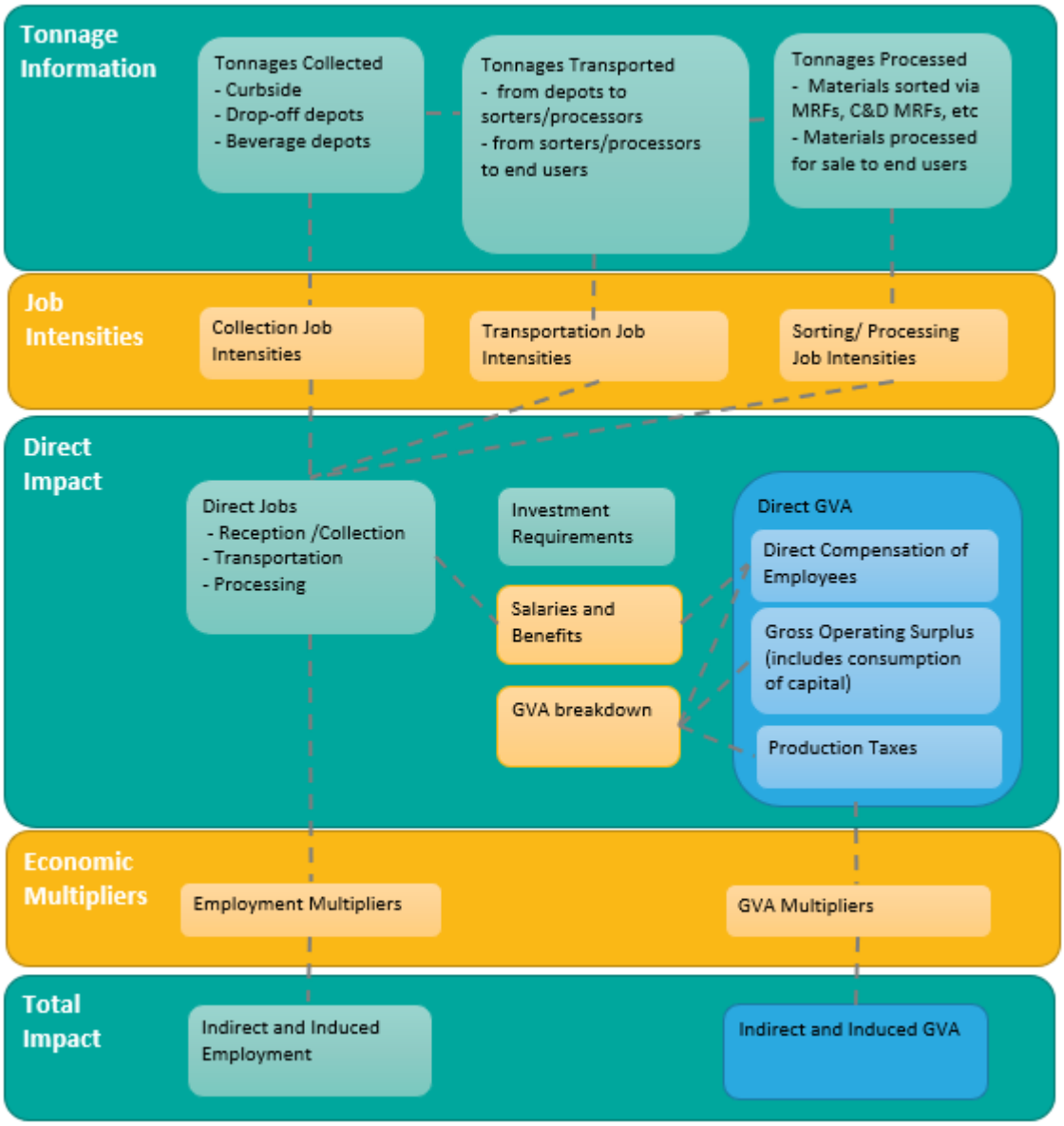
Waste Management Activity	Description
Electronics Processor	Receipt and dismantling of collected electronics under the stewardship program
Paint Processor – Regular Paint	Receipt and processing of collected paint under the stewardship program
Paint Processor – Aerosol Paint	Receipt and processing of collected aerosol paint under the stewardship program
Oil/Filter Processor	Processing collected oil, oil filters and containers into separate streams of oil, containers and filters
C&D MRF	Receipt and sorting of C&D materials into separate materials (wood, drywall, asphalt, concrete, etc.)
Transportation from Central Sorter to Processing Facilities	
Container Glass	Transportation from ABCRC plant to Vitreous Glass
MRF Outputs	Transportation of MRF metal and glass outputs
C&D Outputs	Local transportation of C&D outputs
In Province Material Processing	
Beverage Glass Processing	Vitreous Glass produces GlasSand™ from deposit material for use in fibreglass
Tires Processor	Receipt and processing of collected tires under the stewardship program
Paint Processor	Receipt and processing of latex paint under the stewardship program
Oil Bulker	Aggregation, some processing (gravity separation), some processing and storage for transportation to end markets
Paper and Cardboard/Boxboard Processing	Alberta-based warehousing, sorting and brokerage businesses, primarily out of province end-markets
Plastics Processing	Sorting, shredding and washing in Alberta (primarily Merlin Plastics)

Waste Management Activity	Description
Glass Aggregate	Crushing for use in aggregate or washing
Other Copper/Non-ferrous	Metal production in Calgary and Edmonton
Metal Processing	Metal production in Calgary and Edmonton
Mattress Processing	Mattress disassembly

Source: Eunomia

Figure 2-3 summarizes how the data were assimilated in the model.

Figure 2-3: Model Data Flow



Source: Eunomia

2.1.2.2 Recycling Activites and Tonnage

Data produced from responses to the bi-annual Statistics Canada Waste Management Industry Survey (WMIS) was used as the initial baseline and adjusted during the project period as follows:

- The total material tonnage reported to be recycled was split between municipal, ICI and C&D sources based on assumptions relating to the nature of specific material

streams, so that the total ICI waste diverted across each material category added up to the total diversion from the ICI sector reported by Statistics Canada.

- Data received through survey responses and conversations with public and private sector service providers was incorporated after refining to remove any outlier data that had a distortive effect;
- The tonnage of beverage stewardship materials was added, as these were determined, through conversations with Vitreous Glass and ABCRC, not to be captured in Statistics Canada data.

Residential Programs

For the purposes of analysis and extrapolation, municipalities were split into various categories based on population. Table 2-7 shows the number and percentage of the total population by category as well as the population for which survey responses were received.

Table 2-7:Summary of Municipality Data Responses

	Population	No. of Communities	Population Covered in Survey Responses	Population Covered by Survey Responses
Calgary	1,239,220	1	1,239,220	100%
Edmonton	932,546	1	932,546	100%
Cities and Urban Areas > 65k	410,037	5	144,294	35%
Cities and Urban Areas 20 - 65k	330,949	8	213,547	65%
Cities and Urban Areas 10 - 20k	214,335	14	65,994	31%
Cities and Urban Areas 5 - 10k	173,850	24	39,084	22%
Cities and Towns 1 - 5k	136,065	62	20,352	15%
Smaller Villages & Rural Municipalities	624,741	220	110,411	18%
First Nations	78,274			0%

Source: Statistics Canada and municipal survey responses

Curbside Recycling and Organics Programs

For curbside PPP and organics services, survey responses (combined with internet research for communities over 10k in size) were used to estimate the coverage of services across communities of different sizes. For smaller towns, the coverage is estimated from survey responses (for instance, if communities accounting for 50% of the population who responded in a particular category reported they had curbside services, coverage is assumed

to be 50%). However, we made a conservative assumption of 20% coverage for smaller towns to account for potential participation bias in that those responding to a survey may be more likely to have recycling services than those who don't respond.

To estimate tonnages collected through curbside PPP collections, we assumed that populations for which no survey data were provided generate the same amount on a kilogram per capita (kg/cap) basis as average populations in other survey responses (outside of Calgary and Edmonton). The average curbside recycling yield for responding municipalities was reported at 60 kg/cap/year. To estimate organics curbside tonnages, it was assumed that towns smaller than 20k with organics collection generate the same organic waste per capita as the 20-65k community size bracket.

Due to the reduced accessibility of PPP and organics collections in the multi-family sector, yields from these households tend to be lower. It is assumed that the population of Calgary in multi-family buildings produces half as much recycling per capita as single-family homes receiving curbside service - this is consistent with tonnages collected through Calgary's network of community recycling points which are assumed to collect primarily material from the multi-family sector, although it is noted that ICI and single-family properties are not discouraged from using these recycling points. The multi-family assumption is also consistent with data from Ontario where recycling from single-family and multi-residential households is tracked annually through the Municipal Datacall.

Leaf and yard waste (LYW) collected from multi-family residences is generally minimal, so a capture rate of only 10% of the organics kg/cap from the single-family sector is assumed. PPP and organics from these households in Calgary is collected by the commercial sector, therefore no tonnage data were available to develop more Calgary specific collection rates.

Drop-Off Recycling (excluding stewardship programs)

Most of the dry recycling collected at drop-off sites is collected in separate streams and hauled to processing facilities. For smaller rural drop-off sites, material is often also transported to a central regional depot to be bulked before being shipped to processors.

For the purposes of checking waste quantities implied by the data collection against overall waste quantities reported in the Statistics Canada WMIS survey, we have also extrapolated these tonnages to develop an estimate of what is collected at drop-off sites across Alberta. Because of the difficulty of establishing the actual population coverage of drop-off sites, since people often use their nearest site which may be in a neighbouring community or municipality, there is a higher level of uncertainty regarding this extrapolation compared to curbside assumptions.

To carry out this extrapolation we assumed that:

- For material not normally covered by curbside collections, the tonnage estimate is based on all survey responses providing tonnages.

- For material normally covered by curbside services, the tonnage estimate makes a distinction between areas where a curbside collection is in operation and those without a curbside service.

The tonnage reported by drop-off sites and transfer stations may also include some quantity of non-household waste (notably paper and cardboard) from offices and businesses.

Certain materials show wide variation in the reported quantity per resident at municipality-collected sites, and for each material (the data points are too few to conduct a robust statistical analysis) a judgement is made as to how to interpret this variation to estimate overall tonnages. For scrap metal, the Statistics Canada data is viewed as more comprehensive since much collection occurs at dedicated scrap yards.

Leaf and Yard Waste (LYW)

LYW generation depends on multiple factors including weather (which varies from one year to another); climate (which is related to geography, whether the community is in northern or southern Alberta) and plant/vegetation/tree cover, and varies across communities throughout the province. Two distinct ranges were identified in waste generated per capita amongst the survey responses received. The data provided through the municipal survey responses showed a wide range in LYW collection rates, varying from as low as 1-7kg/cap/year in some communities to as high as 21-28kg/cap/year in others.

ICI Waste

The study has gathered little additional data on tonnages of recycling collected by the ICI sector as indicated in Table 2-3. Data on ICI materials in stewardship programs is covered in the data provided by the stewardship program operators. In addition, some primary data was received on:

- ICI cardboard in one region dropped off at a regional transfer station; and
- Paper collected, which may include ICI tonnages at other town drop-off depots.

From the data gathered:

- One private sector hauler data point indicates that commercial cardboard/paper amounted to 20% of the total collected residential co-mingled recycling, though we are not aware of the relative market shares of these markets; and
- At one regional transfer station/bulking location, commercial cardboard amounts to 150% of the household PPP materials collected and processed through the site (this high percentage ratio is likely to be due also to low household PPP tonnages)

Similarly, limited responses from private sector collectors and processors mean that the latest Statistics Canada data (from the 2016 WMIS survey) is still the best starting point for an estimate of overall quantities of waste recovered for recycling from the household and ICI sector combined.

C&D Waste

The study has gathered some data from municipalities and regional landfills on tonnages of C&D waste diverted from landfill, and from one regional waste management commission. Coverage of C&D waste at municipality-run collection sites is variable, and estimates of C&D waste vary considerably depending on the scope.

- Data from one regional waste commission C&D waste sorting facility shows C&D waste generation of between 460 kg/cap and 1,200 kg/cap across the communities it directly serves, with a 50-75% recovery rate. It is possible that a portion of this material is from outside of these communities, and that this region experiences higher than average rates of construction activity.
- C&D waste collected at municipality-run sites receiving C&D waste range between 6.2 kg/cap in Calgary and 37.5 kg/cap in Ponoka (pop. 7,300). Most C&D waste (90% at one site) is hauled to regional landfills or C&D sites by commercial haulers.

Statistics Canada estimates 70,166 tonnes of C&D waste recovered in Alberta in 2016, equating to 17 kg/capita. This does not include:

- Waste managed and recycled or re-used on C&D project sites;
- Waste transported directly from C&D project sites to end markets for re-use or recycling;
- Waste transported directly from C&D project sites to disposal facilities outside of the country;
- C&D waste managed within the residential and ICI waste streams and not identified and recorded as C&D waste;
- C&D waste from large construction projects which is not disposed in MSW landfills; and
- C&D waste from civil engineering, marine and large public infrastructure projects.

A survey conducted for the Alberta C&D Waste Advisory Committee estimated that an amount ranging from 484,000 to 713,000 tonnes of concrete and asphalt was recycled in 1999 (~163 to 241 kg/cap) and noted that the actual figure could be higher. This activity has always taken place and is considered a part of common C&D industry practice, and not likely to be captured within this data. This figure is more consistent with the data received from the municipality source referred to above (230 - 900 kg/cap recycled), and will be used to form a high end of the range of C&D tonnage estimated and associated jobs.

2.1.2.3 Jobs

A bottom up approach has been utilized to calculate job and wage data. Survey information that included employment numbers plus wages data were supplemented by industry wage

data published by Statistics Canada, and assumptions regarding the split of processing jobs over different functions.[14]

For every person directly employed there are further indirect and induced jobs. Indirect jobs are related to those businesses that support the recycling industry, for instance supplying vehicles, plant and equipment. Induced jobs are a result of the direct and indirect employees spending money in the community.

To calculate the indirect and induced jobs, each employment activity was assigned an industry category as defined in the Provincial Input-Output Multipliers 2014 document published by the Industry Accounts Division of Statistics Canada.[15] The multipliers for these industries were then utilized to calculate the indirect and induced impacts. Appendix A.7.0 sets out the industry category used for each activity under each material managed.

Employment values combined with tonnage data enables a jobs intensity to be calculated effectively as the number of jobs per 1,000 tonnes of material recycled for each material. This value incorporates collection, transport and processing. These job intensity factors are used in the customized project model to estimate the employment benefits of recycling to the Alberta economy. Economic benefits are then estimated.

The jobs assessment measures gross, rather than net, employment, and therefore does not account for a reduction in jobs associated with collecting, hauling and landfilling of garbage. As such, the figures cited are not the same as an assessment of the net number of jobs created from the introduction of recycling services. However, the number of jobs displaced by recycling services is small – jobs associated with the landfilling of waste is cited as less than one job per 1,000 tonnes of waste.[16]

Of particular relevance to a study assessing impact at a provincial level is the *location* of manufacturing jobs, which in some instances are related to the presence of raw material inputs. Gathering and collecting the 'raw material', in this case recyclables, in segregated streams that are ready for input into the manufacturing processes creates business opportunities. These jobs might otherwise have been created elsewhere in Canada, North America or elsewhere. This is particularly true for manufacturing processes using recycled glass, which, because of its weight and as such cost of transportation, tend only to be viable when close to where clean glass, such as that from container deposit programs, is collected.

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[14] Statistics Canada, Employee Wages by Occupation, Alberta, both sexes, full- and part- time workers, 15 years and over, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410030701

[15] https://www150.statcan.gc.ca/n1/en/catalogue/15F0046X2018001

[16] Tellus Institute (2014), *From Waste to Jobs: What Achieving 75 Percent Recycling Means for California,* available from https://www.nrdc.org/sites/default/files/green-jobs-ca-recycling-report.pdf

There are, of course, other factors that have an impact on why businesses and industries develop in some regions and not others. In particular, some secondary materials are widely internationally traded, and some materials are not collected in any single province at the scale required to make remanufacturing economically feasible. Prices of secondary materials are strongly linked to prices of primary materials, making recycling businesses vulnerable to price risk, and in many cases market economic instruments are required to create sufficient stability in demand for the recycled product.

Curbside Collection

There are some job intensity differences in the collection of curbside recycling between urban and small-town areas, reflecting the larger distances involved between the works yard, the collection area and the smaller communities. In an urban/large town environment, collections are either conducted by automated cart collection or a bag-based collection. Either way, pass rates of around 1,000 – 1,100 households per day can be achieved with automated collections and 1,100 with bag collections. While these numbers seem counterintuitive (automated collection should be more efficient), they were reported in the municipal survey. In smaller town environments, longer driving distances and smaller communities mean lower daily pass-rates, potentially as low as 300-600 households per day.

These assumptions were subsequently checked against information provided on the costs of collection, on the assumption that the cost differential between areas should largely reflect the scale of the difference in the efficiency of collection. Jobs were calculated from these assumptions (assuming weekly collections and single drivers per vehicle), checked against jobs data provided by survey respondents and translated into jobs per tonne figures based on kilograms per capita yields.

Survey responses on jobs associated with administration, management and support indicate a further 29% administrative, management and support jobs associated with coordinating, contracting and communicating services to residents.

The ICI curbside collection of mixed dry recycling in Calgary, tonne for tonne, is estimated to require 27% additional vehicle resources compared to the residential dry recycling collection, based on the survey response from the city. However, commercial collection efficiencies vary more widely than residential efficiencies depending on the material collected. Larger bins are used so collection time can be more efficient, but businesses are more dispersed. In the absence of other information, we assumed a similar vehicle requirement for recycling collected as for the residential sector per tonne, but also assume that one quarter of commercial waste collections use a helper in addition to the driver to assist with bin manipulation and loading. Overall, based on industry knowledge, it has been assumed that ICI collections are slightly less labor intensive than residential recycling collections.

Drop-off Site/Depot Collection

Drop-off sites in this study cover any location where residents can deposit recyclable material. Where curbside recycling services are in place these tend to target material not collected at the curbside (e.g., white goods, scrap metal, some hard plastics, larger volumes of yard/leaf waste, etc.). Drop-off sites varying in size and the material that is accepted. Smaller drop-off sites may be unstaffed, or have one part-time staff member. Other drop-off facilities are at larger sites or eco-centres in towns, and sometimes adjacent to processing or other waste transfer activities. Drop-sites may also receive stewardship materials – i.e., tires, electronics, paint, oil materials (oil, filters, containers) and agricultural plastics.

The jobs estimate for employees at municipal drop-off sites is based on extrapolating total job numbers associated with handling recycling dropped off by residents. The assumptions about ratios of time dealing with recycling material vs. material for landfill is taken from municipal survey responses.

Establishing the actual population coverage of drop-off sites was difficult because people could use a site in a neighbouring community or municipality if it is closer than the site in their municipality. As such, the extrapolation of data received is likely to have led to a relatively higher level of uncertainty. However, clear differences can be observed between per capita job intensities between major community sizes as outlined in the table below. These job intensities are used as a guide and scaled up by the total Alberta population in each category to estimate total jobs associated with receiving and handling recycling dropped off by residents at municipal drop-off sites.

Table 2-8: Employment at Drop-off Sites by Community Type

Community Size	Jobs Identified	Population Covered (Estimate)	Recycling Collected (Tonnes)	Jobs per 10,000 Population
City Sites	20	32,500	2,030	6.2
Town Sites (with Curbside Services)	13	51,400	3,270	2.5
Town Sites (without Curbside Services)	10	76,700	2,770	1.3
County Network	29	1,562,500	15,700	0.2

Source: Municipal Survey Responses

Estimates of how much staff time is spent on receiving and handling recyclables, as opposed to garbage, and the split between different materials (PPP, organics, electronics and HHW)

also vary between survey respondents. The percentage of time assumed in the modelling for different locations was as follows:

- City depot: 90% of staff time spent handling recycling
- Town depot serving town and surrounding county: 60% of staff time spent handling recycling
- County depot network: 50% of staff time spent handling recycling of which:
    - 20% PPP
    - 10% organics
    - 10% electronics and HHW
    - 10% other (tires, oil, scrap metal)

A simplified assumption that the time allocation between different recycling materials is split proportional to the tonnage collected has been made.

Transportation

A supplementary model has been built to estimate transportation loads and jobs associated with collecting material from sites where material is dropped off to regional aggregation or central processing sites. The model was refined using:

- Data received from processors regarding the jobs associated with collecting material;
- Volumes and bulk densities of collected material (for instance, those supplied by ABDA on numbers of containers per collection bag) or other research;
- The differential in costs of collection and transportation of stewardship materials between different zones in Alberta (to reflect both the variation in distance between collection locations and distance to processing facilities); and
- Additional data from Statistics Canada relating to the number of direct jobs in Alberta associated with spend on truck transportation.

Additionally, a percentage of recycling collected is assumed to be handled through intermediate regional depots/transfer stations; for example, one survey response from a rural region with one small town states that 63% of the recycling was collected at a local drop-off site and then transported to a regional hub. A reported 30% of the population live outside of larger cities and towns, so it is assumed that approximately 19% of waste has an additional local transportation step prior to transportation to processors.

Processing

Employment data received from the following processors was used to calculate job intensities.

Table 2-9: Processing Facility Data Responses

Type of Processing	Number of Data Responses
Mixed dry recycling processing (MRF)	1
Regional MRF/bulking	2
Single material transfer/bulking	-
Organics processing (in-vessel composting)	1
Windrow / aerated static pile composting	-
AD processing (ICI waste)	1
Beverage processing	2
Plastics processing	2
Scrap metal processing	-
Electronics processing	1
Tires processing	2
Paint processing	-
Oil processing – oil and filter separation	2
C&D waste/wood processing	3
Mattress processing	1
Beverage glass processing	1

Source: Eunomia primary research

2.1.3 Wages

A range of salary information was obtained from a mix of official statistical sources and data provided by stewardship organizations and municipalities. Internet searches for jobs advertised also provided up-to-date information on salary ranges for specific roles within Alberta.

Table 2-10: Salary Ranges Based Upon Data Received

	Annual Salary Range $ (thousands/year)	Notes on Data Sources
Collections Driver	47 – 65	Municipal responses – other than Calgary and Edmonton

	Annual Salary Range $ (thousands/year)	Notes on Data Sources
Depot Operator	28 - 77	Municipal responses – other than Calgary and Edmonton
Fleet Supervisor	75 – 92	Municipal responses – other than Calgary and Edmonton
Hauler (Long haul)	50 - 68	Internet-advertised haulage jobs based in Edmonton and Calgary
Processing Plant Worker	38 - 56	Some data provided confidentially by processors or stewardship organizations

Source: Various as stated

Where no source data were provided for processing jobs, an average processing labour wage was used based on hourly wage data published by Statistics Canada, and assumptions regarding the split of processing jobs over different functions, as set out in the table below.[17]

Table 2-11: Processing Jobs Salary Assumption

Occupation	Hourly Wage (Statistics Canada) $	% of Labour Roles
Middle management occupations in trades, transportation, production and utilities	48.00	3%
Business, finance and administration occupations	29.80	9%
Processing, manufacturing and utilities supervisors and central control operators	39.80	14%
Processing and manufacturing machine operators and related production workers	23.80	37%
Labourers in processing, manufacturing and utilities	21.00	37%

[17] Statistics Canada, Employee Wages by Occupation, Alberta, both sexes, full- and part- time workers, 15 years and over

Occupation	Hourly Wage (Statistics Canada) $	% of Labour Roles
Derived average hourly wage	**26.10**	

Source: Statistics Canada

2.1.4 GVA

The model created for this project uses the income approach to measuring GVA. Income-based GVA is a common approach to measuring the contribution of a sector to overall GDP of a region. GVA is closely linked to GDP. Consequently, as a metric of economic activity, GVA has many of the same (and well-discussed) drawbacks as GDP. These include:

1) That environmental costs and benefits (externalities) are not factored into GVA other than to the extent that they are reflected in taxes on production;
2) That the measure is indifferent to the nature and purpose of expenditures; for example, the economic activity resulting from the impact of floods would be included in the same way as any other activity (and the links to the previous point regarding externalities becomes relevant here); and
3) That the measure does not account for 'unpaid activity', such as housework, and of relevance to this study, the labour provided by volunteers involved in promoting and collecting recyclables.

It differs from an assessment of economic costs and benefits, in recognizing that financial 'costs'- i.e., expenditures on waste management – generate income for workers and for companies, which is money that goes back into the economy and forms part of the economic life of a region. It pays no attention to matters of efficiency and productivity.

There are significant external benefits (not captured in this approach to economic assessment) such as the contribution recycling makes to reducing GHG emissions, avoided environmental damage through irresponsible management of hazardous wastes, and avoided impacts of litter, among others.

The income approach to calculating GVA sums up all of the income earned by individuals or businesses involved in the production of goods and services. The main components of income based GVA are:

- compensation of employees;
- gross operating surplus (includes gross trading profit and surplus, mixed income, consumption of fixed capital, rental income, less holding gains); and
- taxes (less subsidies) on production (taxes on products are excluded).

The approach to each of these components is outlined below.

Non-Labour Components of GVA

Gross operation surplus is the gross trading profit of companies – before deductions for depreciation/amortization, before corporation tax, and before finance charges.

The amount of profit made by waste management organizations from their activities is commercially confidential, therefore estimates are made for total GVA for different sectors of the waste industry.

The baseline estimates on non-labour GVA applied to different waste management activities are taken from the detail-level supply and use tables published by the Industry Accounts Division of Statistics Canada, predominantly based on two sectors: waste management and remediation, and truck transportation (see Table 2-12). For remanufacturing, there are other specific industry codes that apply:

- plastic product manufacturing (tire remanufacturing);
- rubber product manufacturing (tire remanufacturing);
- steel product manufacturing from purchased steel;
- converted paper product manufacturing; and
- grant-making, civic, and professional and similar organizations

Curbside waste collection and most waste processing activities are matched to the waste management and remediation sector, whilst transportation is matched to the truck transportation sector. Note, however, that non-labour GVA in production processes for plastic product manufacturing, rubber product manufacturing and converted paper product manufacturing accounts for between 18% and 20% of GVA overall, compared to 57% for waste management and remediation, so using this figure is more likely to over- than under-estimate the non-labour portion of GVA. Moreover, a portion of waste collection is undertaken directly by the public sector, where there is no profit. Therefore, for waste collections, there is a separate bottom up calculation of the gross operating surplus comprised of:

- Estimated annual consumption of capital;
- Private sector profit margins assumed at 11% of operating costs, using the assumption that labour costs amount to approximately 40% of operating costs.

Table 2-12: Components of GVA as Percentage of GVA (basic prices)

GVA Component	Waste Management and Remediation	Truck Transportation	Administrative and Management Functions e.g. Grant-making, Civic, and Professional and Similar Organizations
Subsidies on production	0.00%	-0.06%	

GVA Component	Waste Management and Remediation	Truck Transportation	Administrative and Management Functions e.g. Grant-making, Civic, and Professional and Similar Organizations
Taxes on production	0.24%	1.30%	0.11%
Wages and salaries	40.70%	60.72%	85.24%
Employers' social contributions	1.85%	5.77%	8.76%
Gross mixed income	0.61%	7.92%	
Gross operating surplus	56.60%	24.36%	5.89%

2.1.5 Multipliers for Indirect and Induced Impacts

Type one and type two multipliers for the estimation of indirect and induced impacts were taken from the Statistics Canada publication Provincial Input-Output Multipliers, 2014 for the province of Alberta. Provincial (rather than national) multipliers are used to estimate the impact on Alberta specifically. The matching of waste management activities to industry codes was assessed based on the likely similarity of the activity in question (in terms of use of other goods and services). Again, the main industry codes applied are:

- waste management and remediation; and
- truck transportation.

2.1.6 Investment

Investment calculations included for:

- Capital investment in vehicles, plant and equipment where provided through surveys; and
- Depreciation where identified through review of financial reports.

For the facilities where investment and processing data were supplied, a capital investment cost per tonne was calculated. This was then scaled up using the total tonnage of material recycled for that material.

2.1.7 Tax

The three main components of tax receipts from Alberta's recycling activities are:

- Taxes on labour income;
- Taxes on production; and
- Corporate taxes on company profits.

These taxes are levied at both a federal and provincial level.

This study presents only a simplified estimation of the level of the tax contribution from Alberta's recycling activity, since the amount of corporate tax actually paid relates to the overall profits of corporations from all their activities (rather than just the collection and recycling activities here). Additionally, companies do not tend to provide information on profit margins charged in contracts, so as noted above, the level of profit assumed from activities is set at a generic 11% of estimated total operating costs in line with the assumptions for beverage depot operators. The provincial tax rates are:

- 10% on labour income; and
- 12% on corporate income (profits).

The estimates of taxes levied on production are based on the GVA breakdown indicated in Section 2.1.4. These taxes may have a provincial component but this level of detail is not accessible.

2.2 Approach to Determining Recycling Missed Economic Opportunity

Statistics Canada reports that over 4 M tonnes of waste (over 1.2 M tonnes from residential sources and 2.9 M tonnes from ICI and C&D sources) continues to be disposed of every year in Alberta, much of which could be recycled delivering additional economic benefits.

One component of the study involved estimating the potential economic and waste diversion benefits of recycling Alberta's waste streams (which are currently disposed) at rates that are achieved in other jurisdictions by applying high diversion practice policies and legislative approaches.

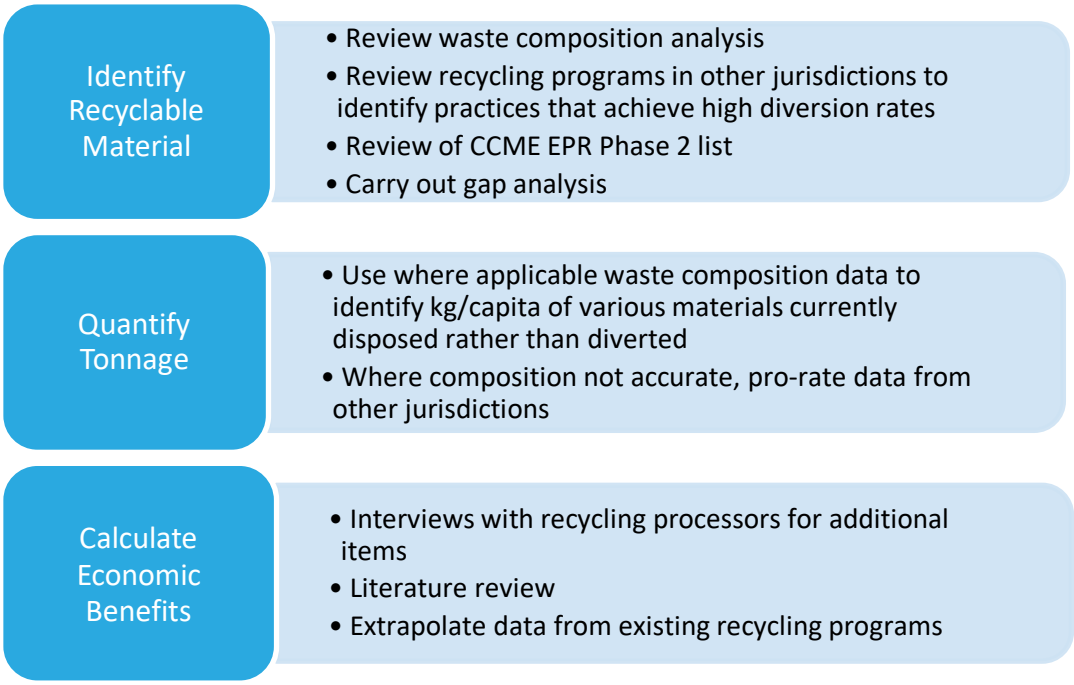
The calculations of incremental tonnage, which are presented in Section 5.1, identify the incremental tonnage that could be reasonably expected to be diverted in Alberta through the implementation of a range of policies and programs in the medium term, over the next 5-10 years. It is reasonable to assume that it would take time to get the policies and

programs in place and to allow time for both residential and business behaviours to fully adjust and adapt to focus on higher waste diversion practices.

Figure 2-4 provides an overview of the steps taken to estimate the incremental amounts of materials that could be diverted from the waste stream and the benefits of higher diversion in the province:

- the material streams that could be recycled in the province were identified;
- the potential tonnage that could be diverted if high diversion practices already in place in other jurisdictions were applied was calculated using a different approach for each material; and
- the economic benefits from that diversion were estimated using the per tonne of material diverted factors described earlier in this section.

Figure 2-4: Approach to Calculating Future Benefit from Increased Recycling in Alberta



Source: Eunomia methodology

Table 2-13 summarizes approaches that achieve high diversion rates for each material.

Additional information on each high waste diversion practice and a more detailed explanation on the tonnage calculation is provided in Section 5.1.

External market factors will have an impact on these estimates in the future. Recent examples of this include:

- design changes: significant change in all electrical and electronic equipment due to light-weighting and product convergence; and
- purchasing changes: rise in online sales that has significantly increased the proportion of cardboard in the waste stream.

Table 2-13: Examples of High Waste Diversion Practices by Material

Material	Example of High Waste Diversion Practice
Residential Packaging and Paper Products (PPP)	Where feasible, increase curbside service to communities currently only serviced by drop-off, so that 90% of the provincial population receives curbside service. Broaden range of materials collected. Standardize materials collected across programs. Education to increase capture rates. Note: Approaches listed above are similar to those used in Ontario and BC.
Household Organics	Ontario's *Food and Organic Waste Framework* for residential organics diversion. A combination of increased mandatory service levels to most municipalities, mandatory source separation by businesses and disposal bans on organics.[18]
ICI Waste Diversion	Calgary ordinance for ICI organics. Ontario *Food and Organic Waste Framework* for ICI organics. Some organics requirements in selected Canadian cities (see Section 5.1). Various mandatory recycling ordinances in the US; a few in Canada (see Section 5.1). Various models for ICI Packaging from the EU (see Appendix A.8.0).
C&D Waste (including drywall, wood, and asphalt shingles)	Disposal bans on C&D materials. Differential pricing to encourage source separation of C&D materials for separate processing. Both of these strategies are already in place in City of Calgary and other Alberta municipalities.

[18] https://www.ontario.ca/page/food-and-organic-waste-framework

Material	Example of High Waste Diversion Practice
	Disposal ban on drywall, clean wood and other C&D materials in Metro Vancouver[19] Lower tipping fee as an economic incentive to source separate asphalt shingles in Simcoe County, Ontario[20].
Mattresses	Disposal ban for mattresses in Metro Vancouver[21]. EPR program for mattresses in California run by the Mattress Recycling Council[22]. EPR program for mattresses in France.
Textiles	Encorp ReturnIT drop-off depot pilot in British Columbia[23]. Custom-designed secure textile bins in public spaces in Markham, Ontario. EPR for textiles in France. New York City textile drop off bins.
Carpet	California stewardship program run by Carpet America Recovery Effort (CARE)
Major Appliances	Major Appliance Recycling Roundtable (MARR)[24][25], BC
Furniture	Eunomia Research & Consulting *EU Circular Economy in the Furniture Sector* study[26] EPR program for furniture in France

[19] http://www.metrovancouver.org/services/solid-waste/bylaws-regulations/banned-materials/Pages/default.aspx
[20] https://www.simcoe.ca/SolidWasteManagement/Documents/Waste%20Management%20By-Law.pdf
[21] http://www.metrovancouver.org/services/solid-waste/bylaws-regulations/banned-materials/Pages/default.aspx
[22] https://mattressrecyclingcouncil.org/programs/california/
[23] https://www.return-it.ca/textiles/
[24] https://carpetrecovery.org/
[25] https://www.marrbc.ca/documents/MARR-Stewardship-Plan-2017-2021.pdf
[26] https://www.eunomia.co.uk/reports-tools/circular-economy-opportunities-in-the-furniture-sector/

Material	Example of High Waste Diversion Practice
Expanded Household Electronics and Outdoor Power Tools Program	The list of products from BC Canadian Electrical Stewardship Association (CESA)[27] and Outdoor Power Equipment Institute of Canada (OPEIC)[28] programs, as well as the broader list of electronics recovered in BC by the Electronic Products Stewardship Association (EPRA)[29]
Expanded Used Oil Program	Add antifreeze (glycol), antifreeze containers and Diesel Exhaust Fluid containers to the program, similar to Quebec, BC and Manitoba, and most other provinces
Expanded Tires Program	Consider adding mining tires, however the mining industry has indicated that they want to manage their own tires. Consider adding agricultural tires Aviation tires could be included.
Expanded Paint Program	Add corrosives, flammables and toxic products similar to Manitoba and BC regulated products lists
Agricultural Plastics	Various programs in other countries (e.g. Norway, Ireland, Iceland, New Zealand) collect a range of additional agricultural packaging and other materials

Source: Various

[27] https://www.electrorecycle.ca/wp-content/uploads/2015/04/CESA-BC-Product-Stewardship-Plan.pdf
[28] https://www.opeic.ca/documents/OPEI-Stewardship-Program.pdf
[29] https://www.recyclemyelectronics.ca/bc/wp-content/uploads/sites/4/2018/11/EPRA_BC_Program_Plan-Revised_Oct_2018.pdf

3.0 Recycling Activity and Tonnage in 2018

Understanding what material is being captured for which recycling programs in each sector is critical to calculating the economic benefit from existing recycling activities as well as identifying and forecasting future programs and benefits. The surveys carried out during this study provided a wealth of information in respect to how services are provided as well as valuable tonnage data. All of the data presented in this section are approximate but provide insight into the overall recycling landscape in Alberta. Section 3.1 provides a high-level overview of the total tonnage of material recycled in the province. Sections 3.2 to 3.6 provide further information for each sector plus the stewardship programs.

3.1 Total Tonnage

Table 3-1 summarizes the quantity of material, by sector, recycled in 2018, which equates to 1.1M tonnes. Statistics Canada data from 2016 has been updated based on study responses. An estimated 56% of all recycling is estimated to come from the residential sector including material collected through the stewardship programs. The same data is shown in a Sankey diagram in Figure 3-1

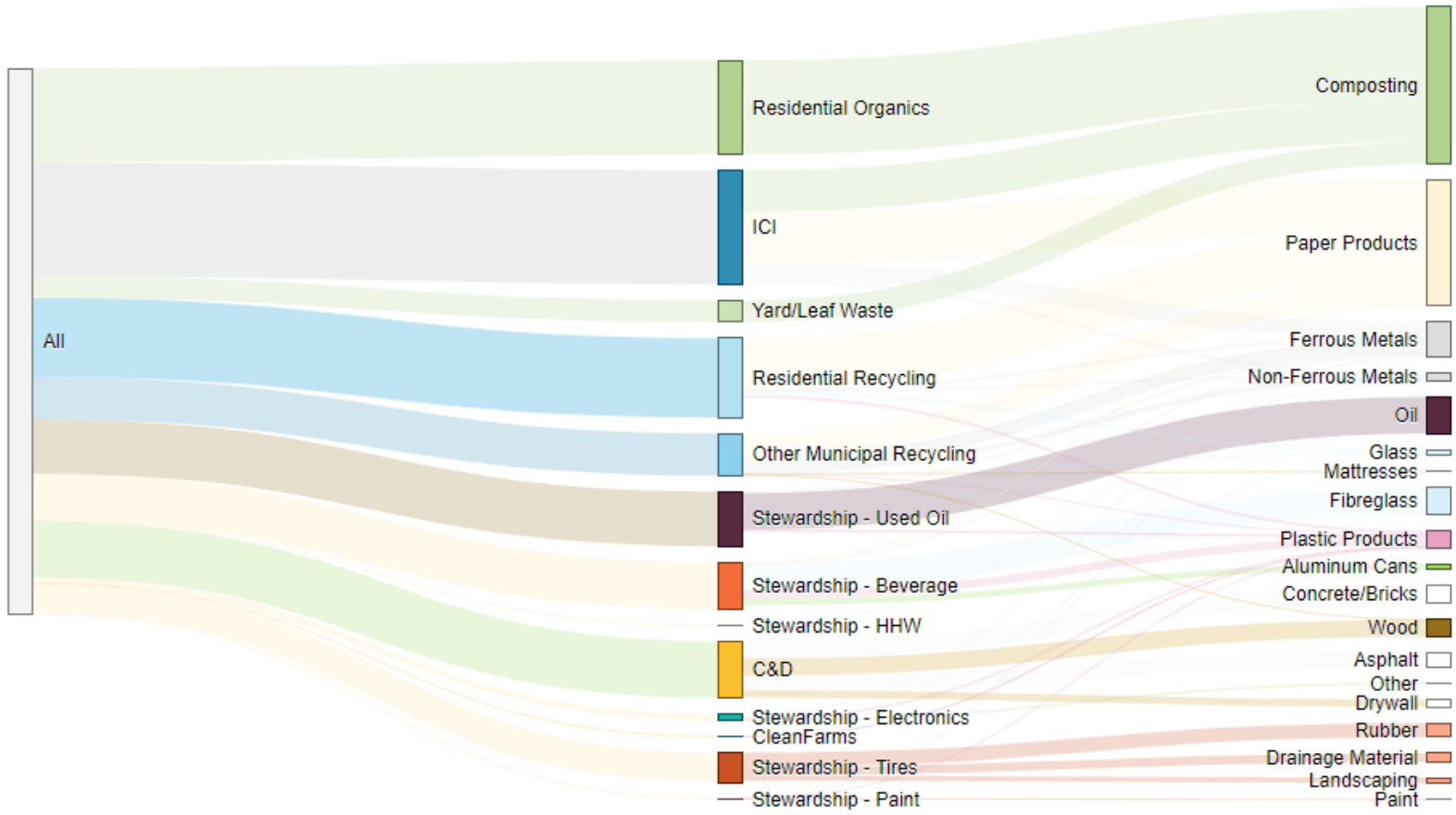
Table 3-1: Tonnage of Material Recycled in Alberta in 2018

	Statistics Canada 2016 WMIS Data	Revised Estimate	Beverage Container	Residential (Excl. Deposit)	ICI
Newsprint	76,159	60,607	0	49,183	11,424
Cardboard/Boxboard	104,682	104,810	0	44,094	60,716
Mixed Paper	78,601	87,573	0	56,132	31,440
Ferrous Metals	33,286	33,551	265	13,314	19,972
Mixed Metals	23,072	23,072	0	9,229	13,843
Copper and Aluminum	16,074	28,997	12,923	9,645	6,430
White Goods	9,365	9,365	0	7,492	1,873
Electronics	8,197	11,992	0	8,221	3,771
Plastics	33,591	54,440	20,697	9,222	24,521
Tires	60,666	60,333	0	48,200	12,133
Construction and Demolition	70,166	115,086	0	34,526	80,560
Organics	239,431	319,276	0	235,475	83,801
Other Materials	13,744	18,324	4,580	12,370	1,374
Glass	64,297	117,625	57,118	9,069	51,437
Used Oil		103,402			

	Statistics Canada 2016 WMIS Data	Revised Estimate	Beverage Container	Residential (Excl. Deposit)	ICI
Used Paint (Latex Only)		1,792			
Total	**831,331**	**1,150,245**	**95,583**	**546,172**	**403,295**

Source: Eunomia estimates from municipal and private sector survey and stewardship programs

Figure 3-1: Alberta's Recycling – Sources and Materials



3.2 Residential

3.2.1 Collection

Of the 546,100 tonnes of residential recycling, 319,300 tonnes are assumed to come from curbside collection services (both mixed dry recycling and organics collections) and the rest through drop-off site collections (including substantial quantities of leaf and yard waste (LYW)).

Curbside Collection of Packaging and Paper Products

Public or private sector service providers provide curbside PPP program services to single-family properties, and the material is generally collected in blue carts or in bags. Where multi-family properties receive services, these are provided predominately by the private sector except in Edmonton where the city provides services.

Alberta does not have a standardized list of PPP materials collected by municipalities; however, the most commonly included materials are:

- plastics (PET, HDPE and LDPE);
- aluminum cans and containers;
- steel cans and containers;
- newsprint;
- cardboard/boxboard; and
- mixed paper.

Some municipalities also include glass, though there are instances of glass being removed from programs due to a lack of end markets. Calgary's MRF creates a glass stream as one output, whereas the MRF receiving Edmonton's mixed recycling does not.

Table 3-2 summarizes coverage and yields from curbside PPP collections, showing:

- The percentage of the population living within communities where there is curbside service (note: this is an overestimate since curbside service is often not provided to households in multi-family dwellings);
- The number of households that are covered by these service (this excludes multi-family households);
- The kilogram per household (kg/hh) and per capita collected from covered households (note: these values are greater than the actual amount diverted and recycled due to contamination collected in PPP collections and rejects from sorting at MRFs).

In total it is estimated that 75% of the total population live in communities with curbside PPP services. Excluding multi-family dwellings not covered by municipal services, this equates to approximately 62% of Alberta households. However, some cities including

Calgary and Airdrie have mandated that multi-family properties have the same level of service as single-family properties. This equates to an additional 12% of properties, resulting in an estimated 74% of households having access to a curbside service.

Table 3-2: Access to Curbside PPP Services in Alberta in 2018

	Population *	% of Households with Access to Curbside PPP	Population Covered by Data Responses *	PPP Collected, kg/SF hh covered [a]	PPP Collected, kg/cap [a]
Calgary	1,239,200	100%	1,239,220	153	62
Edmonton	932,500	100%	932,500	107	45
Cities and Urban Areas > 65k	410,000	77%[b]	317,300	151	59
Cities and Urban Areas 20 - 65k	331,00	100%	331,000	174	62
Cities and Urban Areas 10 - 20k	214,300	66%	141,100	169	60
Cities and Urban Areas 5 - 10k	173,900	48%	83,400	140	51
Cities and Towns 1 - 5k	136,100	34%	46,600	169	60
Smaller Villages & Rural Municipalities	624,700	5%	31,200	159	60
First Nations	78,300	0%[c]	0	N/A	N/A

Source: Eunomia Calculation extrapolated from municipal survey

Notes:

** Numbers are rounded*

a. Obtained from survey data

b. Lethbridge is introducing a curbside dry recycling service in 2019, taking coverage to 100% this year.
c. The First Nation and Metis populations tend to form smaller and more dispersed settlements, making curbside collections less efficient, and it is assumed that these communities have access to depots but that curbside collection coverage is minimal as with other hamlets, villages and rural municipalities across Alberta.

Based on the data received, cities between 20-65k in population for which there is 100% coverage are collecting 62kg per capita. These cities and towns include: Grand Prairie; Airdrie; Spruce Grove; Okotoks; and Cochrane. Grand Prairie and Spruce Grove achieve this through a bag rather than box or cart program.

Details of services provided to multi-family households were provided by Calgary, Airdrie, Edmonton, and St Albert. Edmonton provides the service directly, while Calgary and Airdrie have mandated services to multi-residential households through a bylaw.

Some communities provide either community drop-off bins or community recycling points dispersed throughout a city (for instance, in Calgary) – residents in the single-family, multi-family and small business sectors are able to use these as local points for dropping off PPP material.

Curbside Organics

As with curbside PPP programs, curbside organics programs are provided by both the public and private sectors. Table 3-3 provides data on the percentage of communities that have access to curbside organics collection services, the kg per household collected, and kg per capita collected through those municipal programs as captured from the municipal survey and internet research. Based on the survey and internet research of municipal websites, it is estimated that approximately 43% of Albertans have access to curbside organics programs. Where data were provided the average kg per capita was similar at between 141-143 kg/cap/year and per household capture at between 295-359 kg/hh/year.

Table 3-3: Access to Curbside Organic (Food and Yard Waste) Services in Alberta

	Population *	% of Population with Curbside Organics	Population with Access to Curbside Organics *	Organics Curbside, kg/hh covered	Organics Curbside, kg/cap covered
Calgary	1,239,200	100	1,239,200	350	143
Edmonton	932,500	0**	0	0	0
Cities and Urban Areas > 65k	410,000	35	144,300	359	141
Cities and Urban Areas 20 - 65k	331,00	81	267,800	295	105
Cities and Urban Areas 10 - 20k	214,300	64	135,600	336	120
Cities and Urban Areas 5 - 10k	173,900	14	25,000	233	84
Cities and Towns 1 - 5k	136,100	0	0	N/A	N/A
Smaller Villages & Rural Municipalities	624,700	0	0	N/A	N/A
First Nation	78,300	0	0	N/A	N/A

Source: Eunomia calculation extrapolated from municipal survey

** Numbers are rounded*

*** Edmonton processed organics at their mixed waste composting operation along with biosolids for many years. This facility has closed and Edmonton is now pilot testing a Green Bin (household organics) program.*

The cities of Airdrie and Calgary have mandated organics programs for multi-family properties that are provided by the private sector.

Drop-Off Facilities

The vast majority of the population has access to recycling services for some materials through some kind of depot provision in the region. Only communities cut off from reliable transport routes may find it challenging to arrange collections.

Drop-off facilities range in scale from unmanned containers to sites accepting a wide range of materials including C&D waste.

The range of material collected through drop-off facilities varied across municipal responses. For those materials most commonly collected, an average kg/cap was calculated along with a comparison of kg/cap from municipalities that only have drop-off facilities versus those that have curbside and drop-off facilities. These data are provided in Table 3-4.

Table 3-4: Drop-Off Site Collection by Material Type (Kg/Capita)

	Average Drop-off Site Collection by Material (kg/cap)	Collection Rates for Materials Normally Targeted by Curbside Collections (kg/cap)	
		At drop-off sites serving communities with no curbside service	At drop-off sites serving communities with curbside service
Newsprint	2.12	9.92	0.31
Office Paper	1.17	2.18	0.57
Mix Paper	2.11	3.29	1.49
Cardboard	8.20	18.14	3.56
Glass	0.41	0.59	0.17
Plastics	1.05	2.77	0.34
Cans	0.15	0.44	0.00

	Average Drop-off Site Collection by Material (kg/cap)	Collection Rates for Materials Normally Targeted by Curbside Collections (kg/cap)	
		At drop-off sites serving communities with no curbside service	At drop-off sites serving communities with curbside service
Scrap Metal	5.77	-	-
Wood	0.33	-	-

Source: Eunomia calculation extrapolated from municipal survey

These figures indicate collection rates in the range of:

- 37 kg/cap of commonly curbside-targeted materials where there is no curbside provision (60% of the average rates seen at the curbside). These numbers are likely to overestimate actual kg/cap captures since:
  - The population using drop-off sites in towns are likely to include residents in surrounding municipalities. Attempts have been made to account for this in the data provided but some error is likely to remain;
  - Some of this tonnage (particularly paper and cardboard) is likely to originate from small businesses. Approximately 90% of this is paper and cardboard/boxboard. This rate is high compared to what would be expected, in the region of 30%, as seen in curbside collection services.
- 6.5 kg/cap where there is some curbside service (again 90% paper and cardboard/boxboard). Similarly, a quantity of this may be waste from offices and small businesses.

Only one municipality reported separating mattresses for recycling. Additionally, only one reported separately on tonnages of white goods collected – though in other communities these may be included in the scrap metal tonnage. This tonnage was not included in the 37 kg/cap calculation.

3.2.2 Material Processing

Table 3-5 summarizes the main processing routes for different materials collected from municipal sources within Alberta.

Table 3-5: Residential Material Processing Routes

Collected Waste Stream	Sorting/Initial Processing	Further Material Processing
PPP	Sorting via materials recovery facility (MRF)	Paper brokers Shredding/flaking of plastics Scrap metal to metal dealers
Mixed Organics	Input to In-Vessel Composting (IVC) or aerated static pile	
LYW	aerated static pile	
Separate Paper Grades (Cardboard/Boxboard/ Newsprint/Office Paper/Mixed Paper)	N/A	Paper brokers
Hard Plastics	N/A	Potential shredding/flaking or direct to e.g., lumber
Scrap Metal and White Goods	N/A	Metal dealers
Mattresses (also ICI sources)	Mattress processor	Dealers for composite parts, foam, steal, plastics, cardboard, felt, textiles and wood
Stewardship Materials	Via stewardship routes (see below)	

Source: Eunomia primary research

3.3 ICI

Recycling services available to the ICI sector vary across Alberta with the most comprehensive services predominately driven by local by-laws. Examples include:

- Calgary's by-laws that require business and organizations to separate:
  - The same dry recycling items as households (introduced November 1, 2016); and
  - Food and LYW for composting or diversion (introduced November 1, 2017).

- Airdrie's 2017 by-laws[30] require businesses to, where applicable, separate organic materials and arrange for collection by a private service provider.

Where not regulated, the primary material collected by the private sector from the ICI sector is cardboard/boxboard.

As already stated, no ICI private sector service provider would agree to an interview or complete a survey. Therefore, Statistics Canada data were only supplemented by data provided by those municipalities that provide services to the ICI sector.

ICI recycling waste tonnage is shown in Table 3-1.

3.4 C&D

C&D recycling activities occur when financially viable and there are markets for the resulting materials, or where municipalities have instituted disposal bans or differential tipping fees. Materials identified as being recycled in Calgary[31] include: wood, drywall, asphalt shingles and pavement, concrete, brick and masonry block, cardboard and metal.

No data were collected regarding the collection of C&D waste however interviews were carried out with two C&D MRF operators. These conversations in conjunction with reviewing the secondary data listed in Table 2-1 resulted in the tonnage identified in Table 3-1 and following insight into recycling practices:

- Recycled asphalt shingles can easily be incorporated into road surfacing. However, the city of Calgary recently revised their road design specification removing recycled asphalt shingle for reasons of reduced performance. One C&D recycler reported that prior to this change, they were recycling 30,000 tonnes/year but that now the material is being stockpiled. Testing is required to understand the level of primary asphalt that can be replaced with secondary without compromising performance.
- Wood is a significant proportion of mixed C&D waste; one facility operator provided an estimate of 60%. A total of 49,000 tonnes/year of clean wood was identified through survey responses as being recycled into the following products in Alberta:
    - mulch supplied to customers in Alberta and Western Canada;
    - animal bedding supplied to customers in Alberta;
    - thermal fuel to customers in Alberta
- Drywall: Drywall is separated into cardboard and gypsum. The paper is generally processed into animal bedding and the gypsum is sent to a dry wall manufacturer

[30] https://www.airdrie.ca/getDocument.cfm?ID=4952

[31] Construction and Demolition Waste Diversion Update 2016, City of Calgary https://pub-calgary.escribemeetings.com/filestream.ashx?DocumentId=17284

approximately 20% of new drywall consists of recycled gypsum. A portion of it is also sent to composting facilities.

3.5 Stewardship Programs

Stewardship programs had the most comprehensive data, much of it publicly reported through annual reports.

3.5.1 Beverage Container Deposit Refund System

Alberta has two beverage container deposit return system operators, one for non-refillable containers and one for refillable beer bottles. As this report only considers the economic benefits from recycling – and not re-use – the refillable program is excluded from the assessment although commented on in Section 5.0. The BCMB is responsible for regulating Alberta's beverage container recycling system and leads the development of policy that enables the recycling of beverage containers in Alberta.

Alberta's non-refillable beverage container system has the widest scope and highest return rates of any province in Canada. Of the 2.2 billion beverages containers sold in 2017, an estimated 1.9 billion were redeemed, representing an 86.1% return rate.[32,33] As set out in Table 3-1, a reported 95,582 tonnes of material were recycled through this system in 2017.

Returned beverage containers are collected though the province's 217 privately operated depots and transported to two initial processing facilities before being transported to end processors. ABCRC operates the collection and recycling system for these containers, the two sorting facilities and markets the material collected.

Materials are taken to end processors set out in Section 3.5.6

End Processors

End processors taking material from the non-refillable beverage container system are summarized in Table 3-6.

[32] https://www.bcmb.ab.ca/uploads/source/Annual_Reports/BCMB_2017_Annual_Report_Final_Web.pdf
[33] https://www.abcrc.com/assets/2017-Sustainability-Report.pdf

Table 3-6: Beverage Container End Processors

Material	Processor Details
Glass: Vitreous Glass	In-province processor Processing three-color glass from Alberta, British Columbia and Saskatchewan, 99% of which comes from beverage container programs. Produce GlasSand™ supplied to Alberta fibreglass insulation manufacturers.
PET: Merlin Plastics	In-province processor processing PET from both Alberta and British Columbia
HDPE: Merlin Plastics	Shipped to Merlin's British Columbia site for processing
Tetra Pak/Gable Top: The Paper Tigers Inc	Shipped to US for processing.
Aluminum: Novelis	Shipped to US for processing

Source: ABCRC Sustainability Report 2017

3.5.2 Electronics

In 2004, Alberta became the first province in Canada to implement a waste electrical and electronic equipment (WEEE) recycling program. This province-wide program is regulated under the Environmental Protection and Enhancement Act and the *Electronics Designation Regulation*. The law was signed in 2004 and came into force on October 1st, 2004.

Alberta Recycling Management Authority (Alberta Recycling) is the registered not-for-profit organization responsible for managing the province's tire, electronics, paint and used oil materials recycling programs.

Under this program, Alberta consumers can return designated end-of-life electronics free of charge to any of the province's 372 registered collection sites. Designated waste electronics can also be dropped off at collection events held annually across the province (in 2017/2018, there were 74 of these events). Performance of the electronics program for the last 10 years is presented in Table 3-7. Tonnage has declined over the last few years due to lower sales and product design changes including multi-functional units, light weighting and miniaturization.

Table 3-7 Electronics Processed in Alberta (2010-2018)

Year	Tonnes Processed (rounded)
2010	18,620
2011	15,180
2012	15,770
2013	17,280
2014	18,000
2015	18,800
2016	16,700
2017	13,500
2018	12,000

The kg/capita of electronics collected in Alberta has decreased from 4.79 in 2013/14 to 2.88 in 2017/18. This trend is seen in all consumer electronics programs in Canada, the US and the EU.

The full range of electronics included in the program is included in Appendix A.5.0.

Alberta Recycling registers electronic processors, and manages payments to processors and depots. There are currently seven approved processors collecting and processing material from 365 depots located in municipalities and First Nation communities throughout the province.[34,35] Data for the seven approved processors[36]was received directly or indirectly (aggregated data) through Alberta Recycling.

Each processor has different processing approaches. Smaller electronics processors will process all material through their Alberta facility, whereas the two larger processors carry out partial processing in Alberta before shipping to further processing facilities out of

[34] https://www.albertarecycling.ca/about/quick-facts-sheets/
[35] https://www.albertarecycling.ca/about/quick-facts-sheets/
[36] https://www.albertarecycling.ca/processors/registered-electronic-processors/

province (their large facilities are located in Ontario). Manual and mechanical approaches are used for electronics processing.

End Markets/Manufacturers

End markets and manufacturers using recycled material from the processed electronics are included in Table 3-8.

Table 3-8: Processed Electronics End Processors and Product Manufacturers

Material	End Market
CRT Glass	Out-of-province processor (Teck Resources in British Columbia) where it is used in the smelter (for lead recovery).
Plastics	Out-of-province processor (Blue Planet, British Columbia) where material is shredded, washed, melted and extruded into plastic pellets
Precious Metals	Various depending on cleanliness

Source: Alberta Recycling and Eunomia interviews

3.5.3 Used Oil Materials

There are currently 230 depots across the province where Albertans can bring their used oil materials to be recycled. In 2017, the program collected more than 90M litres of used oil, 7.6M oil filters, and 2.6M kg of plastic automotive fluid containers.[37]

The full range of materials collected under the oil materials stewardship program is provided in Appendix A.2.0.

There are currently 14 approved processors who participate in the used oil materials program.[38] The fate of each material is described below.

Filters

Almost every company that collects oil or containers also takes filters. The filters are generally brought back to the company where they are drained, crushed and sent to a metal recycler. Recycling isn't complete unless a metal recycling ticket is provided to confirm that the filters were recycled for their metal value. Some companies collect the filters and bring them to another place for crushing, but this is less common.

[37] http://usedoilrecyclingab.com
[38] https://www.albertarecycling.ca/processors/registered-used-oil-processors/

Oil

Used oil is deposited and stored in bulk, then collected by tankers and stored in tank farms before onward transport.

The majority of collected oil is re-refined, with some being used as fuel in industrial oil burners or for other industrial heating purposes.

Plastic Containers

Plastic containers are sent to a number of processors (Merlin Plastics, RPM, Pnewko, Terrapure and others)[39] for recycling. See Table 3-9 for details.

Table 3-9: Oil Stewardship Material End Processors

Material	End Processor
Used Oil	Consolidated in tank farms. Water is removed and it is sold as heating fuel to industrial clients.
Metal Containers and Metal Filters	Usually crushed on site and sent to a metal smelter. Recycling isn't complete unless metal ticket provided.
Plastic Containers and Plastic Filters	Sent to a number of plastic recyclers in Alberta including Merlin Plastics, RPM, Pnewko, Terrapure and others

Source: Alberta Recycling

3.5.4 Paint

The full range of materials collected under the paint stewardship program is provided in Appendix A.3.0.

There are 319 municipal recycling depots set up by 121 municipalities and Indigenous communities throughout the province that accept paint and containers for recycling.[40] Alberta Recycling has approved four registered processors[41] to collect and process paint dropped off at these depots.

In 2017/18 a reported 848 tonnes of oil paint, 1,792 tonnes of latex paint, 206 tonnes of plastic containers and 72 tonnes of aerosols were collected and processed.

Processors

Table 3-10 summarizes the end markets for material collected through the paint program.

[39] https://www.albertarecycling.ca/processors/registered-used-oil-processors/
[40] https://www.albertarecycling.ca/about/quick-facts-sheets/
[41] https://www.albertarecycling.ca/processors/registered-paint-processors/

Table 3-10: Paint Stewardship Material End Processor

Material	End Processor
Oil-based Paint	Used as a fuel blend at Swan Hills (SENA). This is a hazardous waste rotary kiln facility in Swan Hills, Alberta.
Latex Paint	KBL Environmental (in province) Aevitas (in province) Calibre (in Province)
Plastic Paint Containers	Full Circle, Alberta: Make industrial grade plastic lumber with mixed plastics from residential, ICI, and agricultural plastic recycling programs. Process 1,000tpa. 5% of product sold into Alberta market. Pnewko (in province) DBS (in province)
Metal Paint Containers	Sent to metal recycler
Aerosols	Various

Source: Alberta Recycling

3.5.5 Tires

The tire recycling program started in 1992 collecting and recycling car tires. In 2011 the program expanded to include off-road, industrial and speciality tires. In 2017/18, a reported 60,333[42] tonnes of tires were collected for recycling through the provinces two approved processors.[43] The processors collect or contract with transport companies to collect tires dropped off at 345 municipal recycling depots set up by 127 municipalities and Indigenous communities throughout the province that accept tires for recycling[44], plus 3,000 vehicle and tire dealers and auto repair shops.[45] Table 3-11 summarizes the tonnage of each tire type converted to different processed products.

[42] Provided in email by Alberta Recycling March 1, 2019 (rounded)
[43] https://www.albertarecycling.ca/processors/registered-tire-processors/
[44] https://www.albertarecycling.ca/about/quick-facts-sheets/
[45] https://www.albertarecycling.ca/recycling-programs/tire-recycling-program/

Table 3-11: Tonnage of Processed Tire by Type and Product, 2017/18

Tire Type	Processed Product	Tonnes Processed
Passenger and Light Truck Tire		**37,600**
	Tire Derived Aggregate	15,200
	Crumb – Sold in AB	1,100
	Crumb – Sold outside AB	11,100
	Mulch	10,300
Medium Truck Tire		***20,400***
	Crumb – Sold in AB	8,700
	Crumb – Sold outside of AB	11,600
Off the Road Tires		***2,400***
	Tire Derived Aggregate	2,400
Total		**60,000**

Source: Alberta Recycles, all numbers are rounded

End Markets

A reported 70% of crumb is shipped for use outside the province. Uses of tire crumb confirmed during the survey and interview process are included in Table 3-12.

Table 3-12: Tire Crumb Use in Alberta

Company	Activity
Champagne Edition	Use between 7,000-8,000 tonnes of recycled crumb to produce industrial matting, sidewalk and sound barrier panels
G.E.M.	Produce rubber roofing shingles
GPI Outdoor Flooring	Use approximately 450 tonnes per year of tire crumb and pure sifted recycled rubber. Produce playground flooring, athletic pitches and sidewalks.
Park N Play	Do not lay crumb flooring; subcontract work to Softline or GPI
PlayQuest	Do not use crumb-based products directly
Softline Solutions	Use 800 tonnes per year of crumb supplied by AERP to produce sports facility playing surfaces and playgrounds. Use 30 tonnes per year to produce moulded rubber structures such as rubber structures for children to jump off in playgrounds

Company	Activity
Tanko Sports Systems	Previously used recycled crumb when there was a subsidy; since the subsidy was removed, this is no longer financially viable.

Source: Eunomia interviews with companies

3.5.6 Pesticide and Fertilizer Containers

Cleanfarms is a not-for-profit industry stewardship organization committed to protecting the environment through responsible waste management of agricultural waste.

On behalf of its members, Cleanfarms offers the following core programs to help farmers responsibly manage the waste products they generate on the farm:

- The container management program (CMP) for the collection and recycling of small (< 23 litre) pesticide and fertilizer containers (offered in Alberta through municipal sites);
- The obsolete pesticide and livestock medication collection program (offered on a three-year rotating cycle to different locations in Alberta); and
- The non-deposit bulk container program for commercial one-way non-deposit used pesticide containers > 23 litres in capacity (offered at agricultural retailer sites in Alberta).

The total tonnage of containers collected through both the non-deposit bulk and CMP programs in 2018 was 51 tonnes; 96% of this was through the CMP.

Curtis Construction, a Cleanfarms contractor, shreds CMP material dropped off at municipal depots on site before it is transported to the Curtis Construction facility in Naicam, Saskatchewan. Once at that facility, it is cleaned before being sold to a further processor for washing and manufacturing into a new product.

Bulk containers are collected and processed by Access Distribution. Access transports the containers collected from agricultural retail sites to their processing facility in Vermilion, where they sort and shred containers by plastic type.

Cleanfarms retains ownership of the material throughout the process.

3.6 Other Processors

During the study we identified one mattress recycler, which recycled 39,000 mattresses (approx. 685,000lbs), 60% of which were supplied by retailers and 40% were diverted from landfill.

4.0 Economic Benefits from Recycling in 2018

4.1 Overview of All Economic Benefits

This section provides an overview of all economic benefits of recycling in Alberta as a whole and by material. In total, over 7,500 FTE jobs are created as a result of current recycling activity. A minimum of $125M of capital investment has taken place and $59M in taxes have been returned to the provincial government. The market value of the material recycled was an estimated $70M.

Table 4-1: Total Economic Benefit from All Recycling Activities in Alberta

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	4,600	1,570	1,370	7,540
Wages ($M)	229.0	73.5	46.1	348.7
GVA ($M)	468.4	124.3	99.7	692.4

Source: Eunomia calculation, all numbers are rounded

Table 4-2 summarizes the jobs, wages and GVA from residential recycling activities. In addition to the 2,030 direct, indirect and induced jobs created and $210M of GVA to the economy, $50M of capital has been invested. The market value of the material recycled equated to an estimated $20M.

Table 4-2: Total Economic Benefit from Recycling Activities in the Residential[46] Sector

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	1,160	480	400	2,030
Wages ($M)	75.7	23.7	14.8	114.1
GVA ($M)	148.2	34.2	28.1	210.5

[46] Includes residential recycling, residential organics and yard/leaf waste and other municipal recycling collected through drop-sites

Source: Eunomia calculation, all numbers are rounded

Table 4-3 shows the contribution to the economy from recycling in the ICI sector, which is considerably less than from the residential sector. This is likely due to both lower recycling rates and poor reporting of what is recycled. Along with over 1,300 direct, indirect and induced jobs the GVA contribution to Alberta's GDP was over $126M.

Table 4-3: Total Economic Benefit from Recycling Activities in the ICI Sector

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	770	300	250	1,310
Wages ($M)	49.8	15.2	9.7	74.6
GVA ($M)	83.3	22.3	19.5	126.1

Source: Eunomia calculation, all numbers are rounded

Table 4-4 shows the jobs, wages and GVA associated with recycling 115k tonnes of C&D waste.

Table 4-4: Total Economic Benefit from Recycling Activities in the C&D Sector

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	190	90	70	350
Wages ($M)	11.5	3.8	2.3	17.5
GVA ($M)	33.7	7.3	5.8	46.7

Source: Eunomia calculation, all numbers are rounded

Table 4-5 to Table 4-10 show the economic benefits delivered through the stewardship programs. In total they contribute $310M of GVA to Alberta's GDP plus create 3,800 direct, indirect and induced FTE jobs.

Table 4-5: Total Economic Benefit from Recycling Activities Related to the Beverage Container Stewardship Program

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	1,620	310	350	2,280
Wages ($M)	54.4	12.6	9.8	76.8
GVA ($M)	96.3	22.9	23.5	142.7

Source: Eunomia calculation, all numbers are rounded

Table 4-6: Total Economic Benefit from Recycling Activities Related to the Electronics Stewardship Program

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	180	80	60	320
Wages ($M)	10.2	3.5	2.0	15.7
GVA ($M)	23.5	5.4	4.2	33.1

Source: Eunomia calculation, all numbers are rounded

Table 4-7: Total Economic Benefit from Recycling Activities Related to the Paint Stewardship Program

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	60	30	20	110
Wages ($M)	3.8	1.4	0.8	6.0
GVA ($M)	8.8	2.1	1.6	12.5

Source: Eunomia calculation, all numbers are rounded

Table 4-8: Total Economic Benefit from Recycling Activities Related to the Tire Stewardship Program

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	230	100	80	410
Wages ($M)	13.6	15.0	2.7	31.3
GVA ($M)	31.6	10.7	6.9	49.2

Source: Eunomia calculation, all numbers are rounded

Table 4-9: Total Economic Benefit from Recycling Activities Related to the Oil Stewardship Program

Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	350	170	120	640

Benefit	Direct	Indirect	Induced	Total
Wages ($M)	19.5	8.0	4.0	31.5
GVA ($M)	41.8	17.6	9.8	69.2

Source: Eunomia calculation, all numbers are rounded

Table 4-10: Total Economic Benefit from Recycling Activities Related to the Agricultural Waste Stewardship Program

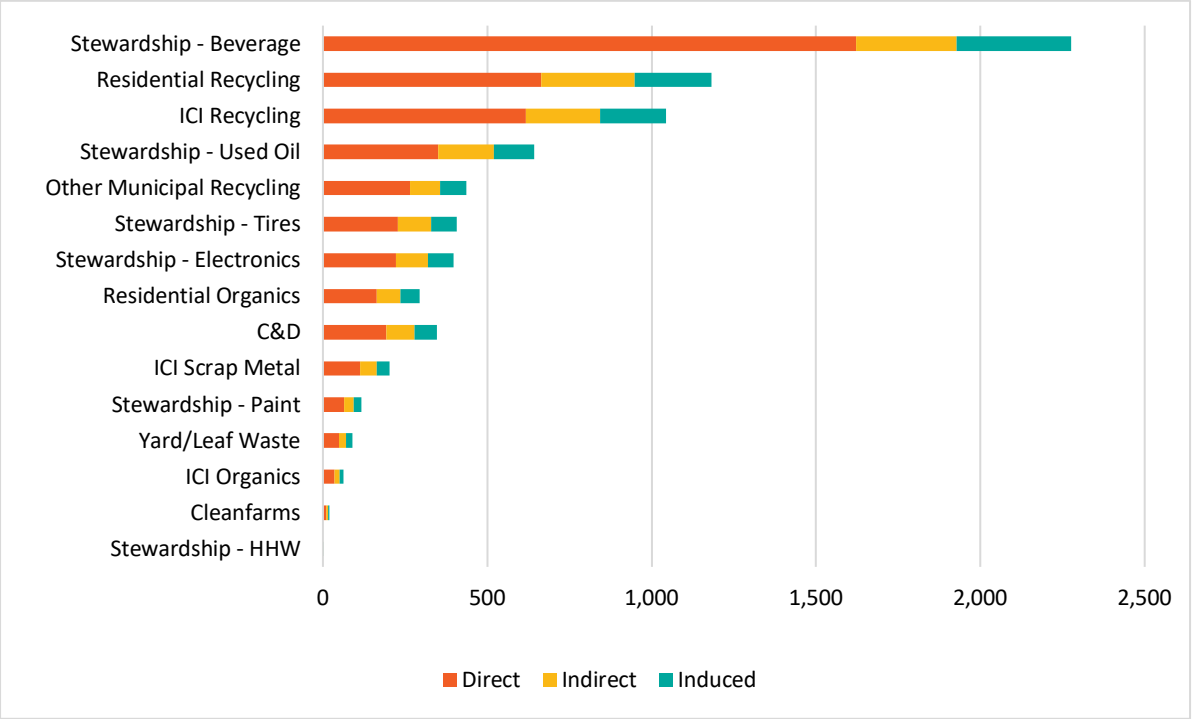
Benefit	Direct	Indirect	Induced	Total
Jobs (FTE)	10	6	3	19
Wages ($M)	0.6	0.4	0.1	1.1
GVA ($M)	1.1	0.9	0.4	2.4

Source: Eunomia calculation, numbers not rounded

4.2 Jobs and Wages by Waste Type

Figure 4-1 presents the wage data set out in the tables above graphically. Of all materials, the beverage container stewardship program provided the greatest number of jobs across the recycling sector.

Figure 4-1: Direct, Indirect and Induced Jobs by Waste Type



Source: Eunomia calculation

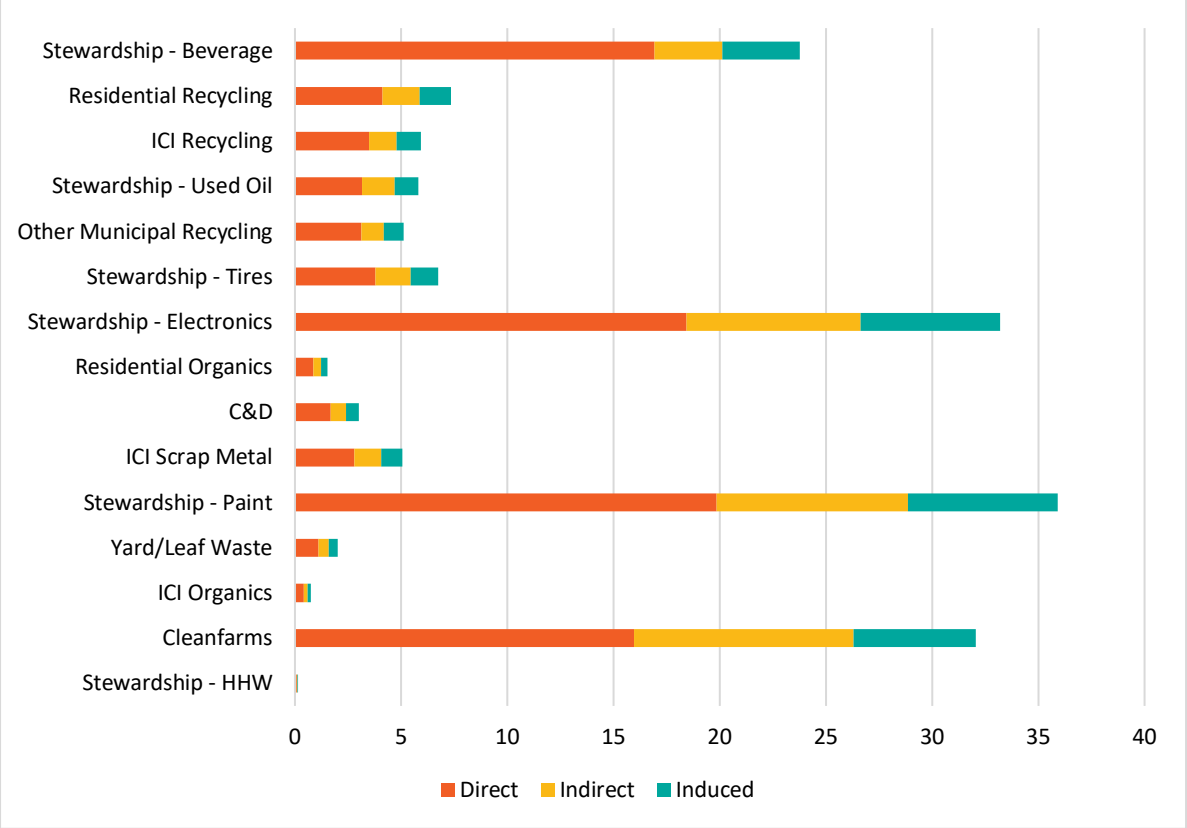
Total jobs are important, but to ascertain the impact of increased recycling in the future an understanding of jobs per 1,000 tonnes of material recycled is more beneficial. Figure 4-2 presents the jobs per 1,000 tonnes of material processed and shows that the electronics and paint programs create the most jobs per 1,000 tonnes recycled. Responses from electronics processors suggested that much of the disassembly process involves manual labour, which is resource intensive. This is especially true in the case of electronics that contain a lithium-ion battery, which must be removed manually before the electronic product can be sent to a shredder.

It is understood that some of the larger processors ship material out of the province to process mechanically in larger facilities. These jobs are not captured in the above table, though more mechanical processing within province might reduce the number of manual jobs in the province. The agricultural stewardship program run by Cleanfarms appears to be the next most resource intensive, however this is likely to be because of the low volume of material that is produced in the first place and as such available for collection. There are economies of scale as tonnages increase, for instance in respect to collection efficiencies. This and the mechanical nature of the tire shredding process (into tire derived aggregate) is likely to be one reason why the tire program has a low labour resource intensity.

The difference between the ICI and residential collections for recycling relates to the composition of the material being collected. ICI has a larger percentage of cardboard, which

allows higher vehicle payloads. The ICI data, however, were based on limited amounts of data that were available from municipal collections and might not be representative of private sector ICI collections.

Figure 4-2: Direct, Indirect and Induced Jobs per 1,000 Tonnes Managed by Waste Type



Source: Eunomia calculation

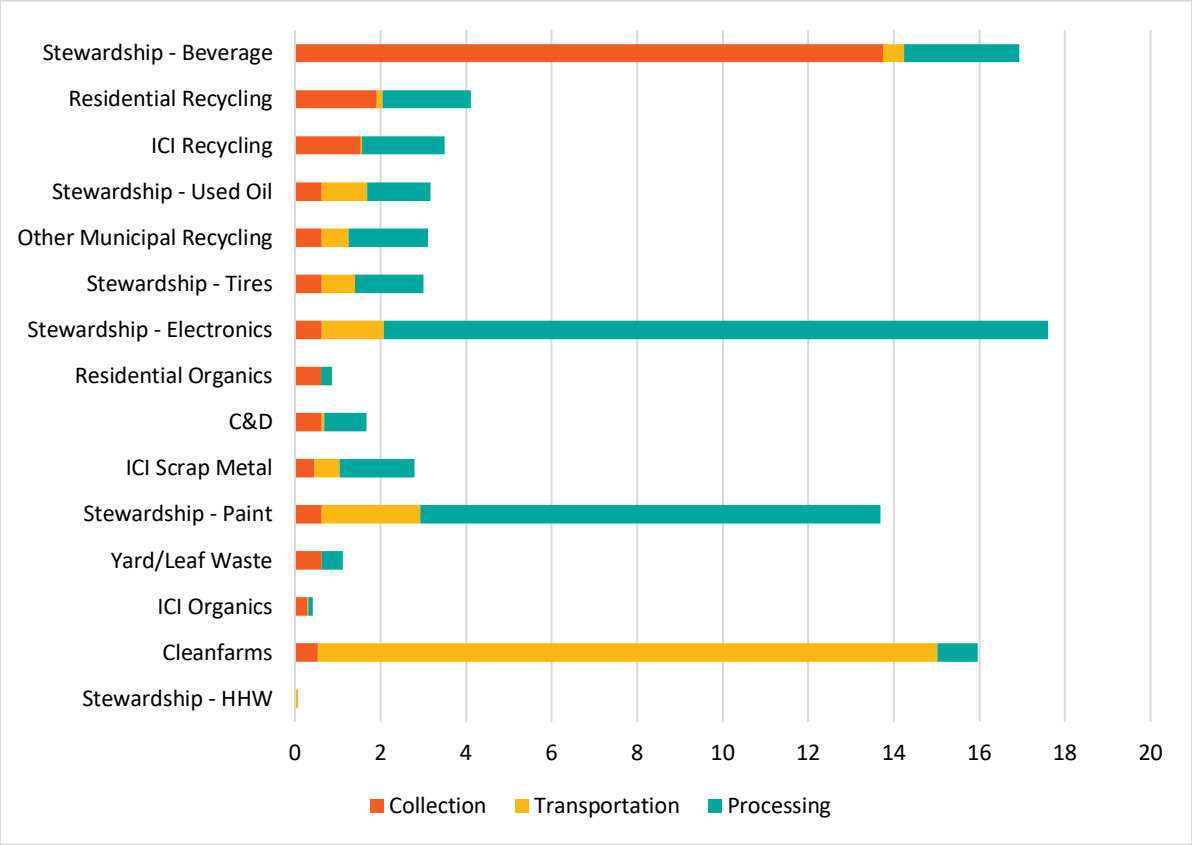
4.3 Jobs by Activity

The impact on jobs can also be split according to waste management activity. Figure 4-3 below displays the estimated job intensities (direct jobs only) for each part of the chain. In this way, collection intensities can be more easily compared to job intensity outputs from previous studies. The simplified set of three categories shown in the graph contain the following activities:

Collection	Includes collection from residential sector and the management and staffing of drop-off sites and depots.
Transportation	Includes collection/transportation from depots to processors and onward haulage of materials

Processing	Includes sorting and further processing of material prior to shipment to end markets

Figure 4-3: Job Intensity in Collection, Transportation and Processing by Waste Type



Source: Eunomia calculation

Notably, the waste streams with the highest direct job intensities have very different profiles:

- The electronics and paint programs have labour-intensive processing operations.
- The beverage program has a very high collection job intensity at beverage depots – again, because all of the sorting of containers is done manually by depot staff.

Pesticide containers are collected in a single stream and the first stage of processing happens within the vehicle. This activity is captured within the transportation sector.

Other material collection efficiencies range from below 1 to just under 2 jobs per 1,000 tonnes collected. Tellus (2009) attributed between 1.23 and 1.67 jobs involved in collection of all waste materials, depending on the level of automation, and not taking into account

differences in material density and collection logistics.[47] Most combined collection and transportation figures fall within this range. The Container Recycling Institute summarized an estimate of 2.3 jobs per 1,000 tonnes for manual curbside collection of dry recycling, and 0.77 jobs per 1,000 tonnes for automated collection (excluding administration and management). This study estimate for curbside recycling sits midway between these figures, reflecting a high degree of automation in Albertan systems and potentially sparser collection logistics.

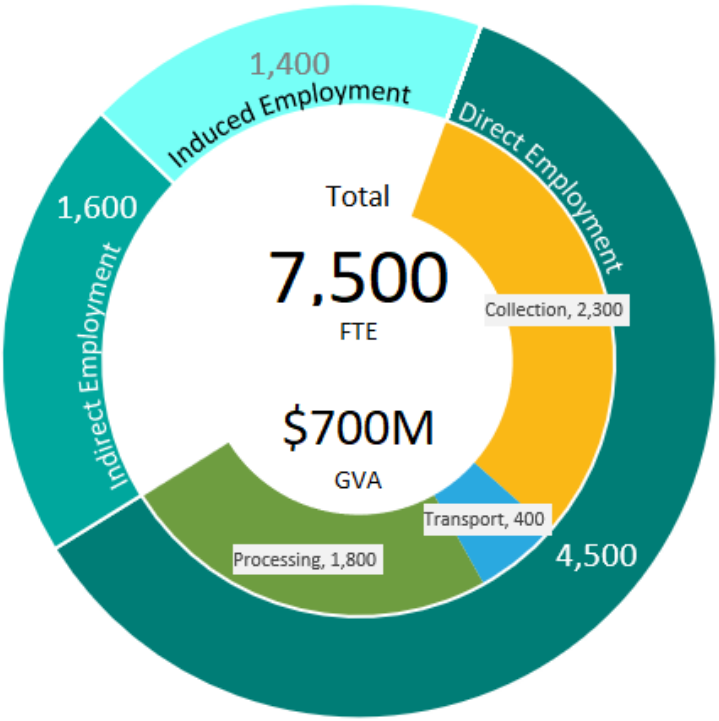
Residential PPP collections are more resource intensive than drop-off site collections for the same materials, but more material is collected and diverted per capita.

Organics curbside collection routes are more efficient tonne for tonne compared with PPP due to the greater tonnage collected in each vehicle round.

There is greater consistency of processing job intensity for most materials, around 2 jobs per 1,000 tonnes, again matching the Tellus Institute figure. The exceptions are lower intensities where processing is relatively simple and the material is dense (C&D waste and organics), and conversely higher intensities with more complex separation processes for lighter or more complex materials (paint, electronics).

The overall economic benefit derived from recycling 1.2M tonnes of material in the province (excluding manufacturing-related benefits, which are detailed in Section 6.0) are summarized in Figure 4-4.

Figure 4-4: Total Economic Benefit Overview from Existing Recycling Activity in Alberta



[47] https://www.nrdc.org/sites/default/files/glo_11111401a.pdf

5.0 Future Recycling and Economic Potential

In order to ascertain the future economic benefit from recycling activities in Alberta, the first step is to identify the potential additional tonnage of material that could be diverted for recycling. The assumptions that have been applied to calculate this are detailed in Section 5.1. Section 5.2 converts this tonnage data into economic benefits in terms of jobs, GVA, and tax revenue.

5.1 Additional Tonnage

This section identifies high waste diversion practices from other jurisdictions and then uses this information to ascertain the amount of additional material that could be diverted from disposal and recycled back into the circular economy in Alberta over time if such practices were implemented.

The target categories of material for incremental diversion fall into the following broad groupings:

- PPP and organics that represent a large percentage of the residential and ICI waste stream for which there is already some collection in place;
- CCME Phase 2 EPR Materials which include C&D wastes; mattresses; textiles; carpet; appliances with ODS (ozone depleting substances, generally refrigerants) and furniture;
- Expansions to existing stewardship programs (oil, tire, electronics and paint programs); and
- Agricultural packaging and other materials.

The potential incremental amount of material that could by diverted along with the approach used to develop the estimate is provided for each material. In all cases the incremental tonnage identified is the annual amount estimated to be achievable by year 10 of a ten-year implementation strategy. This timeline is considered practical to implement the substantial policy changes and programs needed to move Alberta to a circular economy.

5.1.1 Incremental Diversion Estimate for Residential Packaging and Paper Products

5.1.1.1 High Diversion Practices for Household PPP

Current diversion of residential PPP in Alberta consists of:

- 116,000 tonnes through curbside collection (see Section 3), and
- 45,000 tonnes through drop-off depots.

An additional 95,000 tonnes are collected through the deposit return system (DRS).

With a population of 4.2 M, this translates to 60kg/cap of PPP diverted.

High diversion of residential PPP from disposal can be achieved through the provision of curbside services to at least 90% of the population and drop-off depots for the remainder of the population. This increased level of service helps to ensure maximum convenience and participation in diverting these materials from disposal, and can be achieved through a number of policy instruments, including provincial legislation mandating minimum service levels as well as recovery targets.

The current BC system consists of the Recycle BC program, which achieves 38.3kg/cap[48] of PPP diversion, and the DRS system for beverage containers, which diverts an additional 19.5 kg/cap, for a total PPP diversion rate of 57.8 kg/cap.

The Ontario Blue Box system diverted 850,000 tonnes in 2017. This value could be increased by 45,000 tonnes if Ontario introduced a DRS for non-alcohol beverage containers.[49] This translates to 67 kg/cap of PPP recovery.

The higher 67 kg/cap recovery rate (an increment of 7 kg/cap over current performance) was applied to a population of 4.2 M for Alberta to identify the incremental tonnes that could be achieved. This translates to an increment of 29,900 tonnes (rounded) per year in year 10 of a ten-year strategy.

5.1.2 Incremental Diversion Estimate for Residential Household Organics

5.1.2.1 High Diversion Practices for Household Organics

Household organics make up a large fraction of household waste currently landfilled in Alberta, and the largest remaining fraction that can be addressed through one broad policy. Waste audits from Edmonton show that residential organics make up at least 30% to 40% of residual garbage depending on the season. Diverting more household organics offers an excellent opportunity to divert large amounts of waste to productive use either through composting or AD (anaerobic digestion).

There are numerous Canadian examples of practices that divert substantial amounts of household organics from disposal to the circular economy, from provincial (e.g. Nova Scotia and Prince Edwards Island) and regional level disposal bans (e.g. Metro Vancouver) to the proposed Ontario Organics Strategy, which targets both residential and ICI organics. These are described in Appendix A.8.0. The City of Calgary curbside organics program which

[48] https://recyclebc.ca/wp-content/uploads/2018/06/RecycleBCAR2017-June292018.pdf
[49] Confidential report produced by Eunomia Research & Consulting Inc

diverts substantial quantities of household organics from disposal through separate organics collection is described in Box 5-1.

Box 5-1: City of Calgary Green Cart Program

Established in 2017, the City of Calgary's green cart food and yard waste program provides curbside organics collection to single-family homes. Collection frequency varies depending on the time of year; during the winter months, green carts are picked up on a biweekly basis, while weekly collection resumes in the spring.[50] The monthly fee for the Green Cart is $8.65 (2019 rate). This fee covers all components of the program, including the cost of carts, pickup from homes, composting of material, as well as education and program support.[51] All kitchen scraps and yard waste collected is taken to the Calgary Composting Facility and turned into high quality compost in 60 days.[52] From July 2017 to August 2018, the program collected more than 111,000 tonnes of food and yard waste, and the City's garbage tonnage reportedly decreased by 46%.[53]

In addition to launching its green cart program, the City of Calgary plans to implement a ban on organics to landfill by Q4 2019.

5.1.2.2 Potential Impact if High Diversion Practice for Household Organics is Applied in Alberta

The municipal survey has concluded that 43% of Alberta's population has access to a curbside organics program, with the City of Calgary being the largest.

The incremental diversion that could be achieved with a comprehensive organics program has been estimated using the following assumptions and methodology:

- 4.2M population in Alberta in 2017[54]
- An estimated 43% of the provincial population already has access to curbside organics programs.
- At least 85% of the provincial population would have Green Bin programs over a 10-year period.

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[50] https://calgarysun.com/life/homes/city-of-calgary-announces-new-green-cart-collection-schedule
[51] http://www.calgary.ca/UEP/WRS/Pages/Recycling-information/Residential-services/Green-cart/Green-cart-composting.aspx
[52] http://www.calgary.ca/UEP/WRS/Pages/Recycling-information/Residential-services/Green-cart/Green-cart-composting.aspx
[53] https://calgaryherald.com/news/local-news/a-great-thing-calgary-residents-tossing-nearly-half-of-household-waste-into-green-bins
[54] https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=PR&Code1=48&Geo2=PR&Code2=01&Data=Count&SearchText=alberta&SearchType=Begins&SearchPR=01&B1=All&TABID=1

- Diversion would be based on City of Calgary performance, where 110,000 tonnes of organics were diverted in a period of somewhat more than a year. This value was used as a likely future annual total from the program. The diversion of 110,000 tonnes/year equates to 350 kg per single-family household serviced; 143 kg/cap per household with access to the Green Cart program; or 85 kg/cap for the total Calgary population (over 1.2M).
- The overall 85 kg/cap/year value estimated from Calgary was applied to the incremental 2M people who would receive Green Bin service to estimate an incremental diversion of 173,000 tonnes/year by year 10 of the program.
- This total assumes that City of Edmonton will implement a curbside household organics program.

5.1.3 Incremental Diversion Estimate for ICI Waste

5.1.3.1 High Diversion Practices for ICI Waste

Many efforts have been made to regulate or force more diversion by the ICI sector in jurisdictions throughout the US and Canada. Examples from the US and Canada are summarized in Appendix A.8.0 and include:

- Regional District of Nanaimo, BC; City of Abbotsford, BC; St Johns, Newfoundland; City of Calgary, Alberta; and Halifax, Nova Scotia in Canada; and
- Los Angeles, Santa Clarita and Elk Grove California; Boston, Massachusetts; Seattle, Washington; New York City, New York; Philadelphia; Pennsylvania; and Austin, Texas in the US.

5.1.3.2 Potential Impact if High Diversion Practice for ICI Waste is Applied in Alberta

To estimate the potential incremental diversion of ICI waste through high diversion practices, existing available data (which is limited) had to be adapted to identify current practices.

Table 5-1 shows data available from Statistics Canada on ICI and C&D waste disposed. Statistics Canada kept track of C&D waste separately until 2010 but now combines C&D waste with ICI waste into the category “non-residential” waste.

Of significance in the table is the fact that about 2.9 M tonnes of ICI and C&D waste combined have been disposed in Alberta annually for about the last ten years. This amount has not varied or increased, but represents a significant loss of valuable materials that should be re-introduced to the circular economy.

Table 5-1: Statistics Canada Data on ICI Waste Disposed in Alberta, 2008 to 2016 (tonnes/year)

	2008	2010	2012	2014	2016
ICI and C&D Waste Disposed (tonnes/year)	3,153,600	2,824,300	2,737,700	2,867,000	2,907,000

Source: Statistics Canada WMIS[55], figures are rounded

It is estimated that about 2.25M tonnes of ICI waste were disposed in Alberta in 2016.[56]High diversion practice examples from other jurisdictions do not report on actual program or policy performance, therefore for this assessment we used an approach to reduce the amount of ICI waste landfilled in Alberta over time. A target to divert about one third of this total is considered reasonable and would lead to approximately 700,000 tonnes/year of ICI waste diverted to the circular economy and away from disposal.

The City of Calgary carried out a study on the composition of ICI waste disposed in 2014.[57] This study represents the most comprehensive data on ICI waste composition that was found, and was used to estimate the amounts of different recyclable or divertible materials in the disposed 2.25M tonnes of ICI waste in Alberta. For each of the twelve materials identified (ten recyclables and two categories of organic materials), a reasonable percentage of diversion was assumed. For materials like cardboard (OCC), it was assumed that 30% of what is currently disposed could be diverted, recognizing that some of this cardboard may not easily be recoverable or may be contaminated with food or other materials which would make the OCC unsuitable for recycling.

Table 5-2 shows the step-by-step logic used to estimate the amount of each material currently in the ICI waste stream that could reasonably be diverted. The assigned percentage recovery values range from 10% for glass and the “other” category to as high as 40% for wood, some of which is likely to be wood pallets. For most materials in the ICI waste stream (paper, plastics, metals), a 30% recovery assumption was considered reasonable.

On the basis of the percentages shown in Table 5-2, which apply professional judgement to assess the potential recovery by material when supported by strong policies, regulation and

55 https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3810003201

[56] Statistics Canada reported total of 2.9 M tonnes of non-residential waste disposed, minus the 660,000 tonnes of C&D waste.

[57] Results of Kelleher Environmental Waste Allocation Model and Waste Audits of ICI Generators, Report to City of Calgary by 2cg and Kelleher Environmental, July, 2014

enforcement, an estimated 650,000 tonnes/year of ICI waste currently disposed could be diverted by year ten of a ten-year strategy, consisting of:

- Approximately 155,000 tonnes (rounded) of ICI organics and
- Approximately 495,000 tonnes (rounded) of ICI packaging and other dry materials over ten years.

The basis of the estimate is presented in Table 5-2.

Table 5-2: Estimate of Potential Diversion of ICI Waste Using High Diversion Practices

Material in Current Alberta ICI Waste Disposed	% of Residual ICI Waste Stream Currently Disposed	Tonnes in Residual ICI Waste Stream	% Diversion of Material Currently in Residual ICI Stream Considered Achievable	Tonnes of Incremental Dry Recyclables ICI Diversion Considered Achievable	Tonnes of ICI Organics Diversion Considered Achievable	Total ICI Diversion Considered Achievable
Cardboard/ Boxboard	9%	201,600	30%	60,500		60,500
Old Newsprint	4%	89,600	30%	26,900		26,900
Paper	23%	515,200	40%	206,100		206,000
Glass	3%	67,200	10%	6,700		6,700
Ferrous	3%	67,200	30%	20,200		20,200
Non ferrous	4%	89,600	30%	26,900		26,900
HDPE	1%	22,400	30%	6,700		6,700
PET	1%	22,400	30%	6,700		6,700
Plastic	10%	224,000	20%	44,800		44,800
Food	22%	492,800	30%		147,800	147,800
Yard	2%	44,800	20%		9,100	9,000
Wood	7%	156,800	40%	62,700		62,700
Other	12%	268,800	10%	26,900		26,900
Total		2,262,400		495,100	156,800	651,900

Source: Estimates developed for Alberta Recycling by Kelleher Environmental, numbers are rounded

5.1.4 Incremental Diversion Estimate for C&D Waste

5.1.4.1 High Diversion Practices for General C&D Material

Many high diversion practices are already in place in communities across Canada and the US to encourage the recycling of C&D wastes. Some of these practices are also in place in Alberta municipalities such as the City of Calgary. These include:

- Policies at local, provincial or federal levels that promote the use of recycled building materials and require high diversion at C&D projects through green procurement specifications such as building certifications (e.g. LEED, BOMA, BEST, etc.), green building codes and other standards;
- Differential tipping fees at transfer stations and landfills to encourage C&D waste recycling;
- C&D waste bans (particularly on drywall and wood) at specific landfill sites to encourage development of a local recycling infrastructure;
- Mandatory source separation requirements at C&D projects for materials which are readily recyclable (e.g. wood, cardboard, metal);
- Mandatory C&D waste diversion targets;
- Refundable deposits on C&D projects which achieve high diversion targets;
- Occupancy permits are only issued after proof of diversion; and
- Expedited development plan review for high C&D waste diversion projects.

Two high diversion practice examples in Alberta are contained in Box 5-2. Other C&D high diversion policies and practices are described in Appendix A.8.0.

Box 5-2: C&D High Diversion Practice Examples in Alberta

In the **City of Calgary**, C&D materials including concrete, road asphalt, brick and masonry block, scrap metal, recyclable wood, drywall, and asphalt shingles are subject to a disposal surcharge of $180/tonne. The disposal surcharge materials rate is higher than the basic sanitary waste rate ($113/tonne) in order to encourage recycling and composting. City of Calgary landfill staff inspect commercial vehicle loads of garbage for these materials.[58] The Spyhill and East Calgary landfills accept clean separated loads of some of these items at a reduced rate.

In January 2012, the **City of Edmonton** opened its new construction and demolition (C&D) waste recycling facility at the Edmonton Waste Management Centre. The $4.3 M facility uses both mechanical and manual sorting to separate loads of mixed material and is expected to process 100,000 tonnes of mixed C&D material per year, recovering up to 70% of the material for recycling. To qualify as a dedicated mixed load, at least 75% of an individual load must be made up of wood, metal, drywall, asphalt/concrete, asphalt shingles, cardboard and paper. The 2012 rate for mixed C&D loads at the C&D recycling facility was $60/tonne, compared with $75/tonne charged at the landfill for commercial waste. Pre-sorted loads of wood, asphalt and drywall are charged $40/tonne, while there is no charge for segregated concrete.

[58] http://www.calgary.ca/UEP/WRS/Pages/Commercial-Services/Disposal-Surcharge-Materials.aspx

5.1.4.2 Potential Impact if High Diversion Practice for General C&D Material is Applied in Alberta

2010 was the last year that Statistics Canada reported C&D waste separately in the WMIS survey. This data was supplied to Kelleher Environmental by Statistics Canada staff for a study carried out for Environment and Climate Change Canada (ECCC) in 2015.[59]

At that time, about 650,000 tonnes of C&D waste were reported to be disposed in Alberta. Appendix A.8.0 shows the data split into residential and non-residential components. The potential diversion through high diversion practices was estimated by applying a percentage diversion rate by material to the estimated composition of disposed C&D waste in Alberta taken from the ECCC report. The calculation is shown in Table 5-3.

Table 5-3: Estimate of Potential Diversion of C&D Waste Using High Diversion Practices

C&D Material in Disposed Alberta Waste Stream	Tonnes Disposed	Potential Diversion (Tonnes)	Percentage of Material That Can Reasonably Be Diverted
Clean Wood	126,90	88,900	70%
Engineered Wood	59,000	0	0
Treated Wood	21,900	0	0
Painted Wood	53,7000	0	0
Total Wood	261,500		
Concrete	24,700	17,300	70%
Asphalt	1,900		0
Drywall	57,800	40,400	70%
Asphalt Roofing	64,800	45,400	70%
Ferrous	12,100	8,500	70%
Non-ferrous	6,100	4,300	70%
Total Metals	18,200		
Foam Insulation	1,100	0	0
Carpet and Padding	8,100	4,100	0
Other Plastics	20,800	10,400	50%
Total Plastics	30,000		

[59] Kelleher Environmental, Guy Perry and Associates in association with Robins Environmental and SAMI Environmental: Characterization and Management of Construction, Renovation and Demolition Waste in Canada Foundation Document. Report to Environment Canada, March, 2015

C&D Material in Disposed Alberta Waste Stream	Tonnes Disposed	Potential Diversion (Tonnes)	Percentage of Material That Can Reasonably Be Diverted
Corrugated Cardboard	5,600	2,800	0.5
Fibreglass	900	0	0
Mixed Glass	1,600	0	0
Total Glass	2,400		
Other	183,000	91,500	0.5
Total	650,000	313,500	

Source: Estimates developed for Alberta Recycling by Kelleher Environmental, numbers are rounded

On the basis of approximately 650,000 tonnes of C&D waste disposed in Alberta in 2010 (the last year for which the split out is available) it is reasonable to set a target to divert 300,000 tonnes/year (rounded) of this C&D material annually by year ten of a ten-year strategy.

5.1.5 Incremental Diversion Estimate for Mattresses

5.1.5.1 High Diversion Practices for Mattresses

In Canada, although EPR for mattresses is recommended in Phase 2 of the Canada-wide Action Plan for EPR, no province has implemented an EPR program for mattresses. However, various other policies and practices to encourage the diversion of mattresses are in place in Canada and the US. For example, some municipalities have banned mattresses from landfill because they are difficult to manage at disposal sites.

Box 5-3 provides several examples of programs and policies that have been enacted to increase the diversion of mattresses in various jurisdictions. Further details on these and other examples are provided in Appendix A.8.0.

Box 5-3: Mattress High Diversion Practice Examples

The City of Airdrie was one of the first Alberta municipalities to establish a mattress recycling program, residents can deposit mattresses at the transfer station.

The City of Edmonton launched a mattress recycling program in January 2017, after awarding a 3-year contract to Redemptive Developments. According to one article[60], approximately 40,000

[60] https://globalnews.ca/news/4019140/city-of-edmonton-diverts-40000-mattresses-from-landfill-in-1st-year-of-mattress-recycling-program/

mattresses were recycled in all of 2017 through the city's four eco stations as well as the Edmonton Waste Management Centre. The city currently pays $15 per mattress for the vendor to recycle it, which brings the total cost per year to more than half a million dollars.

Metro Vancouver has a disposal ban on mattresses. These can be taken to selected mattress recyclers who will process mattresses for $15/unit. A 2017 report by Morrison Hershfield[61] for Metro Vancouver estimated that 165,000 mattresses (4,005 tonnes) were diverted from landfill in 2016 because of the ban. The Metro Vancouver population base is 2,463,431[62], therefore the mattress diversion rate is equivalent to 1.8 kg/cap/year.

France has an EPR program for furniture and mattresses, run by Eco-mobilier who is responsible for transporting the mattresses from drop-off centers for recycling.[63] They also offer a service for hotels, hospitals and other institutions that may be replacing beds and furniture.[64]

California's mattress recycling program collected 1,286,757 units in 2017. Based on Metro Vancouver average mattress weights this translates to about 31,230 tonnes. Based on a population of 39.78 M this translates to 0.78 kg/cap in California.

5.1.5.2 Potential Impact if High Diversion Practice for Mattresses is Applied in Alberta

Applying the Metro Vancouver mattress diversion potential of 1.8 kg/cap/year to the Alberta population of 4.2M,[65] a potential 7,000 tonnes of mattresses per year could be recycled.

5.1.6 Incremental Diversion Estimate for Textiles

Best practice programs for diverting textiles are provided in Box 5-4.

Box 5-4: Textile High Diversion Practice Examples

City of Calgary: Since August 2015, Calgary residents can take clothing and textiles to any city landfill for free textile recycling. Their 'Throw 'N' Go' bins accept a variety of textiles including[66]:

- Clothing
- Outerwear (e.g. coats and jackets)

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[61] http://www.metrovancouver.org/services/solid-waste/SolidWastePublications/EconomicandEnvironmentalImpactsofMattressRecyclinginBC.pdf

[62] https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CMACA&Code1=933&Geo2=PR&Code2=59&Data=Count&SearchType=Begins&SearchPR=01&B1=All&TABID=1

[63]https://www.europur.org/images/Documenten/16_EU_Member_States_Recycling_Schemes_for_mattresses_and_furniture_the_French_example-Cecile_des_Abbayes.pdf

[64] https://www.eco-mobilier.fr/page/des-solutions-pour-les-professionnels-de-lameublement/

[65] 4,286,134,

[66] http://www.calgary.ca/UEP/WRS/Pages/What-goes-where/Clothing-and-shoes.aspx

- Shoes and footwear (sandals, sneakers, runners, dress shoes, heels)
- Purses, backpacks, suitcases and luggage, wallets, and belts
- Household linens (e.g. bedding, towels, curtains, pillows, tea towels, duvets and blankets)
- Reusable shopping bags (e.g. cloth grocery store bags, Lululemon bags)
- Underwear, bras and hosiery
- Accessories like hats, mittens and scarves
- Cleaning cloths, rags, and scrap fabric

A non-profit called Clothing for a Cause is responsible for managing the bins and collecting the textiles once a week. Using a third-party broker, the organization sells the material to international recyclers. The recyclers shred the material into things like car seat stuffing, furniture padding, and insulation. Depending on the type of textile, the fibres can also be re-woven into new fabric.[67] In the first five months of the program, 11.3 tonnes of clothing and textiles were diverted from the landfill.[68]

British Columbia: Starting March 1st, 2019, Encorp Return-It launched a pilot program in the Lower Mainland of BC that gives residents an option to conveniently drop-off old, unused, or unloved clothing while they are dropping off other recyclables at 13 of its depot sites. Items accepted through this program include clothing (e.g. shirts, dresses, shorts, jeans, undershirts, baby and children clothes), footwear (e.g. shoes, boots, and slippers), and household textiles (e.g. sheets, towels, curtains and drapes, blankets and table linens). The pilot is being launched in partnership with Bank and Vogue (one of the largest traders of used clothes in North America) to test the feasibility of using the province's existing Return-It depot network to collect textiles. All textiles collected through the program will be distributed to reuse organizations and companies within Western Canada.[69]

Metro Vancouver: Metro Vancouver is a national leader in textiles diversion. Information collected from non-profit organizations in Metro Vancouver in 2017 (Value Village, Canadian Diabetes, Possibilities, Cerebral Palsy, Big Brother, Inclusion, etc.) indicated that 19,800 tonnes of textiles and accessories were collected and either reused locally or shipped to Africa. Encorp Return-It has estimated that 20,000 tonnes/year of textiles are still landfilled in BC, and have launched a program to divert more of this material from disposal.

France: France has set a 50% (about 300,000 tonnes, 4.6 kg/cap/year) collection target for the annual sales of textiles (clothing, linens, and footwear) in addition to a 95% material recovery rate. To date, France is the only country in the world that has implemented an EPR scheme for end-of-use clothing, linen, and shoes, introduced in 2007. In 2016, 210,000 tonnes of textiles were collected for a population base of 66.86 M, resulting in a recovery rate of 3.14 kg/cap.

[67] https://www.calgaryjournal.ca/news/3185-nonprofit-helps-keep-textiles-out-of-calgary-s-landfills.html
[68] https://www.calgaryjournal.ca/news/3185-nonprofit-helps-keep-textiles-out-of-calgary-s-landfills.html
[69] https://www.return-it.ca/textiles/pilot-program/

In 2017, Eco TLC collected financial contributions from 4,476 members that introduced 564,000 tonnes of textiles, linen and shoes onto the French market in 2016.[70] The collection system is a mix of on-street containers (privately and charitably owned), curbside pick-up and retail take back. The 2020 target is one collection container per 1,500 residents.

City of Markham: In 2016, the City of Markham, with an urban population of approximately 350,000, introduced a textile recycling program in partnership with the Salvation Army. This program includes the installation of municipally managed "high- tech" textile donation containers at all city facilities, including Markham recycling depots, fire stations, and select community centres. This recycling program is funded by a grant from the Federation of Canadian Municipalities.

New York: Early in 2016, the Department of Sanitation's refashionNYC program provided large textile collection bins to apartment buildings with 10 or more units. Housing Works (a New York–based non-profit that operates used-clothing stores to fund AIDS and homelessness programs), received the textile goods, paying refashionNYC for each tonne collected. RefashionNYC in turn put the money toward more bins. Housing Works collected textiles from 700 residential apartment buildings in NYC. Between January and June 2016, New York residents saw the program as most convenient, with 677 tonnes of textiles collected. In 2016, the refashionNYC program collected and diverted from landfills a cumulative 1,358 tonnes of textiles. As of 2017, 890 residential buildings were enrolled in the program. Presently, the program is collecting approximately 103 tonnes of textiles per month. Since the program launched in 2011, Housing Works has opened up several new second-hand clothing retail stores.

5.1.6.1 Potential Impact if High Diversion Practice for Textiles is Applied in Alberta

There are a number of voluntary, charity-based collections of textiles in Alberta including:

- Value Village reports that it diverted 43M lbs (19,550 tonnes) of textiles in Alberta in 2017[71].
- The Salvation Army reports an annual figure for Canada of 79 M lbs (35,000 tonnes)[72] of textiles reused for 2017-2018. Pro-rating this value to Alberta based on population (11.68% of the Canadian population), this translates to 4,088 tonnes of textiles reused in Alberta.

In addition, the city of Calgary has a comprehensive program described above. The challenge in estimating the incremental textile volume that could be collected in Alberta

[70] https://journals.sagepub.com/doi/full/10.1177/0734242X18759190
[71] https://www.valuevillage.com/sites/default/files/community_impact_report_2017-vv.pdf
[72] https://salvationarmy.ca/wp-content/uploads/docs/sa_annual-report_2017-2018_web.pdf

started with estimating current activity and then estimating the maximum that could realistically be collected in additional programs.

Value Village and Salvation Army are the end markets generally used by textile collectors, and are the two organizations for which data could be located in public sources. The combined tonnage reported or estimated for the two organizations in Alberta (19,550 tonnes for Value Village and 4,088 tonnes for Salvation Army) were added together to get a total figure of 23,640 tonnes (rounded). This value is considered reasonable as the current textile diversion amount in Alberta for this study.

The September 2018 waste audit for the city of Airdrie reported that textiles and leather make up 2.6% of residential waste disposed. This information was used to calculate the current diversion rate for textiles, and identify the potential to divert more textiles through various policies. The calculation steps are presented in Table 5-4. An incremental value of 16,900 tonnes is considered reasonable over 10 years.

Table 5-4: Estimated Potential Textile Diversion in Alberta

Key Figures	
Alberta Population (2016)	4,286,000
Proportion of Alberta to Canada Population	11.68%
Textile Diversion - Value Village Alberta (2017)	19,600 tonnes
Textile Diversion - Salvation Army Alberta (2017-2018)	4,200 tonnes
Total Textile Diversion Identified in Alberta	23,700 tonnes
Statistics Canada 2016 Alberta Residential Residual Garbage	1,299,900 tonnes
Estimated Textiles in Residential Garbage (2.6% from City of Airdrie 2018 audit)	33,800 tonnes
Textiles Generated (Diversion + Disposal)	57,500 tonnes 13.4 kg/cap/year
Textiles Diversion Rate	41.3%
Potential Additional Diversion*	16,900 tonnes

Source: Estimates developed for Alberta Recycling by Kelleher Environmental, numbers are rounded

*Assumes only half of the remaining textiles

5.1.7 Incremental Diversion Estimate for Carpet

5.1.7.1 High Diversion Practices for Carpet

Carpet, like mattresses, is a problematic material to handle at landfills as it is heavy and does not compact. Although there have been a number of efforts to implement EPR for carpet in the, most have not been successful to date.

In 2010, California passed the only carpet EPR law in the US (AB2398), which put in place a manufacturer-designed and run incentive program operated by Carpet America Recovery Effort (CARE) which pays carpet recycling processors a subsidy for material they sell to be used in new products. The program does not pay directly for collection, transportation, and other recycling costs.

CARE's program initially increased the carpet recycling rate to 14% – double the rate of voluntary programs. However, due to the lack of direct funding for recycling costs, the recycling rate stalled at 14%. A 2017 amendment (AB1158) to the law was enacted to strengthen the program by requiring CARE to achieve a goal of 24% recycling by 2020, and improve collection options. Information on this program in Appendix A.8.0 is taken from the California Program 2017 Annual Report[73.]

5.1.7.2 Potential Impact if High Diversion Practice for Carpet is Applied in Alberta

Discarded carpets and foam/rubber underlay make up a significant portion of the waste stream. Metro Vancouver's 2016 waste audits showed that carpet made up 2.3% of landfilled waste. This equated to 19,700 tonnes or 7.75 kg/cap for Metro Vancouver. The 7.75 kg/cap carpet generation rate was assumed to be reasonable for Alberta and was used to estimate generation of carpet waste at 33,220 tonnes per year. All of this carpet is assumed to be currently disposed.

A target of 40% carpet diversion over ten years was considered reasonable. This would result in diversion of 13,290 tonnes/year in year ten of a ten-year strategy. The value is rounded to 13,300 tonnes.

5.1.8 Incremental Diversion Estimate for Furniture

5.1.8.1 High Diversion Practices for Furniture

To date, there are not many policies or programs in place that have specifically targeted furniture for recycling. Significant reuse of furniture already exists, as used furniture is given to relatives or set out at the curb for others to take. With the advent of sites such as

[73] https://carpetrecovery.org/wp-content/uploads/2018/09/2017careannualrptfinal.pdf

Craigslist and Kijiji, there are many more opportunities to reuse furniture, either by giving it away or selling it when no longer needed.

Ikea offers discounts for customers who bring their old furniture to Ikea stores, even if the furniture was not bought at Ikea.

France has a recycling target of 45% for household furniture and 75% for commercial furniture. Eco-mobilier manages the household furniture system and Valdelia is the producer responsibility organization responsible for collecting and recycling non-household furniture.

5.1.8.2 Potential Impact if High Diversion Practice for Furniture is Applied in Alberta

The potential diversion of furniture was estimated by first identifying the total amount of furniture generated, and then applying a reasonable diversion and reuse rate to that number.

Estimates of furniture generated in Alberta were based on two different sources:

- A 2017 Morrison Hershfield report[74] estimated that 30,500 tonnes of bulky furniture was landfilled in Metro Vancouver annually. This number was pro-rated to Alberta's population to estimate that about 53,400 tonnes of furniture is discarded in Alberta each year.
- A recent report[75] released by the European Environmental Bureau (EBB) and authored by Eunomia estimated that 10 M tonnes of furniture are discarded by business and consumers in the EU each year. With a population of 515M, this equates to 19 kg/cap/year. When pro-rated to Alberta's population this would result in an estimated 81,500 tonnes of furniture discarded.

The Eunomia report estimated that a full mandatory EPR program for furniture in the EU (based on 10 M tonnes of furniture generated) could lead to:

- Over 2M tonnes of additional reuse of furniture;
- 3.7M tonnes of additional recycling of furniture;
- 5.7M tonnes of CO_2^e reduced; and
- Over 157,000 new jobs created.

[74] www.metrovancouver.org/services/solid-waste/SolidWastePublications/AssessementEconEnvImpactsEPRPrograms-Feb2014.pdf
[75] https://www.eunomia.co.uk/reports-tools/circular-economy-opportunities-in-the-furniture-sector/

On the basis of an estimated 53,000 to 81,000 tonnes of furniture generated (this study used 67,500 tonnes, which is the average of the two estimates), and using Eunomia factors from the EU study, a recycling program for furniture in Alberta could lead to the following furniture diversion values by year ten of a ten-year implementation strategy:

- Reuse of 13,500 tonnes/year of furniture; and
- Recycling of 25,000 tonnes/year of furniture.

5.1.9 Incremental Diversion Estimate for Major Appliances

5.1.9.1 High Diversion Practices for Major Appliances

Major appliances are covered in the EU Waste Electrical and Electronic Equipment (WEEE) Directive[76] which sets targets for recovery and also performance requirements for proper management.

With the exception of BC, major appliances are not generally the target of EPR programs in Canada or the US. The Major Appliances Recycling Roundtable (MARR) is a not-for-profit stewardship agency created to implement and operate a stewardship plan for end-of-life major household appliances in BC on behalf of the major appliance "producers" who are obligated under BC's Recycling Regulation. Designated products include major appliances that have been designated for residential use, including dual fuel natural gas or propane products provided the other power source is electricity. Appliances used in or sold for ICI applications that have the same essential design characteristics as major household appliances are also included.[77] The list of products captured by the MARR stewardship program in BC is presented in Appendix A.8.0.

5.1.9.2 Potential Impact if High Diversion Practice for Major Appliances is Applied in Alberta

The collection rate of the BC market-driven collection and recycling system can be estimated using a "capture rate" calculation, which compares the estimated weight of products "available to collect" with the estimated weight of products collected in the same year. The system study update estimated that 39,073 tonnes reached end-of-life in BC in 2017 and were "available to collect." The 2017 collection rate was estimated at 98.9% of all discarded appliances, exceeding the program target of 90%.[78]

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[76] http://ec.europa.eu/environment/waste/weee/index_en.htm

[77] https://www.marrbc.ca/consumers/products

[78] The Study on the Operations and Effectiveness of the Major Appliance Collection and Recycling System in BC, dated 8 May 2014 ("System Study") which was originally prepared for the 2013 fiscal year and has been updated to reflect 2017 fiscal year data

Pro-rating from BC data to Alberta based on population, it is estimated that major appliances at end-of-life in Alberta are about 34,630 tonnes/year.

Existing diversion of major appliances in Alberta is probably 80% due to their metal value, but some major appliances, particularly those which have ODS (ozone depleting substances, generally found in refrigerants in fridges and freezers as well as air conditioners) may not be properly managed because there is a cost to pay a technician to remove them.

Assuming that 20% (6,920 tonnes) of the major appliances currently at end-of-life each year in Alberta are not properly managed, it was assumed that proper management would increase to 95% under a formal recycling program that would require proper data collection and monitoring of the collection system performance. This would lead to diversion of an incremental 5,200 tonnes/year of major appliances in Alberta by year ten of a ten-year implementation strategy.

5.1.10 Incremental Diversion Estimate for Agricultural Plastics

5.1.10.1 High Diversion Practices for Agricultural Plastics

Several European countries have addressed agricultural plastics through a variety of different policies, including landfill bans (Germany), take-back obligations in packaging legislation (Iceland), separate take-back obligations (Ireland, Spain) or voluntary agreements on packaging and agricultural film (Norway). All systems are financed by license fees from industry.[79]

The Irish Farm Film Producers Group (IFFPG) operates the national farm plastics recycling compliance scheme for farm plastics. The program currently includes LDPE and LLDPE film products, polypropylene twine and HDPE and recycles about 28,000 to 30,000 tonnes of plastics annually, which is estimated to represent a national recycling rate of over 70%. [80]

Svensk Ensilageplast Retur (SvepRetur), a Swedish industry association for manufacturers, importers and retailers of silage film, plastic bags and horticultural foil, runs a collection and recycling system for bags that contained fertilizer or seeds, silage film, foil, net, spools and drums. [81] New Zealand has a voluntary recycling program targeted to rural farmers.

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[79] Bauer, Jan. "Advances in agricultural plastics recycling in Europe." *European Association of Plastics Recycling.* October 20, 2015. <http://www.srsweb.sk/dokumenty/6RLD/1%20den/03%20%20Advances%20in%20agricultural%20film%20recycling_JB%20NITRA.pdf>

[80] https://www.farmplastics.ie/about-us/

[81] https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/regeringsuppdrag/2016/mikroplaster/swedish-sources-and-pathways-for-microplastics-to-marine%20environment-ivl-c183.pdf

There are also a number of innovative programs in Canada, run by Cleanfarms. A brief summary of these is provided below:

- The Saskatchewan grain storage bag EPR program is the first program for grain storage bags in Canada. It started in November 2018 and is operated by Cleanfarms with partial funding from the Saskatchewan government. Farmers roll up bags and deliver them to collection sites located at municipal landfills and private sites.
- In Manitoba, a pilot program to collect bale and silage wrap, grain storage bags and twine is funded by Manitoba Sustainable Development and has been operated by Cleanfarms since 2013. The materials can be dropped off for free at municipal landfills and transfer stations and some agricultural/farm retailers.
- Manitoba and Quebec both have mandatory EPR programs funded by steward fees to collect pesticide and fertilizer jug programs. Both of these programs are operated by Cleanfarms.

5.1.10.2 Potential Impact if High Diversion Practice for Agricultural Plastics is Applied in Alberta

In 2017, a total of 1,221,764 pesticide containers were collected in Alberta as part of Cleanfarms' empty container recycling program.[82]

On January 21, 2019 the Alberta Department of Agriculture & Forestry announced their approval of the agricultural plastics recycling group's 3-year pilot project to recycle grain storage bags and bale twine, which will start in fall 2019.

Estimated quantity ranges for the primary sources of selected agricultural waste in Alberta are summarized in Table 5-5, along with the potential amount of film and non-film plastic that could be targeted in future programs. Paper products from agricultural sources were not included in the analysis. Assuming a 70% recovery rate over 10 years, a total of 7,210 tonnes/year of the following additional agricultural plastic could be diverted:

- 3,240 tonnes/year of film plastic; and
- 3,970 tonnes/year of non-film plastic.

[82] https://cleanfarms.ca/wp-content/uploads/2018/04/CF_AR_E_2017.pdf

Table 5-5 Potential Plastic and Paper Agricultural Related Waste Diversion in Alberta

	Estimated Total Annual Generation (tonnes)	Used for Planning Estimates	Recovery at 70%
Plastic Film Waste			
Bale Wrap	550 to 1400		
Grain Bags	700 to 1800		
Greenhouse Film	60 to 160		
Silage Plastic	1,500 to 2,300		
Total Agricultural Film Waste	3,260 to 6,360	4,630	3,240
PP Twine	2,000 to 6,000		
Net Wrap	450 to 700		
Polypropylene Totes	275 to 300		
Pesticide Containers	620		
Sanitation Containers	4		
Total Plastic Agricultural Waste	6,600 to 14,000		
Total Agricultural Plastic (Non-Film)		5,670	3,970
Paper Waste			
Paper and Multi-Walled Bags	630 to 815		
Cardboard	650 to 800		
Total Paper Agricultural Waste (rounded)	1,300 to 1,600		
Total Agricultural Waste	**7,900 to 15,600**		

Source: Alberta Agricultural Waste Characterization Study, August 2013, Clean Farms

5.1.11 Expanded Household Electronics and Outdoor Power Tools Program

5.1.11.1 High Diversion Practices for Household Electronics

The EU WEEE Directive[83] mandates the collection and proper management of a wide range of electronic and electrical products. Together with the EU Battery Directive, all products with a battery or a plug are effectively covered in EPR programs.

[83] http://ec.europa.eu/environment/waste/weee/index_en.htm

There are significant differences across Canada in terms of what types of electronics are accepted for recycling in each of the provincial programs. BC's electronics recycling program is the most comprehensive, and is the only program in Canada that collects e-toys, medical monitoring and control equipment, electronic musical instruments, power tools, IT and telecom devices, among others. The BC Recycling Regulation contains a list of products similar to the EU WEEE Directive.

The general categories of electronic products accepted for recycling in different programs across Canada are presented in Appendix A.8.0.

Table 5-6: Electrical and Electronic Products Collected in Recycling Stewardship Programs Across Canada

Electrical or Electronic Product Category	BC	YT	NT	AB	SK	MB	ON*	QC	NB	NS/ PE	NL
Desktop Computers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Large Battery-Powered Ride-On Toys	✓	-	-	-	-	-	-	-	-	-	-
Portable Computers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Small Battery-Powered Ride-On Toys	✓	-	-	-	-	-	-	-	-	-	-
Display Devices ≤ 29" All-in-one (AIO) computers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Display Devices 30-45" All-in-one (AIO) computers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Display Devices ≥ 46"All-in-one (AIO) computers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Desktop Printers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Floor Standing Printers	✓	-	✓	✓	✓	✓	✓	-	-	-	-
Computer Peripherals	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓
Personal/Portable Audio/Video Playback and/or Recording Systems	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓
Electronic Toys	✓	-	-	-	-	-	-	-	-	-	-
Home Audio/Video Playback and/or Recording Systems	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓
Home Theatre in a Box	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓
Vehicle Audio and Video Systems	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓
Non-Cellular Telephones and Answering Machines	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓
Cellular Devices and Pagers	✓	✓	-	-	-	✓	✓	✓	✓	✓	✓

Electrical or Electronic Product Category	BC	YT	NT	AB	SK	MB	ON*	QC	NB	NS/ PE	NL
Countertop Microwave Ovens	-	✓	-	-	✓	✓	-	-	-	-	-
IT and Telecom Equipment	✓	-	-	-	-	-	-	-	-	-	-
Musical Instruments	✓										
Medical and Monitoring Equipment	✓										
Micro Toys Electronic	✓										
Time Measurement Devices	-	✓	-	-	-	-	-	-	-	-	-
Weight Measurement Devices	-	✓	-	-	-	-	-	-	-	-	-
Air Treatment Appliances	-	✓	-	-	-	-	-	-	-	-	-
Garment Care Appliances	-	✓	-	-	-	-	-	-	-	-	-
Personal Care Appliances	-	✓	-	-	-	-	-	-	-	-	-
Kitchen Countertop Heating and Cooking Appliances	-	✓	-	-	-	-	-	-	-	-	-
Kitchen Countertop Motorized Appliances	-	✓	-	-	-	-	-	-	-	-	-
Kitchen Countertop Appliances For Making Hot Beverages	-	✓	-	-	-	-	-	-	-	-	-
Small Floor Cleaning Devices	-	✓	-	-	-	-	-	-	-	-	-
Full Size Floor Cleaning Devices	-	✓	-	-	-	-	-	-	-	-	-

Source: Province program review

5.1.11.2 Potential Impact if High Diversion Practice for Household Electronics and Outdoor Power Tools is Applied in Alberta

Estimates of potential diversion through an expanded electronics program in Alberta are based on values developed for Alberta Recycling by Kelleher Environmental in 2012, in anticipation of expansion of the electronics program at that time. The list of products used for development of the estimates was the same as that used by EPRA and Canadian Electrical Stewardship Association (CESA) in BC.

Most electronics programs in Canada collect a wider list of designated electronics than Alberta (with the exception of floor standing printers), and most add audio/visual products. Should these products be added to the Alberta program, it would increase the tonnage of designated products sold into the market by an estimated 24,780 tonnes (see Table 5-7). Assuming at least a 50% recovery rate, this would lead to diversion of an additional 12,390 tonnes of electrical and electronic products.

Table 5-7: Estimated Weight of Electrical and Electronic Products Sold into Alberta Market (2012) and Estimated 50% Recovery Rate

Electronics Category	Estimated Units Sold into Alberta Market 2012	Estimated Tonnes Sold into Alberta Market 2012
Small Appliances	4,930,400	16,500
Audio visual	2,227,500	5,600
Telecom	9,147,300	1,200
Power Tools	324,700	1,500
Total	16,629,900	24,800
Assumed recovery rate of 50%		12,400
Alberta Base with existing list of designated electronics		45,500

Source: Estimates developed for Alberta Recycling by Kelleher Environmental, all numbers are rounded

Outdoor Power Tools

In BC, outdoor power equipment is included in a provincial recycling program that was launched on July 1st, 2012 by the Outdoor Power Equipment Institute of Canada (OPEIC), a non-profit organization representing the outdoor power equipment industry in Canada. OPEIC has partnered with Product Care Association of Canada (PCA) to set up and operate the program. Included in this program are electric lawn mowers, trimmers, tillers, chain saws, and others (outdoor power equipment that relies on a fuel-powered engine is not included in the program, however many collection sites may accept them, at their discretion). A complete list of accepted items is presented in Appendix A.8.0. These items are accepted free of charge at 120 recycling depots across the province.

OPEIC estimates that 150-200 tonnes of electric powered outdoor powered equipment reach end-of-life in BC each year.[84] It also estimates that about 197,000 outdoor power tools are sold into BC annually. Most of these are hand held units.

Using the higher-end value of 200 tonnes, and pro-rating this to Alberta, it is estimated that about 180 tonnes of outdoor power tools reach end-of-life in Alberta each year. Based on a recovery rate of 70% over 10 years, about 130 tonnes/year of outdoor power tools would be diverted.

[84] The Outdoor Power Equipment Institute Stewardship Program for Outdoor Power Equipment, February, 2012, p8

5.1.12 Expanded Used Oil Program

5.1.12.1 High Diversion Practices for Used Oil Programs

Table 5-8 details the products collected by used oil programs across Canada. At this time Alberta collects the narrowest list of products.

Table 5-8 Products Accepted in Used Oil Recycling Programs Across Canada[85]

Product Category	AB	BC	MB	SK	QC	NB	PEI
Lubricating Oil	✓	✓	✓	✓	✓	✓	✓
Containers HDPE or Metal	✓	✓	✓	✓	✓	✓	✓
Containers Non-Metal or Non-HDPE	✓	✓	✓	✓	✓	✓	✓
Filters < 8" or All Sump Type Filters	✓	✓	✓	✓	✓	✓	✓
Filters ≥ 8"	✓	✓	✓	✓	✓	✓	✓
Glycol/Antifreeze Concentrate		✓	✓	✓	✓	✓	✓
Glycol/Antifreeze Premix		✓	✓	✓	✓	✓	✓
Glycol/Antifreeze Container		✓	✓	✓	✓	✓	✓
Diesel Exhaust Fluid Container			✓	✓			
Brake Cleaner Aerosol Container					✓	✓	✓
Lubricant Aerosol Container					✓	✓	✓

Source: Provincial program websites

In 2004, the companies that were members in the first five provincial used oil materials recycling associations (BC, Alberta, Saskatchewan, Manitoba, and Quebec) formed the Used Oil Management Association (UOMA) which allows for consistent data reporting across these five programs. Of these five jurisdictions, Quebec is the only province that has set

[85] https://www.albertarecycling.ca/recycling-programs/used-oil-recycling-program/eligible-products-fees/

recovery and reclamation targets for used oil materials in their regulations. Sections 5 through 7 of the Regulation respecting the recovery and reclamation of used oils, oil or fluid containers and used filters establish rates of recovery for 2005 (50%) and 2008 (75%).[86] As of 2017, this target increased to 80%.[87]

Quebec's used oil recycling program is managed by the Société de gestion des huiles USgées (SOGHU), a private non-profit organization recognized by Recyc-Quebec. SOGUU has developed a partnership with more than 1,037 collection facilities throughout Quebec, where residents can return used oil and glycol products free of charge. These collection sites include garages, car dealers, as well as many municipalities.[88] In 2017, Quebec's program recovered 84.5% of used oils, 87% of used oil filters, and 94.2% of oil containers, exceeding the provincial target for each material of 80%.[89] Alberta had similar rates even though the recovery rates are not set in regulation.

5.1.12.2 Potential Impact of Expanding the Used Oil Program in Alberta

Table 5-9 presents performance data from other used oil programs in Canada. The data on which the estimates are presented is included along with references in Appendix A.8.0.

Table 5-9: Reported Performance of Used Oil Programs Across Canada[90]

	Oil kg/cap	Antifreeze kg/cap	Containers kg/cap
New Brunswick and PEI	3.80	0.12	0.30
Quebec	7.17	0.21	0.26
Ontario	0.00	0.09	0.11
Manitoba	10.36	0.29	0.23
Saskatchewan	14.78	0.15	0.38
Alberta	19.53	Not collected	0.61

[86] http://legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,%20r.%2042
[87] https://www.recycfluo.ca/en/files/2014-01/Guide-to-the-Application-of-the-Regulation.pdf
[88] https://soghu.com/en/soghu-an-eco-logical-partner
[89] https://soghu.com/wp-content/uploads/SOGHU-2017-Annual-Report.pdf
[90] A specific gravity of 1 has been assumed for both oil and anti-freeze to convert reported litres to kg and tonnes

	Oil kg/cap	Antifreeze kg/cap	Containers kg/cap
British Columbia	9.22	0.54	0.37
Weighted Average	6.35	0.18	0.26

Sources: Used Oil Can be Used Again and Again, BC Used Oil Management Association 2017 Annual Report[91]; Next, Saskatchewan Association for Research Recovery Corp, 2017 Annual Report[92]; Manitoba Association of Resource Recovery Corp, MARRC 2017 Annual Report[93]: Stewardship Ontario 2017 Annual Report[94]; SOCIÉTÉ Keep Nature Clean, DE GESTION DES HUILES USAGÉES 2017 Annual Report[95]; Keep Nature Clean, UOMA Atlantic, Atlantic Used Oil Management Association, Annual Report 2017[96]

The Alberta used oil program already collects a higher per capita rate of used oil (19.53 kg/cap) compared to other provincial programs, although the collection rate varies significantly across the country based on local oil usage. The program could be expanded to include antifreeze which is collected in BC, Quebec, and other provinces. Actual recovery of antifreeze varies widely in these provinces. Potential recovery was based on the national weighted average value of 0.18 kg/cap applied to Alberta, for a total recovery of 771,504 kg (771 tonnes) of anti-freeze. An estimated 77 tonnes of antifreeze containers (all plastic) would also be collected based on pro-rating data on antifreeze containers collected from Manitoba, where 38,700 kg of containers and 389,200 litres of anti-freeze were collected.

5.1.13 Expanded Tire Program

The current tire program is operated by Alberta Recycling.

There is potential for aviation tires and agricultural tires to be formally added to the existing program. However, the discarded volumes are not large and are only estimated to amount to 300 to 400 tonnes a year for aviation tires and 1,400 tonnes for agricultural tires.

Alberta Recycling staff has had various meetings with industry in the past about adding giant mining tires to the program. The feedback has been that industry wants to manage their

[91] http://bcusedoil.com/wp-content/uploads/2018/06/BCUOMA_AR_2017.pdf

[92] http://usedoilrecyclingsk.com/wordpress/wp-content/uploads/2018/07/2017-annual-report-revised.pdf;

[93] http://usedoilrecycling.com/en/mb/sites/default/files/MARRC%20ANNUAL%20REPORT%202017%20COMPLETE%20FINAL%20April%2020%202018.pdf

[94] https://stewardshipontario.ca/wp-content/uploads/2018/06/SO-2017-Annual-Report.pdf;

[95] SOCIÉTÉ DE GESTION DES HUILES USAGÉES

[96] https://nb.uoma-atlantic.com/wp-content/uploads/sites/2/2017-UOMA-Atlantic-annual-report.pdf

own tires. At this time (and based on Board direction), Alberta Recycling would not be looking to expand the program to include mining tires.

Aviation tires are only currently accepted in the following programs in Canada:

- Manitoba: Aircraft tires 30kg or under; and
- Ontario: Aircraft tires but not commercial aircraft tires

5.1.14 Expanded Paint Program

The current paint program is operated by Alberta Recycling.

Based on a review of data from BC[97] and Manitoba[98] for 2017, adding the full range of HHW materials (flammable, corrosive, pesticides) to Alberta's program would increase the current tonnages collected by about 7% to 16% (based BC and Manitoba data, respectively).

5.1.15 Total Incremental Diversion Tonnage Through Application of High Diversion Practices in Alberta

Table 5-10 summarizes the calculation of the incremental quantity of material in different streams that could be recycled in Alberta under a circular economy scenario. The estimates by material are discussed in more detail earlier in this text. The additional tonnage is primarily coming from the collection of PPP and organics from the ICI sector.

Table 5-10: Total Additional Material Achievable if High Diversion Practices are Implemented in Alberta

Material	Additional Tonnage
Residential PPP	29,900
Residential Organics/Green Bin	173,000
ICI Organics	155,000
ICI PPP and Other Dry Recyclables	495,000
C&D	300,000
Mattresses	7,000

[97] https://www.productcare.org/app/uploads/2018/12/2017-BC-Paint-HHW-Annual-Report-FINAL-to-Website.pdf
[98] https://www.productcare.org/app/uploads/2018/12/Manitoba-HHW-Annual-Report-2017.pdf

Material	Additional Tonnage
Textiles	16,900
Carpet	13,300
Furniture	25,000
Major Appliances	5,200
Agricultural Packaging and Other Wastes	7,200
Household Electronics	12,400
Outdoor Tools	130
Used Oil Program – Antifreeze	770
Used Oil program – Antifreeze Containers	80
Aviation and Agricultural Tires	1,800
Total	1,243,000

5.2 Economic Benefits from Additional Recycling

This section summarizes the additional economic benefit that could be derived from recycling the tonnage of material set out in Table 5-10. Table 5-11 details the additional direct, indirect and induced jobs that would be created along with the additional GVA to Alberta's GDP resulting from diverting each identified material stream. Approximately 1.2M additional tonnes of material has been identified as having the potential to be recycled over a ten-year period if appropriate policies and program are implemented. An additional 5,790 direct, indirect and induced jobs would be created resulting in almost $760M GVA. Alongside these economic benefits there would be environmental and GHG benefits that were not in the scope of this study and were not calculated in this report.

Table 5-11: Potential Economic Contribution from Expansion of Recycling Programs in Alberta

Material	Incremental Tonnes Diverted Through High Diversion Practices	Direct, Indirect and Induced Jobs (FTE)	Direct, Indirect and Induced GVA ($M/year)
PPP Residential	29,900	220	31.1
Organics Residential	173,000	270	52.2
PPP ICI	495,000	2,900	347.9
Organics ICI	155,000	120	23.2
C&D Recycling	300,000	900	147.2
Electronics and Outdoor Power Equipment	12,500	320	34.4
Major Appliances	5,200	30	3.14
Mattresses	7,000	500	56.3
Textiles	16,900	150	15.9
Carpet	13,300	120	12.5
Agricultural Plastics - Grain Bags	875	5	1.3
Agricultural Plastics - Other Film and Twine	6,325	20	9.1
Used Oil Program – Additional Antifreeze and Antifreeze Containers	850	5	0.6
Tire Program – Aviation and Agricultural Tires	1,800	10	1.6

Material	Incremental Tonnes Diverted Through High Diversion Practices	Direct, Indirect and Induced Jobs (FTE)	Direct, Indirect and Induced GVA ($M/year)
Furniture	25,500	220	23.5
Total	**1,243,000**	**5,790**	**759.9**

Source: Maria Kelleher and Eunomia Calculation rounded

The economic impact figures estimated here use the 'per tonne' figures from the baseline (existing) activity, and as such are an approximate estimate. In reality, expansion of curbside recycling may involve additional labour (since the un-serviced population is largely in smaller towns with less efficient collection routes requiring higher job intensities) but may also as previously noted displace some jobs as less staff are needed at drop-off sites or for garbage collection.

For textiles, since much of this activity takes place in existing charity collection networks, only the job impact from additional processing of textiles for recycling is included (estimated at 5 jobs per 1,000 tonnes processed) as it is assumed that the same collection network will be utilized without the need for additional personnel. The resale (and/or upcycling) of textiles will generate substantial additional revenues for charitable organizations, which is not included in this assessment.

Due to the higher job collection intensity of the current pesticide container collection program, job impacts of the other agricultural plastics programs are estimated conservatively because these activities are considered more similar to jobs associated with the collection and processing of plastics at drop-off sites.

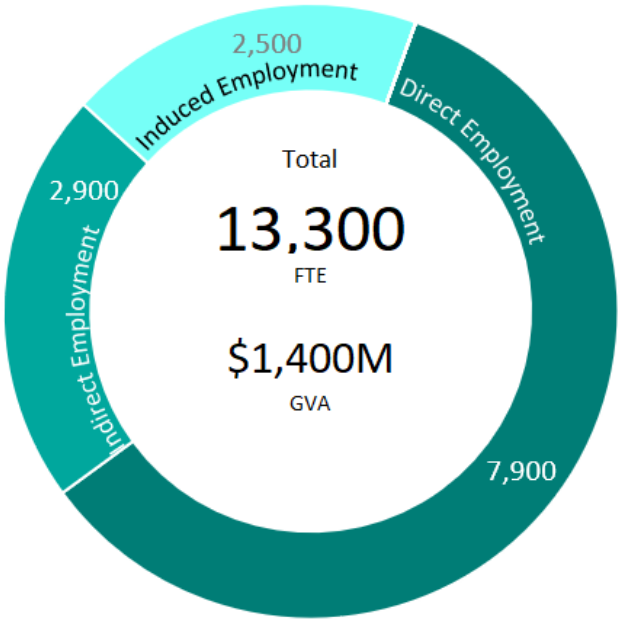
Similarly, the job impacts of increased white goods recycling are based upon the job impacts of metal collection and recycling, since this is likely to remain the primary processing route.

This level of additional recycling would result in an estimated additional $19M in material revenue.

5.3 Future Economic Contribution to the Alberta Economy from the Recycling Sector

If high diversion practice policies and programs are implemented in Alberta over a realistic ten-year period, a total of 2.4M tonnes of waste could be diverted for recycling increasing GVA to $1,400M (a 104% increase from current activities). There would also be an increase of more than 76% in direct, indirect and induced jobs created, taking the total number of jobs attributed to the recycling sector to approximately 13,300 FTE jobs as set out in Figure 5-1.

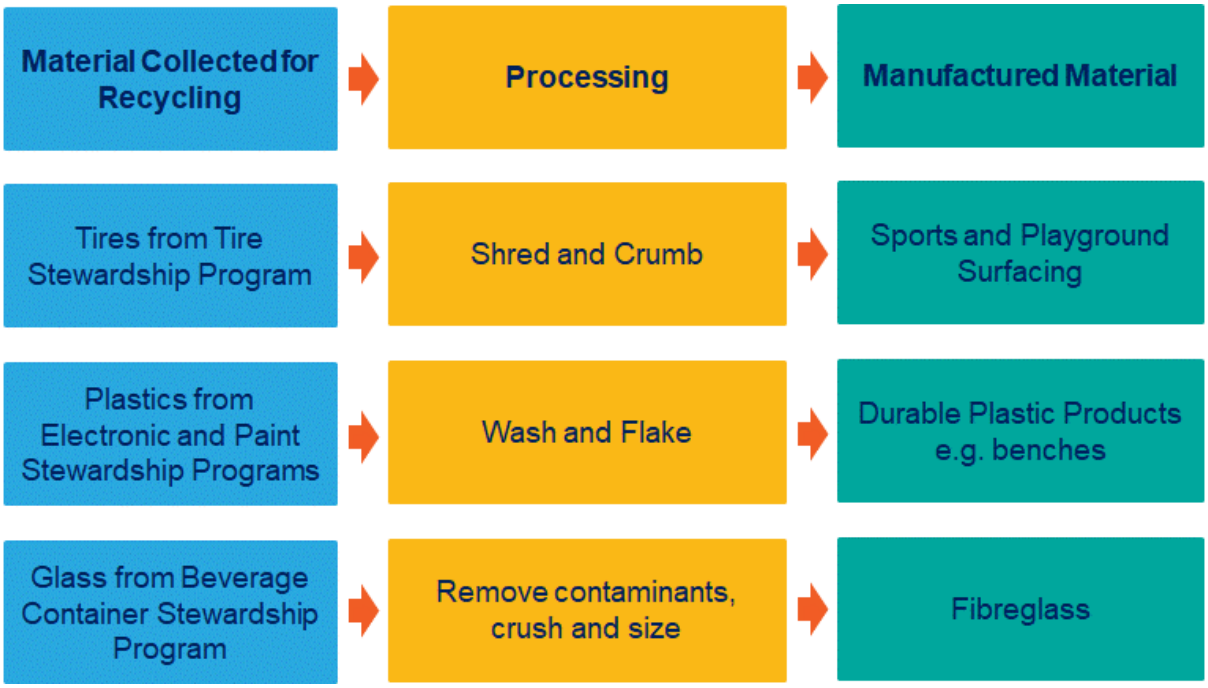
Figure 5-1: Total Future Potential Economic Benefit Attributed to the Recycling Sector



6.0 Progress Towards a Circular Economy

The diversion of waste materials creates secondary raw material inputs for the manufacturing of new products. Currently a significant proportion of the secondary raw material generated from recycling activities in Alberta goes to markets outside of Alberta, in North America and in some cases more globally. The recycling activities identified as creating secondary material that is replacing primary material in established manufacturing applications in Alberta are summarized in Figure 6-1.

Figure 6-1: Examples of Where Material Collected for Recycling in Alberta is Replacing Primary Material in Manufacturing



Other examples include:

- Aggregate from C&D recycling in construction;
- Steel to local steel furnaces; and
- Asphalt pavement to asphalt pavement.

Additionally, most compost produced within Alberta is used within the province, however this study does not include any estimate of jobs in agriculture and horticulture related to its use.

The more material diverted for recycling the greater the potential for new processing and manufacturing facilities to be developed in Alberta.

Table 6-1 below presents estimates of the existing jobs within Alberta related to manufacturing processes using secondary material. In many cases, these jobs would exist whether or not material was diverted for recycling, as the manufacturer would be required to use primary material that has a significantly greater environmental impact.

Job estimates come from Tellus (2011), with the exception of plastic and rubber production, and other material streams where in the absence of data a conservative estimate of 1 job per 1,000 tonnes remanufactured has been applied for these materials.

Table 6-1: Manufacturing Job Intensities, Current and Future Manufacturing Jobs in Alberta Resulting from the Use of Secondary Material

Material	Job Intensity (Jobs per 1,000 Tonnes Input to Remanufacturing)	Estimate of Current Remanufacturing Jobs in Alberta*	Estimate of Total Remanufacturing Jobs Related to Alberta's Material*
Fibreglass	7.9	140	430
Glass Aggregate/Filtration	1.0	10	9
Unknown	7.9	0	25
Paper	4.2	0	1,060
Plastic	9.0	15	310
Aluminum Sheet	17.6	0	230
Steel Rebar, etc.	4.1	210	230
Non-Ferrous	17.6	120	290
Paint	10.6	30	30
Rubber Products	9.8	110	280
Drainage Material	1.0	20	20
Landscaping	1.0	5	10
Asphalt Production	1.0	0	70

Material	Job Intensity (Jobs per 1,000 Tonnes Input to Remanufacturing)	Estimate of Current Remanufacturing Jobs in Alberta*	Estimate of Total Remanufacturing Jobs Related to Alberta's Material*
Asphalt Pavement	1.0	20	20
Drywall	4.1	0	40
Construction	1.0	20	20
Total		690700	3,074

Source: Tellus Institute and Sound Resource Management (2011), More Jobs, Less Pollution: Growing the Recycling Economy in the U.S,

** numbers are rounded*

Three of the key principles of the circular economy include:

- Designing out obsolescence, designing for durability, repairability and recyclability;
- Focussing, where possible, on closed loop recycling where products are recycled back into the same product such as bottle to bottle recycling;
- Processes that allow material to be continuously used in the manufacture of new product (no end-of- life).

Although not included in the scope of this study, a number of examples of repair and reuse – which are clearly instrumental to the circular economy – were identified including:

- Refillable beverage container program managed through BCMB; this program collected 64 M units for recycling in 2018. Additional economic benefits are associated with the collection reverse logistics, warehousing of returned containers and washing prior to refilling.
- Electronics repair: Alberta Computer for Schools not-for-profit repaired between 9,000 – 10,000 computers in 2018 and employed 3 full-time permanent employees; 3 part-time permanent employees; and between 8-12 full-time temporary employees.

Economic benefits derived from repair and reuse are additional to those created when the product eventually needs recycling.

In respect to closed loop recycling the only real activity identified was asphalt to asphalt recycling.

7.0 Conclusion and Recommendations

Recycling activities vary across the sectors with 54% of material currently collected for recycling originating from residential properties. Based on the limited data available, the ICI and C&D sectors appear to offer the most diversion opportunity and potential to create a significant increase in jobs and economic prosperity to Albertans. An estimated 1.2M tonnes of material is currently collected for recycling, and based on the performance of high diversion practice programs in other jurisdictions, there is the potential to increase this to 2.4M which would result in a 105% increase in GDP and 76% increase in the number of direct, indirect and induced jobs. These benefits are compared in Figure 7-1 and Figure 7-2.

Figure 7-1: Current Economic Benefit from Recycling

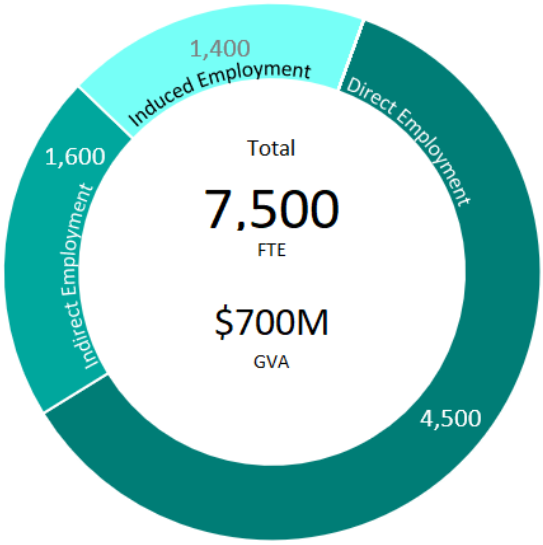
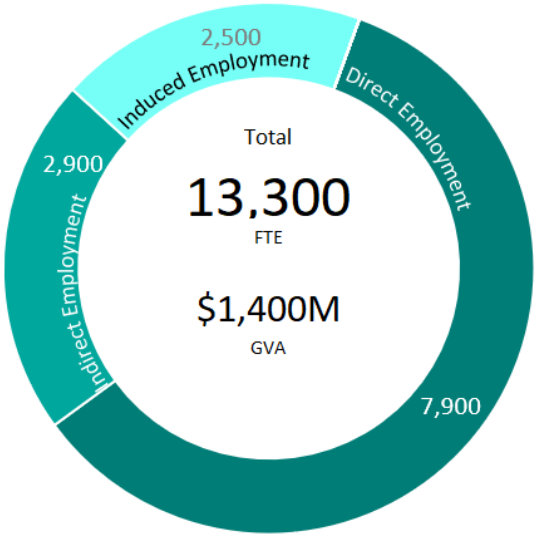


Figure 7-2: Total Potential Economic Benefit from Recycling



Additional benefit can be derived where collected material is processed and turned into a secondary material that can replace primary raw material in local manufacturing processes. The most successful examples of are tire crumb being used to produce sports and playground surface and recycled glass feeding into the production of local fibreglass manufacturing processes. Whilst neither of these processes are closed loop they do result in additional manufacturing jobs. It is worth noting that both of these examples use material from stewardship programs that produce material low in contamination. Tires and glass are also costly to transport making local markets more of a necessity if secondary material is to compete with primary. One fibreglass manufacturer stated that they could not get enough recycled glass for their manufacturing process, demonstrating a demand for material that meets manufacturers' specifications. The impact of not meeting users input specifications was recently highlighted when the city of Calgary's Roads Department was forced to

eliminate the use of recycled asphalt shingles from road construction as a result of some paved roads in the city (which were constructed using recycled asphalt shingles) exhibiting signs of early degradation.

One of the biggest challenges encountered during the study was accessing reliable data in respect to the tonnage of material collected for recycling, the amount of material recycled, and the systems in place to collect and process the material. This data deficiency resulted in the study using primary data collected through surveys and interviews, which required some interpretation, plus assumptions. Although data was relatively forthcoming from the public sector, very little information could be gathered from private sector, especially private sector haulers.

It is recommended that a process be put in place to require all organizations involved in the collection, transportation and processing of waste and recyclables to record and annually report key waste flow data that can be verified and used to update this study over time. Systems have tended to focus on requiring municipalities to enter data (often collecting it from their contractors) and on central recording of treatment capacities. However, as recycling efforts increase there is a greater need to improve the recording and understanding of commercial waste flows. The ability to accurately monitor waste trends and track waste flows through the waste management system allows for the development and implementation of more effective policies and programs.

This study identifies the potential future economic benefits from investing and growing the recycling sector. It is recommended that Alberta put in place a 5-10-year delivery strategy. This strategy should be based on a detailed cost benefit analysis to determine the most appropriate suite of polices and market instruments to capture the identified materials that are currently disposed. The policies and market instruments chosen should cost effectively deliver the optimum levels of diversion and recycling to help grow the Alberta economy and minimize environmental impact for future generations. They should also help establish markets for the material collected and ensure collection and processing can meet the specifications, where possible, of local manufacturers.

This strategy should consider short-, medium- and long-term benefits of moving from current practice to a circular economy.

APPENDICES

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A.1.0 Alberta Stewardship Non-Refillable Beverage Container Scope

Beverages and containers covered by Alberta's non-refillable beverage container deposit return program include:

- Materials:
  - Polyethylene terephthalate (PET clean plastic containers)
  - Other Plastics
  - Glass
  - Aluminum
  - Pouches
  - Bi-metal
  - Tetra Brik
  - Gable top
- Beverages
  - All 'ready to serve' alcoholic and non-alcoholic beverages including milk products
  - Over 130,000 beverage containers registered in the province[99]

[99] http://portal.bcmb.ab.ca/product

A.2.0 Alberta Stewardship Oil Program Scope

Items included in the Alberta oil stewardship program include:

- Used oil
- Oil filters
- Plastic automotive fluid containers

A.3.0 Alberta Stewardship Paint Program Scope

Alberta's paint stewardship program includes the following paint products in containers sized 100ml to 23L:

- Empty aerosol cans
- Concrete sealers, driveway paints or sealers, masonry sealers (non-tar or non-bitumen based)
- Dry fog coating
- Drywall paint
- Empty paint cans and pails of eligible product
- Enamels (including standard single component enamels)
- Encapsulant coating
- Fire retardant/resistive coating e.g. Pink Shield
- Interior and exterior paints and stains regardless of finishing type (e.g. water-based: eggshell, satin, chalk finish; latex; acrylic; oil and solvent-based (alkyd))
- Marine paint and enamel (non anti-fouling)
- Paint-based aerosols
- Porch, floor, fence, barn and deck paints and stains
- Pre-catalyzed and nitrocellulose lacquers
- Pre-catalyzed epoxies
- Primers, undercoats and water repellent sealers
- Rust and decorative metal paints
- Scenic, movie set paint
- Sealers, glazes (water-based and oil-based)
- Shellac and shellac-based products
- Stain blocking paint
- Stone effects coatings
- Stucco paint
- Swimming pool coating (single-component)
- Textured paint
- Traffic marking paints
- Tree marking paint
- Truck bed coating
- Varnishes and single component urethanes - interior and exterior
- Water borne lacquers
- Water-based elastomeric coatings
- Wood finishing oils & stains

Ineligible products include:

- Acid stain
- Battery cleaner
- Battery terminal protectors
- Brushes, rags and rollers
- Chalk-based aerosol or liquid
- Colorants and tints (this refers to the pigments which are added to paint bases to colour them; however, paint which has been coloured or tinted is subject to a surcharge)
- Corrosive products
- Deck cleaners
- Glues, fibreglass resins, adhesives, caulking compounds and block filler - aerosol or liquid (e.g. contact cement)
- Heat reactive coatings
- High temperature coatings
- Ink-based aerosol or liquid
- Milk-based aerosol or liquid
- Non-aerosol automotive paints
- Non-aerosol craft and artist paints
- Nuclear coatings
- Paint/coatings specifically formulated for industrial application
    - industrial paints and finishes (e.g. baked-on, heat resistant)
- Professional stripper
- Quick dry enamels
- Roof patch, tars and greases
- Solvents, thinners and mineral spirits
- Tar (bitumen) based aerosol or liquid (e.g. liquid rubber sealant)
- Thermoplastic rubber, mastic or bituminous coatings
- Two-part or multi-component coatings requiring catalyzing reaction
- Wood preservatives (e.g. creosote)

A.4.0 Alberta Stewardship Tire Program Scope

Items accepted under Alberta's tire stewardship program include:

- Car and light truck tires (including spares), medium truck tires with a rim diameter of 19.5" or less and multipurpose passenger vehicles including sport and crossover utility vehicles;
- Specialty, industrial and other tires with a rim diameter of 8" up to and including 24" such as trailer tires (e.g. boat, recreation/travel; motorcycle (on and off-road), ATV, golf cart, lawn tractor, skid steer, forklift, and mini-loader);
- Medium truck tires, for example those used on larger commercial freight trucks and passenger buses; and
- OTR used in construction, road building, forestry, mining, oil exploration and other industries.

Currently excluded items include:

- Aviation tires
- Electric bike tires
- Bicycle tires
- Electric scooter tires (tires with a rim diameter less than 8")
- Farm/agricultural tires, both drive and free rolling tires for farm implements, tractors and other farm equipment with the following sidewall codes: F-1, F-2, F-2M, F-2D, R-1, R1W, R-2, R-3, HF-1, HF-2, HF-3, HF-4, I-1, I-2, I3, IMP, IMP FLOTATION
- Hand-powered equipment tires (e.g. wheelbarrows, wagons, dollies, wheelchairs, bicycles, hand powered lawn and garden equipment)
- Mini-bike, quad and moped tires where the tire rim size is less than 8"
- Segway tires
- Motorized mobility aid tires

A.5.0 Alberta Stewardship Electronics Program Scope

The list of designated products in the current Alberta electronics program is presented in the table below along with exclusions.

Table A. 1: List of Eligible Electronic Products Accepted in Alberta's Electronics Recycling Program (As of November 30, 2017 – latest information published)[100]

Eligible Electronic Category	Products Included in This Category	Products Excluded in This Category
Desktop Computers: This category includes, but is not limited to: • **CPUs/servers which are not physically embedded or contained within industrial, commercial point-of- sale (POS), medical imaging, diagnostic, monitoring or control equipment.** • **Computer peripherals (e.g. keyboard, mouse, cables, speakers, docking stations) are included for recycling but no surcharge is applied.**	• Blade (rack mount), Desktop and Floor Standing Servers • Computer Terminals • Desktop Computer acting as Servers • Desktop Computers • Desktop/Tower Servers • Microcomputer • Minicomputer (Mini PCs) • Laptop Computers • Server Modules • Small office tower servers • •	• KVM • Print Server • Processor Chips/microprocessors • Stick PCs
Portable computers **Tablet definition: A portable computer with an integrated touch screen display which can connect wirelessly, WIFI and/or via cellular network for purposes of data exchange and transfer. A tablet does not have cellular phone capability.**	• Lap docks • Laptop • Mini Notebooks • Netbook • Notebook • Notepads • POS Tablets • Tablet • Thin Clients • Ultra Mobile PCs • Ultrathin Client • Zero Clients	• Calculators • Cellular enabled PDA • E-book Readers • Portable Video Conference Device

[100] https://www.albertarecycling.ca/recycling-programs/electronics-recycling-program/eligible-products-fees/

Eligible Electronic Category	Products Included in This Category	Products Excluded in This Category
• **Visual Display Devices: This category includes, but is not limited to: All-in-One Devices** • **Devices with built-in components necessary to operate as a monitor.** • **Processing units combined with a monitor.** • **Closed circuit monitor screens (security or multi-purpose).** • **Devices with a television tuner or a device that can operate as both a computer monitor and television.** • **Visual display devices which are not physically embedded or contained within industrial or commercial equipment for example POS, medical imaging, diagnostic, monitoring or control equipment, ATM kiosk, self-service kiosk, gas station pump.**	• 3D Displays • All-in-One Computers • Closed Circuit Monitor Screens • Combination TV/DVD or TV/VHS Players • Computer Monitor Used with a POS System • Computer Monitors • Digital Interactive Monitors with Touchscreen Capabilities • Dual Monitors (fee applies per monitor) • Graphics Tablets with Display • POS All-in-One Computer • POS Touchscreen Monitor • Professional Display Monitors • Robust Panel PCs • Security System Monitors with Integrated DVR • Televisions including Smart TVs • Video Baby Monitors	• 3D Glasses • Digital Photo Frames • Mobile/Person Gaming Environment/Device • OEM Television supplied on the original sale of a recreational vehicle • Monitors and TVs designed for use solely in a motor vehicle, boat or RV, such as: In-vehicle DVD monitors, DVD navigation systems • Portable DVD player with display • Portable Video Conference Device • Refrigerator with built in TV • Wireless Inspection Device/Camera
Printers: This category includes, but is not limited to: • **All printers/printer combinations weighing less than 1,000 kilograms.** • **Large multi-function printer copiers: document centres & facsimile machines with computer direct or networked printing function.** • **Standalone photocopiers, fax machines, and scanners.** • **Printers which are not physically embedded or contained within industrial,**	• Camera Dock Printer • Cheque Scanners • Commercial Plotter • Desktop Business Card Scanners • Desktop Label, Barcode, Card Printers • Desktop Multi-Function or "all-in-one" devices • Desktop Photo Printer (including dock printers) • Desktop Printers • Desktop Scanner • Fax Machine Drum Scanner	• 3D Printers • ATM Printers • Cash Registers • Digital Press • Film Scanner • Garment Textile Printers • Handheld Device with a Printing Function (e.g. label makers, calculators) • Handheld Scanners • Interac Printer • POS Printer • POS Printer (label)

Eligible Electronic Category	Products Included in This Category	Products Excluded in This Category
commercial POS, medical imaging, diagnostic, monitoring or control equipment, ATM kiosks, Self-service kiosks, exercise equipment, refrigerators.	• Fax Machines including Desktop • Fax Machines/Photocopiers • Label, Barcode and Card Printers that are not Handheld with Computer-Direct or Networked Printing Function • Thermal Printers	• POS Terminal • Printer that weighs more than 1000 kilograms • Typewriters

A.6.0 Municipal Survey

Study on Economic Benefits of Recycling in Alberta

Municipality Survey, December, 2018

A.6.1 Introduction to Municipal Survey

The RCA is undertaking a research project to quantify the economic benefits of Alberta's recycling programs, and the economic opportunity presented by expanding and adding programs.

Eunomia Research & Consulting is the consultant undertaking the study.

Our first step is to collect available waste management data from municipalities.

The tables below list the information we would like you to provide as part of the study. This information will then be used in economic models to calculate the economic benefits of recycling to Alberta's economy.

Please fill out what you can and let us know where you are not able to provide data.

Where services are contracted out, provide a few details about the contract:

- The contractor;
- The term of the contract (start year to end year);
- Annual contract costs;
- What specific activities the contractor undertakes for the municipality; and
- How the contract is structured (e.g. net cost per household; tipping fee or per tonne costs, etc.)

We have split out the data request into the following categories of activity:

- Curbside collection;

- Drop-off sites;
- Bulking/transfer sites;
- Haulage from bulking/transfer to processing; and
- Processing.

Where the municipality does all of these activities, we hope you can provide a breakdown of labour costs, operating costs, tonnes managed, etc. Where the service is contracted out, provide whatever data you can.

Thank you very much in advance for your help in filling out this survey.

A.6.2 General Information

Municipality	
Contact Person Name, Title, Email and Phone #	
Total Population	
Total Households (served and not served) Single-Family Multi-Family	
Split Between Urban, Sub-urban and Rural (by %)	

A.6.3 Curbside Collection (i.e., prior to bulking/sorting)

Information Required on Curbside Collection Services	Recycling	Organics (Kitchen scraps and Leaf/yard waste separate)	Garbage/Residual Waste
Number of households served			
Single-Family households served			
Multi-Family households served			
If subscription-based service,			
Number of households paying subscription			
Subscription amount ($/household/year)			
Tonnes collected by material			
Total per household cost for collection ($/household) (Note if this includes or excludes material revenues from recycling or tipping fees for collected material)			
Tipping fee or gate fee ($/tonne) by material			
Revenue ($/tonne) by collected material			
Frequency of collection/service provided by household type			
Urban	e.g., every other week	e.g., seasonal	e.g., weekly
Small urban service			
Mix of urban and rural			
Rural service	e.g., drop-off only		
Total jobs related to collection			

Collection jobs			
Total jobs supervision/management/ administration related to collection			
Location where collected material is dropped off			
Are materials bulked at a collection point then transferred to the facility, or tipped at the facility by the collection trucks?			
If material is bulked & hauled: How many haulage vehicles are used?			
How many people are employed doing this hauling work?			
Curbside collection system			
How many collection trucks do you use?			
Is there more than one type of collection truck? If so, identify number of each type of truck used to collect each type of material			
Truck lifetime	e.g., 7 years or more		
Investment in collection system How much is spent annually on trucks?			
How much is spent annually on containers?			
Additional collection related operational detail If possible:			
Average km travelled per vehicle per day			

Average households served per vehicle per day			
Average tonnes per vehicle/day			
Additional Financial Detail if Possible:			
Capital cost ($) by vehicle type			
Average salary of collection vehicle driver			
Average salary of collection vehicle fleet supervisor			
Average salary of collection vehicle fleet maintenance staff			
The split of operational costs between labour, vehicles and fuel (i.e., 50% labour, 30% vehicles, 5% containers, 15% fuel)			

A.6.4 Drop-Off Sites

If you own or manage drop-off sites, fill in the data below to the extent possible.

Information Required on Drop-Off Sites	
Households/population served by drop-off	
List communities served by drop-off	
Are curbside recycling services also provided to these households? If so, what ones? (recycling, composting/organics, garbage.)	
Tonnes of each material collected (e.g., paper, metal, plastic, tires, electronics, paint, garbage, etc.)	
Total people employed at the drop-off site	

Average salary of drop-off or depot staff (by category if available)	
Investment	
Average annual expenditure on: new equipment containers vehicles (broken out by category where available)	
Percentage of time spent on different materials (garbage, recycling, other) if possible	
Markets for recyclables and other materials Indicate by material (glass, paper, metals, etc.) where recyclables are sold/marketed, and the revenue ($/tonne) received Indicate whether markets are within or outside Alberta	

A.6.5 Data on Bulking/Transfer Locations

If your system uses bulking locations or transfer sites, fill in the table below with available information.

Information Required for Bulking and Transfer Locations	
Tonnes of what material input/output	
Jobs in bulking/transfer	
Investment - **Total annual depreciation/capital write-down** - **Estimated total site & equipment investment cost and lifetime**	

A.6.6 Data from Each Hauler (Material-Specific)

If a hauler is used to haul material from transfer and bulking locations to processors (MRFs, composting, etc.) or direct to market from transfer/bulking locations, provide any data available in the table below.

Information on Haulage from Bulking/Transfer to Processing or Markets	
Communities served	
Locations where materials are hauled	
Tonnes hauled by material	
Jobs in haulage - **Average tonnes per vehicle/day** - **Average miles per vehicle/day**	
Average tonnes hauled per vehicle/day **Average km travelled per vehicle/day**	
Tonnes output of different materials & approx. value / tonne	
Investment - **Total annual depreciation/capital write-down** - **Estimated total facility & equipment investment cost and lifetime** - **Annual $ spent on trucks**	

A.6.7 Data on Sorters/Processors

Where you use sorters/processors (MRFs for recyclables, composting for organics, etc.) fill in this table separately for each major processor.

Information on Sorters/Processors	
Name and location of facility	
Tonnes processed by material	
Capacity (t/y) and if shared with other municipalities	
Jobs in processing, i.e., at facility **– receiving material, operating/sorting/dismantling, bulking, baling, administration**	
Tonnes output of different materials and approx. value ($/tonne)	
Investment - **Total annual depreciation/capital write-down** - **Estimated total facility & equipment investment cost and lifetime** - **Annual spend on trucks**	

A.7.0 Industry Categories for Indirect and Induced Jobs and GVA Calculation

Table A.2 shows the industry categories assigned to each employment activity taken from the Alberta Provincial Input-Output Multipliers 2014, published by the Industry Accounts Division of Statistics Canada in April 2018. These were used to determine the multipliers for indirect and induced jobs, wages and GVA.

A. 2: Industry Categories to Determine Multipliers

Material	Employment								
	Waste Drop-Off	Collection - From Residential/ICI	Collection - From Depots	Bulking	Sorting	Output Haulage	Reprocessing	Remanufacturing	Program Management
Stewardship - Beverage	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
Stewardship - Electronics	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
Stewardship - Tires	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Rubber product manufacturing	Grant-making, civic, and professional and similar organizations
Stewardship - Paint	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations

Material	Employment								
	Waste Drop-Off	Collection - From Residential/ICI	Collection - From Depots	Bulking	Sorting	Output Haulage	Reprocessing	Remanufacturing	Program Management
Stewardship - Used Oil	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
Stewardship - HHW	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
Cleanfarms	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
Residential Recycling	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Converted Paper Product Manufacturing	Grant-making, civic, and professional and similar organizations
Residential Organics	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
Yard/Leaf Waste	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
Mattresses	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations

Material	Employment								
	Waste Drop-Off	Collection - From Residential/ICI	Collection - From Depots	Bulking	Sorting	Output Haulage	Reprocessing	Remanufacturing	Program Management
Other Municipal Recycling	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Wholesale electronic markets, and agents and brokers	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
Metals	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Iron and steel mills and ferro-alloy manufacturing	Grant-making, civic, and professional and similar organizations
ICI Recycling	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Wholesale electronic markets, and agents and brokers	Converted Paper Product Manufacturing	Grant-making, civic, and professional and similar organizations
ICI Organics	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations
C&D	Waste Management and Remediation Services	Waste Management and Remediation Services	Truck Transportation	Warehousing and Storage	Waste Management and Remediation Services	Truck Transportation	Waste Management and Remediation Services	Waste Management and Remediation Services	Grant-making, civic, and professional and similar organizations

A.8.0 High Diversion Practices Background Information for Selected Materials

This appendix presents supplemental high diversion practice information on a range of materials from different jurisdictions as background to the high diversion practice estimates presented in Sections 2.2 and 5.1 of the report.

A.8.1 Household Organics Programs

In 1998, Prince Edward Island and Nova Scotia became the first provinces to ban the disposal of organic waste in landfills. To date, they remain the only provinces with a fully implemented province-wide ban. Quebec is currently implementing a ban in phases, with a 2022 goal to eliminate the disposal of organic waste in both the residential and ICI sectors.

The province of Ontario is also considering a ban on organic waste to landfill, as outlined in its new "Strategy for a Waste-Free Ontario: Building the Circular Economy."

At the municipal level, a number of municipalities in British Columbia have also recently banned organic waste from landfills. For example, Metro Vancouver, which represents 21 municipalities as well as an electoral area and one Treaty First Nation, banned residents and businesses from disposing of organic waste in landfills in 2015. An overview of provinces and municipalities that have banned (or plan to ban) disposal of organic waste in landfills[101] is provided later in this appendix.

Table A. 3 presents the amount of household organics collected by single-family households through Green Bin organics programs in the top ten performing Ontario municipalities in 2017. The figure shows that these municipalities collect between 142 and 334 kg/hh/year of household organics.

[101] http://www3.cec.org/islandora/en/item/11771-characterization-and-management-organic-waste-in-north-america-foundational-en.pdf

A. 3: Curbside Household Organics Collected by Top 10 Ontario Municipalities (2017) (kilograms/SF households)[102]

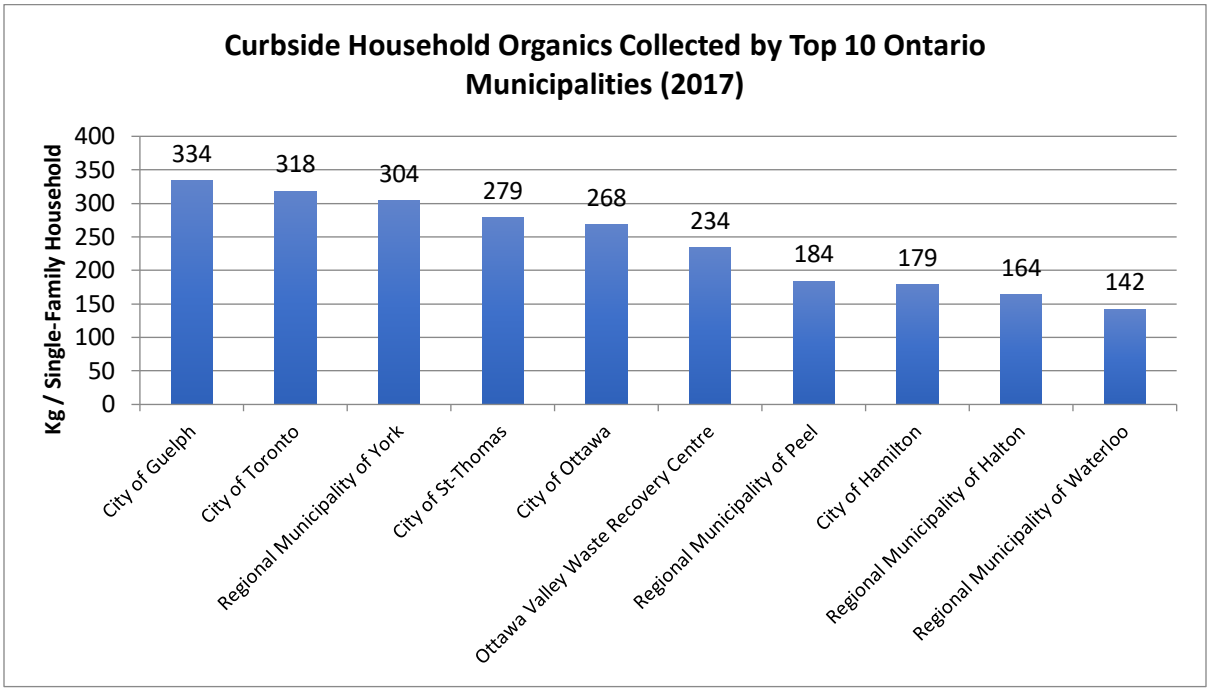
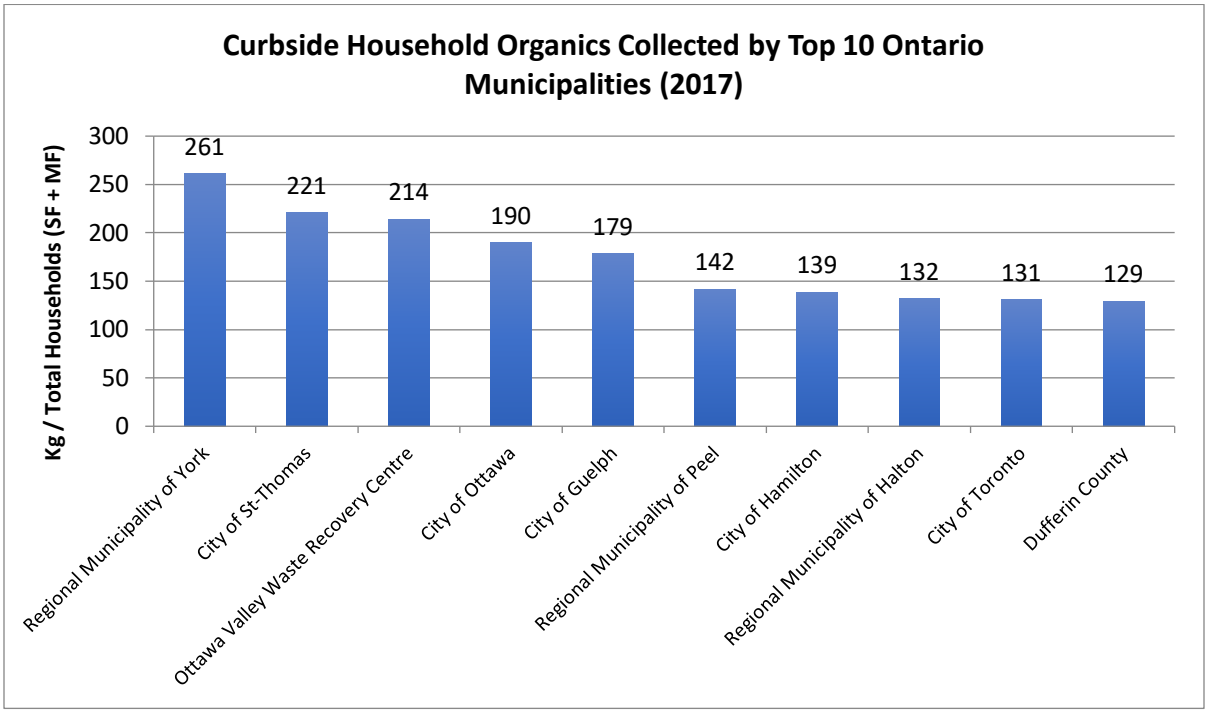


Figure A. 4 shows the performance of Ontario Green Bin programs for large communities who also service some multi-residential households. In the case of city of Toronto, where over half of households are in multi-residential buildings, adding all households drops the average recovered per household rate from 309 kg/hh/year to 131 kg/household/year. This is because of the very poor performance of most multi-residential building programs in the city, with some diverting an average of 50kg/hh/year or less.

[102] Ontario 2017 RPRA (Resource Productivity and Recovery Authority) Datacall (https://rpra.ca/programs/about-the-datacall/)

A. 4: Curbside Household Organics Collected by Top Ten Ontario Municipalities (2017) (kilograms/household) (Single and Multi-Family Combined)[103]



Impact of Metro Vancouver Organics Disposal Ban

Metro Vancouver's organics disposal ban has shown measurable success in increasing waste diversion[104]:

- In 2015, the percentage of organics in the overall waste stream (all sectors combined) was 28%, which results in an estimated 257,000 tonnes of disposed compostable organics. This represents a reduction of approximately 66,000 tonnes from 2014 figures.
- In 2014, Metro Vancouver recycled 301,948 tonnes of yard and food waste. In 2015, the year that the ban was implemented, this increased to 372,603 tonnes. The amount of yard and food waste recycled increased again in 2016 to 439,071 tonnes.

[103] 2017 RPRA Datacall
[104] http://www.metrovancouver.org/services/solid-waste/about/reports-statistics/Pages/default.aspx

- In 2016, Metro Vancouver collected nearly 450,000 tonnes of organic waste for diversion, an increase of nearly 30% from 2015 when new rules banning organic waste from garbage bins were implemented.[105]

A.8.2 Dry ICI Waste Diversion

A.8.2.1 High Diversion Practice Examples for Dry ICI Waste Diversion

Some examples of efforts by Canadian municipalities or provinces to divert ICI waste include:

- At the beginning of 2013, the city of Abbotsford, BC implemented a bylaw mandating all ICI properties to offer adequate space for recycling on their premises.
- All ICI enterprises in St. John's, Newfoundland with 25 or more employees are required to participate in a mandatory office paper recycling program that began in September 2005. All remaining businesses need to comply with the regulation starting March 2006.
- In Halifax, Nova Scotia, ICI property owners/managers must obtain separate bins for recyclables, paper, cardboard, garbage, and organics from their commercial waste hauler.
- Ontario Regulation 103/94 (Industrial, Commercial and Institutional Source Separation Programs) requires some large ICI establishments to source separate some materials but it is not enforced, and does not address most ICI establishments. The province has made various efforts over the years to encourage ICI diversion, but none have been successful to date. The previous provincial Liberal government established the Resource Recovery and Circular Economy Act and had planned to tackle ICI diversion, potentially by establishing service standards (requiring recycling service to be offered as a condition of licencing haulers). The first step was going to be a data collection effort to understand the flow of ICI materials in the province. A new Environmental Plan by the Conservative government elected in June 2018 is under consultation at this time and future directions are not yet clear, although it states a commitment to tackle ICI diversion, first by collecting reliable data.

[105] https://www.cbc.ca/news/canada/british-columbia/organics-ban-update-metro-vancouver-2017-1.3957186

A.8.2.2 US High Diversion Practice Examples for ICI Diversion

Some US cities use franchises and licensing powers to influence diversion in ICI establishments. Waste haulers who are awarded franchises must meet waste diversion goals (e.g. 30% diversion) among their ICI customers and are penalized if they do not achieve and maintain these goals. Examples include:

- Seattle, WA – haulers must provide diversion services
- Elk Grove, CA – haulers must achieve 30% diversion)
- New York and Los Angeles both use ICI waste collection franchising as a method to achieve diversion goals.
- Since 1994, operators of all ICI establishments in Philadelphia have been required to provide recycling collection of the same materials as residents. Penalties for noncompliance can be as high as $300 per violation per day. ICI generators are required to develop a recycling plan.
- Since 1996, businesses in Portland, Oregon are required by City Code to recycle 50% of their waste. Metro Portland has adopted Business Recycling Requirements which require businesses in the Portland metropolitan area to recycle paper, metal cans, plastic bottles, and glass bottles and jars. In addition to these requirements, Oregon state law states that a hauler cannot charge more for recycling collection than would be charged for the same quantity of waste collection.
- As of July 1, 2012, state law required that the City of Santa Clarita, California create a commercial recycling program. Under this law, all Santa Clarita businesses with four yards or more of collection services per week are required to establish and maintain recycling service.
- Boston, MA - In 2008, a City ordinance was passed requiring all commercial waste haulers working in the city to provide recycling services or risk losing their licenses. Failure to offer these services can result in a $150 fine for the first violation, $300 fine for the second violation, and on a third violation the hauler's permit will be revoked.
- In 2010, Austin City Council, Texas passed the Universal Recycling Ordinance. By October 1, 2017, all commercial properties larger than 50,000 sq. ft. (retail, medical facilities, hotels and motels, religious buildings, office buildings, private educational facilities, industry and manufacturers) will be required to ensure that tenants and employees have convenient access to recycling.

A.8.2.3 European High Diversion Practice Examples in ICI Diversion

Recycling targets for both residential and ICI packaging and packaged goods in Austria are presented in the table below. ICI recycling is managed through an organization that collects data on ICI recycling performance.

A. 5: ICI and Residential Material Specific Recycling Targets in Austria

Material	Household Packaging Targets in Austria		ICI Packaging Targets in Austria	
	Material Separately Collected	Collected Material Recycled	Material Separately Collected	Collected Material Recycled
Glass	80%	100%	90%	100%
Paper/Cardboard	80%	95%	90%	95%
Metals	50%	100%	60%	100%
Plastic	60%	50%	85%	75%
Aseptic Drink Cartons	50%	60%	N/A	N/A
Wood	N/A	15%	25%	60%
Other Composites	40%	40%	40%	40%
Total Recycling	55%		55%	
Total Recovery	60%		60%	

In Belgium, Val-I-Pac (which represents over 8,000 companies that sell packaging into the Belgian market) is responsible for managing data on ICI packaging waste recycling but does not get involved in collection contracts.

In Germany, under the German Packaging Ordinance, manufacturers and distributors of sales (i.e. primary and secondary) packaging consumed in ICI establishments that produce waste similar to residential (e.g. restaurants, hotels, schools, cafeterias, hospitals, offices, museums, stadiums, etc.) are subject to EPR.

A.8.3 ICI Organic Waste Diversion

Calgary Food and Yard Waste By-law for ICI Sector

As of November 1, 2017, businesses and organizations in the city of Calgary are required to separate food and yard waste from the garbage for composting or diversion. The food and yard waste bylaw applies to all businesses and organizations, including property management companies, offices, stores, malls, restaurants, hotels, schools, healthcare

facilities, manufacturers, factories, non-profits, places of worship, warehouses and other operations.

In order to comply with this bylaw, business owners and property managers are responsible for setting up a food and yard waste program. This program must accept the following items: plate scrapings; fruits and vegetables; eggshells and dairy products; pastries, cookies, cakes, and muffins; meat, fish, shellfish and bones; bread, noodles, rise, and grains; jams, sauces and salad dressings; nuts, seeds, chips, popcorn and candy; food soiled paper; fats, oil and grease; and yard waste.[106] The bylaw also requires business owners and property managers to provide signage on all collection containers and education to employees and tenants at least once per year. Property owners that fail to comply with the by-law could be subject to a fine.

Ontario Food & Organic Waste Framework

On April 30, 2018, the Ontario Ministry of the Environment and Climate Change (MOECC) released the Food and Organic Waste Framework, as part of the larger Waste Free Ontario Strategy and the Ontario Climate Change Action Plan. The Framework aims to reduce the amount of food and organic waste sent to landfill, as well as reduce greenhouse gas emissions for a "waste-free Ontario." The Framework consists of two complementary components:

- **Food and Organic Waste Action Plan**, which includes commitments by the government on what the province will do to address food and organic waste; and
- **Food and Organic Waste Policy Statement**, which directs the province, municipalities, producers, the ICI sector, waste management companies, and others take action to reduce and recover food and organic waste.

A key component of the Framework is to increase the recovery of residential food waste by requiring all cities of a certain size and density to have an organic food and waste collection program in place within seven years. The first type of municipality that will need to introduce a curbside organics collection program for single-family dwellings will be those that have a population of over 50,000 people and a density of 300 people per square kilometer. The second type is municipalities that have populations between 20,000 and 50,000 and a density of 100 people per square kilometre.

In addition to calling for green bin collection at single-family dwellings, the Framework calls for organics collection at shopping centres, grocery stores, and restaurants, and looks to ban all waste that can be diverted from landfill beginning in 2022. It also proposes

[106] http://www.calgary.ca/UEP/WRS/Pages/Commercial-Services/ICI-Food-Yard-Diversion.aspx

diversion targets for the ICI sector. These targets, which are to be achieved by 2025, are summarized Table A. 6. The persons or entities set out in column 1 must meet the targets in column 2 by the dates set out in column 2.

A. 6: ICI Targets Outlined in Ontario's Food and Organic Waste Policy Statement

Person or Entity Responsible for Achieving the Target	Target
Industrial and commercial facilities subject to policy 4.14	• 70% waste reduction and resource recovery of food and organic waste generated in the facility by 2025
Industrial and commercial facilities subject to policy 4.15	• 50% waste reduction and resource recovery of food and organic waste generated in the facility by 2025
Educational institutions and hospitals subject to policy 4.18	• 70% waste reduction and resource recovery of food and organic waste generated in the facility by 2025

Requirements for Organics Diversion by Multi-Family Buildings under the Ontario Food & Organic Waste Framework

In addition to calling for green bin collection at single-family dwellings, the Framework calls for green bin collection at multi-unit residential buildings. Sections 4.10 to 4.13 of the Framework laying out the requirements for multi-residential buildings are presented in Table A. 7.

A. 7: Multi Residential Building Requirements to Divert Organic Waste in the Ontario Food & Organic Waste Framework

Section of Policy Statement	Text Related to Multi-Residential Building Requirements
4.10	Multi-unit residential buildings shall provide collection of food and organic waste to their residents.
4.11	For multi-unit residential buildings: Collection of sources separated food and organic waste is the preferred method of servicing multi-unit residential buildings.

Section of Policy Statement	Text Related to Multi-Residential Building Requirements
	Alternatives to the collection of sources separated food and organic waste may be used if it is demonstrated that provincial waste reduction and resource recovery targets can be achieved efficiently and effectively.
4.12	Multi-unit residential buildings should implement best practices that support convenient access to resource recovery efforts.
4.13	Multi-unit residential buildings shall provide promotion and education materials to residents that support and increase participation in resource recovery efforts.

Source: Ontario's Food and Organic Waste Framework[107]

In addition to the above, the new Food and Organic Waste Framework looks to ban all waste that can be diverted from landfill beginning in 2022. It also proposes diversion targets for residential buildings. These targets, which are to be achieved by 2025, are summarized in Table A. 8. The persons or entities set out in column one must meet the targets in column two by the dates set out in column two.

A. 8: Targets Outlined in Ontario's Food and Organic Waste Policy Statement

Person or Entity Responsible for Achieving the Target	Target
a) Municipalities subject to policy 4.1	• 70% waste reduction and resource recovery of food and organic waste generated by single-family dwellings in urban settlement areas by 2023
b) Municipalities in Southern Ontario subject to policy 4.2i	• 70% reduction and resource recovery of food and organic waste generated by single-family dwellings in urban settlement areas by 2025
c) Municipalities in Southern Ontario subject to policy 4.2ii	• 50% waste reduction and resource recovery of food and organic waste generated by single-family dwellings in urban settlement areas by 2025
d) Municipalities in Northern Ontario subject to policy 4.3	• 50% waste reduction and resource recovery of food and organic waste generated by single-family dwellings in urban settlement areas by 2025

[107] https://www.ontario.ca/page/food-and-organic-waste-framework

e) Multi-unit residential buildings subject to policy 4.10	• 50% waste reduction and resource recovery of food and organic waste generated at the building by 2025

Source: Ontario's Food and Organic Waste Framework[108]

Regional District of Nanaimo, British Columbia Commercial Food Waste Ban

In 2005, in accordance with its Zero Waste Plan (2004) and the Organics Diversion Strategy (2005), the Regional District of Nanaimo (RDN) introduced a landfill ban on the disposal of all food waste from all commercial premises.[109] Under Bylaw 1531, "Commercial Organic Waste" means compostable material including raw and cooked food waste from a commercial premise and includes but is not limited to: fruits and vegetables; meat, fish, shellfish, poultry and bones thereof; dairy products; bread, pasta and baked goods; tea bags, coffee grounds and filters; soiled paper plated and cups; soiled paper towels and napkins; soiled wax paper, food soiled cardboard and paper; and egg shells.

In 2006, the first year of the disposal ban, over 4,200 tonnes of commercial food waste was diverted from disposal, representing a reduction of 30 kg/capita. Diverting this waste from landfill also contributed to reducing the RDN disposal rate from 553 kg/cap in 2005 to 517 kg/cap in 2006.[110]

Portland, Oregon Commercial Organics Bylaw

In July 2018, Metro Council—the regional governing body for the Portland, Oregon metropolitan area—adopted a mandatory ordinance that requires certain types of businesses that process, cook or sell food to keep food scraps out of their garbage.[111] The policy will be phased in over five years, as follows:

- July 31, 2019: Deadline for local government adoption of requirement
- Phase 1 (March 31, 2020 – March 31, 2021): Businesses that generate 1,000 pounds or more of food scraps per week
- Phase 2 (March 31, 2021 – September 30, 2022): Businesses that generate 500 pounds or more of food scraps per week

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[108] https://www.ontario.ca/page/food-and-organic-waste-framework

[109] https://www2.gov.bc.ca/assets/gov/environment/waste-management/organic-waste/casestudies/cs_3_rdn_ban.pdf

[110] http://www.sC&D.ca/files/File/Infrastructure/Solid%20Waste/2018%20JAN%2008%20SC&D%20Regional%20Organics%20Diversion%20Strategy%20-%20Final.pdf

[111] https://www.oregonmetro.gov/food-scraps-policy

- Phase 3 (September 30, 2022 – September 30, 2023): Businesses that generate 250 pounds or more of food scraps per week

Eventually, almost 3,000 ICI generators will be required to separate their food scraps. The types of businesses that are required to participate in the program include grocery stores, restaurants, lodging and hotels, hospitals, nursing and residential care facilities, correctional facilities, colleges and universities, elementary and secondary schools, and food and beverage manufacturers. Businesses that generate less than 250 pounds of food scraps per week are exempt. It is important to note that the food scraps separation requirement only applies to food scraps that are generated "back-of-house," in the area of business operation where food preparation areas and kitchens are located, and that is not accessible to customers. A business may choose to include front-of-house food scraps in its collection program, but it is their responsibility to ensure that the food scraps are free of non-food items such as napkins and cutlery, before placing them in their collection bin.

The council believes that the ordinance and pre-processing facility could increase the amount of commercial food waste collected to 50,000 tons a year (up from 24,000 tons) once full implementation is complete.[112]

Metro intends to provide funding to local governments for the first five fiscal years of the business food waste requirement (after the first five years of implementation, ongoing program maintenance funding may be provided subject to Metro Council approval during the annual budget process). Specifically, Metro will fund (via the Regional System Fee, which is $18.50 per ton of solid waste disposed in the region) outreach materials, local government technical assistance staff, 50% of internal collection containers provided to businesses, and will pay certain haulers a stipend to cover extra distance they may have to travel to deliver food scraps to their transfer station. As of July 2018, Metro had budgeted $400,000 for technical assistance to local governments.

Hennepin County, Minnesota County-Wide Requirement to Implement Commercial Organics Diversion Program

On November 27, 2018, Hennepin County approved revisions to its recycling ordinance that include new requirements for cities and businesses. The mandate requires businesses that generate large quantities of food waste, such as restaurants, hotels, grocers, residential care facilities, and office buildings with dining services to implement food waste recycling by January 1, 2020. This requirement applies to businesses that generate one ton of garbage per week, or those who contract for weekly collection of at least 8 cubic yards

[112] https://www.wastedive.com/news/portland-oregon-regional-government-approves-commercial-organics-mandate/528434/

of garbage. The ordinance also incorporates state recycling requirements for businesses, which require commercial buildings with one or more businesses that contract for weekly garbage collection of 4 or more yards of garbage to recycle. Businesses must offer adequate service for the collection of recyclables and increase service levels if insufficient. They are also required to label internal waste containers and provide education and train employees annually. The county will have the authority to enforce these requirements, including the ability to issue warnings or citations to cities and businesses for noncompliance.

City of San Francisco and many others have developed ordinances and programs targeting ICI organics also.

A. 9: Organic Waste Disposal Bans (Implemented and Planned) in Canada[113]

Ban Features	Provinces					
	British Columbia		Nova Scotia	Prince Edward Island	Quebec	Ontario
Area(s)	Regional District of Nanaimo	Metro Vancouver Regional District / City of Vancouver	Province-wide	Province-wide	Province-wide	Province-wide
Sectors Covered	"Commercial and institutional facilities such as restaurants, grocery stores, and school and hospital cafeterias"	Businesses: Every business-license holder Residential: Every owner/occupier of a residential property where food waste is produced	All generators (i.e., nearly 1,000,000 citizens)	Every household and business	"All stakeholders"	All
Applicability/ Threshold	2005: Commercial food waste disposal ban	"All food scraps— raw and cooked food, plate scrapings,	"Compostable organic material [including] food waste"	"Province-wide mandatory composting program	2015: 60% recycling target for organics	"The province will develop, consult on,

[113] http://www3.cec.org/islandora/en/item/11771-characterization-and-management-organic-waste-in-north-america-foundational-en.pdf

Ban Features	Provinces					
	British Columbia		Nova Scotia	Prince Edward Island	Quebec	Ontario
	2011: Region-wide green-bin residential food waste collection	leftovers, expired food, meat, bones, and dairy products" banned, effective 1 January 2015"	banned, effective 1998	for all residents and the ICI sector," since 1999	2016–2021: Gradual implementation of complete organics-to-landfill ban 2022: Ban to eliminate organics from disposal	and implement a food and organic waste disposal ban regulation. The regulation could prohibit the disposal of food waste and organic waste at waste disposal sites (e.g. landfills, incineration facilities) 2022: Phased-in beginning 2022 Diversion targets set for 2023 and 2025 for both single-family and multi-family sectors

A.8.4 C&D Waste Statistics for Alberta and High Waste Diversion Practices

A. 10 presents detailed estimates of C&D waste generated, diverted and disposed in Alberta, split out among residential and non-residential sources; construction, renovation and demolition activity as well as at a detailed material level. These estimates were developed as part of an Environment and Climate Change Canada (ECCC) project on C&D waste diversion practices in Canada in 2015.[114]

Some examples of best practice in diversion of C&D waste at the municipal level[115] include:

- The city of San Francisco's C&D Recovery ordinance[116]
- The city of Surrey, BC's Demolition Waste Disposal and Recycling Bylaw 19453[117]
- The city of Vancouver, BC's Demolition Permit with recycling and deconstruction requirements[118]
- The city of Halifax, Nova Scotia's Construction and Demolition licensing by-law, which establishes a minimum diversion rate of 75% and requires all C&D material to be directed to C&D processing facilities for recycling and a single approved landfill.

Dedicated disposal levies are used in some EU countries to encourage or force diversion and reuse of C&D materials.

Procurement specifications are considered a very efficient way to require diversion of C&D waste also.

Metro Vancouver has implemented a landfill ban on drywall which is processed at New West Gypsum; in the recycling process, paper is separated from old drywall and the gypsum inside is recovered for use in new gypsum. At Metro Vancouver disposal facilities, loads are inspected for banned materials, and surcharges apply if these materials are found in the garbage. A $50 minimum surcharge, plus the potential cost of removal, clean-up or remediation is applied to loads containing "operational impact" materials. Drywall is

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[114] Kelleher Environmental; Guy Perry and Associates in association with Robins Environmental and SAMI Environmental: Characterization and Management of Construction, Renovation and Demolition Waste in Canada – Foundation Document. Prepared for Environment Canada, March, 2015

[115] (https://www.durhamyorkwaste.ca/Assets/PublicOutreach/EFWWMAC/Meetings/Meeting_4/WMAC_Meeting4_AdditionalMaterials.pdf).

[116] https://sfenvironment.org/construction-demolition-requirements

[117] https://www.surrey.ca/files/DemolitionNewConstructionWasteBrochure.pdf

[118] https://vancouver.ca/home-property-development/demolition-permit-with-recycling-requirements.aspx

considered an operational impact material because of the risk of hydrogen sulfide formation when it gets wet. A surcharge of 50% of the tipping fee on the entire load is applied to loads containing banned materials.

Simcoe County in Southern Ontario operates a recycling program for asphalt shingles. The county charges a tipping fee of $75/tonne for asphalt shingles, which is lower than the mixed-waste fee of $310/tonne. Since the implementation of the variable fee structure, the county has noticed a dramatic increase in the quantity of material received; twice the amount of asphalt shingles is dropped off. The county processes the shingles and sells the crushed shingles to asphalt companies in the region.[119]

[119] http://www.nzwc.ca/focus/construction-renovation-demolition/working-group/member-resources/Documents/WasteResourceSummaryReport.pdf

A. 10: Estimation of Composition of C&D Waste Recycled and Disposed in Canada

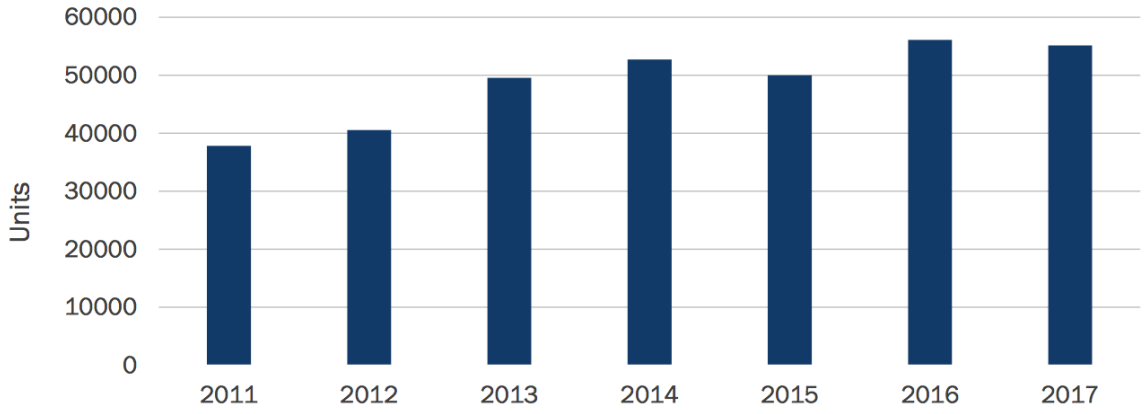
Alberta 2010																		
C&D Material	Generated (tonnes)						Recycled (tonnes)						Disposed (tonnes)					
	Residential			Non-Residential			Residential			Non-Residential			Residential			Non-Residential		
Source	Con	Ren	Dem	Con	Ren	Dem	Con	Ren	Dem	Con	Ren	Dem	Con	Ren	Dem	Con	Ren	Dem
Clean Wood	12,200	44,900	22,400	3,030	17,700	36,300	800	1,430	1,040	490	1,490	4,350	11,400	43,500	21,400	2,530	16,200	31,900
Engineered Wood	5,910	21,100	10,500	1,540	8,440	17,000	590	870	530	370	910	2,210	5,320	20,200	9,930	1,180	7,530	14,800
Treated Wood	1,990	7,580	3,750	440	2,870	5,740	8	70	60	5	70	230	1,980	7,510	3,690	440	2,800	5,510
Painted Wood	4,980	20,300	9,410	1,160	8,800	15,100	150	1,880	390	90	1,960	1,630	4,830	18,400	9,020	1,070	6,840	13,500
Total Wood	25,100	93,800	46,000	6,170	37,800	74,100	1,550	4,250	2,020	960	4,430	8,430	23,600	89,600	44,000	5,220	33,400	65,700
Concrete	2,310	8,480	4,580	550	3,170	7,970	90	10	420	50	10	1,760	2,230	8,470	4,160	490	3,150	6,210
Asphalt	170	660	320	40	240	480	<1	<1	<1	<1	<1	<1	170	660	320	40	240	480
Drywall	5,510	20,600	10,900	1,340	8,180	19,400	300	770	1,170	180	800	4,880	5,210	19,800	9,730	1,150	7,380	14,500
Asphalt Roofing	6,020	23,300	11,400	1,400	9,420	18,300	170	1,100	480	110	1,150	2,020	5,850	22,200	10,900	1,290	8,280	16,300
Ferrous	1,170	4,850	2,160	290	2,270	3,520	80	690	110	50	720	470	1,100	4,160	2,040	240	1,550	3,050
Non-ferrous	570	2,200	1,040	130	890	1,600	20	110	20	10	120	70	550	2,090	1,030	120	780	1,530
Total Metals	1,740	7,050	3,200	420	3,160	5,120	100	800	130	60	830	530	1,640	6,250	3,070	360	2,330	4,580
Foam Insulation	100	370	180	20	140	270	2	7	<1	1	7	<1	100	360	180	20	130	270
Carpet & padding	750	3,240	1,370	170	1,510	2,040	20	450	<1	10	470	<1	730	2,790	1,370	160	1,040	2,040
Other Plastics	1,960	7,340	3,540	460	2,870	5,370	80	210	30	50	210	140	1,880	7,130	3,500	420	2,660	5,230
Total Plastics	2,800	10,900	5,080	660	4,520	7,680	100	670	30	60	690	140	2,710	10,300	5,050	600	3,830	7,540
Corrugated Cardboard	560	2,070	970	150	880	1,510	60	160	30	40	160	110	500	1,910	940	110	710	1,400
Fibreglass	80	300	200	20	120	480	3	10	60	2	10	260	80	290	140	20	110	210
Mixed Glass	150	670	370	30	340	820	5	130	100	3	140	420	140	540	270	30	200	400
Total Glass	230	970	570	50	460	1,290	8	140	160	5	150	680	220	830	410	50	310	610
Other	16,700	64,700	31,200	3,810	25,500	47,800	260	2,050	450	160	2,140	1,870	16,500	62,700	30,800	3,650	23,300	46,000
Total	61,200	232,600	114,300	14,600	93,300	183,700	2,620	9,940	4,880	1,620	10,400	20,400	58,600	222,700	109,400	13,000	83,000	163,300
Total by stream (tonnes/yr):	699,800						49,800						649,900					
(kg/cap/yr):	187.5						13.4						174.1					
Diversion (%)	7.1%																	

A.8.5 Mattresses

Metro Vancouver Disposal Ban

Mattresses have been banned from garbage disposal in Metro Vancouver since 2011, and can be dropped off at the transfer stations for a fee of $15. Several private companies also pick up used mattress for a fee, or exchange new-for-old when customers purchase a new mattress. A Morrison Hershfield study[120] conducted on behalf of Metro Vancouver estimated that Metro Vancouver's mattress ban generates the following benefits: $350,000 in avoided landfilling costs; $315,000 in value of recovered materials; 46 jobs; and 8,900 tonnes of CO_2e reduced.

A. 11: Mattresses Recycled at Metro Vancouver Transfer Stations (2011-2017)[121]



United States

In the US, a non-profit organization called the Mattress Recycling Council (MRC) was established by industry to operate the end-of-life mattress recycling programs in the states that have enacted mattress recycling laws. As of 2019, these included California, Rhode Island, and Connecticut. Connecticut was the first state to launch a regulated stewardship program (May 2015), followed by California (January 2016) and Rhode Island (May 2016).

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[120] http://www.metrovancouver.org/services/solid-waste/SolidWastePublications/EconomicandEnvironmentalImpactsofMattressRecyclinginBC.pdf
[121] http://cwma.ca/wp-content/uploads/2018/10/Henderson.pdf

Across the three states, mattresses are collected at more than 300 locations where the public is able to drop off old mattresses and box springs for recycling at no cost. Eleven contracted recycling facilities (operated by a mix of for profit and non-profit businesses) process mattresses on behalf of the program. California has seven recyclers; Connecticut and Rhode Island each have two.[122]

In all three states, the programs are financed by visible fees collected from consumers on all mattresses and box springs at the point of sale. The fees are $9 in Connecticut, $16 in Rhode Island, and $10.50 in California. The fee is used to operate the program in each state by covering the cost of collecting and transporting mattresses to contracted recyclers for deconstruction, and to pay recyclers a per-mattress fee.[123]

It is important to note that although the mattress producers are mandated to create a statewide mattress recycling program to collect and recycled mattresses and boxsprings that are discarded, the recycling of mattresses through the program is voluntary, as none of these states have implemented a landfill ban. Consumers and other entities have the choice of disposing mattresses in the municipal solid waste stream, at a cost, if they choose.

In January 2017, Bye Bye Mattress announced that the three states had recycled 1M mattresses, roughly 5% of all mattresses disposed in a year. In doing so, these programs saved roughly 11M cubic feet of landfill space and employed more than 200 people.[124]

In addition to the three state EPR programs, IKEA introduced a national mattress recycling program in October 2017.[125] The program includes old mattresses of any brand that are picked up when a new IKEA mattress is delivered, as well as all mattresses that are returned by customers at IKEA stores. Through the program, all mattresses returned by customers or those removed from displays in IKEA stores are individually bagged, taped, and stored outside until they are ready to be picked up and transported to recyclers throughout the US.

[122] 2017 report by Cascade Alliance (http://cascadealliance.us/wp-content/uploads/2017-Mattress-Recycling-White-Paper.pdf)

[123] http://cascadealliance.us/wp-content/uploads/2017-Mattress-Recycling-White-Paper.pdf

[124] http://cascadealliance.us/wp-content/uploads/2017-Mattress-Recycling-White-Paper.pdf

[125] https://www.uschamberfoundation.org/ikea-us-introduces-national-mattress-recycling-program-0

A.8.6 Electronics and Appliances Data

Materials designated in expanded electronics and appliances programs in other jurisdictions are presented in the table below.

A. 12: Products Included in BC's Outdoor Power Equipment Program[126]

OPE Category	
1. Hand-Held OPE	
Examples of Products Accepted: • **Brush cutters/loppers** • **Chain saws** • **Garden shears** • **Garden sprayer/insect fogger** • **Ice drill** • **Lawn blowers/vacuums**	• Pole chainsaw • Pole saw / Pole pruning saw • Post hole digger • Tiller • Trimmers (Grass, hedge, etc.) • Split boom
2. Walk-Behind OPE	
Examples of Products Accepted: • **Lawn mower** • **Snowthrower / Snowblower** • **Tiller / Cultivator**	• Walk behind sprayer • Dethatcher • Edger / Trimmer • Lawn Aerator
3. Free-Standing OPE	
Examples of Products Accepted: • **Mulcher** • **Pressure washer** • **Wood chipper / shredder** • **Wood splitter**	
4. Lawn Tractors	
Examples of Products Accepted: • **Lawn tractor**	

The OPEIC program is a non-profit stewardship program funded by an environmental handling fee (EHF) applied to electric outdoor products brought into BC by electric outdoor power equipment manufacturers, distributors, and retailers. The recycling fee may be included in a product's price or displayed as a separate charge at checkout.

[126] https://www.opeic.ca/consumers.html#t12n232

A. 13: 20 Products Addressed in CESA's EPR Plan in BC

Product Category
1. Kitchen Countertop – Motorized Appliances
2. Kitchen Countertop – Heating Appliances
3. Kitchen Countertop – Heating Appliances (coffee/tea)
4. Microwave Ovens [previously Microwaves (large) and Microwaves (small) categories]
5. Time Measurement and Display Devices
6. Weight Measurement
7. Garment Care Appliances
8. Air Treatment Appliances [previously Air Treatment Appliances, Desk & Tabletop Fans categories]
9. Personal Care Appliances
10. Full-size Floor Cleaning Appliances
11. Smaller Floor/Surface Cleaning Appliances
12. Test and Measurement Tools
13. Hand-held Power Tools
14. Bench-top, Demolition, Free-Standing Power Tools
15. Sewing / Textile Machines
16. Exercise Machines
17. Sports, Leisure, Arts, Crafts, Hobby Devices
18. Designated Very Small Items [previously Part 1 & 2 Designated Very Small Items categories]

A. 14: List of Major Appliances Obligated in BC

Product Category	Product List and Details
1. Full-Size Refrigerators & Wine Coolers/Beverage Centres	Side-by-side refrigerators, top mount refrigerators, 3+ Door refrigerator, cooling only refrigerators, full size refrigerators intended as wine coolers and beverage centres, beer keg and wine dispensers
2. Compact Refrigerators & Wine Coolers/Beverage Centres	Refrigerator or refrigerator/freezer combinations, beer keg and wine dispensers, under-counter refrigerator drawers, compact refrigerators intended as wine coolers and beverage centers, compact refrigerators with a built-in cooking unit(s) and/or sink
3. Freezers	Chest freezers, upright freezers, under-counter freezer drawers, compact freezers, ice makers
4. Room Air Conditioners	Through the wall air conditioners, horizontal and/or vertical air conditioners mounted in a window
5. Portable Air Conditioners	Air conditioners specifically designed to be moved from place to place
6. Dehumidifiers	Free standing dehumidifiers
7. Clothes Washers	Top loading clothes washers, front loading clothes washers, top or front-loading clothes washers designed to be assembled by the end user into a stacked laundry unit with a clothes dryer, stacked laundry products; top or front-loading clothes washers that also dries clothes
8. Clothes Dryers / Steam Cleaners	Top loading clothes dryers, front loading clothes dryers, top or front-loading clothes dryers designed to be assembled by the end user into a stacked laundry unit with a clothes washer, stacked laundry products that contain both a washer and a dryer
9. Ranges	Free standing rangers, ranger that include a warming dryer, slide in ranges, ranges with dual cavities, drop-in ranges
10. Range Hoods and Downdrafts	“Downdraft” kitchen cooking ventilation systems, range hoods with fans that are connected to an externally vented duct, decorative hoods, range hoods that contain a filter that are not connected to an externally vented duct
11. Built-In Ovens	Built-in ovens, separate warming drawers, built-in over in combination with a microwave oven, double wall ovens

12. Built-In and Over the Range Microwave Ovens	Over the range microwave ovens, microwave ovens designed to be permanently installed and affixed with kitchen cabinetry
13. Surface Cooking Units	Cook-tops installed into the counter top, surface cooking units used in ICI applications that have the same design characteristics as residential surface cooking units
14. Dishwashers	Portable dishwashers, built-in dishwashers, dishwasher drawers, convertible dishwashers
15. Food Waste Disposers	Food waste disposers that are integrated into the plumbing system of a household
16. Trash Compactors	Trash compactors whether permanently installed or portable
17. Electric Beverage Dispensers	Beverage dispensers mounted under the counter or built-in that are integrated into the residential plumbing system, electric beverage dispensers used in ICI applications that have the same design characteristics as residential electric beverage dispensers

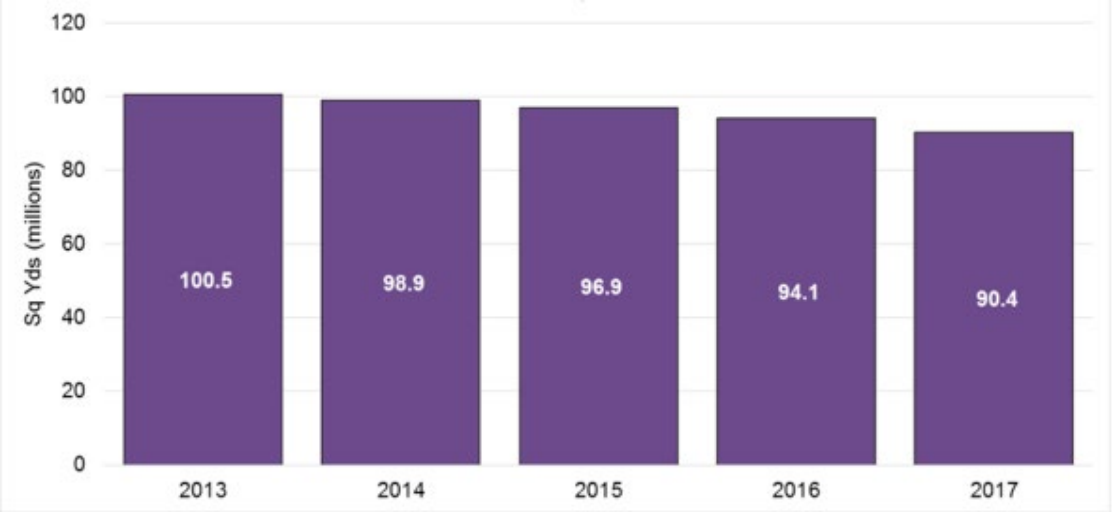
A.8.7 Information on California's Carpet Stewardship Program

California's carpet stewardship program has been in place for over 6 years and is run by CARE (Carpet America Recovery Effort). The information in this appendix is taken from the California Program 2017 Annual Report.[127]

In 2017, reported annual carpet sales (90.4M square yards) were down 3.9% compared to reported sales in 2016 (94.1M square yards).

[127] https://carpetrecovery.org/wp-content/uploads/2018/09/2017careannualrptfinal.pdf

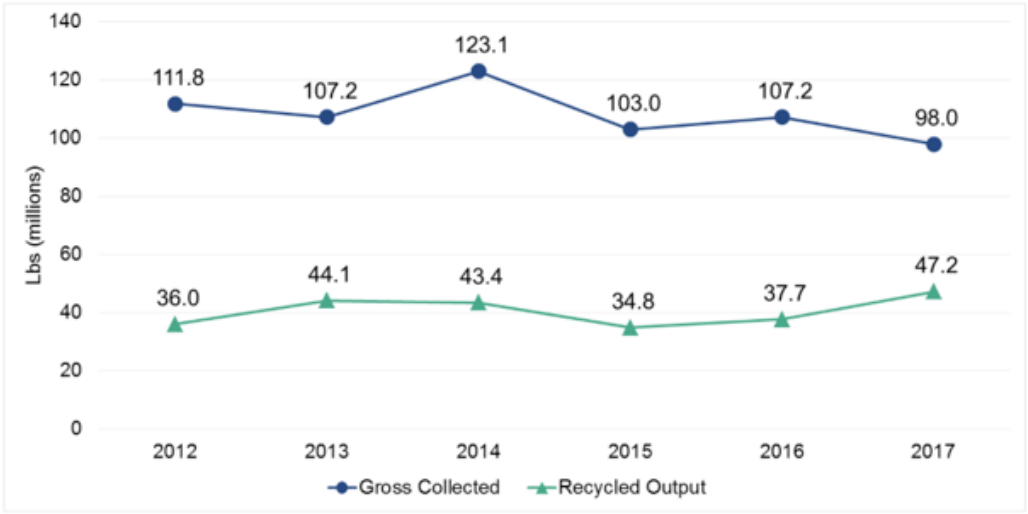
A. 15: California Carpet Sales Over Time



Total carpet sales in 2017 were 90.4M square yards (396.7 M lbs.).

In 2017, an estimated 338M lbs. of post consumer carpet (PPC) were destined for landfills and available for collection in California. Of these calculated discards, approximately 98M lbs. were gross collected (approximately 29%), of which 47M lbs. were recycled. Since the program began, gross collections have ranged from 28-34% of discards, or roughly one third of total estimated discards.

A. 16: Annual Performance Trends for Gross Collections* and Recycling Output** Over Time



**Gross collection in 2017 applies a new calculation methodology to avoid potential double counting of pounds shipped domestically and reported by participating processors. Figures previously reported for prior years are unchanged.*

***Recycled output includes reuse + Type 1, Type 2, and PC4 (used as a raw material) recycled output pounds. Pounds diverted from landfill through international shipments, or via energy recovery (CAAF and/or Kiln and WTE) are reported within pounds diverted.*

Recycled Output

Recycled output includes the portion of gross collected PCC after processing (e.g. shredding, shearing, hammer milling, and de-polymerization) that is shipped and sold as material to be used in the manufacturing of new or secondary products made with post-consumer recycled carpet content. The Program's recycled output is calculated as the sum of all Type-1 and Type- 2 recycled outputs (including PC4 and carcass), plus reuse.

Recycled output for 2017 reached an historical high of 47M lbs., a 25% increase from the 38 M lbs. reported for 2016. Recycled output as a percentage of total discards (recycling rate) increased, from 11% in 2016 to 14% in 2017. One quarter in 2017 (Q1 2017) achieved a 16.3% recycling rate, before falling to 13% in Q2 and Q3 and finishing the year at 14% in Q4. A significant portion of the drop in Q2 is attributed to a major interruption due to mechanical issues for one of the recyclers. Since the program's inception in July 2011, a cumulative total of 255 M lbs. of PCC (14% of discards) have been recycled. Further information about the efforts to increase recycled output.

Disposal

In 2017, total disposal was 259 M lbs. of PCC, up 2% from 257 M lbs. in 2016. (Note that some additional diversion may be occurring due to untracked reuse or other upstream processes outside of the California Program reporting processes. This diversion may have a slight impact on the actual pounds sent to landfill.)