NATIONAL WASTE CHARACTERIZATION REPORT:

THE COMPOSITION OF CANADIAN RESIDUAL MUNICIPAL SOLID WASTE

Executive Summary

In 2016, Canadians generated approximately 34 million tonnes of municipal solid waste. Of this amount, 9 million tonnes (27%) was diverted through material recovery facilities or centralized organics processing operations (i.e., recycling and composting), and 25 million tonnes (73%) was sent for disposal in landfills, to incineration facilities, for thermal treatment (e.g. energy from waste, gasification) or for residual waste processing (e.g. conversion to an alternative fuel source).[1] This national waste characterization study has been undertaken to develop a better understanding of the characterization of Canada's residual municipal solid waste (MSW).

The main approach for this study is outlined below:

- Compile an inventory of residual MSW waste audit data and reports from across Canada
- Compare and harmonize collected residual MSW data using seventeen primary categories and by waste source (sector), where possible
- Estimate the percentage of residual MSW in each primary material category disposed, with a focus on degradable, organic material, by province/territory and prepare a corresponding national weighted average
- Estimate the per capita disposal for residual MSW in each primary material (kg/capita) by province/territory and the corresponding national per capita disposal rate (kg/capita)

Figure 1 shows the current national average (%) of materials in residual MSW originating from residential; industrial, commercial and institutional (ICI); and demolition, land-clearing and construction (DLC) sources. Degradable waste - made up of food, diapers, pet waste, paper and wood - makes up the largest component, followed by plastics and building materials.

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[1] Statistics Canada. Table 38-10-0034-01 Materials diverted, by type and Table 38-10-0032-01 Disposal of waste, by source
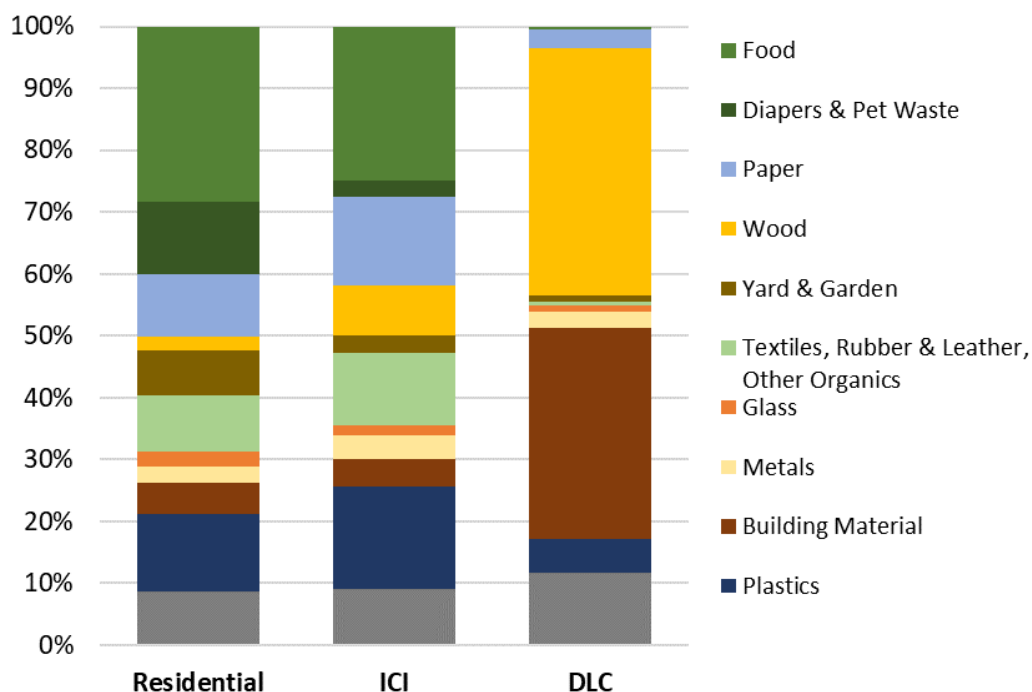
Figure 1 National Average % Composition of residual MSW, by sector (2016)

Figure 2 shows the quantity of materials (by weight) disposed in 2016, per sector. In terms of quantity, degradable materials make up the majority of disposed MSW in Canada. Food waste is the largest category – making up 28% of residential MSW and 25% of ICI MSW. In total, just under 6 million tonnes of food waste (both inedible and edible) were disposed in residual MSW in 2016.

Estimated quantities of select materials disposed in 2016 were compared to quantities estimated for 2002 in a previous waste characterization report completed by Natural Resources Canada in 2006.[2] The most notable difference was the annual quantity of paper disposed - which decreased by over 4 million tonnes between 2002 and 2016. The Plastics, Organics, Wood, and Building Materials categories all show smaller increases in quantities of waste disposed between 2002 and 2016. Overall, per capita disposal of residual MSW decreased from 760 kg/capita in 2002 to 692 kg/capita in 2016.

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[2] NRCAN, 2006. An Analysis of Resource Recovery Opportunities in Canada and the Projection of Greenhouse Gas Emission Implications
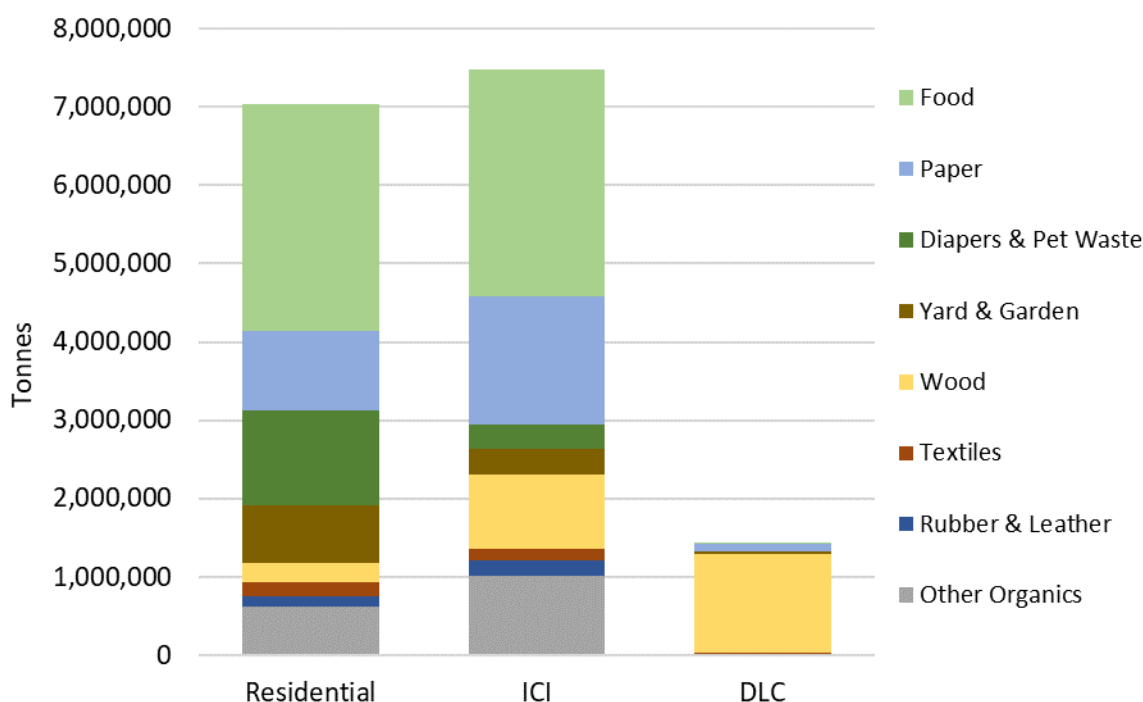
Figure 2: National Quantities of Degradable Waste Disposed, by sector (2016)

In undertaking this study, significant data and information gaps were identified and recommendations were made to support development of a more robust National Waste Characterization in the future. One of the proposed key action areas is to develop a data gathering approach that will support the standardization of residual MSW categorization. Once consistent categories are adopted, the data set will provide a strong and valuable national perspective. Another proposed key action area is to explore the development of a program to collect residual waste characterization information from local/regional/provincial authorities for compilation and analysis on a continual/routine basis.

Consistent measurement and reporting is essential to monitor waste reduction and diversion progress. Many municipalities, provinces, territories, recycling councils, waste management associations and private businesses in Canada have been measuring residual MSW disposed in Canadian landfills on some level, but the measurement approach is inconsistent. Reliable measurement and reporting will eventually result in an improved account of progress in reducing the amount of waste sent to landfill in Canada and reduction of associated greenhouse gas (GHG) emissions from Canada's waste sector.

With improved waste measurement data, municipalities, other orders of government, non-profits and the private sector can measure their success in reducing and diverting waste. This data also provides information on the resource recovery opportunities that exist – supporting project development that removes materials from disposal/incineration to more beneficial uses such as recycling, composting and/or energy generation. Combining this data with knowledge of specific policy approaches, could also assist in identifying the most effective policy approaches.

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1.0   Introduction

Residual municipal solid waste (MSW) is the waste collected from residential; industrial, commercial and institutional (ICI); and construction, renovation, demolition (CRD) sources that is destined for landfill, incineration or a residual waste processing facility. It does not include material that is collected and diverted from landfill to recycling, composting or other management endpoints. Municipal and regional data on the composition of residual MSW in Canada is available but is not regularly inventoried by provinces, territories or the federal government. The goal of this study is to determine the current composition of residual MSW incinerated or disposed in Canadian landfills.

Background on Canada's Waste

In 2016, Canadians generated approximately 34 million tonnes of municipal solid waste. About 40% of the waste generated originated from residential sources and 60% from non-residential sources. Of this total, 9 million tonnes (27%) was diverted through material recovery facilities or centralized organics processing operations (i.e., recycling and composting), and 25 million tonnes (73%) was sent for disposal in public and private landfills.

Between 2002 and 2016, the quantity of solid waste diverted through recycling and composting increased by 40%. In 2016, paper fibres made up the largest portion of all diverted materials at 3.6 million tonnes diverted, followed by organics (food + yard & garden waste) at 2.6 million tonnes.[3] Despite the increase in waste being diverted from landfills, the overall quantity of municipal solid waste sent for disposal increased by 4% during the 2002 to 2016 period.[4]

Study objectives

Although many municipalities conduct waste characterizations regularly to inform waste management planning, this data has not been collected consistently across the country at the provincial, territorial or federal level. The last national effort to compile this data was in 2006 when Natural Resources Canada (NRCan) completed a study to identify the resource recovery opportunities that existed in the waste materials generated in Canada. The study estimated the quantity of recoverable (recyclable) materials disposed in 2006 and the GHG emission reductions that could be realized by diverting this material to recycling processes. Data from municipal waste characterizations reports were compiled and analysed to generate provincial and territorial level estimates of the percentage of materials in urban and rural waste.[5]

This updated national waste characterization was completed to support several current initiatives, including:

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[3] Statistics Canada. Table 38-10-0034-01 Materials diverted, by type and Table 38-10-0032-01 Disposal of waste, by source

[4] Statistics Canada. Table 38-10-0034-01 Materials diverted, by type and Table 38-10-0032-01 Disposal of waste, by source

[5] NRCAN, 2006. An Analysis of Resource Recovery Opportunities in Canada and the Projection of Greenhouse Gas Emission Implications

- The Canadian Council of Ministers of the Environment (CCME) Aspirational Canada-Wide Waste Reduction Goal[6] to reduce per capita waste disposal from 706 kg per person in 2014, to 490 kg per person (a 30% reduction) by 2030, and to 350 kg per person (a 50% reduction) by 2040.
- The CCME Strategy on Zero Plastic Waste[7], which recognizes the importance of effective research and monitoring systems to inform decision-making and measure performance.
- The United Nations Sustainable Development Goal 12.3[8] and the Food Policy for Canada[9] initiative on reducing food loss and waste will both require data on the proportion of food waste in municipal solid waste to track progress and will inform initiatives underway to reduce both the generation and disposal of food waste.
- Estimation of methane emissions from Canadian landfills in the *National Inventory Report (NIR): Greenhouse Gas Sources and Sinks in Canada*[10] requires data on the percentage of specific degradable, organic materials in the municipal solid waste disposed. Updated information on the quantity of degradable organics in residual MSW will enable better estimation of methane emissions from landfills and support the policy approaches identified in Environment and Climate Change Canada's Strategy on Short-Lived Climate Pollutants[11].
- The processing of organic material to generate energy and soil amendments has been accelerating in recent years. Better data on the quantity of organics in residual municipal solid waste could inform an evaluation of the potential for this waste stream to produce low carbon energy.

Study Approach

Throughout 2018, Environment and Climate Change Canada (ECCC) collected waste audit data and reports by reaching out to governments, the private sector, waste associations, recycling councils and through an in-depth internet search for publically available data. Over 120 studies related to waste characterization in Canada were collected and, of these, 61 were selected for incorporation into the analysis. While the amount and quality of waste composition data varied between provinces and territories, each province/territory had at least one residual MSW dataset within the temporal timeframe (2008 to 2018) which could be included. Waste composition data from these studies was organized into seventeen primary material categories and harmonized according to these categories and by waste disposal source (sector), where possible.

The approach used to calculate average % compositions for material categories (e.g. plastic, food, paper, etc.) considers waste disposal distribution (quantity disposed, by sector) to calculate provincial/territorial average % composition, and waste disposal distribution (quantity disposed, by province/territory) to calculate national average % composition. These average % compositions represent the percentage of material categories in residual MSW between 2008 and 2018. Available data on the quantity of total residual MSW disposed in 2016, by province and territory, was used to calculate quantities disposed for

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[6] CCME, 2018. https://www.ccme.ca/en/current_priorities/waste/waste/aspirational-canada-wide-waste-reduction-goal.html
[7] CCME, 2018. Strategy on Zero Plastic Waste
[8] UNEP, 2016. Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development
[9] AAFC, 2019. Food Policy for Canada
[10] ECCC, 2019. National Inventory Report (NIR): Greenhouse Gas Sources and Sinks in Canada
[11] ECCC, 2019. Strategy on Short-lived Climate Pollutants

each material category. Population data from Statistics Canada was used to develop per capita disposal rates for the various material categories.

Based on the experience of undertaking this work, key information gaps are identified and recommendations made that could contribute to a more robust national waste characterization study in the future.

2.0   Methodologies for Characterizing Residual MSW

Municipal/Regional waste characterization studies

In 1999 the Canadian Council of Ministers of the Environment (CCME) published a report titled, *Recommended Waste Characterization Methodology for Direct Waste Analysis Studies in Canada[12]*. This report harmonized the various approaches to characterizing waste so that valid comparisons could be made between and within jurisdictions in Canada. At the same time, the methodology allowed for a wide diversity of approaches to address widely varying objectives and interests. British Columbia has further developed their own waste characterization and waste audit methodology guidelines to support municipalities in undertaking waste characterizations.[13,14]

Waste consultants and contractors will often design their study in accordance with specific requirements outlined by their client. Details of all of the specific methodologies used to collect waste audit data for the waste characterization studies used in this study is beyond the scope of this report. A general indication of varying levels of waste audit types and methodology is outlined below.

A waste characterization study (commonly referred to as a "waste composition study" or "waste audit") involves physically separating, weighing and categorizing residual MSW destined for disposal. Samples are typically measured by weight to avoid inaccuracies associated by volume based measurements. Weight based measurements also increase comparability between jurisdictions.

Many waste composition studies report both primary and secondary material categories. Primary categories identify material types (e.g. Plastic, Paper) and secondary categories identify specific wastes within the primary categories (e.g. Polystyrene Foam, PVC Bottles , Wide Mouth Tubs & Lids, etc.).

Sampling can be conducted at a waste disposal facility (e.g. landfill or transfer station) or directly at the point of generation (e.g. curb-side, dumpsters). Either approach may be appropriate depending on the goals of the study and the availability of resources. The design of waste facility sampling studies is typically simpler and more cost effective. This type of sampling can provide greater insight into the total waste going to landfill, and allow better estimation of the quantity of large and oversize items. Alternatively, generator-based sampling can provide valuable information on waste generation and diversion patterns, as it offers greater opportunity for stratification of the sector that is being studied.

Two categories of waste audit sampling have been defined in this study; they are:

(1) Waste Facility Sort (WFS):

A waste facility sort is typically completed at a landfill or transfer station where collection vehicles unload waste material. Single family (SF) households usually have designated vehicles for residential

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[12] SENES Consultants Limited, 1999. Recommended Waste Characterization Methodology for Direct Waste Analysis Studies in Canada. Prepared for Canadian Council of Ministers of the Environment Waste Characterization Sub-Committee.

[13] Gartner Lee Ltd., 1991. British Columbia Procedural Manual for Municipal Solid Waste Composition Analysis. Prepared for the British Columbia Ministry of Environment, Lands and Parks.

[14] TRI Environmental Consulting Inc., 2012. Solid Waste Characterization Studies – Spreadsheet Tool. Prepared for the British Columbia Ministry of Environment, Lands and Parks.

collection while MSW from multi-family (MF) households may be collected with waste material from the ICI sector, making it more difficult to segregate the waste by sector at the drop-off point.

First, coordination with operations staff on procedures to identify collection vehicles containing garbage and other materials is required. An area must then be set aside for the load to be emptied and observed. The load is divided into a grid and each segment is numbered. One segment is randomly selected for sorting in the range of 100kg (+/- 10kg). Large, bulky objects are considered separately.

(2) Curbside Sampling Sort (CSS):

Waste samples are collected from the curb of SF residences or directly from MF buildings. Sampling is typically conducted anonymously, meaning homes are identified by a sample code and not an address. In this study, an audit was also labeled CSS if the samples were collected from a specific ICI building (dumpster).

ICI studies must consider a number of ICI operations to manage variability; therefore, the complexity of sampling among the various operations would be better managed by collecting samples directly from the waste generator as done using CSS. The high variability expected from a WFS for this sector requires a large number of samples to be collected to achieve a reasonable level of accuracy.

It is assumed that consent is not required for a SF CSS, however if informed consent is necessary, then households need recruitment using stratified random selection. Samples are then collected by a designated team instead of a regular collection vehicle. Sample collection takes place on the same day as regular collection just before the regular collection vehicles arrive. Consent is generally required for MF CSS sorts and ICI CSS sorts.

Provincial/Territorial level waste characterization

Work was undertaken by Alberta Environment, Natural Resources Canada and the Recycling Council of Alberta in 2005 to promote the standardization of waste characterization data and identify an approach for provincial scale waste characterization studies.[15] Such studies have been undertaken in Quebec and Nova Scotia in recent years and the results are utilized in this study.

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[15] Alberta Environment, 2005. Provincial Waste Characterization Framework.

3.0   Data Analysis Methodology

3.1 Data Sources

Waste Characterization Studies

Available post-2006 waste characterization studies were obtained through the cooperation of a wide network of industry and government professionals. The data extracted from each study is described below. Most studies included composition data by material type for distinct sectors (e.g. residential, ICI, DLC) whereas others reported only combined-sector averages. A list of the waste characterizations used in this report are included in Annex A.

Data Field	Description
Study Name/Location	The title of the study and the location where the study was completed
Province	The province in which the study was completed
Year	The year the study was completed
Population centre	Large, medium, small urban; rural
Sector	SF - Single Family Residential MF - Multi Family Residential ICI - Industrial, Commercial, Institutional DO - Drop Off at Waste Facility DLC - Demolition, Land Clearing, Construction COMB - Combined Weighted Avg. of all sectors categorized
Sort Type	WFS – Waste Facility Sort CSS – Curbside Sort
Source Separated Organics Program	Yes/No
Material composition	The quantity of residual MSW corresponding to each material category (e.g. paper, plastic, etc.), expressed as a percentage (by weight)

Material categories

A key task in compiling data from the collected studies was reconciling differences between material categories used by different fieldwork practitioners for various studies. Inconsistencies in material categories reflected different priorities and variations in fieldwork practices by waste analysis contractors. A primary criterion for inclusion in this study was that data existed for the majority of the material categories being studied.

The predictive model for methane generation in landfills requires detailed composition data for the degradable organic waste fraction of the total waste stream. Individual degradable waste categories were therefore included to support this modeling work.

Variations in material categories across different datasets were present in both primary and secondary data tables. If data was only available in secondary category form it had to be adjusted to fit within one of the primary categories selected for this study. Conversely, if data was only available in a high level category (e.g. "compostable organics"), the proportion of this material was distributed between

categories used in this study, based on observed trends in distribution from other studies with full datasets.

For example, the following assumptions were made to populate a full dataset for a number of studies:

> Compostable organics – This high level category was split into the Food, Yard and Garden, and Wood categories, where possible.

> Clothing, Shoes, etc. – Where possible, materials reported in high level categories such as "clothing" were split into the Textiles (degradable), Rubber and Leather, and Plastics categories.

> Household Hygiene – Since a portion of this category contains degradable categories such as Diapers, this category was subdivided, where required, to estimate the portion of diapers.

Due to variations in characterization methodologies across the studies included in this review, some material categories were not represented consistently across all studies. For example, some studies included a relatively large fraction of material in a generic "other" category, lacking data to support inferential categorization by primary material type.

The primary material categories included in this study are:

Degradable materials	Non-degradable materials
Paper	Plastic
Wood	Metals
Food	Glass
Yard and Garden	Building Material
Textiles (degradable)	Electronic Waste
Diapers	Household Hazardous
Pet Waste	Bulky Objects
Rubber and Leather	Other (Non-Organics)
Other (Organics)	

Waste Disposal Data

The total quantity of waste disposed in 2016, by province and by sector (residential, ICI, and DLC), was retrieved from the biannual Waste Management Industry Survey for Government and Business Sectors[16] published by Statistics Canada.

Statistics Canada does not publish waste disposal data for Prince Edward Island or the territories; therefore, data from a 2012 study completed for Environment and Climate Change Canada[17] and the National Inventory Report[18] was used for this review. Data regarding waste diversion is not available for

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[16] Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source
[17] Arktis, 2012. Foundation Report for a Technical Document on Municipal Solid Waste Landfills in Northern Conditions
[18] ECCC, 2019. National Inventory Report (NIR): Greenhouse Gas Sources and Sinks in Canada

the individual territories, but rather for the three territories combined. As such, the material-specific quantities of waste disposed were calculated for the three territories combined.

Quantities of waste landfilled were calculated by subtracting provincial quantities of waste incinerated (published in the National Inventory Report[19]) from quantities of waste disposed.

3.2 Calculations

For each province and territory, data was compiled by sector, and sector averages of residual MSW composition by primary material category were calculated. These sector averages are presented in Tables BC3, AB3, etc. in Annex B.

Provincial/Territorial averages and quantities disposed (landfilled or incinerated)

The provincial or territorial average is a weighted average based on the quantity of annual waste disposed by each sector. This average is calculated for each material category (where data is available) as follows:

$$Average \text{ \% } category \text{ } X$$
$$= \frac{(\%X_{PT-RES} \times Q_{PT-RES}) + (\%X_{PT-ICI} \times Q_{PC-ICI}) + (\%X_{PT-DLC} \times Q_{PT-DLC})}{(Q_{PT-RES} + Q_{PT-ICI} + Q_{PT-DLC})}$$

Where $\%X_{PT-RES}$, $\%X_{PT-ICI}$ and $\%X_{PT-DLC}$ are the average sector % compositions for a particular waste material category (in that province/territory) and Q_{PT-RES}, Q_{PT-ICI} and Q_{PT-DLC} are the total quantities of residential, ICI and DLC waste disposed (landfilled + incinerated) (per year) in that province/territory.

Where sufficient data exists, the quantity of a waste material landfilled or incinerated in 2016 was calculated for each province and territory, as follows:

$$Quantity \text{ } of \text{ } category \text{ } X \text{ } landfilled \text{ } = (\%X_{PT-AVG} \times Q_{PT-LF})$$

$$Quantity \text{ } of \text{ } category \text{ } X \text{ } incinerated \text{ } = (\%X_{PT-AVG} \times Q_{PT-INC})$$

Where Q_{PT-LF}, is the quantity of waste landfilled and Q_{PT-INC} is the quantity of waste incinerated in each province and territory.

These values are compiled in Annex B.

National averages and quantities disposed

National averages were calculated for each material category for each waste sector (i.e. residential, ICI, DLC). Because there was a lack of representative data for some provinces and territories (mainly Manitoba, Alberta, Ontario, Quebec and PEI) in some sectors and for some categories, data from provinces with similar programs/initiatives in place related to diversion were used. The use of surrogate data and the approach used to generating national averages depended on available data:

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[19] ECCC, 2019. National Inventory Report (NIR): Greenhouse Gas Sources and Sinks in Canada

- **Residential**: There were 56 studies that included residential data, from every province and territory, except for PEI. The average residential waste composition from the NS study was used to represent PEI residential waste. Given the amount of available data, "P/T waste-disposed" weighted averages for each category were calculated to represent national averages. In some cases, where no data was available for a particular category, surrogate data was used and the "other" categories adjusted accordingly.
- **ICI**: There were 28 studies (15 from BC) available for the characterization of ICI waste in Canada. Because some provinces lacked representative studies, surrogate data was used to calculate national averages and quantities of material in ICI waste as follows: BC data was used to represent ON; AB data was used to represent SK and MB; NS data was used to represent PEI. "P/T waste-disposed" weighted averages were calculated to represent national averages for each category.
- **DLC**: There were 15 studies that characterized DLC waste (8 from BC). With sufficient data available for the largest provinces, a "P/T waste-disposed" weighted average was calculated. To fill data gaps at the provincial level, surrogate data was applied as follows: NL data was used for NS, NB and PEI; SK data was used for MB; and NT data was used for NU.
- **DO**: This sector includes a variety of waste types. Most of the 27 studies are from BC, and show significant variability across the primary categories of Food, Wood, Building Materials, and Plastic. An arithmetic average was calculated to provide an estimate of the national composition of DO waste in Canada.

National estimates of the quantity of a particular waste material disposed in 2016 were calculated using the calculated national average % composition for each category (per sector) and the quantity of waste disposed that originated in that sector, as follows:

$$\begin{aligned} Quantity\ of\ &waste\ disposed\ in\ Canada\ for\ category\ X \\ &= (\%X\ RES_{CAN} \times Q_{CAN-RES}) + (\%X\ ICI_{CAN} \times Q_{CAN-ICI}) \\ &\quad + (\%X\ DLC_{CAN} \times Q_{CAN-DLC}) \end{aligned}$$

Where,

$\%X\ RES_{CAN}$, $\%X\ ICI_{CAN}$ and $\%X\ DLC_{CAN}$ are the national average % composition for category X in residential, ICI and DLC waste

$Q_{CAN-RES}$, $Q_{CAN-ICI}$ and $Q_{CAN-DLC}$ are the national quantities of waste disposed originating in the residential, ICI and DLC sectors.

National waste disposed-weighted averages and quantities disposed are presented and discussed in Section 4.0 of the report. It is important to note that all tonnages/percentages in this report have been rounded to one or two significant figures and therefore may not always sum to 100%.

4.0   National results

4.1 Residential

Residential residual MSW is the portion of Canada's waste generated by single-family homes and multi-family residences. Data on residential waste was available from 56 waste characterization studies – with audit approaches split evenly between characterization of curbside collected sorts and waste facility sorts.

Figure 4.1 shows the current national average composition of Canadian residential residual MSW. This represents the average composition of waste that is disposed in landfills or incinerated. The largest category is Food (28%) followed by Plastics (13%), Diapers & Pet Waste (12%), and Paper (10%). Approximately 70% of the residential waste disposed in Canada is degradable and will produce methane when disposed in landfills.
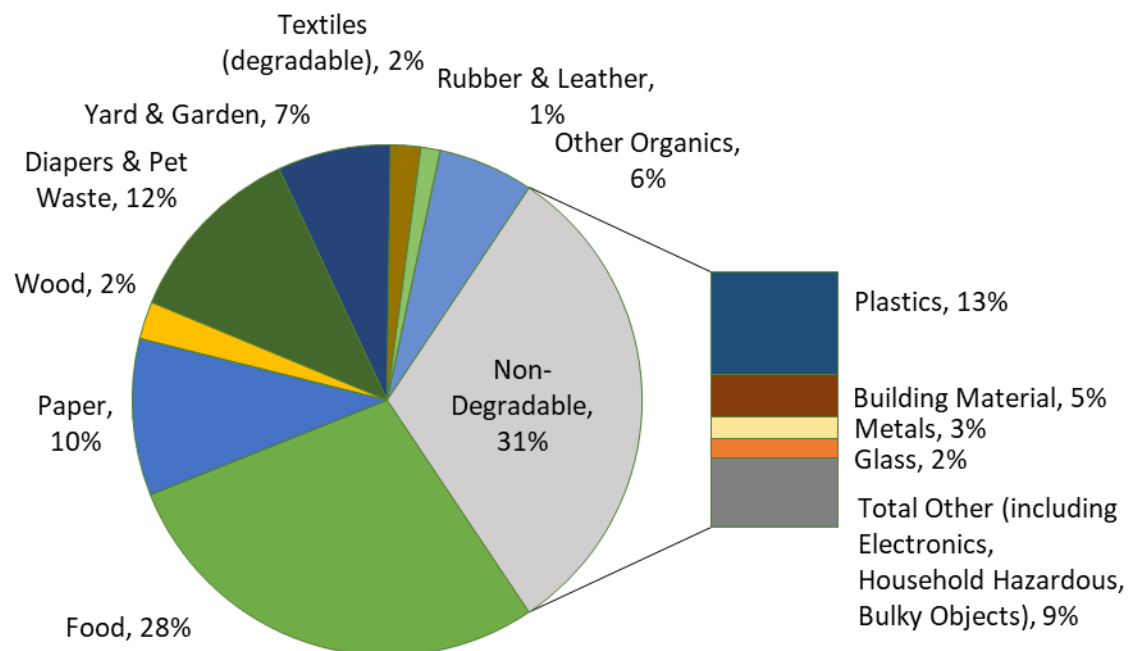
Figure 4.1: National average % composition of Canadian residential residual MSW (2016)

4.2 Industrial, Commercial and Institutional (ICI)

The ICI waste characterization studies included in this review described the types of businesses that were surveyed. Based on these descriptions, it does not appear that a significant portion of industrial sources were represented. Sources of ICI waste typically included institutions such as hospitals, medical clinics, schools, and businesses such as restaurants, retail, and office buildings. Few studies explicitly included manufacturing or other industrial sources, so this data does not provide a complete representation of the residual waste generated from non-residential sources in Canada. A total of 27 waste audits, primarily from waste facility sorts, included characterization data on the ICI sector that was sufficiently detailed to include in the study.

Figure 4.2 provides the average national characterization of waste from the ICI sector in Canada.
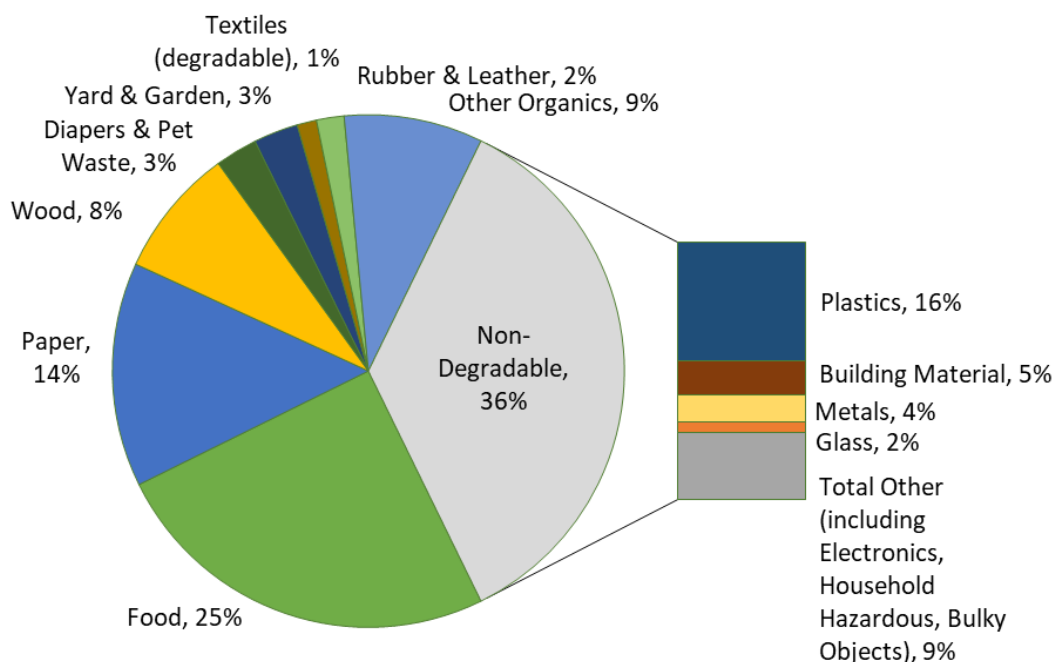
Figure 4.2: National average % composition of Canadian ICI sector residual MSW (2016)

The largest category in ICI sector residual MSW is Food (25%) followed by Plastics (16%), Paper (14%), and Wood (8%). Overall, 64% of ICI waste disposed in Canada is degradable and will produce methane when disposed in landfills.

These national averages could be improved with better characterization of Ontario's ICI sector waste. Ontario disposes just under half of all ICI waste in Canada, but little data is available to describe the composition of this waste.

4.3 Demolition, Land-Clearing and Construction (DLC) and Drop-off (DO)

Construction, renovation and demolition (CR&D) waste, is defined by Statistics Canada as follows: *"CR&D waste, also referred to as DLC (demolition, land clearing and construction waste), refers to waste generated by construction, renovation and demolition activities. It generally includes materials such as brick, painted wood, drywall, metal, cardboard, doors, windows, wiring. It excludes materials from land clearing on areas not previously developed. CR&D waste can come from residential sources such as house renovations or from non-residential sources for example the construction or demolition of office buildings."*[20] Two sectors identified by the waste characterization studies combine to form the CR&D sector defined by Statistics Canada. The DLC sector identified in the waste characterization studies is generally made up of waste that is self-hauled by contractors in the construction, renovation and demolition sector. The other fraction of the waste stream that makes up CR&D waste is drop-off waste (DO), self-hauled by non-professionals (i.e. by residents). Given the presence of non-CR&D materials (e.g. Food, Paper, etc.) in DO waste, it is evident that a portion of DO waste also represents typical residential waste.

There were 15 waste characterizations that included data on the DLC sector – half of which were from BC. Data is quite variable between provinces for certain material categories (e.g. Building Material, Plastics, Paper), and there is notable variation in some categories (e.g. Plastics) within certain provinces. On average, over 80% of DLC waste is composed of three material categories – Wood (40%), Building Material (34%) and Plastics (5%). Figure 4.3 shows the national average material composition of the residual MSW from Canada's DLC sector.
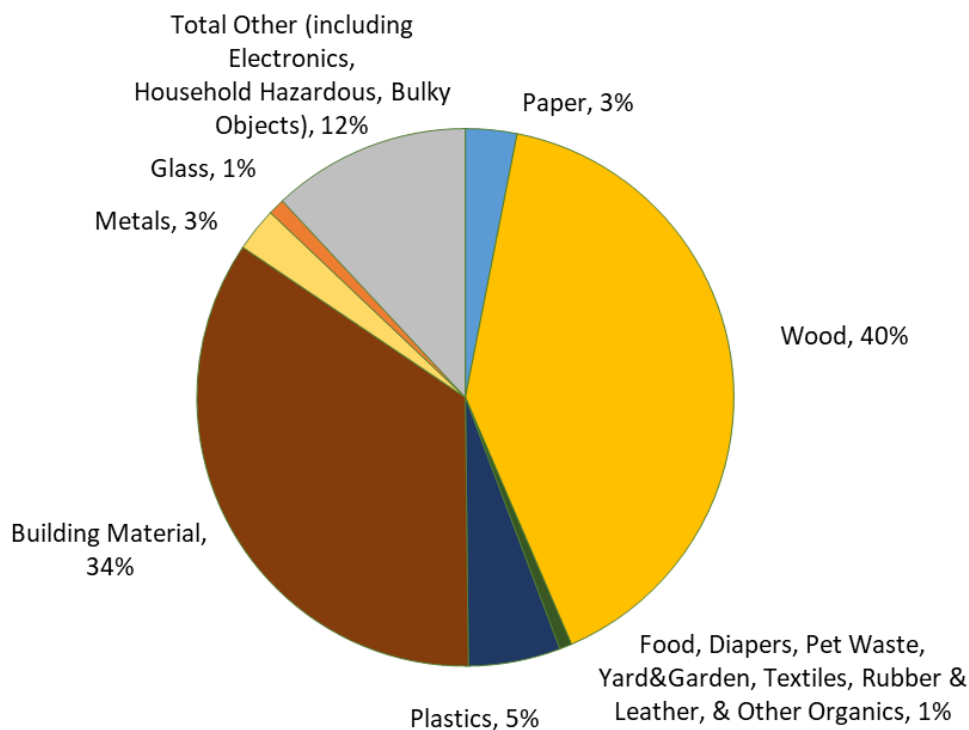
Figure 4.3: National Average % Composition of Canadian DLC residual MSW (2016)

DO waste varies across the waste characterizations available for this sector. For example, the Food category ranges from <1% to 41%, reflecting the range in quantity of typical residential waste that is

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[20] Statistics Canada. 2018 Biennial Waste Management Industry Survey

included in this waste type. Although highly variable across all waste characterizations included in the study, calculated national averages for the largest categories in DO waste are Building Material (15%), Food (14%), Wood (13%) and Plastics (13%).

Figure 4.4 provides a comparison of the characterization of waste across the three sectors – residential, ICI and DLC.
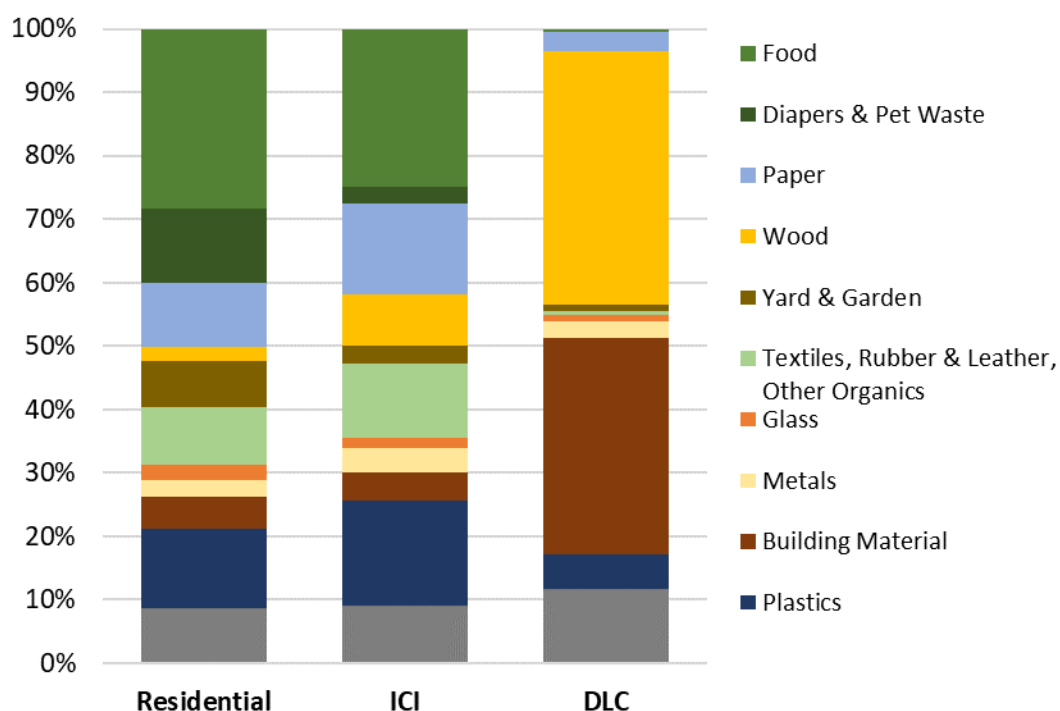
Figure 4.4 National Average % Composition of residual MSW, by sector (2016)

4.4 Quantities of waste disposed

Statistics Canada's most recent available data pertaining to Canadian waste is from 2016, and includes all waste disposed in either Canadian or U.S. landfills as well as waste that was incinerated. Applying the national average composition values to this waste data provides an annual estimate of the quantity of Canadian waste in each material category that was disposed in landfills or incinerated from each sector. In 2016, 10.2 million tonnes of waste generated from the residential sector, 11.5 million tonnes from the ICI sector, and 3.2 million tonnes from the DLC sector were disposed as follows:

- 20.3 million tonnes disposed in landfills in Canada;
- 3.8 million tonnes exported to the United States[21]; and
- 0.85 million tonnes incinerated – primarily to produce energy.

Figure 4.5 shows the breakdown, by category, of the quantity of waste disposed from each sector in 2016.

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[21] Calculated based on available data from Statistics Canada and the National Inventory Report on GHG Emissions and Sinks.
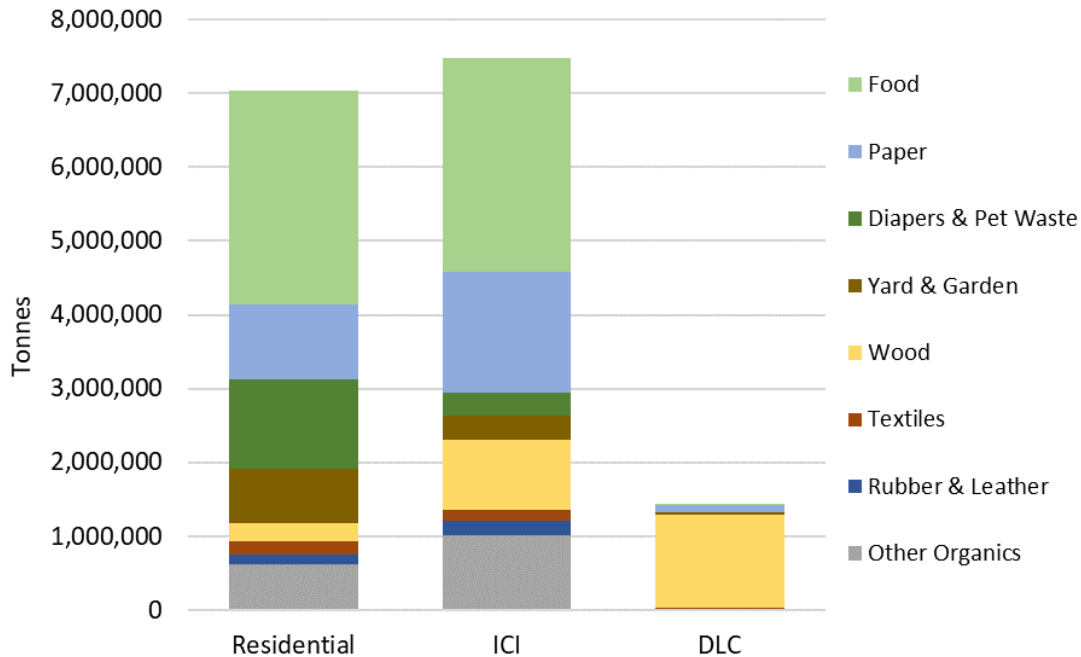
Figure 5.1: National Quantities of Degradable Waste Disposed, by sector (2016)

Figure 4.6 shows an estimated quantity of material disposed, per capita, for each province and for the territories combined. These figures make use of proxy data for provinces where certain sector (for MB, ON, NS, NB, PE) or category (for SK, MB, QC) data was not available.
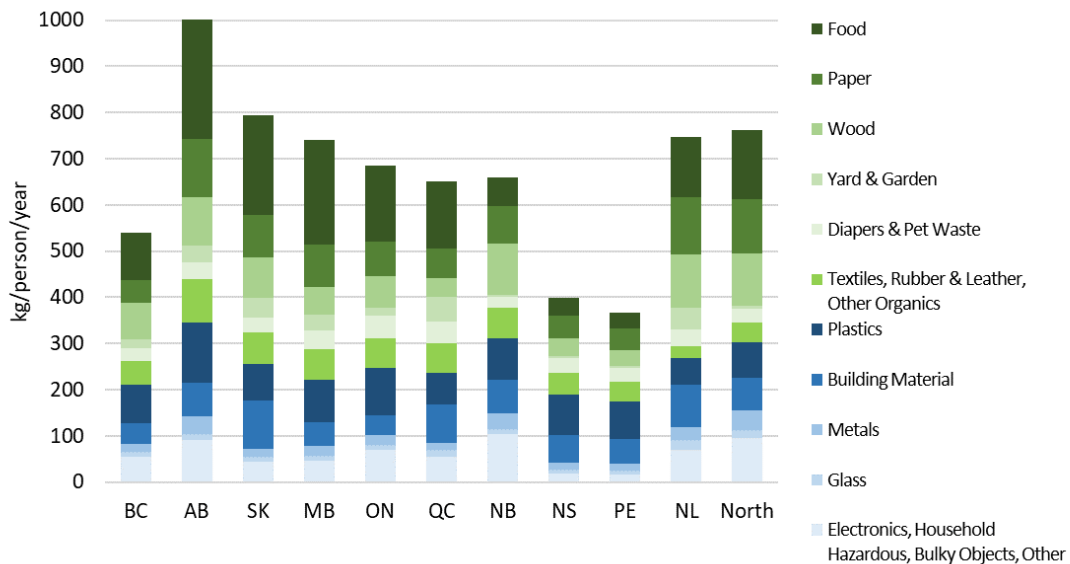
Figure 4.6 Per capita waste disposed, by material type (2016)

National per capita quantities for each waste category were calculated and are provided in Tables 4.1 and 4.2.

4.5 Comparison to 2006 study

The previous national waste composition study was carried out in 2006 by Natural Resources Canada; data from this study is summarized in Table 18.1 of that report, which provides quantities of waste disposed for several material categories for the year 2002.[22] Direct comparison of data is possible for several categories included in this study (e.g. Paper, Glass, Plastics). For others, several categories were combined in order to provide a comparison. These include:

Organics (2002) = Food + Yard & Garden + Diapers + Pet Waste + Other Organics (2016)

Renovation + Concrete + Asphalt + Drywall (2002) = Building Materials (2016)

Other + Multi-Material (2002) = Bulky Objects + Others + Electronics (2016)

Ferrous + Non-ferrous (2002) = Metals (2016)

A comparison of quantities of waste disposed in 2002 and 2016 for several categories is shown in Figure 4.7. A notable difference is the reduction by over 4 million tonnes in the quantity of paper disposed between 2002 and 2016. The Plastics, Organics, Wood, Textiles and Building Materials categories all show increases in quantities of waste disposed between 2002 and 2016. Overall, per capita disposal of residual MSW decreased from 760 kg/capita in 2002 to 692 kg/capita in 2016.
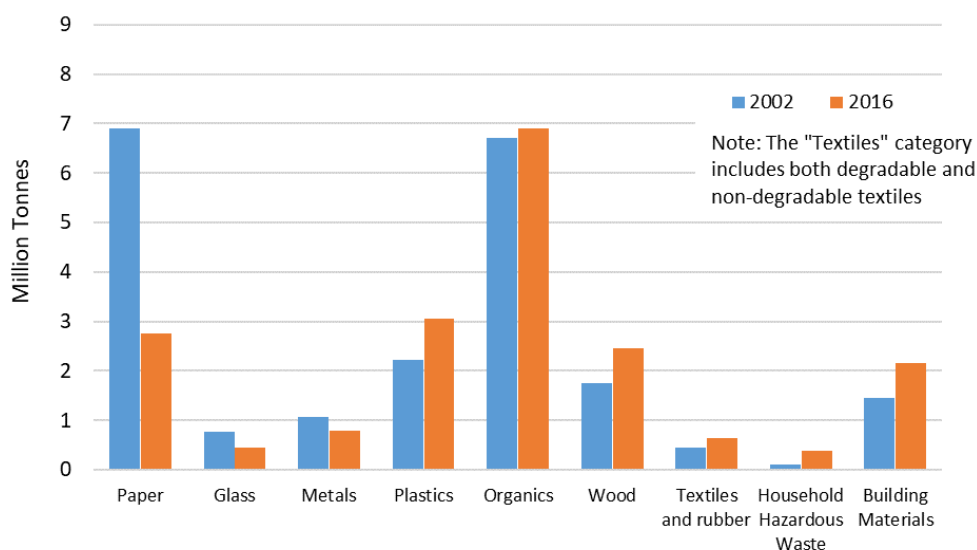
Figure 4.7 Quantities of waste disposed, selected categories - 2002 and 2016

4.6 Summary – National Average

The national average material distribution, total quantity (2016) and per capita quantities of degradable and non-degradable material types in residual MSW disposed are presented in Tables 4.1 and 4.2.

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[22] NRCAN, 2006. An Analysis of Resource Recovery Opportunities in Canada and the Projection of Greenhouse Gas Emission Implications.

Table 4.1: National average percent composition, total quantity and quantity per capita of **degradable waste materials** in residual MSW disposed in 2016

	Food	Paper	Wood and Wood Products	Yard and Garden	Pet Waste	Diapers	Textile	Rubber and Leather	Other (Degradable)
Percentage in Residual MSW (%)	23.3%	11.0%	9.9%	4.4%	3.2%	2.9%	1.4%	1.3%	6.6%
Total quantity of material type disposed (2016) (kilotonnes)	5,802	2,752	2,461	1,092	802	714	347	331	1,644
Quantity of material type disposed per capita (2016) (kg/capita)	161	76	68	30	22	20	10	9	46

Table 4.2: National average percent composition, total quantity and quantity per capita of **non-degradable waste materials** in residual MSW disposed in 2016

	Plastic	Building Material	Metals	Glass	Electronics	Hazardous Household	Bulky Objects	Other (Non Degradable)
Percentage in Residual MSW (%)	13.4%	8.6%	3.2%	1.8%	1.4%	1.5%	2.0%	4.4%
Total quantity of material type disposed (kilotonnes) (2016)	3,352	2,151	792	440	348	375	496	1,097
Quantity of material type disposed per capita (2016) (kg/capita)	93	60	22	12	10	10	14	30

Figure 4.8 illustrates the national average Canadian waste composition. An estimated 64% of the waste disposed in landfills each year is potentially degradable, and capable of producing methane, a powerful greenhouse gas. Food, paper and wood are the three largest degradable materials sent to landfill. Non-degradable waste makes up 36% of the waste disposed in landfills – primarily made up of plastics and building materials.
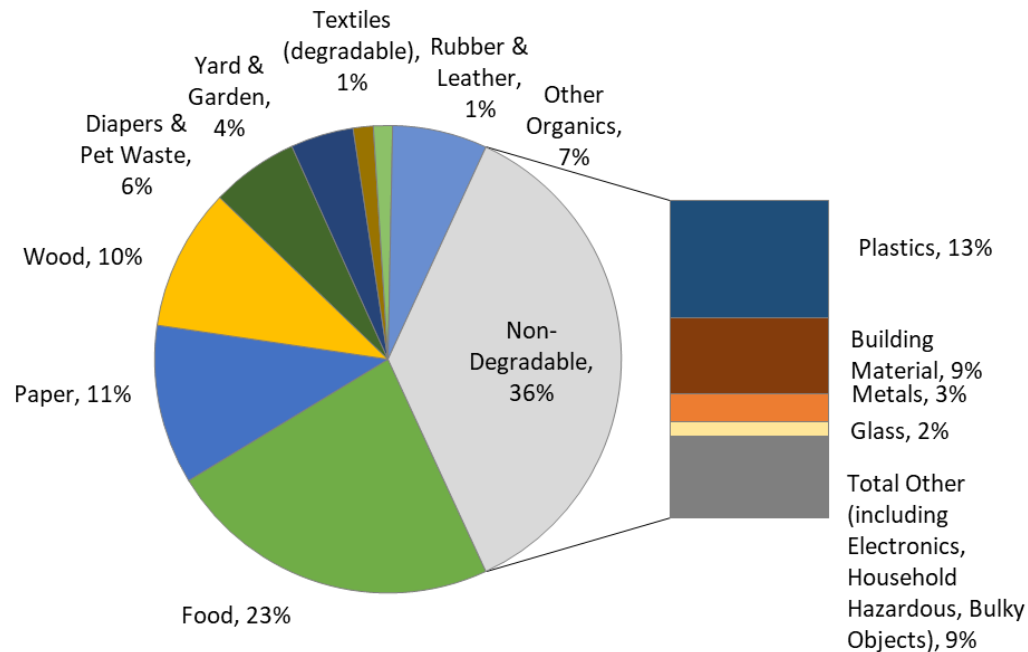
Figure 4.8 National average % composition of residual waste disposed (2016)

5.0 Results by Material Category

5.1 Degradable Waste

Total quantities of degradable waste types disposed in 2016 are shown in Figure 5.1, by sector. Overall, a similar quantity of total degradable waste was disposed from the residential and ICI sectors (7.0 Mt vs. 7.5 Mt). The largest contributors to the degradable waste category are food and paper (from both the residential and ICI sectors). Diapers and pet waste are also significant for the residential sector and wood for ICI. Wood waste is the largest degradable waste type generated within the DLC sector (2.8 Mt).
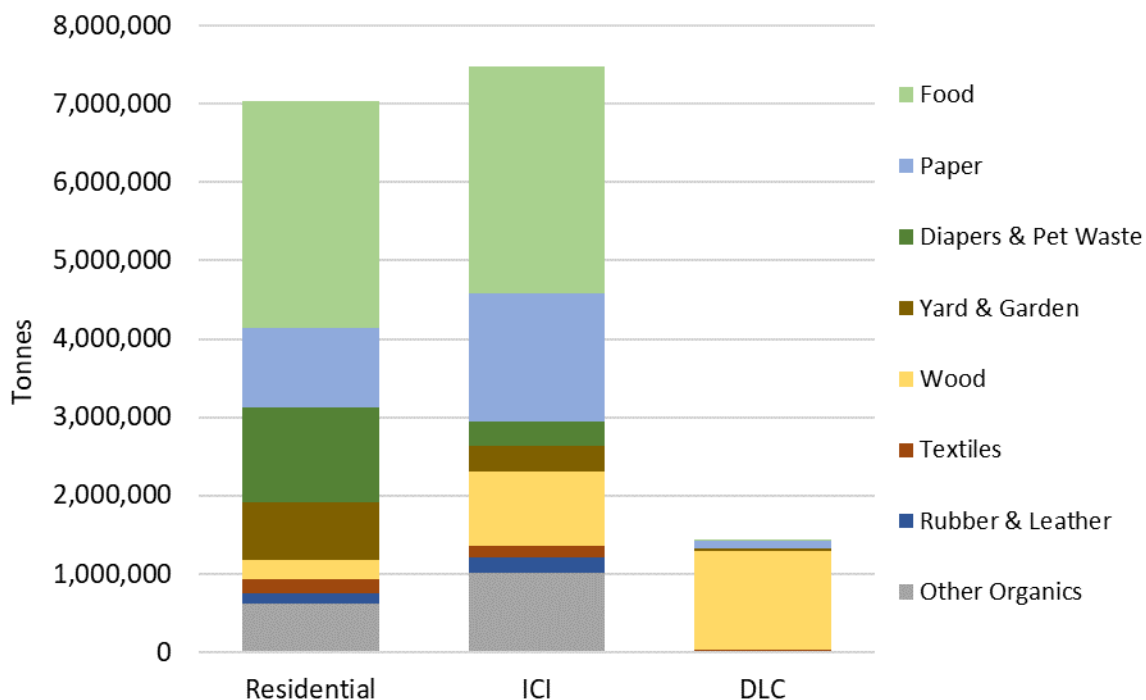
Figure 5.1: National Quantities of Degradable Waste Disposed, by sector (2016)

Food waste made up approximately 23% of all of the residual MSW disposed in 2016. Just under 6 million tonnes of both edible and inedible food waste was disposed – equally split between residential and ICI sectors. In terms of contribution from provinces and territories, the quantity of food waste disposed closely mirrors population - just under 40% of all food waste disposed in Canada is from Ontario and 20% from Quebec.

Yard and garden waste made up a small percentage of waste from all three sectors making up 4% of total residual MSW.

Since the quantity of "organic waste" diverted reported to Statistics Canada is not distinguished further, it was assumed that this category is best represented by Food + Yard & Garden waste. Figures 5.2a and 5.2b show the total quantities calculated in this study of Food + Yard & Garden waste disposed (combining residential and ICI sectors) and the quantities reported to Statistics Canada as diverted "organics". Calculated diversion rates varied across the country ranging from <1% in NL to 80% in NS.

	ON	QC	BC	AB	MB	SK
■ Organic Waste Diverted	1,133,603	268,000	592,294	239,431	51,824	31,329
■ Organic Waste Disposed	2,505,147	1,643,664	589,749	1,265,787	344,313	291,500
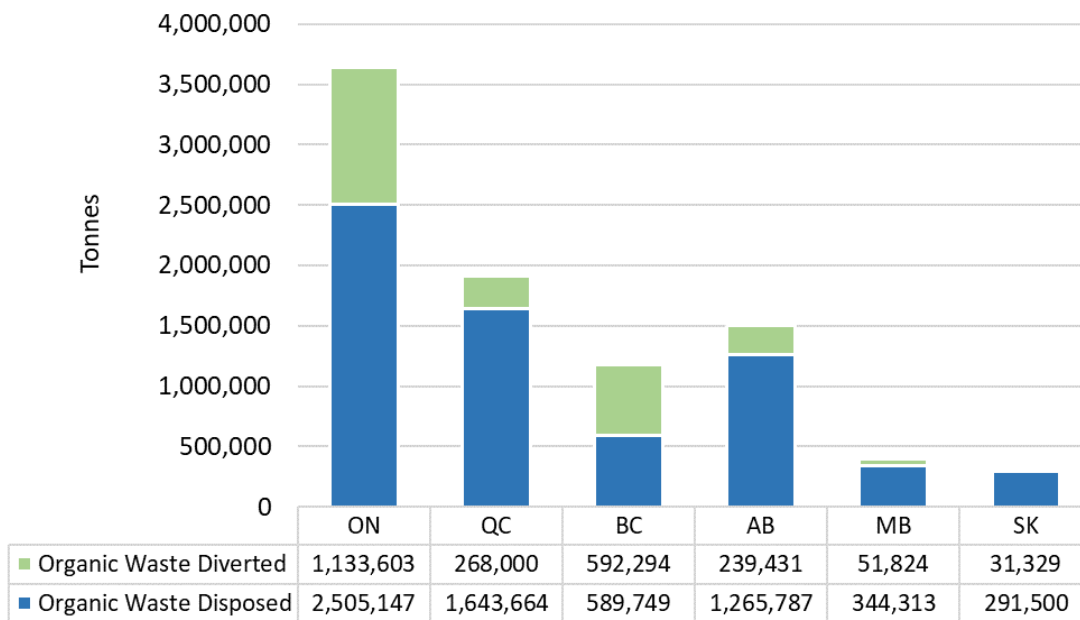
Figure 5.2a. Quantity of Organic Waste Disposed and Diverted, by region (2016)

	NS	NB	NL	PE	Territories
■ Organic Waste Diverted	156,603	97,958	401	20,181	3,990
■ Organic Waste Disposed	38,987	50,649	93,797	5,590	18,519
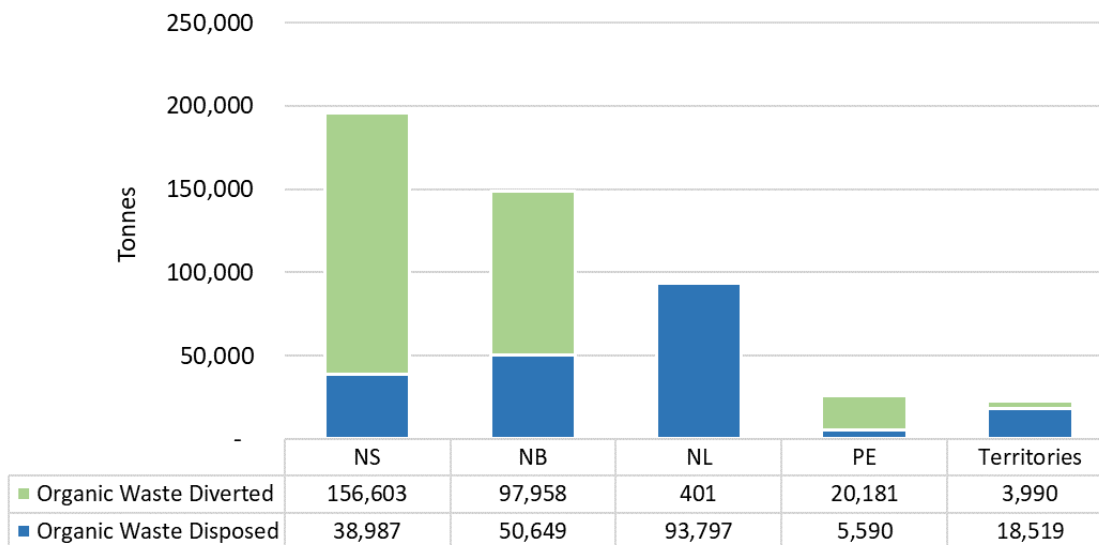
Figure 5.2b. Quantity of Organic Waste Disposed and Diverted, by region (2016)

The second largest categories of degradable waste are Wood and Paper – representing 10% and 11%, respectively, of all Canadian residual MSW disposed. The ICI sector is the largest source of paper waste disposed in Canada – making up 14% of residual MSW from this source. Figure 5.3 shows the quantities disposed (by sector) and diverted by province/region. The national paper diversion rate is 57%, with provincial diversion rates ranging from approximately 35% (AB, SK, NB) to 75% (BC).

	ON	QC	BC	AB	Atlantic	MB	SK
■ Paper Diverted	1,327,911	1,107,000	603,485	259,442	95,030	89,993	51,881
■ Paper Disposed - ICI	630,054	274,890	138,324	338,012	97,083	92,272	60,123
■ Paper - Disposed - RES	397,960	234,510	85,009	144,841	83,522	26,895	40,075
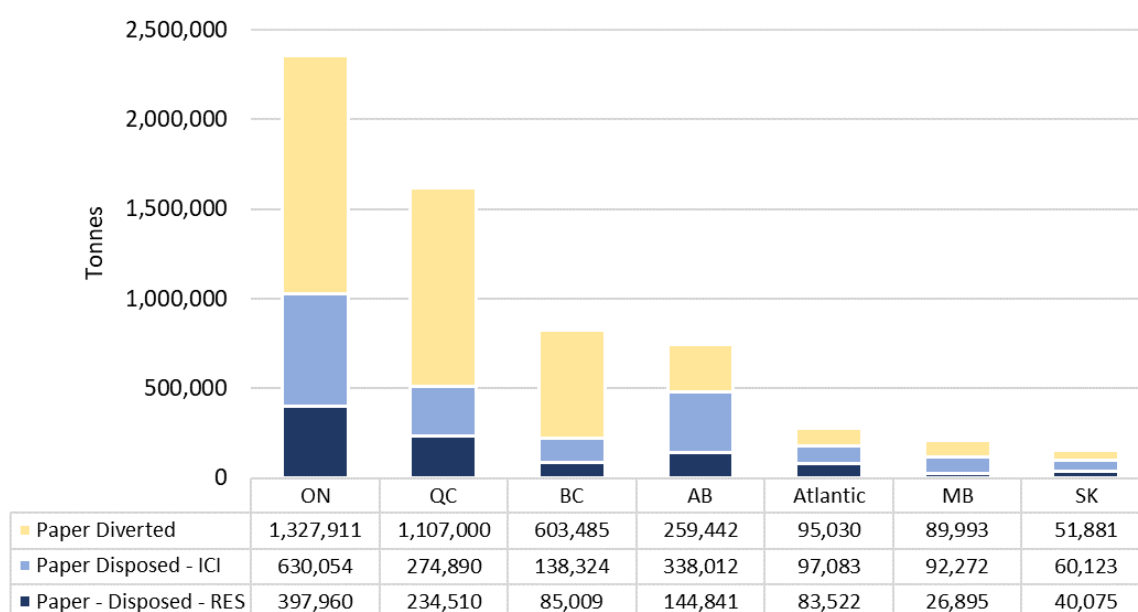
Figure 5.3. Quantity of Paper Disposed and Diverted, by region (2016)

The Wood waste category is composed of treated wood, painted wood and wood furniture. Waste from the DLC sector contains the highest proportion of wood waste, varying in proportion from 25% (QC) to 54% (ON) of the overall waste originating from this sector.

Canadian residual MSW contains minor amounts of other degradable waste types including: diapers and pet waste (both make up 3% of all Canadian MSW), degradable textiles (e.g. cotton, wool) (1.4%) and rubber & leather (1.3%). The "Other organics" category is primarily made up of soiled paper, including tissues, paper towel, and food packaging.

5.2 Non-Degradable Waste

Plastic material in residual MSW was included as a single, primary category in this study, however many waste characterization audits also included data on secondary plastic material categories such as polystyrene, plastic film, PET and HDPE, etc. Plastic resin based textiles are also included in this category. Results from this study identify that plastic waste makes up just over 13% of residual MSW disposed in Canada. The proportion of plastic in residential and ICI sector residual MSW is similar – 13% for residential and 16% for ICI – but lower in the DLC sector (5%). In 2016, the ICI sector contributed the largest quantity of plastic waste disposed (1.89 million tonnes), followed by residential (1.28 million tonnes) and DLC (0.17 million tonnes).

Glass, including beverage containers, windows and dishware, makes up 2% of all Canadian residual MSW – with 0.44 million tonnes disposed in 2016. The composition of glass in residual MSW is similar in all three sectors.

The metal category is composed of metal food and beverage packaging (cans), aluminum foil/trays and scrap metal. Approximately 3.2% of all Canadian residual MSW is composed of metal. In 2016, approximately 0.79 million tonnes of metal was disposed in residual MSW.

Electronic waste makes up 1.4% of Canada's residual MSW – primarily from the residential and ICI sectors. Approximately 0.35 million tonnes of electronic waste was disposed in residual MSW in 2016.

Figure 5.4 provides a comparison of the quantities of selected non-degradable waste categories disposed (by sector) (calculated in this study) and diverted (based on data from Statistics Canada). Metals have the highest diversion rate (44%) followed by glass (40%) and plastic (10%). Diversion rates apply to all waste in a particular category and reflect both the availability of recycling programs, participation rates and limitations on the ability to recycle all materials included in a category.
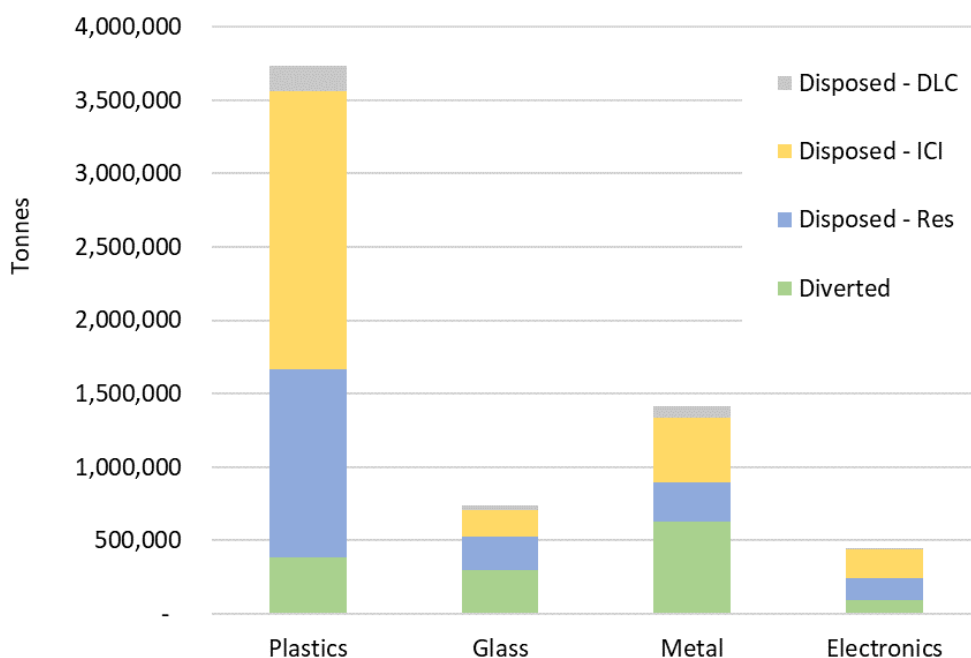
Figure 5.4 - National quantities of selected waste categories disposed and diverted (2016)

The Building Materials category is not a discreet waste type, but typically describes the component of residual MSW that is non-wood construction materials such as asphalt shingles, drywall, plaster, masonry, bricks, flooring and carpets. On a national basis, building materials make up just under 9% of Canada's overall MSW, but make up 33% of the waste derived from the DLC sector. Approximately 2 million tonnes of building materials were disposed in 2016, 50% from the DLC sector and 50% from residential and ICI sectors combined.

Other waste categories were present in total Canadian MSW at approximately 2% each including: household hazardous waste (batteries, paint, motor oil/filters, medical, light bulbs) and bulky objects (furniture, appliances).

6.0 Study Limitations

(1) Quality of data

A wide range of waste audits and associated waste characterization reports were collected and used to generate a reasonable dataset for comparison of waste content disposed from across the country. The waste audit data collection events and subsequent reports were not designed with the intent to be used in this type of study and therefore were not always easily compared. Some of the studies are complex, including data samples from all four seasons, data detailed in secondary waste categories and waste sorts with large sample sizes and multiple sampling events from transfer stations and/or landfills. Others are simple studies representing one sampling event in one season from the curbside or dumpster without the calculation of standard deviation[23] for primary material categories by waste sector. Data also varies widely in terms of population surveyed. For example, some waste composition studies represent a specific sector within a region (i.e. ICI), some represent multiple sectors combined within a region, while others represent one sector within one municipality, and so on. Virtually all of the waste characterization reports were provided by municipalities – the availability of waste characterization reports from the private sector is not known.

While it is important to note the difference in the quality of data, it is also important for the reader to understand that even though the available datasets represent a range in quality, typically the data representing large urban population centres for largely populated provinces was of the higher quality data collected.

Data was omitted from the study if it appeared to be skewed due to improper collection methods or if the sampling generated results that appeared to be beyond reasonable limits. For example, one of the studies generated in Quebec resulted in 64.7% of the material being assigned to the "Other" category; this data does not benefit this study as the twelve remaining material categories may have been inaccurately represented due to a large portion of the material simply being identified as "other".

(2) Number of waste audits collected by province/territory

One of the most obvious inconsistencies within the study is the fact that the number of reports collected and used from each province/territory varied considerably. This was in no way due to either greater participation or a lack of participation from the network of participants representing each province/territory; rather, some province/territories and local municipalities/regions have simply generated more data than others within the temporal timeframe identified. Table 8.1 provides a summary of the number of reports with usable waste characterization data from each province/territory.

Table 8.1: Number of Reports with Residual MSW Data for Use within this study (by province/territory)

Province/territory	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Territories	CANADA
No. of Datasets	21	9	2	2	11	7	1	1	1	1	5	61

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[23] Standard deviations are often determined to normalize to the data set. A large standard deviation could indicate that the data from a particular sector is highly variable depending on the source.

The majority of Canada's population resides in four provinces, BC, AB, ON and QC; therefore the majority of annual waste disposed in Canadian originates from these provinces. As can be seen in Table 8.1, the majority of reports collected for the study were from these four provinces (48 of 61).

(3) Ontario ICI and DLC Data

Ontario is Canada's largest province by population generating the most annual waste disposed in Canadian landfills. The annual waste disposed in landfill per capita is among the lowest in the country, most comparable to BC and NS at approximately 427 kg/capita. Unfortunately, the datasets collected representing the ICI and DLC sectors for ON are considered unfavorable as waste allocated to the "Other" category was approximately 47% and 37%, respectively. Since these two sectors represent over two thirds of annual MSW disposed in landfill in ON and since ON represents over one quarter of all waste disposed in Canada, the lack of data for these two sectors represents a noteworthy gap in this study. As a measure to close this data gap in calculating national averages and quantities of materials in waste disposed, ICI and DLC data from BC was used to represent ON since the per capita disposal rate for BC is most similar to ON and the dataset available from BC is the strongest of all the provinces and territories.

(4) Seasonal Variability and Moisture Content

Samples collected and audited for each of the waste characterization studies used in this study are from a moment in time. The reported quantities represent the waste environment for the period of time in which the data was collected. Seasonal and annual variability, weather, moisture content and other factors can affect the quantity and therefore composition of waste.

Seasonally, residential compostable organics is predominantly food waste throughout the year. Yard and garden waste typically forms a higher percentage of the compostable organics in the warmer months (April to October) than in the winter months. Typically moisture content between waste sectors varies. This may be attributable to the higher proportion of compostable organics (especially food waste) in the residential stream which tend to be very wet. The moisture content in non-recyclable paper and plastic (film and Styrofoam) is lowest in the cooler months, when yard and garden waste is also present in generally lower proportions of total waste. Sometimes waste weight may be lost due to loss in moisture content; therefore, recorded mass of collected sample may not represent the true mass.

(5) Temporal Range of Collected Data and Associated Waste Policies

The full dataset of studies available for use within this study spanned over 10 years from 2008-2018. While more current data is assumed to more accurately represent current disposal practices, the study would have lacked in comparable samples if only data from the last few years was considered. It was outside of the scope of the study to identify all waste collection practices and waste policies in place on a local/regional level at the time of each study; however, whether or not a source separated organics (SSO) or "green bin" program existed at the time of each collected audit was recorded in the raw data file.

7.0 Potential Areas of Future Work

1. In collaboration with provinces and territories through the CCME, explore opportunities to encourage standardization of residual MSW measurement methodologies.

Attempts to introduce a degree of standardization to waste auditing and reporting have been made previously, specifically through CCME and their report titled, *Recommended Waste Characterization Methodology for Direct Waste Analysis Studies in Canada*, 1999[24] and a 2005 collaboration between Alberta Environment, Natural Resources Canada and the Recycling Council of Alberta titled, *Provincial Waste Characterization Framework*[25]. However, local and regional data is often collected according to their precise informational priorities and funding limitations. Waste characterization studies from BC showed significant standardization, enabling a more streamlined and robust analysis. Of note, guidance that supports the development of Solid Waste Management Plans by Regional Districts in BC promotes the use of waste characterization studies to inform solid waste planning, which may be the driver for greater waste composition data availability in that province. [26] The development of a spreadsheet tool and guidance to support waste characterization work in BC has resulted in a consistent and detailed data set in the province.[27]

The range of waste auditing protocols employed by contractors across the country and the variation in reported data illustrates the need for a consistent approach to characterizing waste. Therefore a key recommendation is that measures be taken to encourage standardization of waste auditing protocols and standardization of waste categories included these studies.

2. Explore the development of a reporting protocol to collect the results from waste characterization audits on an annual or continual basis.

Currently, there are no federal reporting requirements for waste characterization data nor is there a reporting platform that would enable an efficient collection and analysis of data. In order to facilitate a future study such as the one outlined in this report, a more robust data collection process could be developed.

3. Continue to analyse the existing dataset.

Datasets used during this review could be further analyzed to provide additional insight into the variation of waste composition. Due to the large quantity of data collected and temporal limitations it was not feasible to analyze waste components at the heightened granularity offered by the secondary material categories. As discussed above, detailed data at the secondary category level was available for several key material categories including food, plastics and paper.

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[24] CCME, 1999. Recommended Waste Characterization Methodology for Direct Waste Analysis Studies in Canada
[25] Alberta Environment, 2005. Provincial Waste Characterization Framework
[26] BC MOE, 2016. A Guide to Solid Waste Management Planning, Version 1.0
[27] BC MOE, 2012. Solid Waste Characterization Studies, Standardized Spreadsheet Tool for Assisting in the Planning, Execution and Reporting for Solid Waste Characterization Studies.

4. Compare waste characterization data with waste policies and other waste reduction drivers.

It would be worthwhile to document the waste policy and waste reduction drivers in place at the time of each waste audit, and compare the waste characterization results to the suite of policy/waste reduction initiatives. This could be especially interesting for municipalities/regions that collect waste characterization data on a regular or semi-regular basis and that also introduce waste reduction policies and/or initiatives on a regular/semi-regular basis.

8.0 Conclusion

The primary objective of this study was to collect waste audit data and reports completed after 2006 to determine the current composition of residual MSW disposed in Canada.

Residual MSW data was obtained through the cooperation of a wide network of industry and government professionals. Data analysis yielded estimates (by province and territory) of the proportion of each material category in residual MSW, by sector, as well as the total and per capita quantity of each material category disposed in residual MSW. National weighted averages for these values were calculated.

This compilation of data on the composition of residual MSW in Canada is available to support a number of waste related initiatives, including work to:

- model the quantity of methane generated in Canadian landfills;
- identify opportunities for recovering resources from Canada's waste; and,
- measure progress in reducing disposal of specific materials over time.

Variability in disposal and diversion rates from one geographic region/municipality to the next is influenced by many factors such as waste management policies, distance to recycling markets, waste management infrastructure, the role of waste management stewardship agencies operating in an area, population density, tourist and transient population fluctuations and economic activity. While disposal data is only a piece of the puzzle it is useful for measuring and striving for continuous improvement.

Consistent measurement and reporting is essential to monitor waste reduction and diversion progress. As identified in this study, many municipalities, provinces, territories, recycling councils, waste management associations, NGO's and private businesses in Canada have been measuring residual MSW going to Canadian landfills on some level but the measurement approach is inconsistent. Reliable measurement and reporting will eventually result in an improved account of Canada's waste reduction and diversion progress and reduction of associated GHG emissions from Canada's waste sector.

Annex A – Waste Characterization Reports

British Columbia

British Columbia Ministry of Environment Residential Food Waste Composition Study (2015)

Metro Vancouver Waste Composition Monitoring Program (2016)

Metro Vancouver ICI Waste Characterization Program (2014)

Metro Vancouver Multi-family Residential Waste Composition Study (2017)

Capital Regional District Solid Waste Stream Composition Study (2016)

Regional District of Nanaimo Waste Composition Study (2012)

Okanagan Waste Composition Summary Data (2013)

Okanagan Regional District Solid Waste Composition Study (2012)

Fraser Valley Regional District Solid Waste Composition Study (2015)

Regional District of Fraser-Fort George Waste Characterization Study (2018)

Thompson-Nicola Regional District Solid Waste Composition Study (2011)

Cowichan Valley Regional District Waste Composition Study (2017)

Comox Strathcona Waste Management Waste Composition Study (2017)

Sunshine Coast Regional District Waste Composition Audit (2014)

Sunshine Coast Regional District Waste Composition Audit: Roll-off Bins at Sechelt Landfill and Pender Harbour Transfer Station (2015)

District of Squamish Zero Waste Strategy (2017)

Columbia Shuswap Regional District, Solid Waste Characterization Study Revelstoke Refuse Disposal Site (2013)

Columbia Shuswap Regional District, Solid Waste Characterization Study Sicamous Refuse Disposal Site (2013)

Columbia Shuswap Regional District, Waste Characterization Study, Golden Refuse Disposal Site (2018)

Regional District of Bulkley-Nechako Waste Characterization Study (2008)

Regional District of Kitimat-Stikine Waste Composition Study (2017)

Alberta

City of Calgary Residential Waste Composition Study (2010)

City of Calgary Residential Waste Composition Study (2014)

City of Calgary Visual Assessment of Construction and Demolition (C&D) Waste at Three City Landfills – October 2013 and April 2014

City of Calgary Results of the Kelleher Environmental Waste Allocation Model and Waste Audits of Industrial, Commercial and Institutional (ICI) Generators (2014)

City of Edmonton Four-Season Residential Waste Composition Study (2016)

Central Waste Management Commission (Red Deer Area) and Leduc and District Regional Waste Management Authority (Leduc) Waste Composition Study (2014)

City of Airdrie Technical Report: Residential Waste Audit (2017)

Parkland County Tri-Region Processing Facility Feasibility Study Phase 1, Stage 1: Waste Characterization Study (2015)

Pre-FEED (Front End Engineering Design) Study for an Organic Waste Processing/Conversion Facility in the St. Paul Region in Alberta (2017)

Saskatchewan

City of Saskatoon Waste Diversion Opportunities Report (2017)

City of Regina Single Family Curbside Waste Audit-Winter (2018)

Manitoba

City of Winnipeg Residential Waste Composition Study (2013)

City of Swan River Residential Waste Composition Study (2014)

Ontario

City of Toronto Single Family Curbside Waste and Participation Audit (2013)

City of Ottawa, Seasonal Single Family Residential Curbside Waste Composition Study (2014/2015)

Niagara Region Seasonal Low-Density Residential Curbside Waste Composition Study (2016)

Durham Region Large Blue Box Container Study (2011)

Durham Region Multi-Residential Waste Composition Audit (2013)

Halton Region Solid Waste Management Strategy (2011)

City of London - The Road to Increased Resource Recovery and Zero Waste (2013)

York Region Single Family Waste Composition Study (2016)

Wellington County Residential Self-Haul and Curbside Waste Audit (2017)

Oxford County Waste Management Facility and Curbside Waste Composition Study (2017)

City of Cornwall Waste Audit (2014)

Quebec

Recyc-Québec, Caractérisation des matières résiduelles du secteur résidentiel (2012-2013)

Recyc-Québec, Bilan de la gestion des matières résiduelles au Québec (2010/2011)

Caractérisation des matières reçues à l'incinérateur de la Ville de Lévis (2016)

Ville de Gatineau rapport sommaire de l'étude de caracterisation des matières résiduelles résidentielles (2015)

Ville de Gatineau rapport sommaire de l'étude de caracterisation des matières résiduelles des secteurs ICI (2015)

Projet de plan de gestion de matières résiduelles MRC de La Mitis (2016)

Ville de Cowansville - Rapport de caractérisation des matières résiduelles, lieu d'enfouissement de Cowansville (2008)

New Brunswick

Fundy Region Solid Waste Composition Study (2014)

Nova Scotia

Divert NS Waste Audit Report (2017)

Newfoundland and Labrador

City of St. John's - Waste Composition Study (2015)

Prince Edward Island

Waste Characterization Study, Energy from Waste Facility, Charlottetown - (2008)

Yukon Territory, Northwest Territories and Nunavut

Economic Viability of Waste Recovery Opportunities in Nunavut and the Northwest Territories (2012)

City of Iqaluit Waste Audit (2011)

Son of War Eagle Landfill Waste Composition Study: Composition of Waste From Communities Outside The City of Whitehorse (2011)

City of Whitehorse Waste Composition Study (2017)

City of Yellowknife Strategic Waste Management Plan (2018)

Annex B - Results by Province and Territory

British Columbia

British Columbia has the most available, detailed and current waste composition data. The studies produced by regional districts and municipalities were found to be the most consistent with each other in terms of methodology used and waste categories accounted for. Raw data from twenty-one waste composition reports and associated datasets was analyzed for the study. Of the waste audits considered, twenty were generated by WFS, while one was generated using a combination of WFS and CSS. Data collected from British Columbia is considered thorough; many of the audits sampled waste from a variety of sectors including, SF, MF, SF/MF, ICI, DLC, DO as well as a combination of all sectors. Results are provided in the following figures and tables.

Table BC1: Population and MSW Disposal Statistics (2016)

Population[1]	4,859,250 people
Quantity of waste landfilled[2]:	2,359,339 tonnes (90%)
Quantity of waste incinerated[2]:	254,748 tonnes (10%)
% of waste from residential[3]	36%
% of waste from ICI[3]	42%
% of waste from DLC[3]	23%
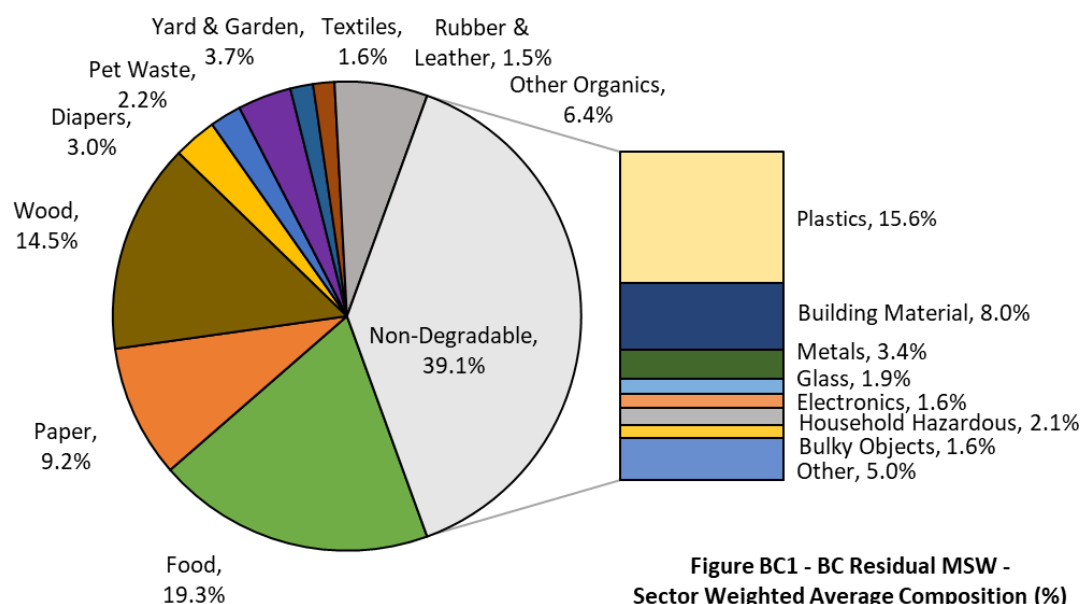
Figure BC1 - BC Residual MSW - Sector Weighted Average Composition (%)

Table BC2: Sector averages - Percentage of material categories in residual MSW in British Columbia

	SF	MF	RES (SF&MF)	ICI	DLC
Paper	7.7%	11.1%	9.1%	12.7%	2.9%
Food	28.7%	25.4%	28.0%	22.2%	0.2%
Yard & Garden	6.3%	4.4%	5.8%	3.3%	1.8%
Diapers	6.7%	6.0%	6.2%	1.9%	0.0%
Pet Waste	5.4%	5.3%	4.8%	1.1%	0.0%
Wood	2.0%	4.2%	2.3%	8.9%	44.1%
Textiles	2.8%	3.0%	2.8%	1.3%	0.2%
Rubber & Leather	1.4%	0.9%	1.5%	2.0%	0.5%
Other Organics	7.9%	7.3%	8.1%	8.3%	0.4%
Plastics	17.3%	16.4%	16.9%	17.6%	9.7%
Building Material	2.2%	3.0%	2.3%	4.1%	24.1%
Metals	3.2%	3.7%	3.4%	3.9%	2.3%
Glass	2.4%	2.1%	2.2%	1.8%	1.5%
Electronics	1.2%	2.4%	1.5%	2.4%	0.1%
Household Hazardous	1.4%	1.5%	1.4%	3.5%	0.6%
Bulky Objects	0.1%	0.4%	0.2%	2.1%	2.7%
Other	4.1%	4.9%	4.3%	3.3%	9.2%
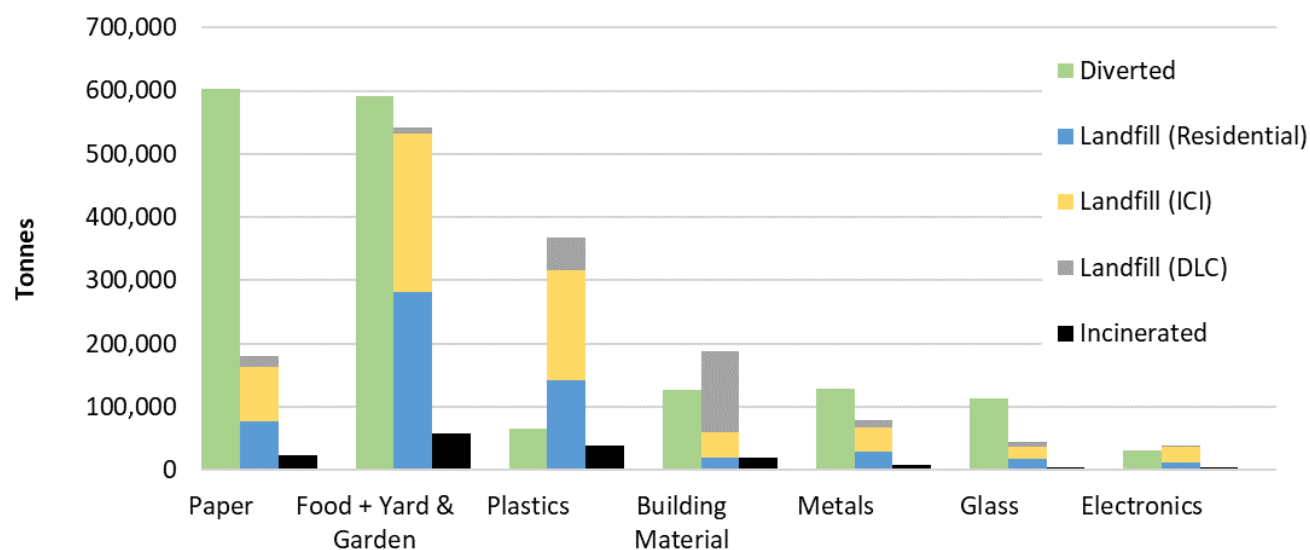
Figure BC2 - Quantities of select materials in MSW landfilled (by sector), incinerated and diverted (2016)

Table BC3: British Columbia sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[4]	Quantity of material disposed per capita (kg/capita)
Paper	9.2%	240,493	603,485	49
Food	19.3%	503,800	592,294[a]	104
Yard & Garden	3.7%	97,425		20
Diapers	3.0%	78,395	NA	16
Pet Waste	2.2%	57,068	NA	12
Wood	14.5%	380,115	NA	78
Textiles	1.6%	41,108	NA	8
Rubber & Leather	1.5%	38,699	NA	8
Other Organics	6.4%	168,394	NA	35
Plastics	15.6%	407,366	65,851	84
Building Material	8.0%	209,123	126,623[b]	43
Metals	3.4%	88,445	129,170	18
Glass	1.9%	49,499	113,955	10
Electronics	1.6%	40,921	30,856	8
Household Hazardous	2.1%	54,578	NA	11
Bulky Objects	1.6%	40,971	20,493[f]	8
Other	5.0%	130,359	72,031[g]	27
TOTAL		**2,626,758**	**1,754,758[e]**	**541**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA Data not compiled by Statistics Canada for this material

(d) X Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes all materials reported as "diverted" (e.g. tires, white goods) and material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) Includes white goods.

(g) Includes tires and "other".

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[4] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

Alberta

Raw data from nine waste composition reports and associated datasets from Alberta was analyzed and harmonized. Many of the audits considered waste from SF, MF, SF/MF, ICI, DLC, DO as well as a combination of all sectors. Of the waste audits considered, four audits were generated by WFS, six generated by CSS and one was generated using a combination of WFS and CSS. Results are provided in the following figures and tables.

Table AB1: Population and MSW Disposal Statistics (2016)

Population[1]	4,196,061 people
Quantity of waste disposed[2]:	4,206,668 tonnes
% of waste from residential[3]	31%
% of waste from ICI[3]	51%
% of waste from DLC[3]	18%
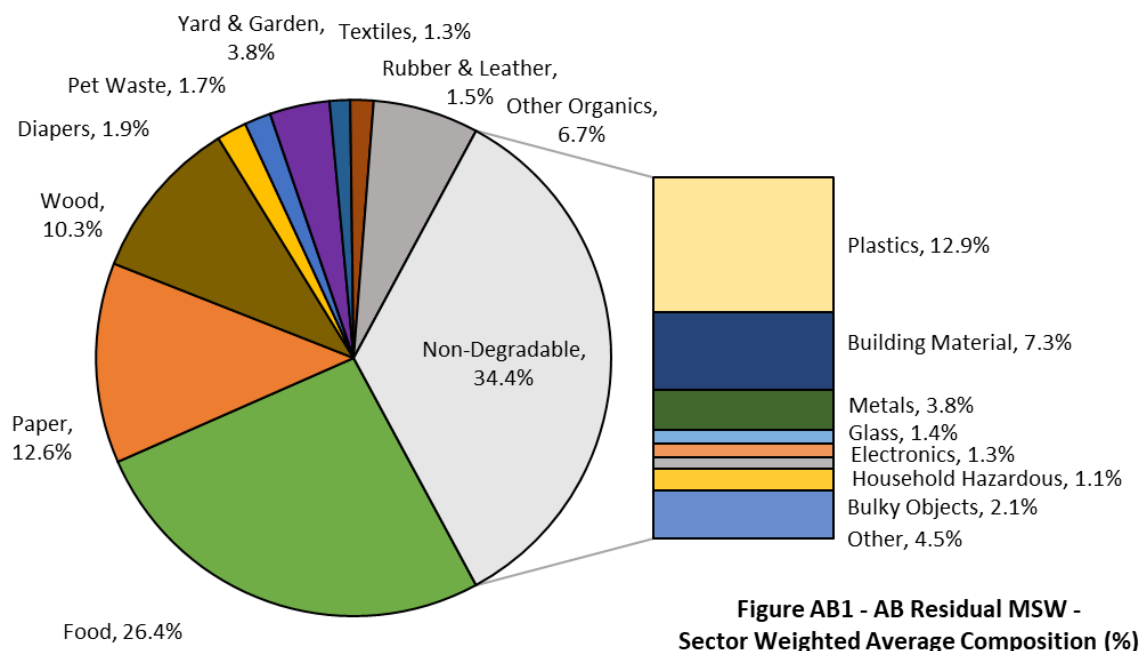
Figure AB1 - AB Residual MSW - Sector Weighted Average Composition (%)

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[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source
[3] Calculated based on data provided by Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

Table AB2: Sector averages - Percentage of material categories in residual MSW in Alberta

	SF	MF	RES (SF&MF)	ICI	DLC
Paper	8.1%	13.5%	11.1%	15.8%	6.2%
Food	29.1%	30.9%	29.0%	34.3%	0.0%
Yard & Garden	20.4%	3.8%	9.8%	1.2%	0.6%
Diapers	4.2%	3.1%	4.6%	0.8%	0.4%
Pet Waste	2.9%	2.5%	4.0%	0.9%	0.0%
Wood	1.6%	3.9%	2.3%	7.2%	32.7%
Textiles	1.6%	2.6%	2.2%	0.9%	0.8%
Rubber & Leather	2.5%	2.6%	2.1%	1.6%	0.1%
Other Organics	5.1%	4.7%	5.1%	9.8%	0.6%
Plastics	11.6%	12.3%	12.6%	14.6%	8.5%
Building Material	2.8%	3.3%	2.7%	2.9%	27.4%
Metals	2.6%	5.5%	3.8%	3.5%	4.9%
Glass	1.7%	2.5%	2.1%	1.1%	1.0%
Electronics	1.5%	2.6%	1.8%	1.3%	0.4%
Household Hazardous	1.2%	0.6%	1.0%	1.4%	0.2%
Bulky Objects	0.3%	3.4%	1.6%	0.9%	6.2%
Other	2.7%	2.3%	4.3%	2.7%	10.1%
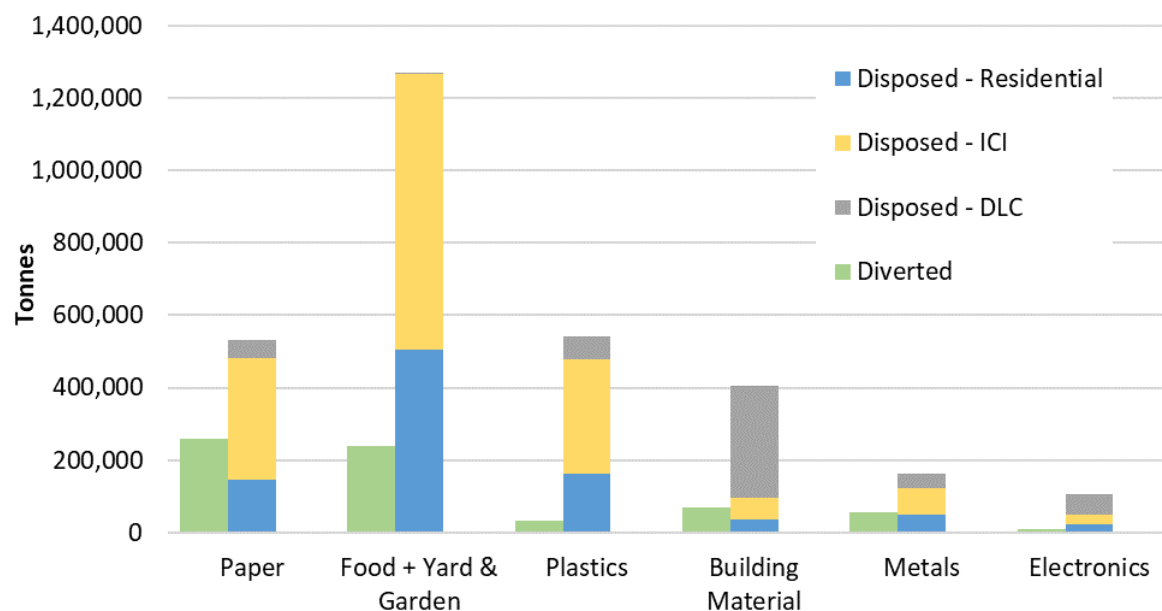
Figure AB2 - Quantities of select materials in MSW disposed (by sector) and diverted - 2016 (tonnes)

Table AB3: Alberta sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[4]	Quantity of material disposed per capita (kg/capita)
Paper	12.6%	530,167	259,442	126
Food	26.4%	1,111,542	239,431[a]	265
Yard & Garden	3.8%	159,066		38
Diapers	1.9%	79,522	NA	19
Pet Waste	1.7%	70,189	NA	17
Wood	10.3%	432,972	NA	103
Textiles	1.3%	54,392	NA	13
Rubber & Leather	1.5%	61,500	NA	15
Other Organics	6.7%	280,491	NA	67
Plastics	12.9%	542,262	33,591	129
Building Material	7.3%	307,200	70,116[b]	73
Metals	3.8%	161,073	56,358	38
Glass	1.4%	57,920	x[d]	14
Electronics	1.3%	54,383	8,197	13
Household Hazardous	1.1%	45,504	NA	11
Bulky Objects	2.1%	88,203	9,365[f]	21
Other	4.5%	190,150	74,410[g]	45
TOTAL		**4,226,536**	**831,331[e]**	**1,007**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes all materials reported as "diverted" (e.g. tires, white goods) as well as material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) Includes white goods.

(g) Includes tires and "other".

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[4] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

Saskatchewan

Though only two Saskatchewan waste composition studies were available (Regina and Saskatoon), they covered all sectors. Of the waste audits considered, one was generated by WFS and one generated by CSS. These audits lacked quantification data for several categories, resulting in a high proportion of materials within the "Other" category.

Table SK1: Population and MSW Disposal Statistics (2016)

Population[1]	1,135,987 people
Quantity of waste disposed[2]:	898,404 tonnes
% of waste from residential[3]	38%
% of waste from ICI[3]	42%
% of waste from DLC[3]	19%
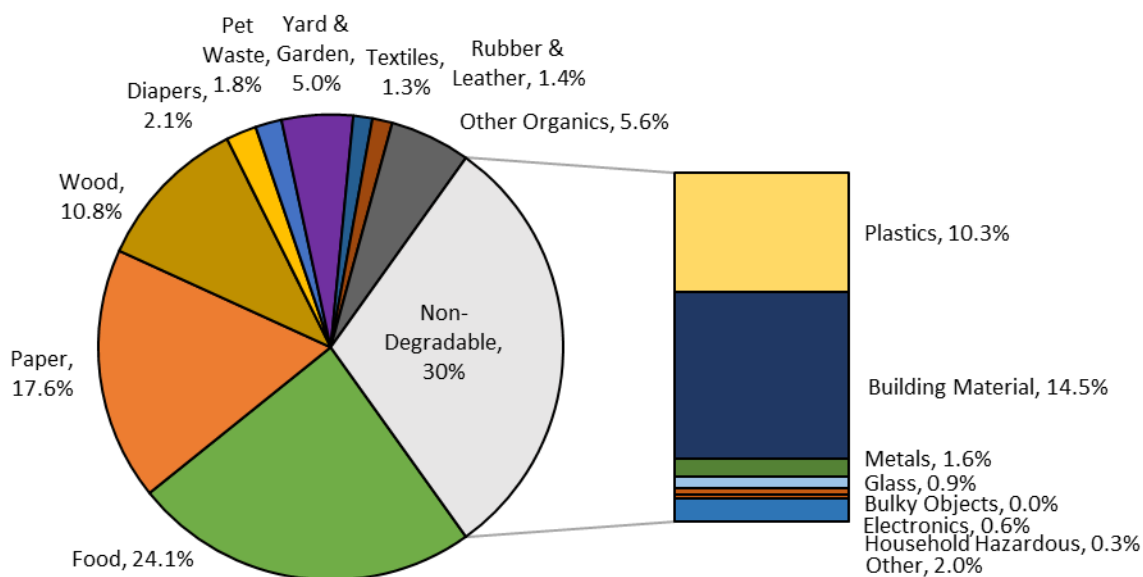
Figure SK1 - SK Residual MSW - Sector Weighted Average Composition (%)

Pie chart values: Pet Waste, 1.8%; Yard & Garden, 5.0%; Textiles, 1.3%; Rubber & Leather, 1.4%; Diapers, 2.1%; Other Organics, 5.6%; Wood, 10.8%; Paper, 17.6%; Food, 24.1%; Non-Degradable, 30%.

Non-Degradable breakdown: Plastics, 10.3%; Building Material, 14.5%; Metals, 1.6%; Glass, 0.9%; Bulky Objects, 0.0%; Electronics, 0.6%; Household Hazardous, 0.3%; Other, 2.0%.

Note: Data for diapers, pet waste, wood, textiles, rubber&leather and other are from AB

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[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source
[3] Calculated based on data provided by Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

Table SK2: Sector averages - Percentage of material categories in residual MSW in Saskatchewan

|	SF	MF	RES (SF&MF)	ICI	DLC
Paper	8.1%	14.2%	11.7%	30.1%	1.7%
Food	26.9%	35.4%	33.3%	26.8%	0.0%
Yard & Garden	30.7%	4.8%	12.2%	0.5%	0.4%
Diapers	-	-	-	-	-
Pet Waste	-	-	-	-	-
Wood	-	-	-	-	38.1%
Textiles	-	-	-	-	-
Rubber & Leather	-	-	-	-	-
Other Organics	-	-	-	-	-
Plastics	6.3%	11.2%	9.1%	15.5%	1.3%
Building Material	7.2%	1.6%	4.3%	6.0%	53.2%
Metals	2.3%	2.3%	2.1%	1.8%	0.0%
Glass	1.4%	1.7%	1.5%	0.4%	0.9%
Electronics	0.7%	1.4%	0.7%	0.6%	0.2%
Household Hazardous	0.8%	0.6%	0.5%	0.2%	0.1%
Bulky Objects	-	-	-	-	-
Other	15.5%	26.8%	24.5%	18.0%	4.0%

"-" Data not available

Figure SK2 - Quantities of select materials in MSW disposed (by sector) and diverted - 2016 (tonnes)

Table SK3: Sector-weighted average %, total quantity and quantity per capita of waste materials disposed in residual MSW and quantity diverted in Saskatchewan

	Sector-weighted average % of material in residual MSW	Total quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[4]	Quantity of material disposed per capita (kg/capita)
Paper	17.6%	157,743	51,881	139
Food	24.1%	216,407	31,329[a]	191
Yard & Garden	5.0%	44,507		39
Diapers	2.1%*	19,050	NA	17
Pet Waste	1.8%*	16,444	NA	14
Wood	10.8%*	97,332	NA	86
Textiles	1.3%*	11,929	NA	11
Rubber & Leather	1.4%*	12,429	NA	11
Other Organics	5.6%*	50,372	NA	44
Plastics	10.3%	92,475	6,506	81
Building Material	14.5%	130,261	x[b]	115
Metals	1.6%	14,188	3,452	12
Glass	0.9%	8,356	x	7
Electronics	0.6%	5,153	x	5
Household Hazardous	0.3%	2,768	NA	2
Bulky Objects	-	-	1,995[f]	-
Other	2.0%	18,321	21,184[g]	16
TOTAL		**897,735**	**169,675[e]**	**790**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) Includes white goods.

(g) Includes tires and "other".

"-" Data not available

"*" Value based on surrogate data from AB.

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[4] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

Manitoba

Two waste composition studies were collected from Manitoba representing one large urban and one small urban population centre. Both audits were generated by CSS, and represented only the residential sector. ICI and DLC data from AB was used to generate sector weighted averages and quantity disposed values.

Table MB1: Population and MSW Disposal Statistics (2016)

Population[1]	1,314,139 people
Quantity of waste disposed[2]:	969,289 tonnes
% of waste from residential[3]	32%
% of waste from ICI[3]	60%
% of waste from DLC[3]	8%

Pet Waste, 7.8%
Yard & Garden, 12.2%
Textiles (Degradable), 2.0%
Diapers, 6.6%
Rubber & Leather, 0.1%
Other Organics, 2.3%
Paper, 8.7%
Non-Degradable, 25.9%
Food, 32.1%

Plastics, 11.8%
Building Material, 2.7%
Metals, 2.7%
Glass, 2.4%
Electronics, 1.2%
Household Hazardous, 0.5%
Bulky Objects, 0.1%
Other, 4.5%

Note: Data for Yard&Garden and Wood are from AB
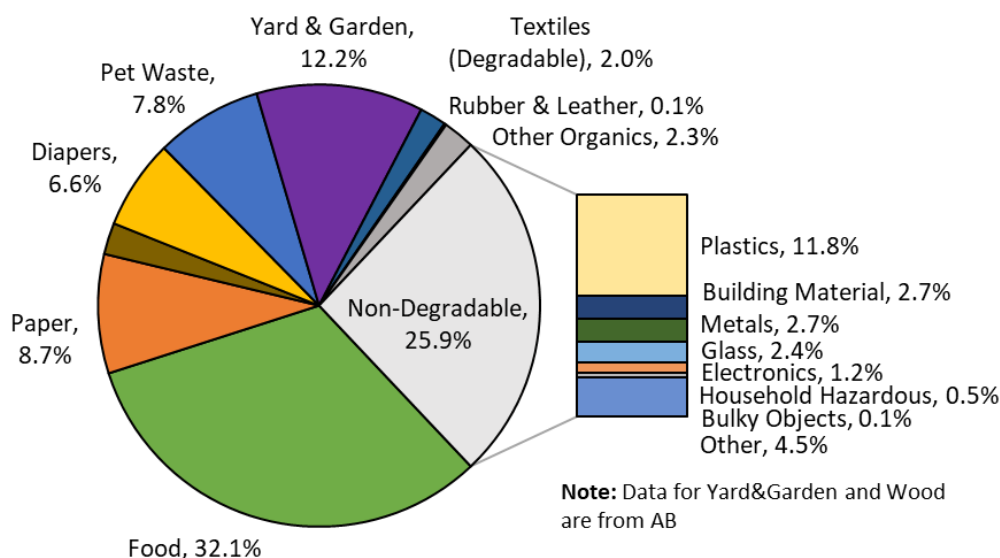
Figure MB1 - Residual MSW - Residential Sector - Composition (%)

[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source
[3] Calculated based on data provided by Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

Table MB2: Sector averages - Percentage of material categories in residential residual MSW in Manitoba

	RES (SF/MF)
Paper	9.9%
Food	36.5%
Yard & Garden	-
Diapers	7.5%
Pet Waste	8.9%
Wood	-
Textiles	2.2%
Rubber & Leather	0.1%
Other Organics	5.2%
Plastics	13.4%
Building Material	3.1%
Metals	3.1%
Glass	2.7%
Electronics	1.3%
Household Hazardous	0.6%
Bulky Objects	0.1%
Other	5.1%

"-" Data not available

Notes:
1. ICI and DLC data from AB used to generate quantity disposed values.
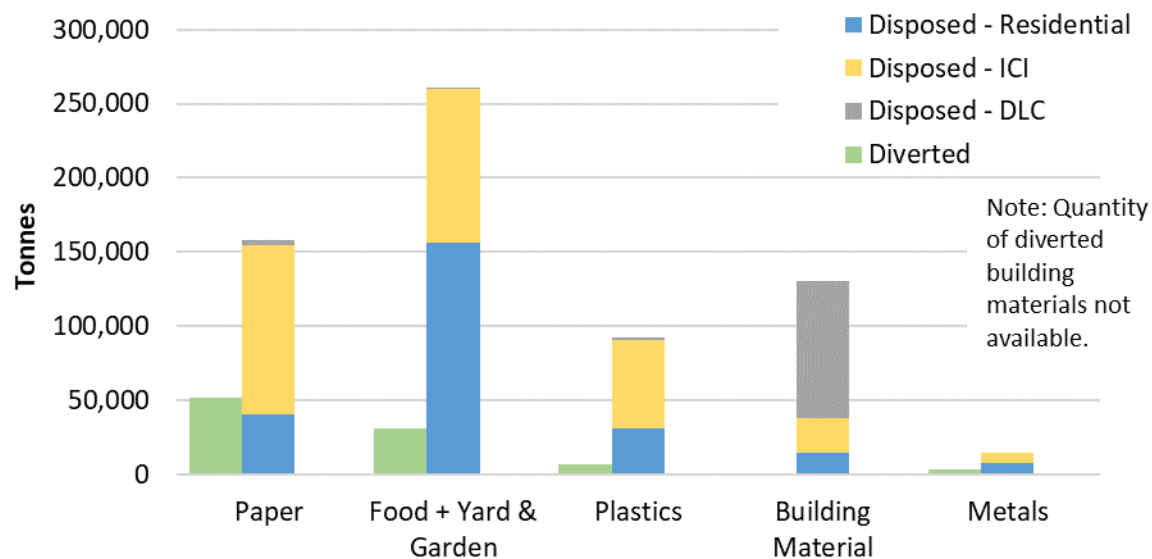2. Quantity of diverted building materials not available.
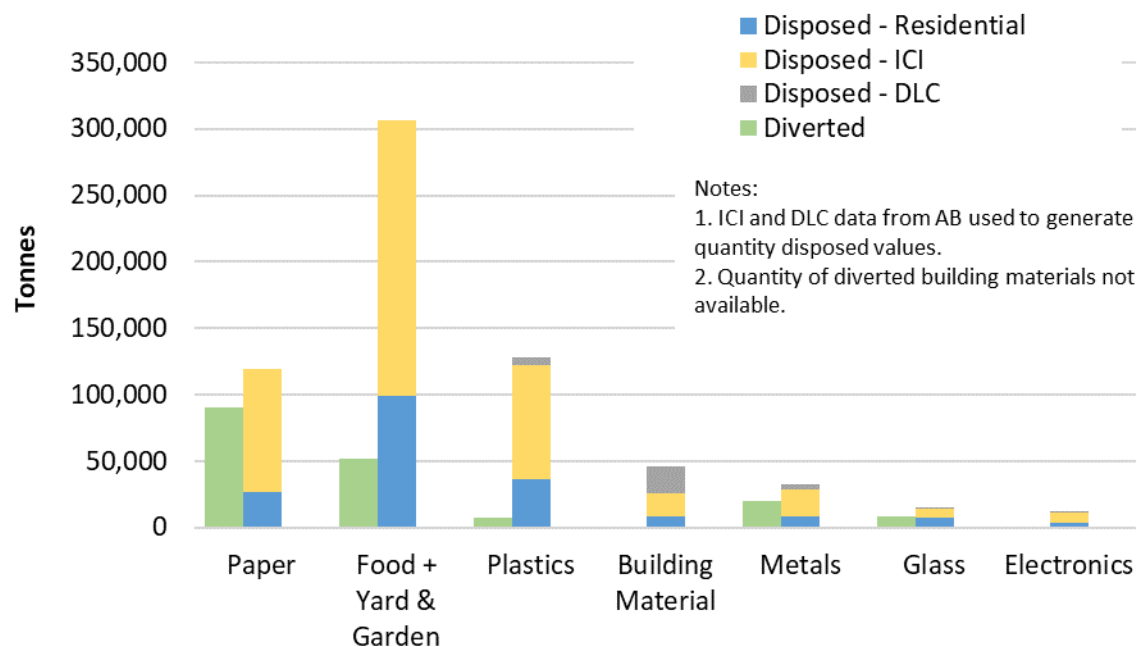
Figure MB2 - Quantities of select materials in MSW disposed (by sector) and diverted - 2016 (tonnes)

Table MB3: Manitoba sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[4]	Quantity of material disposed per capita (kg/capita)
Paper	12.8%*	123,865	89,993	94
Food	30.9%*	299,441	51,824[a]	228
Yard & Garden	4.7%*	45,351		35
Diapers	2.6%*	25,042	NA	19
Pet Waste	3.0%*	29,235	NA	22
Wood	7.6%*	73,847	NA	56
Textiles	1.2%*	12,061	NA	9
Rubber & Leather	1.0%*	9,677	NA	7
Other Organics	6.7%*	64,753	NA	49
Plastics	13.2%*	128,400	7,315	98
Building Material	4.8%*	46,280	x[b]	35
Metals	3.3%*	32,446	19,508	25
Glass	1.5%*	14,500	8,435	11
Electronics	1.2%*	11,541	799	9
Household Hazardous	1.1%*	10,190	NA	8
Bulky Objects	1.1%*	10,399	NA	8
Other	3.8%*	37,101	26,607[g]	28
TOTAL		**974,130**	**210,979[e]**	**741**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) ICI and DLC data from AB used to generate weighted averages and quantity disposed values.

(g) Includes tires and "other".

"*" Value based on surrogate data from AB.

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[4] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

Ontario

Raw data from thirteen waste composition reports and associated datasets was analyzed and harmonized. Of the waste audits considered, only two audits were generated by WFS, while eleven were generated using CSS. Most of the audits considered waste from the residential sector, and assessed SF and MF waste independently as well as cumulatively. The ICI sector and DLC sectors are poorly represented by only one waste audit each from a medium-sized urban population centre.

Ontario is Canada's largest province by population, generating the most annual waste disposed to Canadian landfills. The datasets collected representing the ICI and DLC sectors for ON are considered unfavorable as waste allocated to the "Other" category was approximately 47% and 37%, respectively. Since these two sectors represent over two thirds of annual MSW disposed in ON and since ON represents over one quarter of all waste disposed in Canada, the lack of data for these two sectors represents a noteworthy gap in this study. As a measure to close this data gap, ICI and DLC percent composition data from BC was used to represent these sectors for ON for sector weighted average and quantity calculations; since the per capita disposal rate for BC is most similar to ON and the dataset available from BC is robust.

Table ON1: Population and MSW Disposal Statistics (2016)

Population[1]	13,875,394 people
Quantity of waste landfilled[2]:	9,475,471 tonnes
Quantity of waste incinerated[3]:	304,437 tonnes
% of waste from residential[4]	39%
% of waste from ICI[4]	52%
% of waste from DLC[4]	8%

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[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source
[3] ECCC, 2019. National Inventory Report on Greenhouse Gases and Sinks.
[4] Calculated based on data provided by Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

Table ON2: Sector averages - Percentage of material categories in residual MSW in Ontario

	SF	MF	RES (SF&MF)
Paper	9.6%	15.1%	10.7%
Food	30.7%	34.0%	31.3%
Yard & Garden	1.6%	2.7%	2.2%
Diapers	6.6%	4.5%	6.1%
Pet Waste	8.8%	5.4%	8.3%
Wood	1.8%	4.3%	1.9%
Textiles	1.8%	2.3%	1.9%
Rubber & Leather	0.4%	0.1%	0.7%
Other Organics	4.8%	3.2%	5.1%
Plastics	14.3%	10.9%	14.4%
Building Material	4.7%	5.7%	4.2%
Metals	2.6%	2.5%	2.5%
Glass	1.8%	2.3%	1.8%
Electronics	1.4%	1.6%	1.4%
Household Hazardous	0.9%	0.4%	0.7%
Bulky Objects	0.9%	0.2%	0.8%
Other	7.1%	4.9%	5.8%

Notes:

Data from one study from a medium urban population centre is included for reference. Since they are not considered representative, these values were not used in further calculations.

"-" Data not available
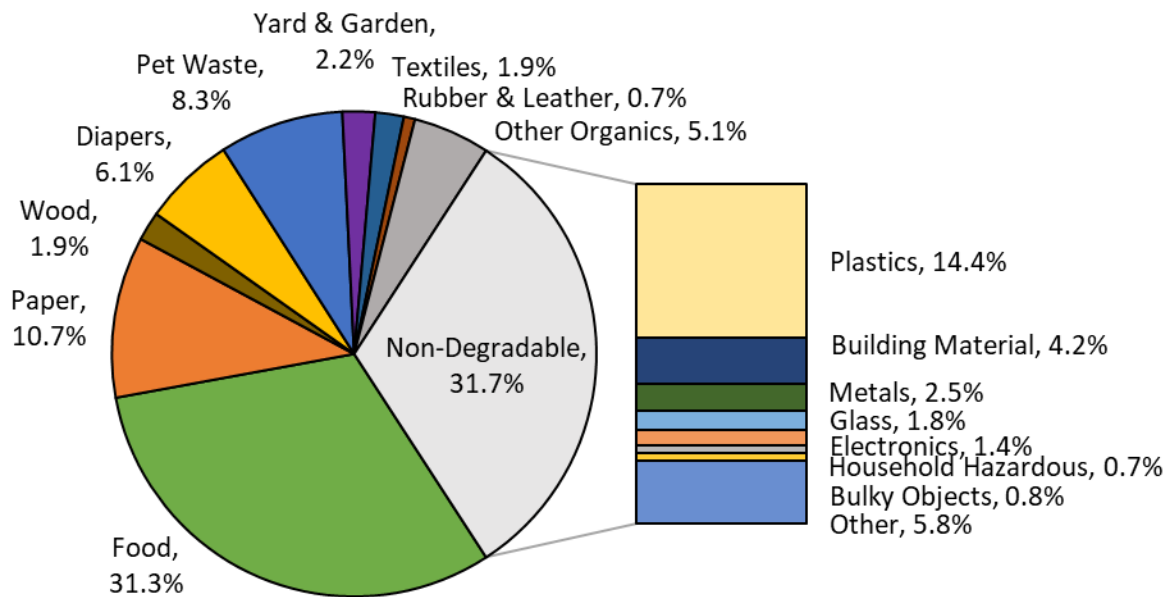
Figure ON1 - Residential Residual MSW - Average Composition (%)

Table ON3: Ontario sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW[f]	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[5]	Quantity of material disposed per capita (kg/capita)
Paper	11.5%	1,092,360	1,327,911	79
Food	24.2%	2,290,534	1,133,603[a]	165
Yard & Garden	2.7%	256,518		19
Diapers	3.3%	308,020	NA	22
Pet Waste	3.5%	333,606	NA	24
Wood	9.4%	892,095	NA	64
Textiles	1.5%	139,677	NA	10
Rubber & Leather	1.3%	119,810	NA	9
Other Organics	6.1%	576,354	NA	42
Plastics	15.2%	1,444,086	120,335	104
Building Material	6.1%	576,879	165,116[b]	42
Metals	3.3%	308,764	152,464	22
Glass	1.8%	174,228	120,076	13
Electronics	1.9%	175,865	35,991	13
Household Hazardous	2.2%	204,052	NA	15
Bulky Objects	1.6%	148,739	11,739[g]	11
Other	4.8%	455,500	242,746[h]	33
TOTAL		**9,497,088**	**3,309,711[e]**	**685**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) ICI and DLC data from BC used to generate weighted averages and quantity disposed values.

(g) Includes white goods.

(h) Includes tires and "other".

"-" Data not available

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[5] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type
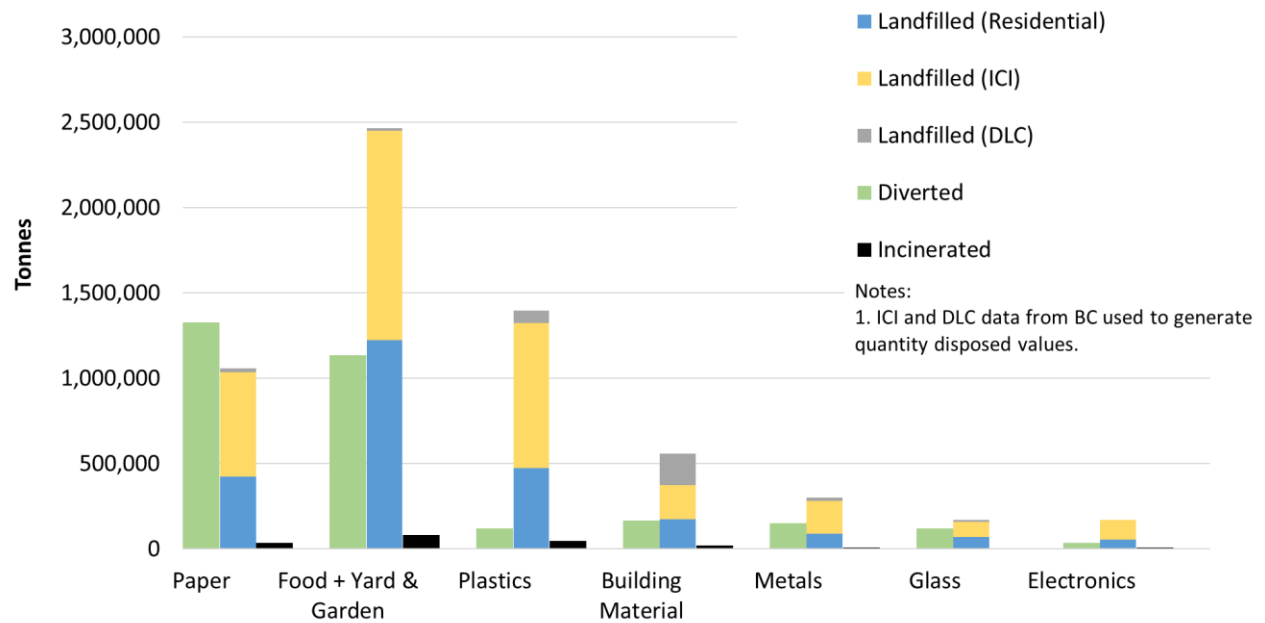
Figure ON2 - Quantities of select materials in MSW disposed (by sector), incinerated and diverted - 2016 (tonnes)

Quebec

A moderate number of waste composition studies were collected from regions and municipalities in Quebec. Of the waste audits compiled, two audits were generated by WFS, while the other eight were generated using CSS. The collected audits cover a wide range of sectors including SF, MF, SF/MF, ICI, DLC, DO as well as a combination of all sectors. A province-wide waste characterization study completed in 2011/12 by Recyc-Québec was used as the most representative composition data for provincial values.

Table QC1: Population and MSW Disposal Statistics (2016)

Population[1]	8,225,950 people
Quantity of waste landfilled[2]:	5,356,133 tonnes
Quantity of waste incinerated[3]:	267,245 tonnes
% of waste from residential[4]	56%
% of waste from ICI[4]	34%
% of waste from DLC[4]	10%
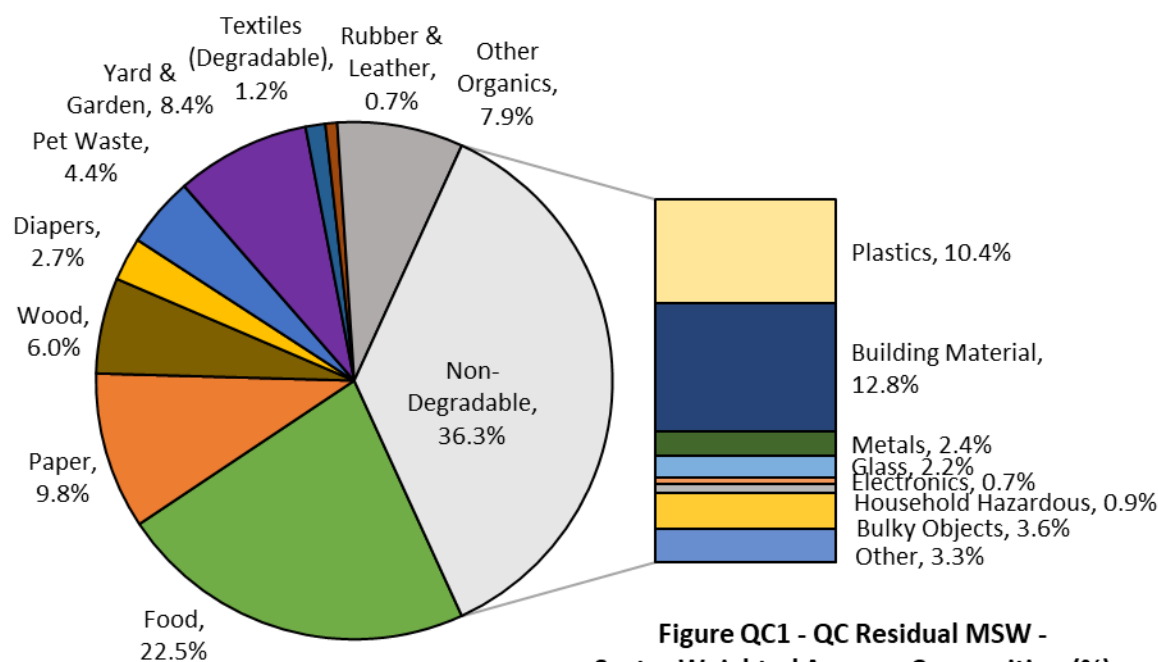
Figure QC1 - QC Residual MSW - Sector Weighted Average Composition (%)

Textiles (Degradable), 1.2%
Rubber & Leather, 0.7%
Other Organics, 7.9%
Yard & Garden, 8.4%
Pet Waste, 4.4%
Diapers, 2.7%
Wood, 6.0%
Paper, 9.8%
Food, 22.5%
Non-Degradable, 36.3%
Plastics, 10.4%
Building Material, 12.8%
Metals, 2.4%
Glass, 2.2%
Electronics, 0.7%
Household Hazardous, 0.9%
Bulky Objects, 3.6%
Other, 3.3%

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[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source
[3] ECCC, 2019. National Inventory Report on Greenhouse Gases and Sinks.
[4] Calculated based on data provided by Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

Table QC2: Sector averages - Percentage of material categories in residual MSW in Quebec

	RES (SF&MF)	ICI	DLC
Paper	7.8%	15.2%	2.9%
Food	25.8%	23.1%	1.9%
Yard & Garden	12.5%	4.2%	0.0%
Diapers	3.7%	-	-
Pet Waste	7.2%*	-	-
Wood	2.2%	6.7%	25.1%
Textiles	1.3%	1.4%	0.2%
Rubber & Leather	1.3%	0.0%	0.0%
Other Organics	7.6%	13.5%	0.6%
Plastics	8.6%	15.4%	4.4%
Building Material	8.9%	8.8%	48.0%
Metals	1.9%	3.3%	2.3%
Glass	2.8%	1.7%	0.4%
Electronics	1.3%*	-	-
Household Hazardous	1.1%	0.8%	0.3%
Bulky Objects	4.8%	1.2%	5.5%
Other	1.3%	4.9%	8.4%

"-" Data not available

"*" Calculated based on averages from available QC waste characterizations.
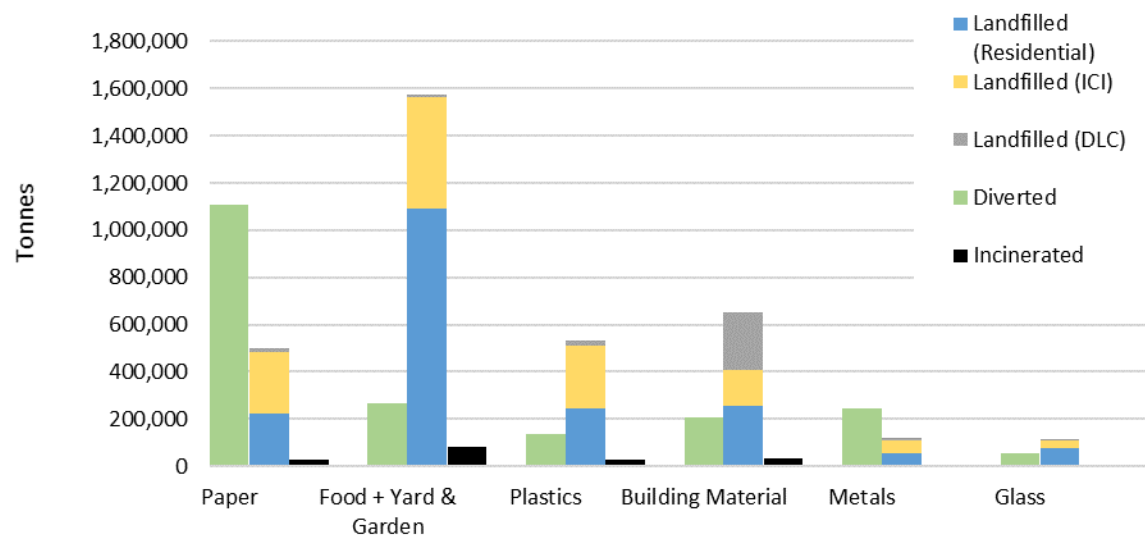
Figure QC2 - Quantities of select materials in MSW landfilled (by sector), incinerated and diverted - 2016 (tonnes)

Table QC3: Quebec sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[5]	Quantity of material disposed per capita (kg/capita)
Paper	9.8%	524,859	1,107,000	64
Food	22.5%	1,203,796	268,000[a]	146
Yard & Garden	8.4%	450,407		55
Diapers	2.7%	145,668	NA	18
Pet Waste	4.4%	235,970	NA	29
Wood	6.0%	320,756	NA	39
Textiles	1.2%	66,158	NA	8
Rubber & Leather	0.7%	39,618	NA	5
Other Organics	7.9%	422,421	NA	51
Plastics	10.4%	559,028	137,235	68
Building Material	12.8%	686,522	210,000[b]	83
Metals	2.4%	129,755	245,413	16
Glass	2.2%	115,793	55,000	14
Electronics	0.7%	37,693	21,525	5
Household Hazardous	0.9%	47,005	NA	6
Bulky Objects	3.6%	194,814	276,767[f]	24
Other	3.3%	174,472	83,541[g]	21
TOTAL		**5,354,737**	**2,404,481[e]**	**651**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X   Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) Includes white goods.

(g) Includes tires and "other".
   "-" Data not available

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[5] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

New Brunswick

Though only one waste composition study was available from New Brunswick (Fundy Region), the audit covered a wide range of sectors including, SF, MF, ICI and DO as well as a combination of all sectors. Data from this audit was generated by a WFS. Surrogate data from NL was used to represent the DLC sector for sector weighted average and quantity calculations.

Table NB1: Population and MSW Disposal Statistics (2016)

Population[1]	763,350 people
Quantity of waste disposed[2]:	503,123 tonnes
% of waste from residential[3]	45%
% of waste from ICI[3]	45%
% of waste from DLC[3]	10%
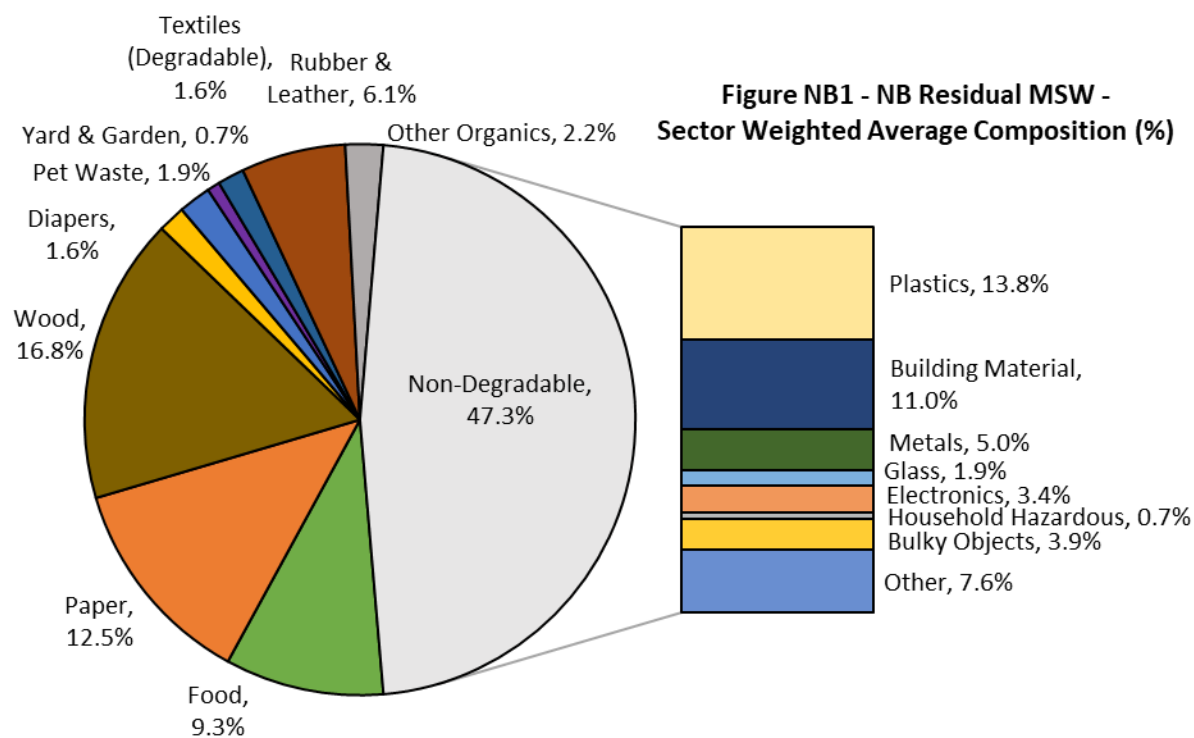
Figure NB1 - NB Residual MSW - Sector Weighted Average Composition (%)

Textiles (Degradable), 1.6%
Rubber & Leather, 6.1%
Yard & Garden, 0.7%
Pet Waste, 1.9%
Diapers, 1.6%
Wood, 16.8%
Paper, 12.5%
Food, 9.3%
Other Organics, 2.2%
Non-Degradable, 47.3%
Plastics, 13.8%
Building Material, 11.0%
Metals, 5.0%
Glass, 1.9%
Electronics, 3.4%
Household Hazardous, 0.7%
Bulky Objects, 3.9%
Other, 7.6%

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[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source
[3] Calculated based on data provided by Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

Table NB2: Sector averages - Percentage of material categories in residual MSW in New Brunswick

|	SF	MF	RES (SF&MF)	ICI
Paper	17.1%	8.9%	13.0%	14.7%
Food	13.8%	9.2%	11.5%	9.3%
Yard & Garden	2.1%	0.1%	1.1%	0.6%
Diapers	4.1%	1.5%	2.8%	0.8%
Pet Waste	3.5%	4.5%	4.0%	0.2%
Wood	7.6%	23.2%	15.4%	12.9%
Textiles	2.4%	0.5%	1.4%	2.0%
Rubber & Leather	2.8%	0.6%	1.7%	12.0%
Other Organics	3.1%	1.3%	2.2%	2.8%
Plastics	17.2%	9.2%	13.2%	17.1%
Building Material	4.7%	3.7%	4.2%	8.5%
Metals	4.4%	3.4%	3.9%	6.9%
Glass	2.4%	2.1%	2.2%	0.9%
Electronics	4.3%	4.9%	4.6%	3.0%
Household Hazardous	2.4%	0.2%	1.3%	0.3%
Bulky Objects	1.5%	12.5%	7.0%	1.6%
Other	6.6%	14.3%	10.5%	6.5%

"-" Data not available
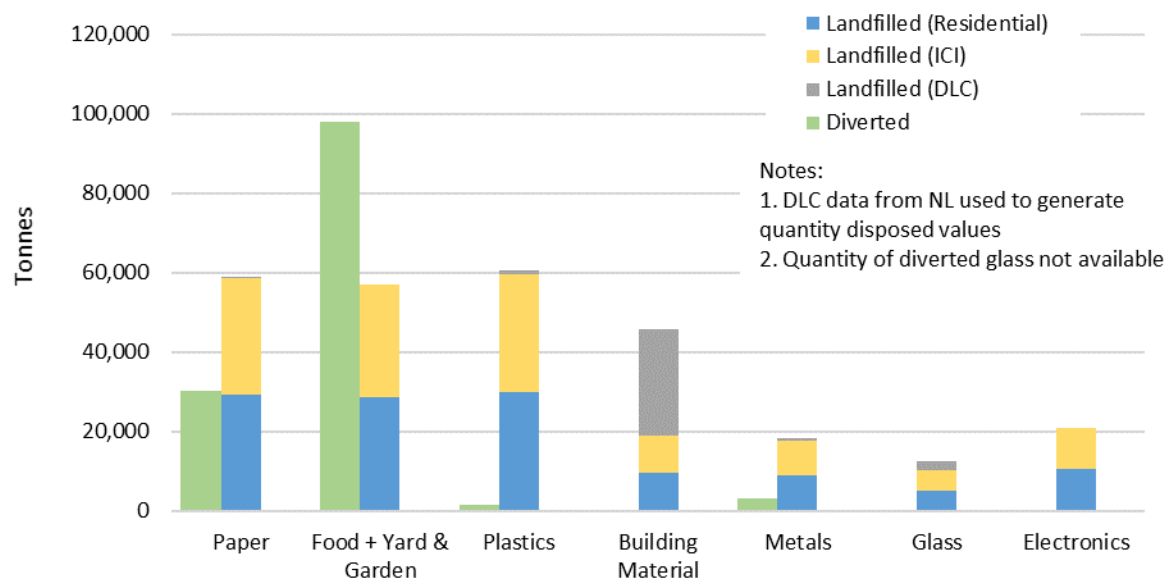
Figure NB2 - Quantities of select materials in MSW disposed (by sector) and diverted - 2016 (tonnes)

Table NB3: New Brunswick sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[4]	Quantity of material disposed per capita (kg/capita)
Paper	12.5%	62,642	30,297	82
Food	9.3%	46,888	97,958[a]	61
Yard & Garden	0.7%	3,761		5
Diapers	1.6%	8,053	NA	11
Pet Waste	1.9%	9,578	NA	13
Wood	16.8%	84,417	NA	111
Textiles	1.6%	7,836	NA	10
Rubber & Leather	6.1%	30,869	NA	40
Other Organics	2.2%	11,155	NA	15
Plastics	13.8%	69,307	1,455	91
Building Material	11.0%	55,493	0[b]	73
Metals	5.0%	25,048	3,171	33
Glass	1.9%	9,529	x	12
Electronics	3.4%	17,135	194	22
Household Hazardous	0.7%	3,468	NA	5
Bulky Objects	3.9%	19,484	NA	26
Other	7.6%	38,427	16,947[g]	50
TOTAL		503,088	151,310[e]	659

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X   Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) ICI and DLC data from NL used to generate weighted averages and quantity disposed values.

(g) Includes tires and "other".
   "-" Data not available

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[4] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

Nova Scotia

Three waste composition studies were collected from Nova Scotia representing the entire Province as these studies were completed provincially by DivertNS, a not-for-profit corporation championing recycling in Nova Scotia. Nova Scotia is the only province/territory that completes a systematic province-wide waste facility sort and associated audit on a regular basis (starting in 2011). Samples are taken from the seven landfills approved by Nova Scotia Environment to receive both residential and ICI waste streams. The waste audits are typically achieved during a fourteen week period, covering two seasons. Raw data from 2011, 2012 and 2017 (all available studies within the temporal range of the this study) was analyzed and harmonized. The data collected represents SF/MF, ICI and a combination of all sectors. With no data available to represent the NS DLC sector, characterization data from NL was used as a surrogate.

Table NS1: Population and MSW Disposal Statistics (2016)

Population[1]	942,790 people
Quantity of waste disposed[2]:	375,258 tonnes
% of waste from residential[3]	45%
% of waste from ICI[4]	36%
% of waste from DLC[4]	13%

**Figure NS1 - NS Residual MSW -
Sector Weighted Average Composition (%)**
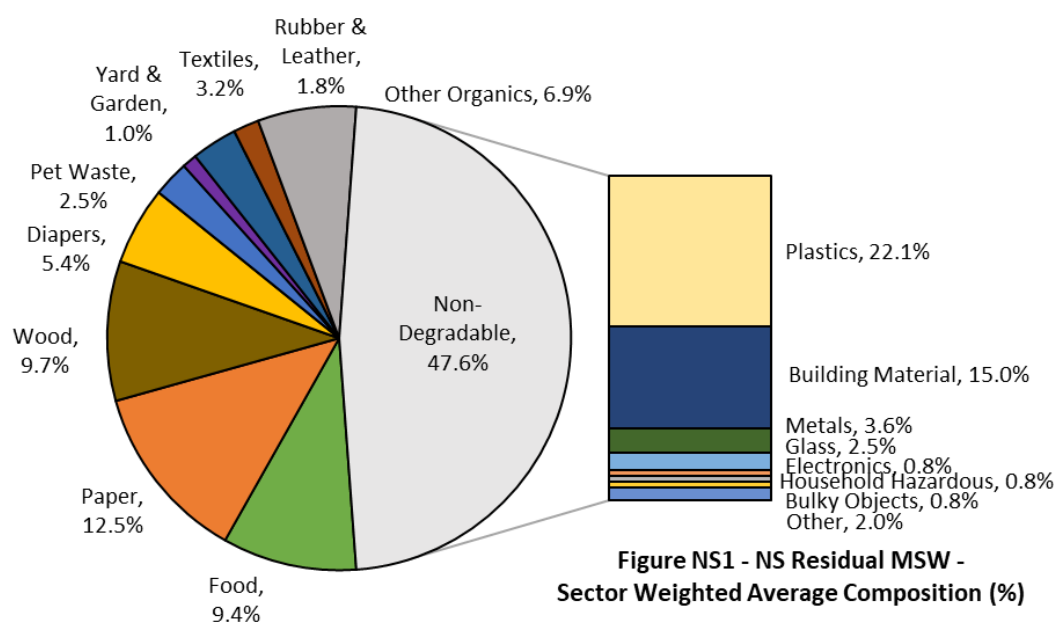
Note: DLC data from NL used to calculate sector weighted averages

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Table NS2: Sector averages - Percentage of material categories in residual MSW in Nova Scotia

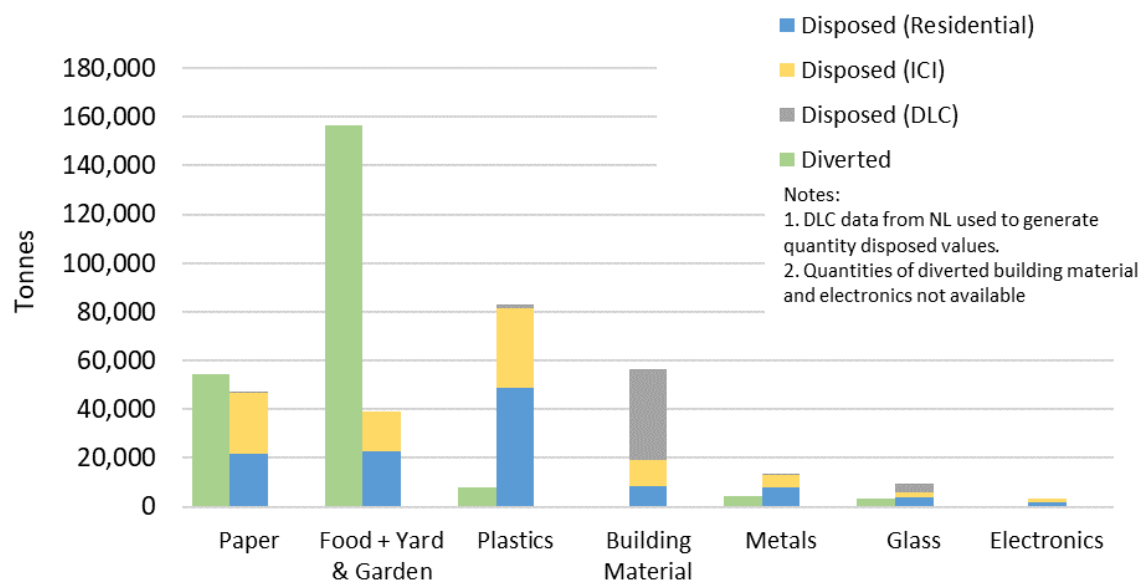|	RES (SF&MF)	ICI
Paper	12.8%	18.5%
Food	12.0%	11.0%
Yard & Garden	1.3%	1.2%
Diapers	5.8%	7.9%
Pet Waste	3.2%	3.0%
Wood	2.1%	3.4%
Textiles	5.1%	2.5%
Rubber & Leather	2.8%	1.5%
Other Organics	8.8%	8.1%
Plastics	28.6%	24.5%
Building Material	4.9%	8.0%
Metals	4.8%	3.6%
Glass	2.3%	1.4%
Electronics	0.9%	1.2%
Household Hazardous	1.3%	0.8%
Bulky Objects	1.2%	0.7%
Other	2.1%	2.9%

"-" Data not available

Figure NS2 - Quantities of select materials in MSW disposed (by sector) and diverted - 2016 (tonnes)

Table NS3: Nova Scotia sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW[f]	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[4]	Quantity of material disposed per capita (kg/capita)
Paper	12.5%	46,773	54,276	50
Food	9.4%	35,133	156,603[a]	37
Yard & Garden	1.0%	3,854		4
Diapers	5.4%	20,426	NA	22
Pet Waste	2.5%	9,413	NA	10
Wood	9.7%	36,493	NA	39
Textiles	3.2%	11,948	NA	13
Rubber & Leather	1.8%	6,725	NA	7
Other Organics	6.9%	25,719	NA	27
Plastics	22.1%	82,765	7,738	88
Building Material	15.0%	56,273	x[b]	60
Metals	3.6%	13,675	4,433	15
Glass	2.5%	9,363	3,264	10
Electronics	0.8%	3,153	x	3
Household Hazardous	0.8%	3,183	NA	3
Bulky Objects	0.8%	3,018	1,412[f]	3
Other	2.0%	7,364	12,289[g]	8
TOTAL		**375,278**	**293,178[e]**	**398**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) DLC data from NL used to generate sector-weighted average.

(g) Includes white goods.

(h) Includes tires.

"-" Data not available

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[4] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

Prince Edward Island

One provincial waste characterization was collected from Prince Edward Island. Data was collected through a WFS. The sort did not take place at a landfill, but rather at PEI's Energy from Waste Facility. The data from the waste audit represents a combination of all sectors, leaving a void of sector-specific data. The annual waste disposed in landfill in PE is the lowest in the country at approximately 200 kg/capita.

Table PE1: Population and MSW Disposal Statistics (2016)

Population[1]	146,969 people
Quantity of waste landfilled[2]:	29,042 tonnes
Quantity of waste incinerated[3]	26,281 tonnes
% of waste from residential[4]	45%
% of waste from ICI[4]	36%
% of waste from DLC[4]	19%
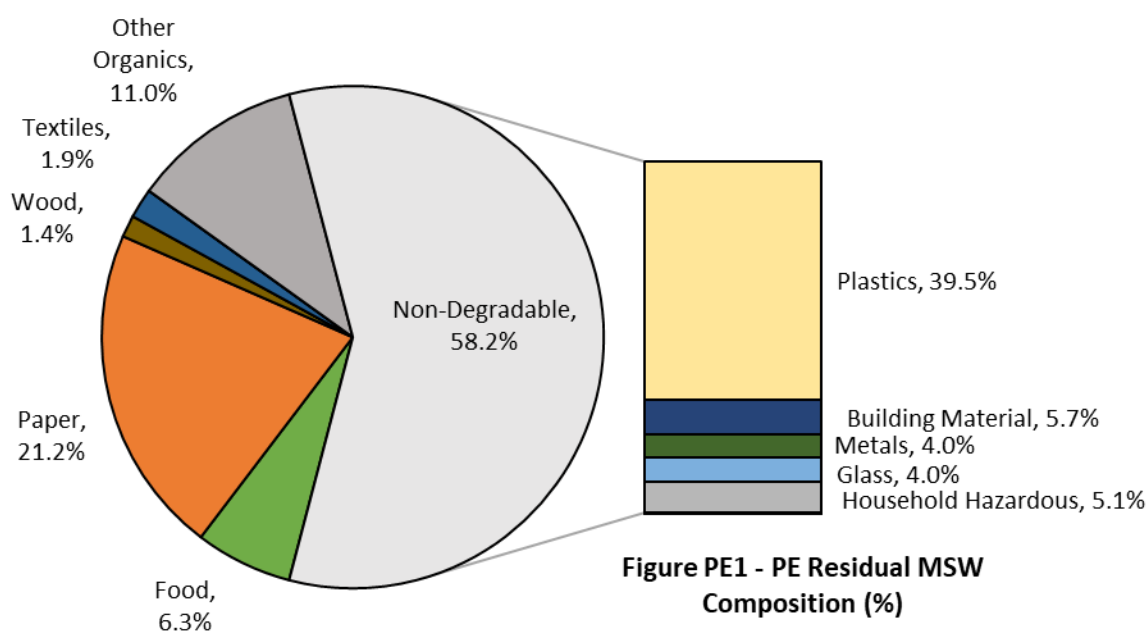
Figure PE1 - PE Residual MSW Composition (%)

Note: Data is representative of residual MSW destined for incineration.

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[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] ECCC, 2019. National Inventory Report on Greenhouse Gases and Sinks.
[3] ECCC, 2019. National Inventory Report on Greenhouse Gases and Sinks.
[4] Calculated based on data for NS provided by Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

Table PE2: Percentage of material categories in residual MSW (destined for incineration) in Prince Edward Island

	All residual MSW
Paper	21.2%
Food	6.3%
Yard & Garden	-
Diapers	-
Pet Waste	-
Wood	1.4%
Textiles	1.9%
Rubber & Leather	-
Other Organics	11.0%
Plastics	39.5%
Building Material	5.7%
Metals	4.0%
Glass	4.0%
Electronics	-
Household Hazardous	5.1%
Bulky Objects	-
Other	-

"-" Data not available

Figure PE3 - Quantities of select materials in residual MSW landfilled, incinerated and diverted (tonnes) - 2016

Table PE3: Prince Edward Island % composition; quantity of materials disposed and diverted; quantity disposed per capita

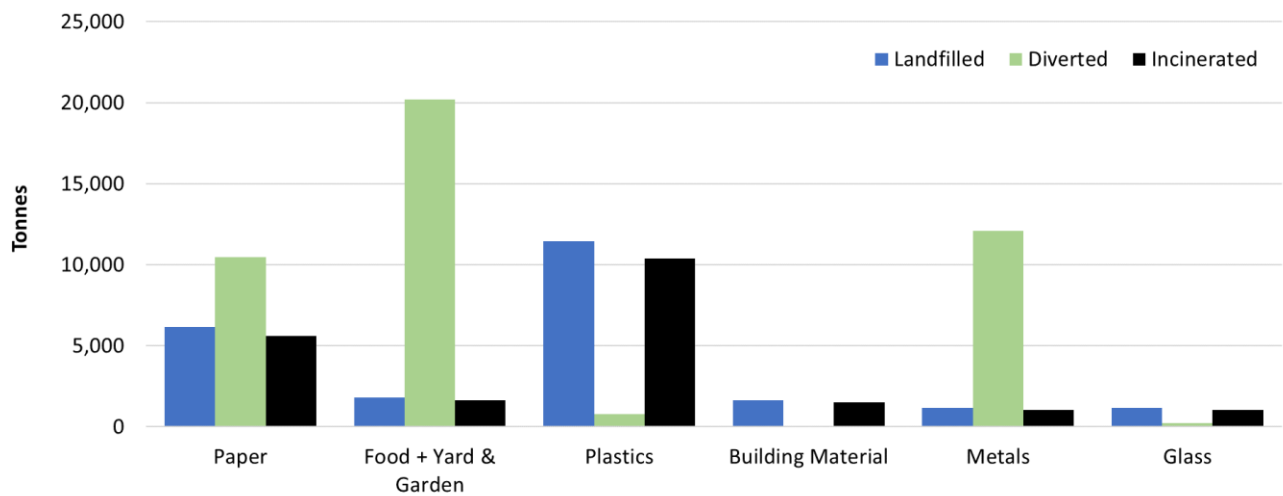|	% of material in residual MSW	Quantity of material landfilled (tonnes)	Quantity of material incinerated (tonnes)	Quantity of material diverted (tonnes)[5]	Quantity of material disposed per capita (kg/capita)
Paper	21.2%	6,169	5,582	10,457	42
Food	6.3%	1,821	1,648	20,181[a]	12
Yard & Garden	-	-	-		-
Diapers	-	-	-	NA	-
Pet Waste	-	-	-	NA	-
Wood	1.4%	407	368	NA	3
Textiles	1.9%	558	505	NA	4
Rubber & Leather	-	-	-	NA	0
Other Organics	11.0%	3,198	2,894	NA	22
Plastics	39.5%	11,460	10,370	781	78
Building Material	5.7%	1,644	1,488	0[b]	11
Metals	4.0%	1,152	1,042	12,103	8
Glass	4.0%	1,152	1,042	223	8
Electronics	-	-	-	629	-
Household Hazardous	5.1%	1,487	1,346	NA	10
Bulky Objects	-	-	-	NA	-
Other	-	-	-	2,562[f]	-
TOTAL		**29,045**	**26,284**	**53,261[e]**	**198**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X   Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) Includes tires and "other"

"-" Data not available

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[5] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

Newfoundland and Labrador

One waste composition study (St. John's) was available to represent Newfoundland and Labrador. The waste audit collected data using a WFS. The data collected represents SF/MF, ICI, DLC and a combination of all sectors with a data gap for DO-specific material.

Table NL1: Population and MSW Disposal Statistics (2016)

Population[1]	529,426 people
Quantity of waste disposed[2]:	395,323 tonnes
% of waste from residential[3]	45%
% of waste from ICI[3]	36%
% of waste from DLC[3]	19%

Figure NL1 - Residual MSW - Sector Weighted Average Composition (%)

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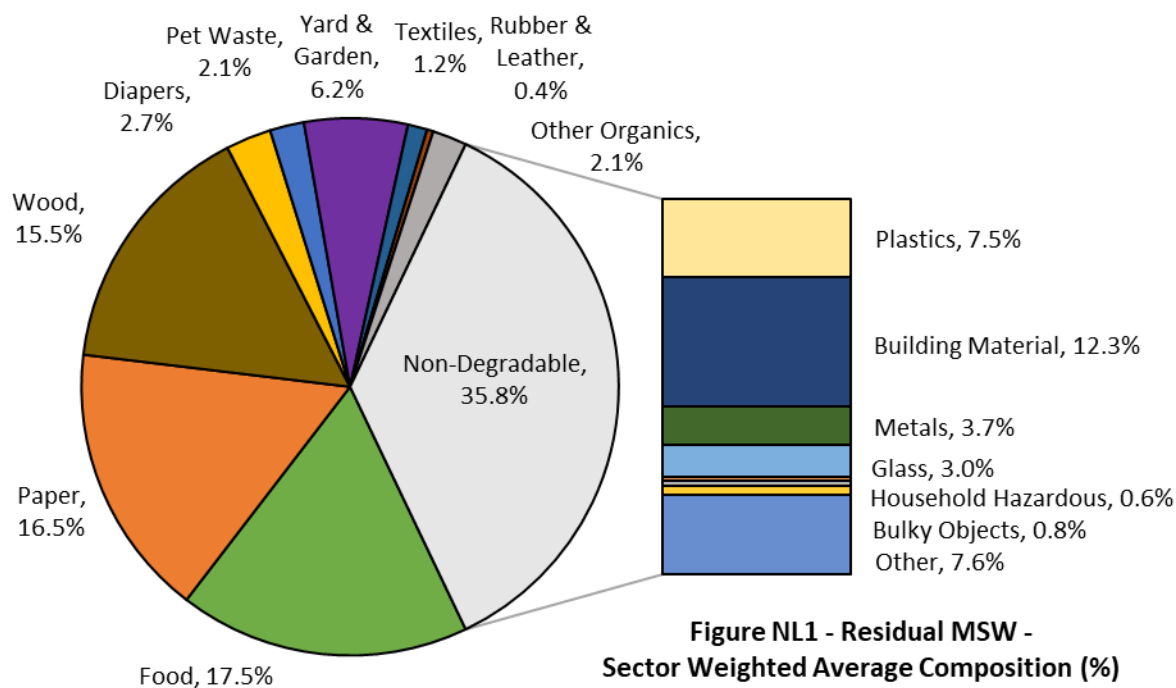
[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] National Inventory Report of Greenhouse Gas Sources and Sinks.
[3] Calculated based on data for NS provided by Statistics Canada. Table 38-10-0032-01 Disposal of waste, by source

Table NL2: Sector averages - Percentage of material categories in residual MSW in Newfoundland & Labrador

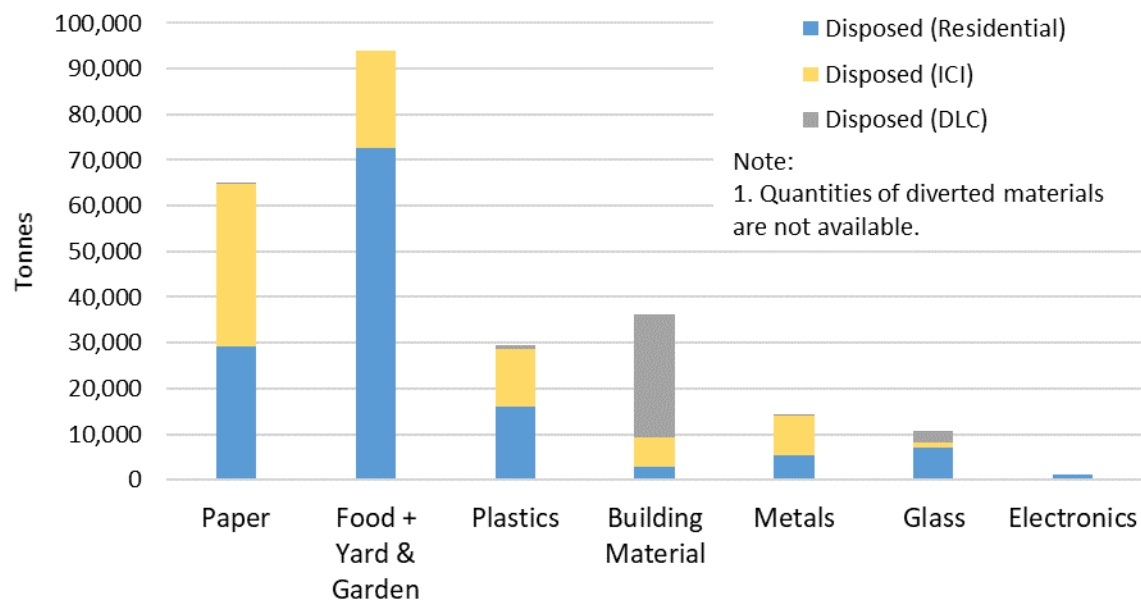|	RES (SF&MF)	ICI	DLC
Paper	16.4%	25.2%	0.3%
Food	32.7%	7.6%	-
Yard & Garden	7.9%	7.4%	0.0%
Diapers	5.6%	0.6%	-
Pet Waste	4.5%	-	-
Wood	0.4%	21.8%	39.9%
Textiles	2.0%	0.7%	-
Rubber & Leather	0.7%	0.2%	-
Other Organics	4.6%	-	-
Plastics	9.0%	8.8%	1.7%
Building Material	1.5%	4.7%	52.2%
Metals	2.9%	6.2%	1.0%
Glass	4.0%	0.8%	4.9%
Electronics	0.7%	-	-
Household Hazardous	0.4%	1.1%	0.0%
Bulky Objects	0.1%	2.0%	0.0%
Other	6.6%	13.0%	0.0%

"-" Data not available

Figure NL2 - Quantities of select materials in MSW disposed (by sector) - 2016 (tonnes)

Table NL3: Newfoundland & Labrador sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[4]	Quantity of material disposed per capita (kg/capita)
Paper	16.5%	65,165	x	123
Food	17.5%	69,215	401[a]	131
Yard & Garden	6.2%	24,582		46
Diapers	2.7%	10,808	NA	20
Pet Waste	2.1%	8,129	NA	15
Wood	15.5%	61,456	NA	116
Textiles	1.2%	4,637	NA	9
Rubber & Leather	0.4%	1,487	NA	3
Other Organics	2.1%	8,183	NA	15
Plastics	7.5%	29,796	NA	56
Building Material	12.3%	48,518	0[b]	92
Metals	3.7%	14,686	1,093	28
Glass	3.0%	11,836	x	22
Electronics	0.3%	1,315	x	2
Household Hazardous	0.6%	2,229	NA	4
Bulky Objects	0.8%	3,150	NA	6
Other	7.6%	30,130	6,966[f]	57
TOTAL		**395,323**	**39,405[e]**	**747**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) Includes tires and "other"

"-" Data not available

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[4] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type

Northwest Territories, Nunavut and Yukon Territory

Although they represent distinct geographic areas, the territories were grouped together as a region in this analysis.

Two waste composition studies from the Yukon Territory were used in the study. These audits characterized waste from Whitehorse and surrounding areas. Both audits were collected using a WFS. The data from the audits represents SF/MF, ICI, DLC and a combination of all sectors with a data gap for DO-specific material.

One waste composition study from the Northwest Territories was used in the study, characterizing waste from Yellowknife through a WFS. Three datasets are provided by the study: SF in isolation, MF and ICI combined, as well as a combination of SF, MF, and ICI with a data gap for DLC- and DO-specific material.

A CSS audit conducted in Iqaluit in 2011 was used to characterize waste from Nunavut. The data collected represents SF/MF, ICI, and a combination of all sectors, with a data gap for DLC- and DO-specific material.

The residential/ICI/DLC distribution estimate from the Yellowknife, NT waste characterization report was used to represent the distribution of different types of waste in NU landfills, and the Whitehorse waste characterization provided a similar estimate for YT waste. Data regarding waste diversion is not available for the individual territories, but rather for the three territories combined. As such, the material-specific quantities of waste generated were calculated for the three territories combined (Table NU-NWT-YT3). This allows for a direct comparison between the waste diversion and waste generation data.

Table NWT-NU-YT1: Population and MSW Generation Statistics (2016)

	Nunavut	Northwest Territories	Yukon Territory
Population[1]	36,975 people	44,649 people	38,547 people
Quantity of waste generated:[2]	28,204 tonnes	34,058 tonnes	29,403 tonnes
% of waste from residential:	30%[3]	30%[4]	11%[5]
% of waste from ICI:	35%[3]	35%[4]	45%[5]
% of waste from DLC:	35%[3]	35%[4]	44%[5]

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[1] Statistics Canada. Table: 17-10-0005-01 Population estimates on July 1st
[2] Waste disposed calculated by subtracting provincial total from national waste disposed and distributing between territories by population.
[3] Assumed to be same as NT
[4] City of Yellowknife, Memorandum to Committee, May 22, 2018
[5] Whitehorse Waste Composition Study (2017)

Table NWT-NU-YT2: Sector averages - Percentage of material categories in residual MSW in the Territories

	Nunavut		Northwest Territories			Yukon		
	RES (SF&MF)	ICI	RES (SF&MF)	ICI	DLC	RES (SF&MF)	ICI	DLC
Paper	12.4%	34.5%	14.1%	30.4%	0.3%	7.4%	12.5%	7.3%
Food	27.3%	40.3%	26.5%	31.3%	0.0%	27.6%	29.9%	0.2%
Yard & Garden	-	-	5.2%	0.7%	0.0%	0.1%	0.8%	0.1%
Diapers	-	-	11.3%	0.1%	0.0%	7.9%	3.4%	0%
Pet Waste	-	-	-	-	-	6.7%	1.1%	0%
Wood	0.5%	0%	0.7%	4.0%	52.0%	1.2%	11.0%	33.6%
Textiles	-	-	2.9%	1.9%	0.0%	1.9%	1.4%	0.8%
Rubber & Leather	-	-	0.1%	0.3%	0.0%	0.1%	0.4%	0%
Other Organics	6.3%	5.1%	5.9%	9.2%	0.0%	9.2%	5.6%	0.2%
Plastics	9.9%	7.3%	18.1%	15.5%	0.5%	13.4%	11.2%	6.1%
Building Material	0.5%	0%	0.4%	0.0%	45.0%	0.7%	2.2%	23.2%
Metals	5.8%	1.5%	4.8%	1.3%	1.0%	4.8%	3.0%	9.5%
Glass	5.4%	8.2%	2.6%	1.1%	0.2%	2.0%	1.3%	0.5%
Electronics	0.3%	0.1%	1.1%	0.2%	0.0%	0.6%	1.2%	0.7%
Household Hazardous	0.2%	0%	0.4%	0.1%	0.0%	1.0%	1.0%	1.1%
Bulky Objects	-	-	0.7%	0.0%	0.0%	5.8%	6.4%	4.3%
Other	31.4%	2.9%	5.2%	4.1%	2.0%	9.6%	7.4%	12.2%

"-" Data not available

Figure NU1 - NU Residual MSW - Sector Weighted Average Composition (%)

Note: DLC data from NT was used to calculate sector weighted average.

Figure NT1 - NT Residual MSW - Sector Weighted Average Composition (%)

Yard & Garden, 1.8%
Textiles (Degradable), 1.5%
Diapers, 3.4%
Wood, 19.8%
Other Organics, 5.0%
Paper, 15.0%
Non-Degradable, 35%
Food, 18.9%

Plastics, 11.0%
Building Material, 15.9%
Metals, 2.2%
Glass, 1.2%
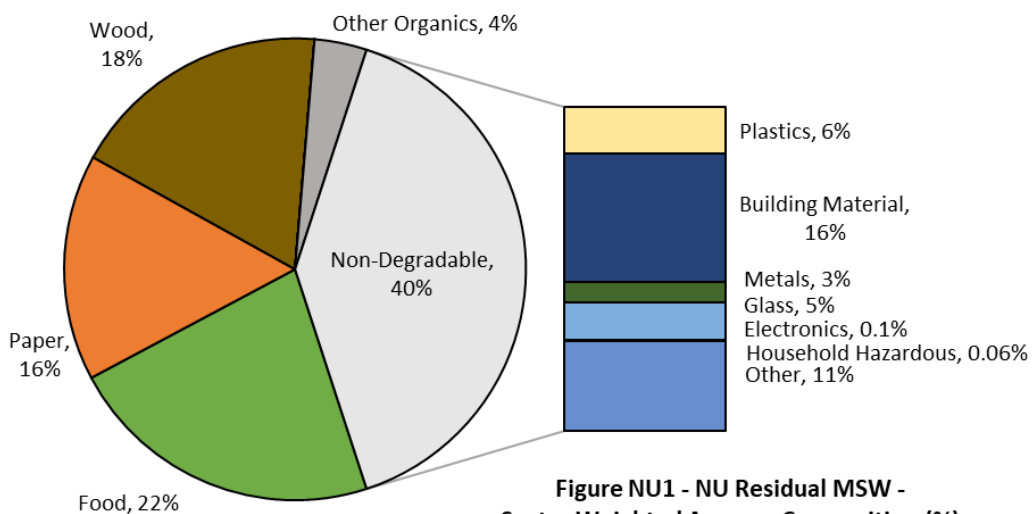Electronics, 0.4%
Bulky Objects, 0.2%
Other, 3.7%

Figure NU1 - NU Residual MSW - Sector Weighted Average Composition (%)

Note: DLC data from NT was used to calculate sector weighted average.

Wood, 18%
Other Organics, 4%
Paper, 16%
Non-Degradable, 40%
Food, 22%

Plastics, 6%
Building Material, 16%
Metals, 3%
Glass, 5%
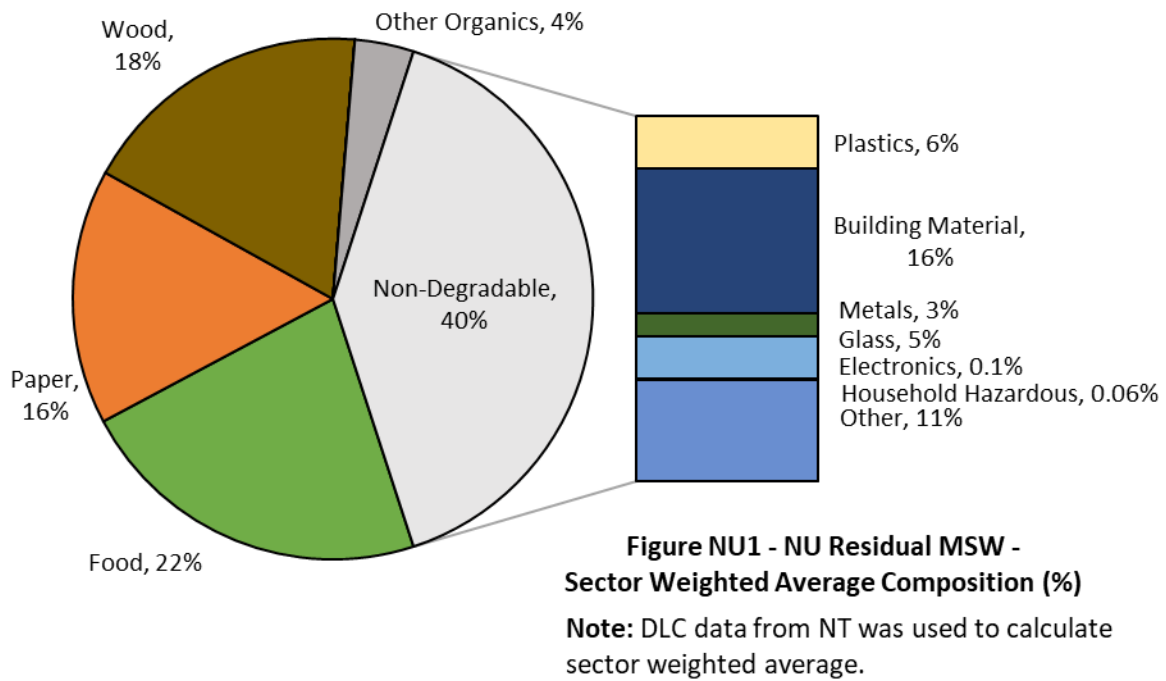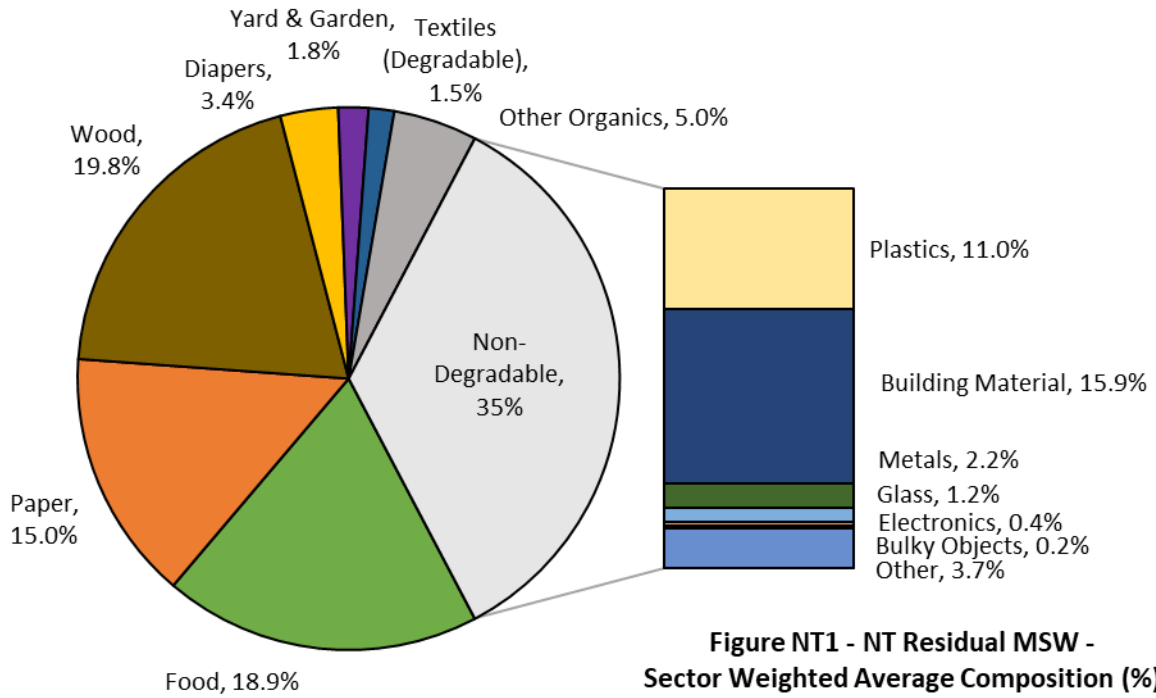Electronics, 0.1%
Household Hazardous, 0.06%
Other, 11%

Table NU-NWT-YT3: Sector weighted average % composition; quantity of materials disposed and diverted; quantity disposed per capita

	Sector-weighted average % of material in residual MSW	Quantity of material disposed (tonnes)	Quantity of material diverted (tonnes)[6]	Quantity of material disposed per capita (kg/capita)
Paper	15.5%	14,209	x[d]	125
Food	19.4%	17,819	3,990[a]	157
Yard & Garden	0.8%	776		7
Diapers	2.3%	2,073	NA	18
Pet Waste	1.7%	1,582	NA	14
Wood	14.9%	13,628	NA	120
Textiles	1.2%	1,074	NA	9
Rubber & Leather	0.1%	95	NA	1
Other Organics	4.2%	3,889	NA	34
Plastics	10.2%	9,329	x	82
Building Material	9.2%	8,445	x[b]	74
Metals	5.5%	5,081	251	45
Glass	2.3%	2,097	648	18
Electronics	0.6%	587	128	5
Household Hazardous	0.7%	611	NA	5
Bulky Objects	2.9%	2,634	NA	23
Other	8.3%	7,624	1,175[f]	67
TOTAL		**91,553**	**32,612**[e]	**806**

(a) Includes organics (food + yard and garden)

(b) Includes construction, renovation and demolition materials

(c) NA   Data not compiled by Statistics Canada for this material

(d) X Data suppressed to meet the confidentiality requirements of the Statistics Act

(e) Total value includes material quantities that were suppressed to meet confidentiality requirements, and may not equal the sum of the material values

(f) Tires

 "-" Data not available

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[6] Statistics Canada. Table: 38-10-0034-01 Materials diverted, by type
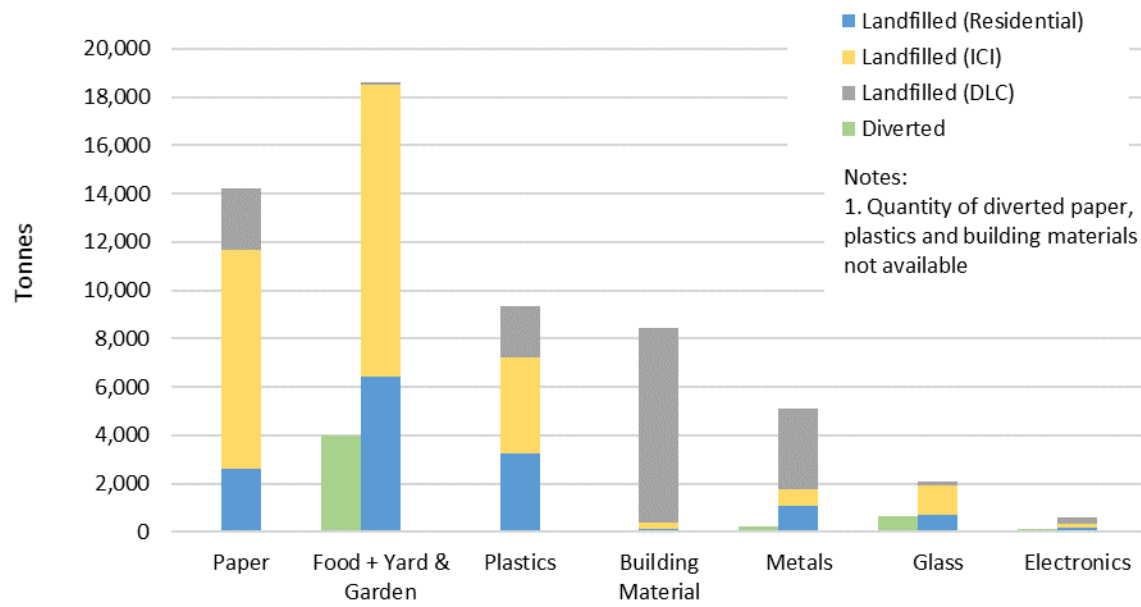
Figure NT/NU/YT2 - Quantities of select materials in MSW generated (by sector) and diverted - 2016 (tonnes)