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STANDARDS RESEARCH

Municipal Food Loss and Waste in the Industrial, Commercial, and Institutional Sector: Recommendations for Measurement Standardization

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Executive Summary

The amount of food loss and waste (FLW) in Canada is substantial and has significant economic, environmental, and social impacts. This research report looks at pre- and post-consumer FLW generated at facilities in the industrial, commercial, and institutional (ICI) sector, which includes food processing, food transport, food retail, and food service. FLW in the ICI sector is poorly understood for three key reasons: (a) less ICI data is collected compared with other sectors; (b) a diversity of (often incomparable) data collection methodologies are used; and (c) the data is not typically made publicly available.

This research report identifies, aggregates, and analyzes existing ICI FLW data in Canada, as well as the prevailing methodologies being used to measure ICI FLW. The findings presented in this report can be used by municipalities and other interested parties to support future sustainability and circularity efforts with respect to ICI FLW. With this in mind, the specific objectives of this research were:

1. To understand and elucidate the current state of ICI FLW data collection in Canada in terms of quantitative estimates of ICI FLW and the prevailing methods being used to measure ICI FLW; and
2. To provide recommendations on a standardized methodology for measurement and reporting that can be used to collect and manage ICI FLW data.

Data for this report were collected through a variety of research methods. ICI facility FLW audit data, including quantities and measurement methods, were gathered from Canadian municipalities and waste auditing companies. A comprehensive literature review and jurisdictional scan were conducted to identify ICI FLW measurement methodologies currently being used in Canada, the United States, and internationally. Finally, 30 interviews were conducted with representatives from Canadian municipalities and other interested parties concerned with the ICI waste stream, including universities, businesses, government agencies, and non-governmental organizations.

The results provide reliable quantitative estimates for FLW in the ICI sector in Canada. Based on a compilation of 614 data points on ICI FLW generation in Canada, it is estimated that waste disposed per employee ranges from 60 to 1,296 kg/year, depending on the industry. Further, the estimated percentage of FLW in the waste disposal stream by subgrouping of businesses within the ICI sector ranges from 6 to 47%. These estimates indicate that the ICI sector disposes of nearly 1,800,000 tonnes/year of FLW.

The literature review and jurisdictional scan revealed two key methodological approaches to ICI FLW measurement: mass balance and direct measurement. The interviews with key parties revealed that although very few had access to ICI FLW data, almost all saw a benefit in developing a standard ICI FLW measurement methodology. Further, all interviewees offered suggestions on what a standard could include, such as comparability, standardized methodologies and metrics, and ease of implementation.

Based on the research findings, this report proposes the elements of a standardized methodology to rigorously define, collect, and report ICI FLW that takes four essential criteria into consideration:

- Scientific defensibility;
- Ease of use;
- Level of detail; and
- Suitability of data for metrics development (i.e., ability to normalize data) for comparability.

This methodology could be used by all business types and would be designed to facilitate comparison between similar generators (e.g., hotels), and also on a like-for-like basis across different generator types (e.g., hotels and grocery stores).

A standard with an easy-to-use methodology could help municipalities and businesses in the ICI sector to measure FLW more effectively, generate more accurate data for estimating the multiple impacts of ICI FLW, and inform circular economy and sustainability efforts to minimize future impacts.



"According to some estimates, almost half of the food available for consumption is wasted every year."

1 Introduction

1.1 Background and Objectives

The amount of food loss and waste (FLW) in Canada is substantial. According to some estimates, almost half of the food available for consumption is wasted every year [1]. FLW also has significant economic, environmental, and social impacts. It has been estimated that FLW in Canada has an annual economic cost of $58 billion [1], and about half of that economic burden is borne by Canadian households [1]. FLW also amplifies the climate change crisis by generating considerable greenhouse gas emissions, notably carbon dioxide (generated through the production, transportation, and handling of food) and methane (generated by wasted food decaying in landfills) [2]. Meanwhile, in 2023, over 8.7 million Canadians lacked safe and nutritious food due to financial constraints, despite Canada being one of the world's largest food producers [3].

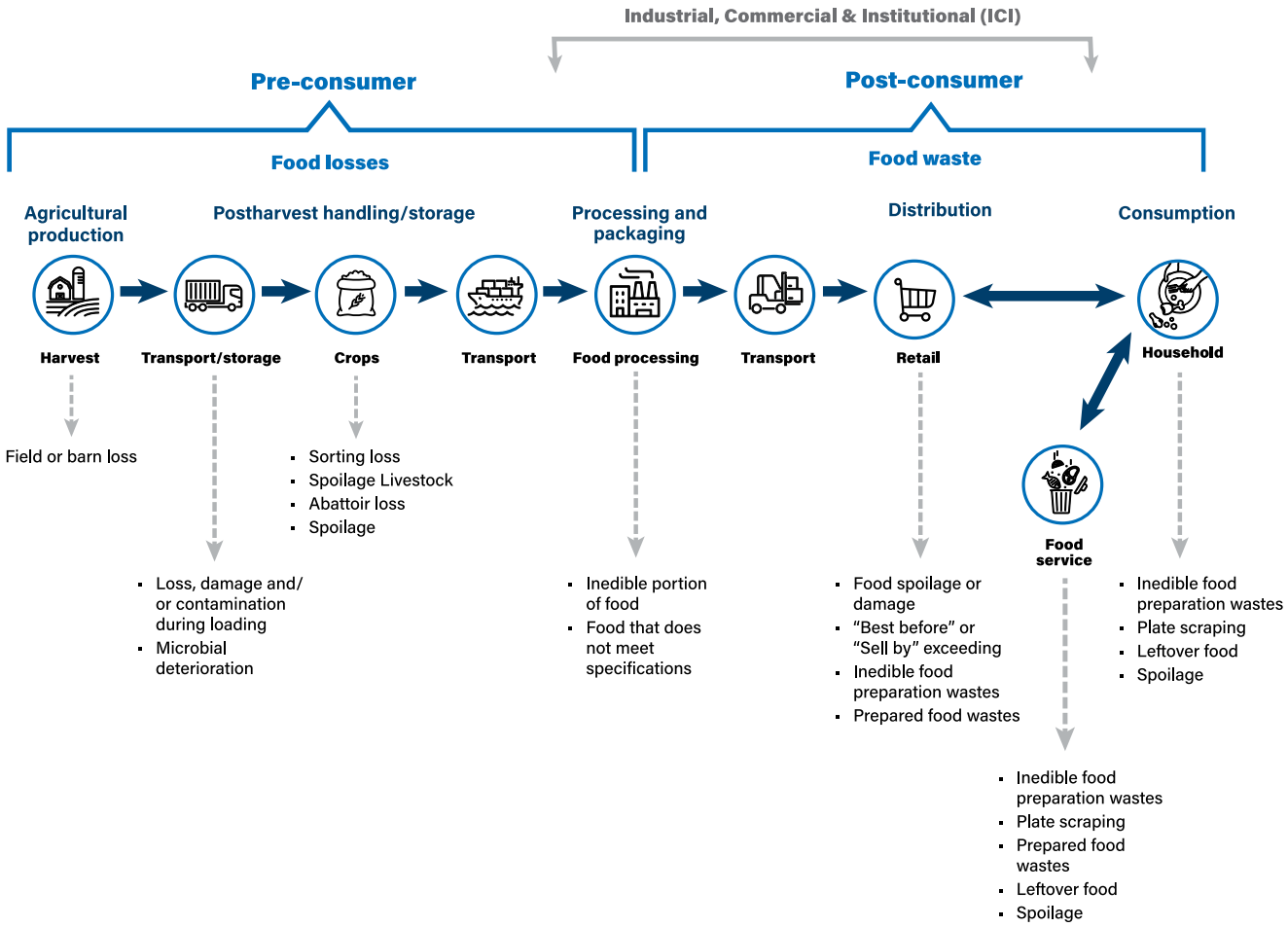
As illustrated in Figure 1, FLW is the result of inefficiencies across the food supply chain, from agricultural production to point of consumption [4]. This research report looks at pre- and post consumer FLW generated at facilities in the industrial, commercial, and institutional (ICI) sector, which includes food processing, food transport, food retail, and food service.

While the abbreviation FLW is used throughout the report for consistency, food loss occurs in the food production (agriculture) and processing (industrial) sectors, whereas food waste occurs after production and processing in the commercial, institutional, and residential sectors [5]. This report focuses on the ICI sector only (i.e., excludes agriculture and residential sectors). While some Canadian and international research has been undertaken to better understand the quantity, correlates, and causes of FLW across the food supply chain [4], most of this research has used diverse methodologies and the work remains scattered across disparate and often inaccessible sources.

A systematic review conducted by van der Werf and Gilliland found that on average, 199 kg/capita of food was wasted each year across the food supply chain in developed countries such as Canada [4]. Another report comparing food system inputs with food consumed in Canada estimated that 21.18 million tonnes of food is wasted each year, and the ICI sector accounts for approximately two-thirds of that amount (49% in processing/manufacturing, 5% in distribution, 5% in retail, and 7% in hotels/restaurants/institutions) [1].

Previous research has focused on FLW measurement methods and the importance of using direct measurement to obtain accurate FLW results, which can then be used as the basis for developing FLW reduction interventions [4], [6]. In general, ICI waste—

Figure 1: FLW across the supply chain. Adapted from [4].



and by extension ICI FLW—is less understood than residential food waste [5], [7]. This knowledge gap exists for three key reasons: (a) less ICI data has been collected compared with other sectors (likely due to concerns regarding the cost of FLW measurement and diversion); (b) a variety of data collection methodologies are used (which do not always facilitate direct comparisons); and (c) the data is not typically made publicly available (due to businesses being private and not having a mandate to collect or report FLW amounts).

This research report identifies, aggregates, and analyzes existing ICI FLW data in Canada, as well as the prevailing methodologies being used to measure ICI FLW. The findings presented in this report can be used by municipalities and other interested parties to support future sustainability and circularity efforts with respect to ICI FLW (e.g., to reduce FLW and greenhouse gas emissions, to increase diversion efforts, and to increase landfill longevity). With this in mind, the specific objectives of this research were:

1. To understand and elucidate the current state of ICI FLW data collection in Canada in terms of quantitative estimates of ICI FLW and the prevailing methods being used to measure ICI FLW; and
2. To provide recommendations on a standardized methodology for measurement and reporting that can be used to collect and manage ICI FLW data.

Establishing standardized methodologies and reporting procedures should be essential for any policy that is developed regarding measuring, reporting, and enforcement of ICI FLW. It should be noted that while the research conducted for this report primarily focused on municipalities, the ICI sector is generally responsible for their own waste management. In some cases, municipalities may enact bylaws that in part govern ICI waste management. While municipalities are generally responsible for residential waste management, some Canadian municipalities extend their services to some ICI waste generators (e.g., businesses and institutions). When municipalities have the interest, resources, and capacity to consider their ICI waste, including assessing its quantity and composition through waste audits, they generally focus on only a small portion of the waste stream (i.e., the portion they manage), and food waste is within this portion. The required ICI FLW data for this report came from communication and interviews with Canadian champions from both the municipal and ICI sectors that already collect and, in some cases, use this data to inform FLW interventions.

2 Methods

2.1 Update, Aggregate, and Analyze Existing Data

2.1.1 Gathering Data on ICI FLW Disposal

Through interviews, a literature review, and previous research, available ICI facility waste audit data were gathered and compiled from cooperating ICI facilities, municipalities that conduct ICI waste audits, and waste auditing companies. This data collection was undertaken to better understand the amount of FLW that is disposed of in the waste disposal stream and, ultimately, to develop a national estimate. In all cases, waste audit data were provided on the basis that it would be treated as confidential business information whose origin would not be disclosed. The scope of data collection included facility information (e.g., facility type, number of employees, tonnes of waste disposed annually) and the percent FLW in the waste disposal stream. It should be noted that this data represents measurements of FLW disposed to landfills and does not include FLW diversion destinations (e.g., composting, anaerobic digesters, animal feed), as there is insufficient data to adequately estimate this portion of ICI FLW. To the extent possible, the data were normalized by the number of employees (i.e., kg FLW/employee/year). Normalization of data (e.g., kg/employee) allows FLW to be compared across various sectors on an apples-to-apples basis. Results from 614 waste audits were compiled and used in this report. Most of this data was originally collected between 2019 and 2023, came primarily from Ontario and western Canada, and was mostly from ICI facility waste audits.

2.1.2 Summarizing Data on ICI FLW Disposal

All food waste audit data were categorized by two-digit North American Industry Classification System (NAICS) code sectors. A considerable amount of generic "office" data (163 of the 614 waste audits) was collected that represented a range of NAICS codes, including 51 (Information and cultural industries), 52 (Finance and insurance), 53 (Real estate and rental and leasing), 54 (Professional, scientific and technical services), 55 (Management of companies and enterprises), 56 (Administrative and support, waste management and remediation services), 81 (Other services), and 91 (Public administration).

The estimates derived using this method were compared to other measurement approaches. A sensitivity analysis that applied typical FLW percentages from waste audits at ICI facilities was also undertaken, with an estimate of total ICI food waste disposed. A sensitivity analysis is a study that considers how uncertainty in the output of a mathematical model, such as an estimated value of total FLW disposed, is impacted by different sources of uncertainty in its inputs (e.g., total ICI food waste disposed and typical FLW percentages).

2.2 Understanding ICI FLW Measurement Methodologies

2.2.1 Literature Review and Jurisdictional Scan of Methodologies

To understand the current state of ICI FLW measurement, a literature review and jurisdictional scan of ICI food and broader waste measurement methodologies were undertaken. This research was divided by Canadian, United States (US), and

international jurisdictions. Relevant reports were reviewed for methods used to measure ICI FLW. It should be noted that while this included reports focused specifically on FLW, reports generally focused on the broader ICI waste stream. Some documents that addressed residential waste audit methods were also included because they may provide useful information that can be applied to the ICI sector. Documents were divided into those that present methodological approaches and those that present results along with methodological detail.

2.2.2 Assessment of ICI FLW Measurement Methodologies

To help identify best measurement practices, the various ICI FLW (and other waste) measurement methodologies were further assessed using the following criteria:

- **Scientific defensibility:** Sample is representative and of adequate size.
- **Ease of use:** A measurement standard that is simple to implement and able to measure ICI FLW across the wide array of ICI generator types.
- **Level of detail:** Methodology that ideally goes beyond measuring/quantifying total FLW, and also provides information on types of food being wasted and whether the waste is avoidable (i.e., edible at one point) or unavoidable (i.e., bones, shells, etc.).
- **Suitability of data for metrics development:** Data can be normalized and used to estimate environmental metrics (e.g., greenhouse gases, circular economy considerations such as composting or anaerobic digestion), economic metrics (e.g., sunk costs), and social impact metrics (e.g., meals wasted).

Professional judgement, from previous direct use of some of these methodologies and familiarity with other methodologies, was used to facilitate this assessment.

2.3 Interviews with Key Parties

2.3.1 Developing the List of Interviewees

A list of relevant organizations and individuals was created using previous experience, professional contacts, and online research. This list of key parties included representatives from municipalities, as well as other interested parties (e.g., universities, businesses, government agencies, and non-governmental organizations). Interviewees were contacted by email and given the option to answer the questions via email or an interview.

2.3.2 Interview Questions

A semi-structured interview script was developed. Interview questions were designed to elicit information on key topics of this report. Each interviewee was asked the following questions:

1. Has your organization undertaken any research into ICI food waste generation, disposal, and/or diversion?
   a. Any research at the residential level?
2. Has your organization been able to quantify the amount of ICI food waste generated, disposed, and/or diverted in your jurisdiction? What methods were used?
3. Do you have ICI waste audit results you could share?
4. Do you have any publicly available reports that you could share?
5. For municipalities: Any bylaws related to food waste disposal for residents or business?
6. If ICI waste/food waste measurement standards were developed, would your organization be likely to use them?
   a. What value would having a standard bring to your organization, if any?
   b. What would you like to see in a measurement standard relating to food waste?
7. Finally, are you aware of any other organizations undertaking research into ICI food waste generation/disposal/diversion?

2.3.3 Conducting the Interviews

Interviews were conducted online via Zoom, MS Teams, or Google Meet, and each lasted approximately 30 minutes. All 30 interviews were carried out by one interviewer and were audio-recorded (with the interviewee's verbal permission) at the start



of the interview. At the end of every interview, each interviewee was asked to recommend other organizations working in ICI FLW across Canada; additional organizations were added to the initial contact list using this method of snowball sampling.

Audio files were transcribed verbatim using either the "transcribe" function in MS Word or using the "record and transcribe" function during the MS Teams interviews. Relevant data were extracted from interview transcripts and, along with any emailed answers, were entered in a table that summarized key components of each interview (see Appendix B).

Forty organizations were contacted, and 30 interviews were conducted, of which 18 were with municipalities and 11 were with other interested parties (see Table 9 and Appendix B).

Of the municipalities interviewed, one was from British Columbia, three were from Alberta, one was from Saskatchewan, ten were from Ontario, one was from New Brunswick, one was from Nova Scotia, and one was from Prince Edward Island.

Of the other interested parties, two were from universities (University of Guelph and Wilfrid Laurier University), four were from private businesses (Enviro-Stewards, FoodMesh, Longo's, and S-Cubed Environmental), and five were from non-governmental organizations (Second Harvest, National Index on Agri-Food Performance, Circular Innovation Council, Ontario Food Collaborative, and Partners in Project Green). All organizations consented to be named in this report.

Interview questions elicited information on key research topics, including current ICI FLW research, available ICI FLW data, methodologies used to collect this data, bylaws relevant to ICI FLW, and thoughts on the development of potential measurement standards.

3 Results and Discussion

3.1 Landscape Analysis of ICI FLW Measurement

3.1.1 Existing ICI FLW Data

A proprietary database of Canadian ICI facility waste audits was updated and is summarized in Table 1. The database includes data points across numerous Canadian regions (mostly from Ontario and western Canada) organized by North American Industry Classification System (NAICS) codes. This database was expanded from approximately 400 to 614 data points during the writing of the report. The number of waste audits per NAICS sector is included in Table 1. As noted in Section 2.1.2, there were 163 generic office waste audits, which represented a range of NAICS codes. The expanded database was used to develop a national estimate of FLW disposed (i.e., to landfill) by the ICI sector.

Table 1 presents the estimated ICI FLW generation in Canada from the expanded database. It shows that total food waste (i.e., disposed) generated per employee ranges from 60 to 1,296 kg/year, depending on the industry. An estimated 7.2 million tonnes of waste (including but not limited to FLW) are disposed of by the ICI sector annually. Table 1 also shows that the estimated percentage of FLW in the total waste stream varies by subgrouping of businesses within the ICI sector, ranging from 6 to 47%. These estimates indicate that the ICI sector disposes of nearly 1,800,000 tonnes/year of FLW, which is approximately 25% (i.e., 1,753,728/7,273,614 * 100) of the total estimated ICI waste disposed from all streams.

The greatest amount of total waste disposed was generated by the manufacturing, food service, and trade industries, but the greatest amount of FLW disposed was generated by the food service (e.g., restaurants), manufacturing (e.g., food processing into products), and trade (e.g., grocery stores) industries (Table 1).

The number of employees listed for each category in Table 1 are reasonable estimates, as they were extracted directly from Statistics Canada employment datasets and compared with Statistics Canada labour datasets [8], [9].

It should be noted that the estimated tonnage of ICI waste disposed may be low based on the interpretation of Statistics Canada estimated waste disposal data [10] (i.e., after removal of construction and demolition waste tonnages that do not apply), which is collected as part of a biennial survey of the waste management sector. The 2022 Statistics Canada estimate of non-residential waste disposal was approximately 15.9 million tonnes/year [10]. Based on Environment and Climate Change Canada's 2020 waste characterization report [11], approximately 78% of this total is from the ICI sector, which would mean that approximately 12.4 million tonnes/year of ICI waste is disposed of compared to the 7.2 million tonnes estimated in Table 1. If the estimate of FLW waste disposed (i.e., 25% of total ICI waste disposed) was adapted accordingly, this would result in just over 3 million tonnes of ICI FLW per year (i.e., 25% * 12.4 million tonnes).

There are at least two possible reasons for the difference in ICI waste disposed. First, Statistics Canada 2022 waste disposal data [10] does not present a precise breakdown of "non-residential sources" of waste for disposal, so the amount of ICI waste disposed, which is included in this total, is not clear. Second, the ICI waste audit data used to build the model in this report may not be fully representative. For example, ICI facilities that undertake waste audits could already have waste reduction and other environmental policies in place to minimize waste disposal, which could be reflected in the data collected for this report.

According to Environment and Climate Change Canada's 2020 waste characterization report [11], in 2016, 25% of ICI waste consisted of food waste and the ICI sector disposed of approximately 3 million tonnes of food waste. However, this was based on a small number (n = 27) of waste audits and included little industrial or manufacturing data.

Second Harvest's 2019 technical report, The Avoidable Food Waste Crisis [12], indicated that almost 22 million tonnes of ICI FLW was generated in the processing, manufacturing, retail, hotels, restaurants, and institutions industries. By examining the percentage of FLW disposed to landfill in the 2019 report, the annual amount of ICI FLW landfilled by these sectors was calculated to be approximately 4.4 million tonnes [12]. The Second Harvest report was updated in 2024 [1] and the annual amount of ICI FLW landfilled was revised to approximately 4.2 million tonnes. The Second Harvest technical reports use a mass balance approach (see Section 3.1.2.1) to ICI FLW measurement, which may account for the differences in these estimates.

Thus, there is a considerable range in the amount of FLW disposed to landfill by the ICI sector, which is summarized in Table 2.

If the estimate of 12.4 million tonnes/year of ICI disposed waste, as extracted from Statistics Canada 2022 data [10], is considered reasonable, then a basic sensitivity analysis can be performed to calculate a range of ICI FLW that is landfilled. Table 3 presents this analysis by applying FLW percentages ranging from 10 to 40% (i.e., a typical range observed in ICI waste audits). The results indicate that a range of 1.2 to 4.96 million tonnes/year of ICI FLW is landfilled annually. The ICI FLW estimates summarized in Table 2 fit within the tonnage range of the sensitivity analysis, so it is reasonable to suggest that the true estimate of ICI FLW lies within the range summarized in Table 2.

Table 1: Estimate of ICI sector food disposed in Canada in 2023.

North American Industry Classification System (NAICS)	Number of Waste Audits	Number of Employees	ICI Waste Disposed		ICI FLW Disposed	
			kg/employee/yr	tonnes/yr	%	tonnes/yr
31-33: Manufacturing	80	1,565,737	1296.0	2,029,211	9%	182,629
41 44-45: Trade	133	2,841,275	659.3	1,873,224	23%	430,842
48-49: Transportation and warehousing	8	839,619	49.9	41,914	16%	6,706
51: Information and cultural industries	Office	364,978	60.1	21,917	19%	4,164
52 53: Finance, insurance, real estate and leasing	Office	1,126,724	60.1	67,660	19%	12,855
54: Professional, scientific and technical services	Office	1,216,322	60.1	73,040	19%	13,878
55 56:Business, building and other support services	Office	963,240	60.1	57,843	19%	10,990
61: Educational services	112	1,432,633	84.0	120,298	29%	34,285
62: Health care and social assistance	18	2,296,896	304.4	699,060	6%	41,656
71: Arts, entertainment and recreation	15	311,004	302.4	94,048	19%	17,869
72: Accommodation and food services -Accommodation	45	194,077	571.5	110,923	44%	48,950
72: Accommodation and food services – Food Service	40	1,110,221	1778.5	1,974,475	47%	928,003
81: Other services	Office	563,212	60.1	33,821	19%	6,426
91: Public administration	Office	1,268,625	60.1	76,181	19%	14,474
Total		**16,094,563**		**7,273,614**		**1,753,728**

Table 2: Range of FLW disposed by ICI facilities in tonnes per year.

	CSA Group (This Report) 2025	Environment and Climate Change Canada 2019	Second Harvest 2024	Second Harvest 2019
Total ICI FLW (tonnes/year)	1,800,000	3,000,000	4,200,000	4,400,000

Table 3: Sensitivity analysis of possible range of FLW disposed by ICI facilities to landfill.

Potential ICI FLW %	**10%**	**20%**	**30%**	**40%**
Estimate of ICI FLW (tonnes/year)	1,200,000	2,400,000	3,720,000	4,960,000

3.1.2 ICI FLW Measurement Methodologies

To better understand quantities and types of food wasted, it is critical that the issue of ICI FLW generation evolves from anecdotal observations to scientifically defensible data collection. Appendix A provides a detailed summary of Canadian, US, and international approaches to measuring FLW and broader ICI waste composition that were identified through the literature review and jurisdictional scan. The analysis starts at a high level and examines the two key approaches to measuring ICI (and other) FLW: mass balance and direct measurement. After a comparison of the two key approaches, this section examines specific methodologies by jurisdiction in greater detail.

3.1.2.1 Mass Balance Approach

The mass balance approach can be used to analyze the tonnes of materials flowing through a physical system. It estimates materials entering and exiting the system and uses that to create a baseline. A Canadian example that used this approach to estimate FLW is the work undertaken by Second Harvest in their 2019 technical report [12] (and its 2024 update [1]). Second Harvest's research focused on the whole food supply chain (i.e., agricultural, ICI, and residential sectors) and used it to estimate the amount of food in the system, accounting for food produced domestically, imported food, and for food processing. The amount of FLW was estimated using loss factors (e.g., food spoilage) by food type across the food supply chain (see Figure 1). These FLW factors are provided by Statistics Canada and the US Department of Agriculture's Economic Research Service (USDA/ERS), and are estimated using primary data provided by industry, from production through to retail. This data was extrapolated and modelled to come up with estimates.

3.1.2.2 Direct Measurement Approach

The direct measurement approach uses estimates of FLW collected through waste audits. Waste audits include the collection of representative samples of waste, manually sorting and weighing this waste to extract the amount of FLW, and then expressing this FLW as a percentage of the waste stream. Ideally, this data is also normalized per employee or by square footage of the generating location so it can be readily compared to other facilities. Waste audit studies generally examine more categories than just FLW (e.g., paper, plastic, glass, metal, and other waste, along with relevant sub-categories).

A Canadian example that used this approach is Environment and Climate Change Canada's 2020 National Waste Characterization Report [11], which used results from ICI sector waste audit studies to develop an estimate of ICI waste composition, including FLW (denoted as food waste in the report).



"To better understand quantities and types of food wasted, it is critical that the issue of ICI FLW generation evolves from anecdotal observations to scientifically defensible data collection."

The report also included an estimate of annual ICI FLW tonnes disposed.

The direct measurement approach also encompasses visual estimates, such as those collected through surveys and diary research, although they are generally viewed as less viable because amounts are difficult to estimate consistently (i.e., people have varying estimation abilities) and subject to self-reporting biases (i.e., people may underestimate FLW generation because it is not desirable, socially or professionally). These types of estimates are typically confined to household, not ICI, investigations.

3.1.2.3 Benefits, Limitations, and Opportunities of Key Approaches

An assessment and comparison of the mass balance and direct measurement approaches to measure FLW is detailed in Table 4. Mass balance is well-suited for developing large jurisdictional estimates (e.g., national), from which smaller jurisdictions can be inferred. The key limitation of the mass balance approach is that few, if any, actual FLW measurements are taken. Direct measurement is well-suited for developing estimates for smaller jurisdictions (e.g., municipalities), from which larger jurisdiction (e.g., provincial, national) estimates can be extrapolated. While direct measurement can be laborious and time consuming, smaller jurisdictions and ICI facilities use the direct measurement approach to collect FLW data themselves.

The key limitation of waste audit calculations is that it can be challenging to collect sufficient and representative data for large-scale (e.g., national level) FLW estimates. For these large-scale estimates, it is useful to combine approaches and compare the results. For the purposes of this report, the focus is on direct measurement methods because these can be independently undertaken by smaller jurisdictions and facilities.

3.1.2.4 Overview of Methodologies Used to Measure ICI FLW

The literature review and jurisdictional scan uncovered various methodology and results documents that included details on methodologies used. These are summarized in Appendix A, and key details are presented in this section, organized by region (Canada, US, and international). Accompanying tables include document publisher and title, year of publication, a brief summary of methods, and whether specific FLW measurement details were included.

3.1.2.4.1 Canadian Documents

Key Canadian documents are summarized in Table 5. These documents provide useful methodological details on how to conduct ICI waste audits, and include audits undertaken at generators (e.g., facilities such as restaurants) and at disposal facilities (e.g., sampling waste from collection vehicles).

Table 4: Comparison of Mass Balance and Direct Measurement Approaches.

Criteria	Mass Balance	Direct Measurement
Scientific defensibility	Less precise compared to direct measurement; relies on assumptions.	Highly defensible; provides accurate data through direct physical weighing.
Ease of use	Easier and less resource-intensive.	Can be labour-intensive and require significant commitment from staff.
Level of detail	Limited detail; provides overall mass but may not always specify types of FLW.	Allows high granularity in data; can differentiate between types of FLW and avoidable/unavoidable FLW.
Metrics development	Basic metrics can be developed but they lack granularity.	Can provide robust data for developing environmental, economic, and social metrics.

Table 5: Summary of ICI Waste Auditing Methods — Canada.

Document	Year	Methods Summary	FLW Details
Canadian Council of Ministers of the Environment (CCME) Waste Audit User Manual: A Comprehensive Guide to the Waste Audit Process [13]	1996	This guide includes step-by-step processes for planning and conducting audits, sorting waste, and estimating the quantity and types of waste generated.	No
Ontario Ministry of the Environment A Guide to Waste Audits and Waste Reduction Work Plans for Industrial, Commercial and Institutional Sectors [14]	1994, updated 2008	This guide provides an overview of how to conduct ICI waste audits and was prepared for Ontario ICI businesses that are required to undertake a waste audit and prepare a waste reduction workplan.	No
Recycling Council of Alberta Waste Audit User Manual: A Comprehensive Guide to the Waste Audit Process [13]	2005	This document includes details on conducting generator-based and disposal facility-based ICI waste audits.	No
Second Harvest A Guide to Food Waste Audits [15]	2022	A brief guide, including an online course and a food waste audit tracking sheet, to help undertake food waste audits.	Yes
Second Harvest The Avoidable Crisis of Food Waste: Technical Report [1], [12]	2019, updated 2024	These reports include details on how food waste estimates were generated. A mass balance approach was used.	Yes

The leading Canadian documents used to measure ICI sector waste include the Canadian Council of Ministers of the Environment (CCME) Waste Audit User Manual [13] and the Ontario Ministry of the Environment Guide to Waste Audits and Waste Reduction Work Plans for Industrial, Commercial and Institutional Sectors [14]. Additionally, Second Harvest has produced a guide to food waste audits, which includes online training and a data tracking sheet [15].

While several of the documents are older, they continue to be used as the basis for methodologies to measure ICI food and other waste. It may be useful to develop an updated waste audit guidance document, particularly one that provides additional details on FLW (e.g., avoidable vs. unavoidable; food categories such as bakery, fruit and vegetables, meat and fish, etc.).

3.1.2.4.2 United States Documents

US documents that provide methodological details on how to undertake ICI waste audits, at both generator and disposal facilities are summarized in Table 6.

Relevant documents used to measure ICI sector waste include ASTM D5231-92, *Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste* [17], which is used to measure mixed ICI (or other) waste streams arriving at waste management facilities in waste collection vehicles, US Environmental Protection Agency webinar, Best Practices for Waste Characterization [18], and ReFED's Food Waste Monitor [19], which provides considerable detail on ICI FLW measurement. Additionally, ReFED's Impact Calculator helps measure the impacts of food waste [20].

Table 6: Summary of ICI waste auditing methods—United States.

Document	Year	Methods Summary	FLW Details
ASTM International ASTM D5231-92, *Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste* [17]	2016	This guide includes step-by-step processes for planning and conducting audits, sorting waste, and estimating the quantity and types of waste generated.	No
Environmental Protection Agency Best Practices for Waste Characterization [18]	2018	This webinar provides information on how to conduct a waste characterization study. Topics covered include study design, waste sampling, waste sorting, data analysis, and data usage.	No
Environmental Protection Agency Guide to Conducting Student Food Waste Audits: A Resource for Schools [21]	2017	This guide was developed to help educate students about the amount of food they waste in their school cafeterias.	Yes
International City/County Management Association Municipal Solid Waste Characterization Protocol [22]	2016	This document outlines a process for conducting a municipal solid waste characterization study.	No
ReFED Food Waste Monitor [19]	2023	This document presents a detailed approach to measuring food waste using a mass balance approach. It includes detailed instructions for how to collect food waste data from manufacturers, food retailers, and food service.	Yes
ReFED Impact Calculator [20]	2024	This calculator quantifies the climate, natural resources, and food security impacts of wasted food.	Yes

3.1.2.4.3 International Documents

International documents that provide methodological detail on how to undertake ICI waste audits, including methods used at generator and disposal facilities are summarized in Table 7.

Relevant documents used include to measure ICI sector waste include the *Food Loss and Waste Protocol Food Loss and Waste Accounting and Reporting Standard* [23], which outlines various approaches to measuring ICI (and other) FLW, and two Waste and Resources Action Programme (WRAP) resources, How to Conduct a Waste Audit [24] and Waste Audit Guide [25].

3.1.2.5 Analysis of Methodologies Used to Measure ICI FLW

To help identify best measurement practices, the various ICI food (and other waste) measurement methodologies were further assessed using the criteria described in Section 2.2.2:

- Scientific defensibility;
- Ease of use;
- Level of detail; and
- Suitability of data for metrics development.

Table 7: Summary of ICI Waste Auditing Methods—International.

Document	Year	Methods Summary	FLW Details
Food Loss and Waste Protocol *Food Loss and Waste Accounting and Reporting Standard* (FLW Standard) [23]	2016	This global standard provides requirements, guidance, resources, and examples for quantifying and reporting FLW.	Yes
Food Loss and Waste Protocol Guidance on FLW Quantification Methods [26]	2016	This guidance document serves as a companion to the FLW Standard and offers practical guidance on methods for quantifying FLW.	Yes
Waste and Resources Action Programme (WRAP) How to Conduct a Waste Audit [24]	2020	This guide outlines a waste auditing method for the ICI sector.	No
WRAP Waste Audit Guide [25]	2020	This short guide provides step-by-step in-structions on undertaking a waste audit.	No
United Nations Environment Programme Developing Integrated Solid Waste Management Plan: Training Manual, Volume 1: Waste Characterization and Quantification with Projections for Future [27]	2009	This manual includes waste auditing meth-ods for a variety of sectors, including ICI.	No
Gawaikar and Deshpande Source Specific Quantification and Characterization of Municipal Solid Waste—A Review [28]	2006	This academic paper outlines methods for characterizing municipal solid waste.	No



Professional judgement was used to assess and grade each of these criteria as high, moderate, or low, which informed an overall evaluation of each document as fair, good, or excellent, all of which is summarized in Table 8. Based on this assessment, the key documents that could be used as a starting point for developing a new FLW measurement methodology are:

- CCME's Waste Audit User Manual: A Comprehensive Guide to the Waste Audit Process [13];
- Second Harvest's Guide to Food Waste Audits [15];
- ReFED's Food Waste Monitor [20];
- Food Loss and Waste Protocol's FLW Standard [23] and Guidance on FLW Quantification Methods [26]; and
- WRAP's How to Conduct a Waste Audit [24] and Waste Audit Guide [25].

These documents include foundational waste audit guides (e.g., CCME and WRAP documents), which describe how to undertake a waste audit, and FLW-specific measuring guides, which focus on measuring the FLW portion of the waste stream.

Table 8: Assessment of ICI FLW measurement methodologies.

Document	Year	Scientific Defensibility	Ease of Use	Level of Detail	Suitability of Data for Metrics Development	Overall Evaluation
CANADA						
Canadian Council of Ministers of the Environment (CCME) Waste Audit User Manual: A Comprehensive Guide to the Waste Audit Process [13]	1996	**High.** Organized and detailed approach to undertaking waste audits.	**Moderate.** Manual is well laid out but requires some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**High.** Manual details collection of various facility data (number of employees, square footage, etc.).	**Good** overview of waste auditing principles. Needs updating.
Ontario Ministry of the Environment A Guide to Waste Audits and Waste Reduction Work Plans for Industrial, Commercial and Institutional Sectors [14]	1994, updated 2008	**Moderate.** Organized approach to undertaking waste audits.	**Low–Moderate.** Guide is well laid out but requires additional waste auditing detail. Requires some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**Moderate.** Guide details collection of various facility data (number of employees, square footage, etc.).	**Fair** overview of waste auditing principles. Needs updating.
Recycling Council of Alberta Provincial Waste Characterization Framework [16]	2005	**High.** Organized and detailed approach to undertaking waste audits.	**Moderate**. Framework is well laid out but requires some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**Moderate.** Framework details collection of facility data (e.g., number of employees).	**Good** overview of waste auditing principles. Needs updating.
Second Harvest A Guide to Food Waste Audits (includes online course and tracking sheet) [15]	2022	**Low–Moderate.** Guide and data tracker documents are very brief.	**High.** Guide and data tracker documents are well laid out and easy to use.	**High.** Focus is on FLW. Online course includes FLW audit detail.	**Low.** Little detail but can increase metrics potential by incorporating with more detailed waste audit methodologies.	**Good** detail to conduct FLW audit. Can pair with more detailed waste auditing methodologies.
Second Harvest The Avoidable Crisis of Food Waste: Technical Report [1], [12]]	2019, updated 2024	**Moderate.** Organized approach to undertaking mass balance approach to measuring FLW.	**Low–Moderate.** Requires specialized expertise and access to data to undertake this analysis.	**High.** Good level of detail on food types.	**High.** Detailed food waste data from which metrics can be developed.	**Good** overview of mass balance methods.
UNITED STATES						
ASTM International ASTM D5231-92, *Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste* [17]	2016	**High.** Organized and detailed approach to undertaking waste audits at disposal facilities.	**Moderate.** Test method is well laid out but requires some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**Low–Moderate.** Test method details collection of various facility data (number of employees, square footage, etc.).	**Good** overview of waste auditing principles. Needs updating.
Environmental Protection Agency Best Practices for Waste Characterization [18]	2018	**High.** Organized and detailed approach to undertaking waste audits.	**Moderate.** Webinar is well laid out but requires some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**Low–Moderate.** Webinar provides little detail on developing metrics.	**Good** overview of waste auditing principles.

Document	Year	Scientific Defensibility	Ease of Use	Level of Detail	Suitability of Data for Metrics Development	Overall Evaluation
UNITED STATES						
Environmental Protection Agency Guide to Conducting Student Food Waste Audits: A Resource for Schools [21]	2017	**Moderate.** Guide presents an approach to undertaking FLW audits at schools.	**High.** Guide and data tracker documents are well laid out and easy to use.	**High.** Focus is on FLW.	**Low.** Guide provides little detail on developing metrics.	**Good** detail to conduct FLW audit at schools. Methods could potentially be applied to other generators.
International City/County Management Association Municipal Solid Waste Characterization Protocol [22]	2016	**High.** Organized and detailed protocol to undertaking waste audits.	**Moderate.** Protocol is well laid out but requires some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**Low.** Protocol details collection of various facility data (number of employees, square footage, etc.).	**Good** overview of waste auditing principles. Needs updating.
ReFED Food Waste Monitor [19] Impact Calculator [20]	2023	**High.** Organized and detailed approach to measuring FLW.	**Low–Moderate.** Requires special-ized expertise and access to data to undertake this anal-ysis.	**High.** Focus is on FLW.	**High.** Focus is on FLW. Impact calcula-tor provides detailed metrics.	**Good** overview of mass balance methods. **Excellent** impact calculator (that can be used with mass balance and waste auditing data).
INTERNATIONAL						
Food Loss and Waste Protocol *Food Loss and Waste Accounting and Reporting Standard* (FLW Standard) [23] Guidance on FLW Quantification Methods [26]	2016	**High.** Organized and detailed ap-proach to various methods of measur-ing FLW.	**Low–High.** Amount of expertise varies by method but there are methods availa-ble for each skill level.	**High.** Focus is on FLW.	**High.** Focus is on FLW. Considerable detail on metrics (Appendix D of FLW Standard).	**Excellent** overview of mass balance methods. **Excellent** impact calculator (that can be used with mass balance and waste auditing data).
Waste and Resources Action Programme (WRAP) How to Conduct a Waste Audit [24] Waste Audit Guide [25]	2020	**Moderate.** A basic waste auditing guide.	**Moderate.** Guides are well laid out but require some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**Low.** Guides provide little detail on developing metrics.	**Good** and basic overview of waste auditing principles.
United Nations Environment Programme Developing Integrated Solid Waste Management Plan: Training Manual, Volume 1: Waste Characterization and Quantification with Projections for Future [27]	2009	**High.** Organized and detailed approach to undertaking waste audits.	**Moderate.** Manual is well laid out but requires some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**Moderate.** Manual details collection of facility data (e.g., number of employees).	**Good** overview of waste auditing principles.
Gawaikar and Deshpande Source Specific Quantification and Characterization of Municipal Solid Waste—A Review [28]	2006	**Moderate.** Organized approach to undertaking waste audits.	**Moderate.** Review is well laid out but requires some scientific expertise to implement.	**Moderate.** Includes FLW as a category.	**Low.** Review is focused on waste audit methods.	**Good** overview of waste auditing principles.



3.2 Interview Results

3.2.1 Municipal Organizations

Of the 18 municipalities interviewed, ten were involved in work relating to ICI FLW, and five were actively conducting waste audits and were willing to share the results and/or reports (Metro Vancouver, City of Calgary, Wellington County, City of Guelph, and Halifax Regional Municipality). All five used the direct assessment waste auditing method and used various categories to define different types of FLW (e.g., avoidable vs. non-avoidable; FLW with packaging vs. FLW without packaging; and edible vs. inedible) depending on green cart/bin regulations.

Two municipalities had conducted qualitative research on ICI FLW (City of Calgary and City of Saskatoon). Four were either starting the process of developing a plan to address ICI FLW or have already conducted some basic research, such as mapping out work (City of Edmonton, Strathcona County, City of Saskatoon, City of London).

Sixteen of the 18 municipalities expressed an interest in the development of measurement standards related to ICI FLW auditing.

A summary of the interviews is provided in Table 9.

3.2.2 Other Interested Parties

Of the 11 other interested parties who were interviewed, five had conducted direct assessment waste audits and were willing to share some waste audit results (to varying degrees of detail), including representatives from the Circular Innovation Council, Longo's, S-Cubed Environmental, the University of Guelph, and Wilfrid Laurier University. Three interested parties were focused on reducing FLW before it enters the waste stream (Enviro-Stewards, FoodMesh, and Second Harvest), and two described their role as conveners for organizations and individuals interested in reducing FLW (Ontario Food Collaborative and Partners in Project Green). The final interested party was the National Index on Agri-Food Performance, which uses science-based metrics, such as emissions and waste audit data, to provide an integrated picture of sustainability for Canada's agri-food sector.

Nine of these organizations expressed an interest in the development of measurement standards related to ICI FLW audits (see Table 9), although some recognized that standards would not be relevant to the current focus of their organization (e.g., the Ontario Food Collaborative would be interested in standards, but are an advocacy organization that does not conduct audits).

Table 9: Summary of Interviews.

Organization	Work on ICI FLW	Waste Audit Data
Municipalities		
Metro Vancouver	Yes	Yes
City of Calgary	Yes	Yes
City of Edmonton	Yes	No
Strathcona County	Yes	No
City of Saskatoon	Yes	No
City of London	Yes	No
Wellington County	Yes	Yes
City of Waterloo	Yes	No
City of Guelph	Yes	Yes
City of Hamilton	No	No
Niagara Region	No	No
Halton Region	No	No
Peel Region	No	No
City of Toronto	Yes	No
City of Ottawa	No	No
City of Moncton	No	No
Province of Prince Edward Island	No	No
Halifax Regional Municipality	Yes	Yes
Other Interested Parties		
National Index on Agri-Food Performance	Yes	No
Circular Innovation Council	Yes	Yes
Enviro-Stewards	Yes	No
FoodMesh	Yes	No
Longo's	Yes	Internal data only
Ontario Food Collaborative	Yes	No
Partners in Project Green	No	No
S-Cubed Environmental	Yes	Yes, but data is confidential
Second Harvest	Yes	No
University of Guelph	Yes	Yes
Wilfrid Laurier University	Yes	Basic and internal data only

3.2.3 Interviewee Suggestions for Measurement Standards

3.2.3.1 Methodological Guidance and Comparability

Many interviewees indicated that detailed methodological guidance on how to conduct an audit of ICI FLW, either on-site or audits of ICI (total waste) waste facilities, would be valued. One municipality noted that they use an older document that provides detailed instructions for conducting a residential audit, but specified that a version for ICI waste audits would be helpful.

Several municipalities said they would like to be more confident that their waste composition results are comparable with those of other municipalities and believe standards would provide greater certainty. In particular, they noted that guidance on sample size and sample composition (i.e., what proportion of the sample should be grocery, restaurant, offices, etc., including business size) would be helpful.

Municipal interviewees also noted that guidance on how to approach mixed-use buildings, such as those that are both multi-residential and commercial buildings, would also be useful.

3.2.3.2 Metrics

Interviewees frequently mentioned that a standard should include common metrics and questioned whether ICI FLW should be reported by weight or volume, and per capita or by square footage. Additionally, interviewees suggested it would be helpful to include a metric that could be used for all types of ICI waste facilities. For example, one interviewee commented that reporting the amount of waste produced by full-time employees might be good for a long-term care home but is less useful for an office building due to remote working, and square footage might be ideal for a grocery store but not for a long-term care home, retirement home, or hospital.

3.2.3.3 Definitions

Some interviewees mentioned the need for clear definitions relating to categories of FLW, especially relating to edible food versus inedible food (e.g., it is difficult to distinguish once something has been in the garbage for a while), and avoidable versus unavoidable FLW. One municipality suggested consideration of how FLW measurements would be applied from a cultural lens (i.e., clear definitions of what is considered "unavoidable" FLW, as food items that might be considered FLW by one culture could be an important food item for another). Standard definitions around what is included in "organic material" were identified as helpful in terms of items such as compostable plastics. Interviewees also suggested that categorization of stores (e.g., when does a mini-mart become a grocery store) could be included. One interviewee referenced the definitions of FLW categories offered by Value Chain Management International, and wondered if everyone was aware of these definitions, and if so, whether everyone was in agreement with them.

Given the comments from the interviewees, any standardization effort for measuring and reporting ICI FLW should also include a list of definitions.

3.2.3.4 Application

Most interviewees indicated that they would value guidance relating to food diversion, in terms of keeping FLW out of landfills and incinerators and directing it to more sustainable and environmentally-friendly disposal and recycling methods (e.g., composting) or food rescue (collecting edible food that would otherwise go to waste and redistributing it to organizations that help people in need). Interviewees would also value guidance on how to include food diversion and rescue in FLW calculations. Furthermore, some interviewees mentioned a need for guidance regarding how to prevent FLW from entering the waste stream.

From the point of view of municipalities, a standard would be valuable to support effective policy development, particularly if it included best practices around key performance indicators. Municipalities were interested in how standardization might support implementation and enforcement of policies relating to ICI FLW. One municipality suggested that standards would likely be used in long-term care homes and other municipal-run facilities that are responsible for food services. Standards could also be used practically to inform ICI businesses and facilities about who to contact

for information relating to audits, hiring a consultant, reduction of food waste, and incentives. Municipalities also noted that standardization could be useful for guiding informational campaigns. Other organizations commented that they would appreciate the inclusion of targets, and noted that a standard might enable them to ensure compliance with diversion efforts.

Interviewees noted that a standard should be easy to implement and compatible with existing systems of waste collection and management, particularly relating to municipal requirements for specific bins. They advised caution, as standards could increase expectations and create requirements to record and report things in certain ways, which could be costly for smaller municipalities. The cost of audits to businesses and organizations should be considered, as should the burden of work required to adhere to any standard. Interviewees also suggested an incentive encouraging ICI organizations to adhere to the standard. They recommended that methodologies and metrics be chosen carefully, and consideration given to how prevention efforts may impact some metrics, such as diversion rates. For example, while certain changes might save a company money or reduce FLW, they could also make a company look worse on some specific targets set by a standard, potentially discouraging environmentally sensible decisions.

Interviewees also mentioned that an effective and comprehensive standard should include a component that encourages organizations to consider the financial impacts, such as incorporating opportunity costs to raise the priority level. They also recommended that a standard should include ways to measure and quantify the impacts of liquid FLW, which is typically overlooked in waste audits and estimates.

Finally, one interviewee commented on the complicated nature of enforcing a standard across different provinces and municipalities. They suggested that the overarching purpose of the standard should be carefully elucidated (e.g., would it be to recover organics?), and the level to which the standard applies (i.e., municipal, provincial) should be clear.

4 Conclusions

4.1 Summary

The purpose of this research report was to identify, aggregate, and analyze existing ICI FLW data in Canada, as well as the prevailing methodologies being used to measure ICI FLW. The findings presented in this report can be used by municipalities and other interested parties to support future sustainability and circularity efforts with respect to ICI FLW. Accordingly, this report had the following objectives:

1. To understand and elucidate the current state of ICI FLW data collection in Canada in terms of quantitative estimates of ICI FLW and the prevailing methods being used to measure ICI FLW; and

2. To provide recommendations on a standardized methodology for measurement and reporting that can be used to collect and manage ICI FLW data.

Based on a compilation of 614 audits on ICI FLW generation in Canada, it is estimated that the amount of waste generated per employee ranges from 60 to 1,296 kg/year, depending on the industry. Further, the estimated percentage of FLW in the waste stream ranges from less than 10% in industries such as manufacturing and health care and social assistance, to over 40% in industries engaged in accommodation and food service. These estimates indicate that approximately 1,800,000 tonnes of FLW is disposed of by the ICI sector each year, which is approximately 25% of the total estimated ICI waste disposed from all streams.

This research found that direct measurement is the predominant approach used to measure ICI FLW by both ICI facilities and municipal waste facility sites. This approach can be used by generators, and with sufficient data points, aggregated to develop estimates for small to large jurisdictions (i.e., from small towns to nations).

It is useful to compare ICI FLW estimates based on direct measurement with those derived from a mass balance approach. This report proposes the elements



"The findings presented in this report can be used by municipalities and other interested parties to support future sustainability and circularity efforts with respect to ICI FLW."

of a standardized methodology to rigorously collect and report ICI FLW that takes four essential criteria into consideration:

- Scientific defensibility;
- Ease of use;
- Level of detail; and
- Suitability of data for metrics development.

This simple methodology can be used by all business types and would be designed to facilitate comparison between similar generators (e.g., hotels), and also on a like-for-like basis across different generator types (e.g., hotels and grocery stores).

4.2 Implications and Significance

The amount of FLW in Canada is substantial, as are its economic, environmental, and social impacts. Even though a significant percentage of total FLW in Canada occurs in the ICI sector, little information was readily available on the amount of ICI FLW in Canada and how it was being measured. It is critical to gain a better understanding of FLW in the ICI sector in order to reduce or mitigate the associated multiple impacts of this inefficiency in the food supply chain. This research report fills a critical gap in knowledge by taking a comprehensive look at FLW in the ICI sector.

As confirmed through interviews with municipal organizations and other interested parties, the information and recommendations presented in this report could have implications for municipal waste management practices. The interviews revealed a desire for more information on ICI FLW measurement and reporting metrics, including guidance on how municipalities and ICI facilities can collect and manage ICI FLW data. Furthermore, this report may provide a basis for future policy formation at the provincial level in Canada, if provinces decide to participate in or further develop methods for ICI FLW auditing and reporting.

Like other approaches, the direct measurement approach has some limitations. Its primary limitation is that it requires many data points to produce reliable estimates for a large jurisdiction, such as an entire country. Nevertheless, it is feasible for use by individual organizations, and the development, publication, and widespread adoption of a standardized methodology would make it significantly easier for individual organizations to collect and report ICI FLW data. Therefore, a key implication of developing a standardized methodology is that it would facilitate the generation of several measurements, which governments and non-governmental organizations (i.e., local, provincial, national) could aggregate to develop and track estimated FLW in the ICI sector over time.

4.3 Recommendations for Future Directions

Interviews with representatives from Canadian municipalities and other interested parties revealed that there is an appetite for a standardized methodology and more guidance for measuring FLW in the ICI sector. It is therefore recommended that an ICI FLW measurement standard be developed. Based on the research findings, such a standard should include common definitions, clear metrics, and detailed methodological guidance to enable municipalities and other groups to monitor and compare their progress over time, and compared to others. Furthermore, as part of sustainability efforts of individual organizations, a standard could also encourage FLW prevention and diversion, including food rescue efforts and should clearly consider how such food is accounted for in organizations' operations.

This standard, when fully developed, could provide a comprehensive guide for implementing a scientifically valid and practical FLW measurement standard at ICI facilities and municipal waste facilities, using direct measurement methodologies such as FLW audits. This would involve the collection of representative samples of waste and manually sorting and weighing this waste to extract the amount of FLW. It is recommended that the standard be presented as a manual that is easy to use, widely applicable, and scientifically defensible to facilitate implementation with current practices.

As very little data exists on ICI FLW being diverted (e.g., to compositing or animal feed), this report focused only on ICI FLW being disposed of in the waste stream. Future research should attempt to estimate the amount of FLW being diverted from the ICI sector. While this would put a greater burden on individual businesses to measure and report, the process would be made easier by a standardized methodology.

The development of an ICI FLW measurement standard could promote consistent and accurate data collection for quantifying FLW within ICI facilities and municipal waste facilities, enable the effective comparison of FLW generation across different ICI facilities and municipal waste facilities using a common methodology, support the development of evidence-based FLW prevention and diversion strategies within the ICI sector based on robust data, and contribute to national FLW reduction targets and sustainable FLW management practices.

References

[1] D. Bucknell *et al.,* "The avoidable crisis of food waste update: Technical report," Second Harvest and Value Chain Management International, ON, Canada, 2024. [Online]. Available: https://www.secondharvest.ca/research/avoidable-crisis-updated

[2] P. van der Werf, J. A. Gilliland, M. Lynch, C. MacArthur, and L. Turner, "Good to the last bite? Data-driven insights to reduce household food waste," Ivey Business School and Human Environments Analysis Laboratory, Western University, London, ON, Canada, 2024. [Online]. Available: https://online.flippingbook.com/view/504660373/2-3/

[3] PROOF. "New data on household food insecurity in 2023." [Online]. Available: https://proof.utoronto.ca/2024/new-data-on-household-food-insecurity-in-2023/

[4] P. van der Werf and J. A. Gilliland, "A systematic review of food losses and food waste generation in developed countries," in *Proc. of the Institution of Civil Engineers – Waste and Resource Management,* vol. 170, no. 2, pp. 66–77, 2017, https://doi.org/10.1680/jwarm.16.00026.

[5] K. L. Thyberg, D. J. Tonjes, and J. Gurevitch, "Quantification of food waste disposal in the United States: A meta-analysis," *Environ. Sci. Technol.,* vol. 49, no. 24, pp. 13946–13953, 2015, https://doi.org/10.1021/acs.est.5b03880.

[6] P. van der Werf, J. A. Seabrook, and J. A. Gilliland, "Food for thought: Comparing self-reported versus curbside measurements of household food wasting behavior and the predictive capacity of behavioral determinants," *Waste Manag.,* vol. 101, pp. 18–27, 2020, https://doi.org/10.1016/j.wasman.2019.09.032.

[7] C. Alexander, M. Bain, E. Ikiz, K. Motta, J.-A. St. Godard, and K. Parizeau, "Food and organic waste diversion in industrial, commercial, and institutional (IC&I) sectors: A Canadian pilot project," *Clean. Waste Syst.,* vol. 6, 2023, Art. no. 100120, https://doi.org/10.1016/j.clwas.2023.100120.

[8] Statistics Canada. "Table 14-10-0287-01: Labour force characteristics, monthly, seasonally adjusted and trend-cycle." [Online]. Available: https://doi.org/10.25318/1410028701-eng

[9] Statistics Canada. Table: 14-10-0027-01: Employment by class of worker, annual (x 1,000)." [Online]. Available: https://doi.org/10.25318/1410002701-eng

[10] Environment and Climate Change Canada, "Solid waste diversion and disposal: Canadian environmental sustainability indicators," Environment and Climate Change Canada, Gatineau, QC, Canada, 2024. [Online]. Available: https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/solid-waste-diversion-disposal.html

[11] N. Tuzi, S. Fraser, and C. Pietka, "National waste characterization report: The composition of Canadian residual municipal solid waste," Environment and Climate Change Canada, Gatineau, QC, Canada, 2020. [Online]. Available: http://publications.gc.ca/pub?id=9.884760&sl=0

[12] M. Gooch *et al.,* "The avoidable crisis of food waste: Technical report," Second Harvest and Value Chain Management International, ON, Canada, 2019. [Online]. Available: https://www.secondharvest.ca/research/avoidable-crisis

[13] Canadian Council of Ministers of the Environment, "Waste audit users manual: A comprehensive guide to the waste audit process," Canadian Council of Ministers of the Environment, Winnipeg, MB, Canada, 1996.

[14] Ontario Ministry of the Environment, "A guide to waste audits and waste reduction work plans for industrial, commercial and institutional sectors," Ontario Ministry of the Environment, Toronto, ON, Canada, 2008. [Online]. Available: https://www.publications.gov.on.ca/001612

[15] Second Harvest. "A guide to food waste audits." [Online]. Available: https://www.secondharvest.ca/training/a-guide-to-food-waste-audits

[16] Recycling Council of Alberta, "Provincial waste characterization framework," Recycling Council of Alberta, Calgary, AB, Canada, 2005. [Online]. Available: https://recycle.ab.ca/wp-content/uploads/2016/01/WasteCharFinalReport.pdf

[17] *Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste,* ASTM D5231-92, ASTM International, West Conshohocken, PA, United States, 2016. [Online]. Available: https://www.astm.org/d5231-92r16.html

[18] B. Dieleman, "Webinar: Best practices in waste characterization," Climate and Clean Air Coalition, 2018. [Online]. Available: https://www.youtube.com/watch?v=aLhFeI9OEak

[19] ReFED, "Food waste monitor," ReFED, Chicago, IL, United States, 2023. [Online]. Available: https://docs.refed.org/methodologies/food_waste_monitor.html

[20] ReFED. "Impact calculator." [Online]. Available: https://insights-engine.refed.org/impact-calculator

[21] M. Terry, S. Sturdivant, and J. Nguyen, "Guide to conducting student food waste audits: a resource for schools," Environmental Protection Agency, Washington, DC, United States, 2017. [Online]. Available: https://www.epa.gov/sites/default/files/2017-12/documents/guide_to_conducting_student_food_waste_audit_-_nov_20_2017.pdf

[22] International City/County Management Association, "Municipal solid waste characterization protocol," International City/County Management Association, Washington, DC, United States, 2016. [Online]. Available: https://icma.org/sites/default/files/308387_Waste%20Composition%20Study%20Methodology.pdf

[23] *Food Loss and Waste Accounting and Reporting Standard,* FLW Standard, Version 1.0, Food Loss and Waste Protocol, Washington, DC, United States, 2016. [Online]. Available: https://flwprotocol.org/wp-content/uploads/2017/05/FLW_Standard_final_2016.pdf

[24] Waste and Resources Action Programme. "How to conduct a waste audit." [Online]. Available: https://businessofrecycling.wrap.ngo/recycling-guide/all-workplaces/planning-your-recycling-needs/how-to-conduct-a-waste-audit

[25] Waste and Resources Action Programme, "The business of recycling: Waste audit guide," Waste and Resources Action Programme, Banbury, United Kingdom, 2020. [Online]. Available: https://assets.ctfassets.net/xodraixfdnfd/31yzh9ArpRQRBFuzcNDO4g/9d83dcfad92f9bae853280b8538a019b/Waste_Audit_Template.pdf

[26] C. Hanson *et al.,* "Guidance on FLW quantification methods," Food Loss and Waste Protocol, Washington, DC, United States, 2016. [Online]. Available: https://flwprotocol.org/wp-content/uploads/2016/05/FLW_Protocol_Guidance_on_FLW_Quantification_Methods.pdf

[27] United Nations Environment Programme, "Developing integrated solid waste management plan: Training manual, volume 1: Waste characterization and quantification with projections for future," United Nations Environment Programme, International Environmental Technology Centre, Osaka, Japan, 2009. [Online]. Available: https://apps.unep.org/publications/pmtdocuments/ISWMPlan_Vol1.pdf

[28] V. Gawaikar and V. P. Deshpande, "Source specific quantification and characterization of municipal solid waste—A review," *J. Inst. Eng. (India): Environ. Eng. Div.,* vol. 86, pp. 33–38, 2006. [Online]. Available: https://silo.tips/download/source-specific-quantification-and-characterization-of-municipal-solid-waste-a-r

Appendix A: Waste Auditing Methodologies

Title	Year	Description	Link
CANADA: METHODS DOCUMENTS			
Canadian Council of Ministers of the Environment (CCME) Waste Audit User Manual: A Comprehensive Guide to the Waste Audit Process [13]	1996	CCME developed this manual to guide users in conducting waste audits for commercial and manufacturing facilities. The manual includes step-by-step processes for planning and conducting audits, sorting waste, and estimating the quantity and types of waste generated. It emphasizes practical approaches and provides detailed forms and standardized methods to ensure consistency and accuracy across different audits.	No (old document with no link on CCME website)
Ontario Ministry of the Environment A Guide to Waste Audits and Waste Reduction Work Plans for Industrial, Commercial and Institutional Sectors [14]	1994, updated 2008	This guide was developed to help ICI entities understand the requirements of Ontario Regulation 102/94, Waste Audits and Waste Reduction Work Plans. In this guide, entities includes retail shopping establishments and complexes, office buildings, restaurants, hotels and motels, hospitals, educational institutions, and large manufacturing facilities.	https://www.publications.gov.on.ca/001612
Second Harvest A Guide to Food Waste Audits (includes online course and tracking sheet) [15]	2022	This brief guide was developed to help users undertake food waste audits, and includes an online course and a food waste audit tracking sheet.	https://www.secondharvest.ca/training/a-guide-to-food-waste-audits
Second Harvest A Guide to Food Waste Audits (webinar)	2021	This webinar presentation provides guidance on food waste audits.	https://www.youtube.com/watch?v=_sqs9z_5HYM
Stewardship Ontario Guide for Single-Family Waste Audits	2005	This residential waste audit guide was developed for municipalities planning to complete waste quantification and composition studies of single-family residences. It describes the standardized methodology used by communities participating in Stewardship Ontario's province-wide Waste Audit Program.	No (old document with no link on Stewardship Ontario's website)
Continuous Improvement Fund Curbside Waste Audits: Considerations for Small Communities	2012	This residential waste audit guide is similar to the Stewardship Ontario guide.	http://thecif.ca/wp-content/uploads/2016/09/CIF-Waste-Audit-Curb-Sm-Communities.pdf

Title	Year	Description	Link
CANADA: RESULTS DOCUMENTS WITH METHODS DETAIL			
Recycling Council of Alberta Provincial Waste Characterization Framework [16]	2005	The Recycling Council of Alberta developed this provincial waste characterization framework to provide a protocol for conducting waste characterization studies, as well as a process for coordinating and aggregating waste characterization data on a provincial level, and presents some detail on the methods used.	https://recycle.ab.ca/wp-content/uploads/2016/01/WasteCharFinalReport.pdf
Metro Vancouver 2022 Commercial and Institutional Waste Composition Study	2023	This study presents results sampled from 143 businesses and institutions throughout Metro Vancouver. The methods detailed in the CCME manual were used.	https://metrovancouver.org/services/solid-waste/Documents/commercial-institutional-waste-composition-study-2022.pdf
Second Harvest The Avoidable Crisis of Food Waste: Technical Report [1], [12]	2019, updated 2024	These reports include detail on how food waste estimates were generated. A mass balance approach was used, which estimated total food in the system and then estimated food waste by applying food waste factors (% food waste by food type). The food waste factors were derived using a survey and from other sources.	https://www.secondharvest.ca/research/avoidable-crisis https://www.secondharvest.ca/research/avoidable-crisis-updated
Environment and Climate Change Canada Overview of Organics Diversion Requirements and Practices for the Canadian Industrial, Commercial and Institutional Sector	2021	This report sought to develop a better understanding of ICI food and organic waste generation and management. Results from 421 Canadian ICI waste audits were obtained, primarily from companies that undertake ICI waste audits (those that manufacture and process food and those that sell and serve food). Data were used to create normalization factors (e.g., food waste disposed/full time equivalent/year), which were used to estimate food and organic waste disposed and diverted from different types of ICI facilities. This report provides detail on how ICI FLW results were gathered and analyzed.	https://partnersinprojectgreen.com/wp-content/uploads/2023/03/Consultant-Report_Overview-Canadian-ICI-Organic-Waste-Practices_Spring-2021.pdf
Environment and Climate Change Canada National Waste Characterization Report: The Composition of Canadian Residual Municipal Solid Waste [11]	2020	This report sought to develop a better understanding of the characterization of Canada's residual municipal solid waste (MSW). The main approach involved (a) compiling an inventory of residual MSW waste audit data and reports from across Canada; (b) comparing and harmonizing the data by sector using 17 material categories; (c) estimating the percentage of residual MSW in each category by province/territory and generating a national weighted average; and (d) estimating the per capita disposal for residual MSW in each category (kg/capita) by province/territory and the corresponding national per capita disposal rate (kg/capita). This report provides detail on how ICI FLW results were gathered and analyzed.	http://publications.gc.ca/pub?id=9.884760&sl=0
Divert NS 2017 Waste Audit Report	2018	Divert NS conducted disposal facility waste audits to accurately identify and quantify the various materials that enter provincial landfills. The report includes the results of both residential and ICI wastes. The methods used are based on the CCME manual and ASTM D5231-92.	https://divertns.ca/sites/default/files/researchreportsfiles/2021-09/WasteAudit2017.pdf

Title	Year	Description	Link
UNITED STATES: METHODS DOCUMENTS			
ASTM International ASTM D5231-92, *Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste* [17]	2016	This test method describes procedures for measuring the composition of unprocessed MSW using manual sorting. It provides detail on sample collection from disposal vehicles at disposal facilities and sorting procedures.	https://www.astm.org/d5231-92r16.html
Environmental Protection Agency A Guide to Conducting Student Food Waste Audits: A Resource for Schools [21]	2017	This guide is intended to educate students about the amount of food they waste in their school cafeterias and to encourage them to reduce waste and eat more of the nutritious foods provided through school meals programs or brought from home.	https://www.epa.gov/sites/default/files/2017-12/documents/guide_to_conducting_student_food_waste_audit_-_nov_20_2017.pdf
Environmental Protection Agency Webinar: Best Practices for Waste Characterization [18]	2018	This webinar provides information on how to conduct a waste characterization study, what data you can expect to obtain from a study, and how it can be used to make waste program and policy decisions. Topics discussed include types of studies, why do a study, study design, waste sampling, waste sorting, health and safety, data analysis, and data usage.	https://www.youtube.com/watch?v=aLhFel9OEak
International City/County Management Association Municipal Solid Waste Characterization Protocol	2016	The document presents a process by which a municipal solid waste characterization study can be conducted.	https://icma.org/sites/default/files/308387_Waste%20Composition%20Study%20Methodology.pdf
ReFED Food Waste Monitor [19] Impact Calculator [20]	2023	The monitor presents a detailed approach to measuring food waste using a mass balance approach. It includes detailed instructions on how to estimate food waste data from food manufacturers, food retailers, and food service. The calculator quantifies the climate, natural resources, and food security impacts of wasted food.	https://docs.refed.org/methodologies/food_waste_monitor.html https://insights-engine.refed.org/impact-calculator
ENGIE Impact How to Plan and Conduct a Successful Waste Audit	2020	This article describes what a waste characterization audit is, discusses the benefits of conducting a waste audit, and provides a high-level waste audit checklist.	https://www.engieimpact.com/insights/waste-audit-checklist
Recology Recycling Legislation and Zero Waste Facilitator Tutorial (video) Large Refuse Generators Diversion Audits	2019	These articles include information about San Francisco's legislation requiring large refuse generator's to conduct a waste audit every 3 years, and information and videos on how to conduct large refuse generator waste audits.	https://www.recology.com/recology-san-francisco/recycling-legislation/ https://www.recology.com/recology_news/large-refuse-generators-diversion-audits/

Title	Year	Description	Link
INTERNATIONAL: METHODS DOCUMENTS			
Food Loss and Waste Protocol *Food Loss and Waste Accounting and Reporting Standard* (FLW Standard) [23] Guidance on FLW Quantification Methods [26]	2016	The FLW Standard provides requirements, guidance, resources, and examples for quantifying and reporting FLW. This guidance document serves as a companion to the FLW Standard and offers practical guidance on methods for quantifying FLW.	https://flwprotocol.org/wp-content/uploads/2017/05/FLW_Standard_final_2016.pdf https://flwprotocol.org/wp-content/uploads/2016/05/FLW_Protocol_Guidance_on_FLW_Quantification_Methods.pdf
Waste and Resources Action Programme (WRAP) How to Conduct a Waste Audit [24] Waste Audit Guide [25] Waste Audit Guide for Business	2020	How to Conduct a Waste Audit provides details on a waste auditing method for the ICI sector. The Waste Audit Guide provides brief step-by-step instructions on undertaking a waste audit. The Waste Audit Guide for Businesses provides an infographic with step-by-step instructions on undertaking a waste audit for WRAP members.	https://businessofrecycling.wrap.ngo/recycling-guide/all-workplaces/planning-your-recycling-needs/how-to-conduct-a-waste-audit https://assets.ctfassets.net/xodraixfdnf-d/31yzh9ArpRQRBFuzcNDO4g/9d83dcfad-92f9bae853280b8538a019b/Waste_Audit_Template.pdf https://www.wrap.ngo/resources/campaign-assets/waste-audit-guide-businesses
United Nations Environment Program Developing Integrated Solid Waste Management Plan: Training Manual, Volume 1: Waste Characterization and Quantification with Projections for Future [27]	2009	This document includes waste auditing methods for a variety of sectors including ICI.	https://apps.unep.org/publications/pmtdocuments/ISWMPlan_Vol1.pdf
Gawaikar and Deshpande Source Specific Quantification and Characterization of Municipal Solid Waste—A Review [28]	2006	This academic paper outlines methods for characterizing municipal solid waste.	https://silo.tips/download/source-specific-quantification-and-characterization-of-municipal-solid-waste-a-r
INTERNATIONAL: RESULTS DOCUMENTS WITH METHODS DETAIL			
Clean Technology Center at Munster Technological University (Ireland) 2022 Commercial Municipal Waste Characterisation Report 2022 Commercial Municipal Waste Characterisation Booklet	2022	The report summarizes the results of Ireland's 2022 assessment of municipal waste from the non-household (commercial) sector, and includes some methodological detail. The booklet provides a graphical summary of the report, and includes some methodological information for conducting ICI waste audits.	https://www.epa.ie/publications/monitoring--assessment/waste/national-waste-statistics/2022-Non-Houshold-Municipal-Waste-Characterisation-Report-(CTC-2023).pdf https://www.epa.ie/publications/monitoring--assessment/waste/national-waste-statistics/2022-Non-Household-Municipal-Waste-Characterisation-Booklet.pdf

Appendix B: Detailed Summary of Interviews

Organization	Work on ICI FLW	Link to Data and/or Reports	Bylaws	Thoughts on Potential Standards
MUNICIPALITIES				
Metro Vancouver	Yes. ICI food waste audits since 2014 (2014, 2019, 2022, and 2023).	https://metrovancouver.org/services/solid-waste/reports-resources	Regional coordinator: cannot impose bylaws, but there is a disposal ban in place for all landfill sites (https://metrovancouver.org/services/solid-waste/disposal-ban-program).	Would like guidance on sample size and sample composition (i.e., what proportion of the sample should be grocery, restaurant, offices, etc., including business size). Would like clear definitions on categories of waste and categories of stores (e.g., when does a mini-mart become a grocery store).
City of Calgary	Yes. Waste audit in 2019 that included ICI. Have also completed some qualitative surveys relating to ICI waste.	https://data.calgary.ca/Help-and-Information/Waste-Composition-2019-Garbage/p2fv-5peq/about_data.	Green cart program: waste bylaw requires source separation for multifamily and ICI for organics.	Would like to be confident that waste composition results are comparable across municipalities. Would like sampling guidelines. Would like guidance on how to categorize food waste, particularly edible vs. inedible, which is difficult to distinguish once something has been in the garbage for a while. Would like guidance on food diversion and how to include it in food waste calculations.
City of Edmonton	Yes. No waste audits. Developing an action plan for ICI waste.	Draft report on current state of regional organics: https://emrb.civicweb.net/document/27463/Current%20State%20Analysis%20of%20Regional%20Organics%20Rep.df?handle=D1D-6BE01A4AC41C199C199F-33CB9720B.	None for ICI.	Could be useful for policy development if the timing matches up with what Edmonton is doing. Would have value if it helps standardize auditing across municipalities and enable comparability.
Strathcona County	Yes. Started a waste diversion pilot with Circular Innovation Council in 2024. No data collection yet.	None.	None for ICI.	Would value detailed guidance on how to conduct an audit (currently using older document produced by the province that details how to conduct a residential audit). Would value a metric that is helpful for all types of ICI facilities. Would like standard to include best practices around key performance indicators. Would appreciate some consideration of how to categorize food waste before it enters the waste removal stream.

Organization	Work on ICI FLW	Link to Data and/or Reports	Bylaws	Thoughts on Potential Standards
MUNICIPALITIES				
City of Saskatoon	Yes. No waste audits. Have developed regulations relating to source separation for ICI waste. Participating in National Solid Waste Benchmarking Initiative. Have conducted qualitative research relating to ICI FLW.	None.	ICI bylaw requires that businesses have a green cart, but only if they produce organic waste as part of their operations (e.g., restaurants, etc.).	Would like guidance on sample size; definition for "organics" and categorization of waste; guidance on how to report waste generated to allow comparability (e.g., by weight or volume, per capita); and guidance on how to approach mixed-use buildings.
City of London	Yes. No waste audits. Some research to understand how much general ICI waste (including food) is collected for disposal, and some research, relying on a database of ICI waste audits, to generate an estimate.	None.	None for ICI.	None.
Wellington County	Yes. No waste audits. Participating in waste diversion pilot with Circular Innovation Council, City of Guelph, and University of Guelph.	Food and organic waste diversion in industrial, commercial, and institutional (ICI) sectors: A Canadian pilot project: https://doi.org/10.1016/j.clwas.2023.100120.	None for ICI.	Not likely to conduct ICI waste audits but having standards would certainly be beneficial for the industry, particularly if there are more regulations pertaining to food waste at the provincial level. In the short term, the county might not use this sort of information, but in the longer term, it would.
City of Waterloo	Yes. No waste audits. Some research to record total ICI waste tonnage landfilled using Geoware at transfer stations. Do not collect ICI waste.	None.	None.	A standard could bring several benefits. It could contribute to ensuring compliance with diversion efforts and it could facilitate education.

Organization	Work on ICI FLW	Link to Data and/or Reports	Bylaws	Thoughts on Potential Standards
MUNICIPALITIES				
City of Guelph	Yes. Participated in waste diversion pilot that includes audits with Circular Innovation Council, University of Guelph, and Wellington County. Developing a circular economy focus.	Winter 2024 data and pilot data from work with Circular Innovation Council: https://circularinnovation.ca/guelphwellingtonpilot/.	Source separation required of any businesses whose waste is collected by the city.	In Ontario, ICI waste is regulated at the provincial level. Would like standard to support implementation and enforcement of policy relating to ICI FLW.
City of Hamilton	No.	None.	None for ICI.	Currently not applicable to Hamilton, but would be interested if the ICI waste mandate changed.
Niagara Region	No.	None.	General waste bylaw only.	At this time, there would be no impact to Niagara Region. However, consistent definitions, measurement methods, and food waste categories would be helpful.
Halton Region	No.	None.	None for ICI.	Would potentially be useful to direct ICI businesses interested in food waste diversion and food loss reduction to the standard. Would find it useful to have guidance on defining avoidable vs. unavoidable food waste.
Peel Region	No.	None.	None, but delegations to council have advocated for the development of a bylaw.	Peel Region would support the development of mandatory (not voluntary) measurement standards. As an ICI (municipal office buildings), they would likely use them in long-term care homes and places where there are food offerings (many offices no longer offer food). From a waste management lens, they could be used to inform ICI businesses of what is available for them. A standard should provide clarity with definitions and measurement methodologies. It should also be easily implemented and compatible with existing systems. It should also include guidelines for reducing food waste at the source.

Organization	Work on ICI FLW	Link to Data and/or Reports	Bylaws	Thoughts on Potential Standards
MUNICIPALITIES				
City of Toronto	Yes. No waste audits. Some research at the ICI level of tonnes collected for each stream. Trucks that collect waste from ICI customers are weighed when they drop the waste at city transfer stations. Developing a circular economy focus.	None. Baselining for a Circular Toronto (Technical Memorandum #3): https://www.toronto.ca/wp-content/uploads/2021/09/90e4-Technical-Memorandum-3Final-Report-09.09.2021FinalAODA.pdf	Toronto Municipal Code Chapter 841, Waste Collection, Commercial Properties (https://www.toronto.ca/legdocs/municode/1184_841.pdf). Bylaw for organics containers and detailed definition of organic materials. Toronto also abides by the Food and Organic Waste Policy Statement issued by the Government of Ontario (https://www.ontario.ca/page/food-and-organic-waste-policy-statement).	Measurement standards would help inform future work and could act as a basis for any audit categories and methodologies. Food waste measurement standards, if agreed upon, could fill a gap by providing consistency across the province in measuring success of green bin programs against regulated targets established under the Food and Organic Waste Policy Statement. Would like some recognition or consideration on how food loss measurements would be applied from a cultural lens (e.g., definition of what is considered unavoidable FLW).
City of Ottawa	None. No waste audits. Ottawa collects waste from multi-residential buildings, which might include commercial. City also collects organics from schools.	None specific to ICI. 2024 Winter Waste Audit Organics Results (Residential) – City of Ottawa.	Source separation bylaw.	Standards would be useful to enable the development of effective policy.
City of Moncton	None.	None.	Source separation for green cart.	Currently, the City of Moncton is not responsible for collecting ICI waste. Would be interested in thinking about how the city might use ICI waste audit data, were it available (e.g., in information campaigns).
Province of Prince Edward Island	None. Mandate for residential waste collection only.	None.	None.	Standards would be useful in creating context and enabling comparisons. From the point of view of a small province, standards can increase expectations and bring in requirements to record and report things in certain ways, which can be costly for smaller municipalities.
Halifax Regional Municipality	Yes. ICI waste audits in 2017 and 2023.	Halifax_2017-09 Final Organic Materials Audit HRM; Halifax_2018-01-Final Organic Materials Audit HRM; 2023 Organic Waste Audit: https://www.shapeyourcityhalifax.ca/34648/widgets/180100/documents/128901.	Provincial landfill ban on organics so all municipalities have bylaws to facilitate diversion of organics from the garbage stream. Bylaw S600 requires businesses and residents to provide and have source separation for garbage recycling, organics, and paper.	Would be interested in guidance on how to approach mixed-use buildings and multi-residential buildings. Would also find guidance on generation rates for multi-residential buildings useful (e.g., how many carts for a given number of residents).

Organization	Work on ICI FLW	Link to Data and/or Reports	Bylaws	Thoughts on Potential Standards
OTHER INTERESTED PARTIES				
National Index on Agri-Food Performance	Yes. No waste audits. Developed a report that defines how sustainability should be measured in the agri-food sector.	None.	Not applicable	A standard should enable comparability yet aim to bring people in different organizations together. The cost of audits to the individual businesses should be considered, as should the burden of work required to adhere to the standard. Perhaps include an incentive to adhere to the standard? Standard should contain clear definitions as to what food waste is. Should include a measurement of food waste diversion if possible.
Circular Innovation Council	Yes. Waste diversion pilot projects with Wellington County, City of Guelph, and Strathcona County.	Yes, for Guelph and Wellington County: https://circularinnovation.ca/wp-content/uploads/2-Year-Pilot-Interim-Report-FINAL_2.pdf.	Not applicable	Would like standard to include best practices around key performance indicators. Would appreciate consideration of how to categorize food waste before it enters the waste removal stream.
Enviro-Stewards	Yes. Work is primarily on ICI food loss prevention at source, such as food loss prevention pre-disposal and diversion (assembly lines, nursing homes etc.). Report money saved, acres of agricultural output no longer wasted, etc.	No waste generation audit data.	Not applicable	A standard should include a component that gets people to consider money, (i.e., raise the priority level by adding the opportunity cost). A standard should also include ways to measure liquid food loss. A standard should consider impacts of prevention on some metrics (e.g., diversion rates). Might save a company money or reduce food loss, but if they're looking worse on some specified targets, they won't do it. Metrics should be chosen carefully.
FoodMesh	Yes. Food recovery provider with three goals: (1) match surplus food with new markets, (2) advocacy and education, and (3) measurement. Track what is picked up, when, by who, and destination.	No waste generation audit data.	Not applicable	A standard would not be relevant to the work of FoodMesh.

Organization	Work on ICI FLW	Link to Data and/or Reports	Bylaws	Thoughts on Potential Standards
OTHER INTERESTED PARTIES				
Longo's	Yes. Have set internal targets for waste diversion (90% of all waste should be diverted, not landfilled) and keep track for all stores. Conduct waste audits if certain stores show changes over time.	Detailed audit data is internal only, but wider progress shared in sustainability reports: https://www.longos.com/about-us/sustainability.	Not applicable	Would be helpful for standard to include targets, so Longo's can compare themselves against other similar businesses. A standard should also include some requirements for food rescue.
Ontario Food Collaborative (OFC)	Yes. OFC is a collaboration between public health and waste management with the aim of tackling food literacy relating to organic waste. Have conducted some baseline research (a gap analysis).	None.	Not applicable	It is unlikely that the OFC will be carrying out waste audits, but would use results for advocacy.
Partners in Project Green (PPG)	No. PPG is a membership organization (comprising businesses, government, institutions, and utilities from the Greater Toronto Area), whose goal is to advance both social and environmental sustainability.	None.	Not applicable	A standard would not be relevant to the work of PPG.
S-Cubed Environmental	Yes. Consultant that conducts food waste audits.	Shared via email (to remain confidential).	Not applicable	Uses the existing Council of the Commission for Environmental Cooperation (CEC) guidance for conducting waste audits and finds it helpful.

Organization	Work on ICI FLW	Link to Data and/or Reports	Bylaws	Thoughts on Potential Standards
OTHER INTERESTED PARTIES				
Second Harvest	Yes. No waste audits. Published The Avoidable Crisis of Food Waste in 2019 and 2024, which provides estimates of food waste from a value chain perspective.	2019: https://www.secondharvest.ca/research/avoidable-crisis 2024: https://www.secondharvest.ca/research/avoidable-crisis-updated	Not applicable	Sits on Standards Council of Canada, which is currently developing standards related to ICI food waste auditing. Thinks there is a lot of duplicate work happening related to the development of standards for food waste measurement.
University of Guelph	Yes. Involved with waste diversion pilot with Circular Innovation Council, City of Guelph, and Wellington County.	Food and organic waste diversion in industrial, commercial, and institutional (IC&I) sectors: A Canadian pilot project: https://doi.org/10.1016/j.clwas.2023.100120.	Not applicable	Identified two main issues requiring guidance: measurement (how measured, in what unit, and how reported); and definitions (is everyone aware of—and in agreement with—the Value Chain Management International definitions?).
Wilfrid Laurier University	Yes. Have begun conducting waste audits in-house (published in an Annual Sustainability Report). Some data available, although not detailed.	2022–2023: https://www.wlu.ca/about/discover-laurier/sustainability/assets/documents/2022-2023-annual-report1.pdf. 2023–2024: https://www.wlu.ca/about/discover-laurier/sustainability/assets/documents/2023-2024-annual-report.pdf.	Not applicable	Conscious of the complicated nature of enforcing a standard across different provinces and municipalities. The level to which the standard applies should be considered carefully (municipal, provincial), as should the main purpose of the standard. Would it be to recover organics? Are there minimum values or volumes that need to be recovered?

CSA Group Research

In order to encourage the use of consensus-based standards solutions to promote safety and encourage innovation, CSA Group supports and conducts research in areas that address new or emerging industries, as well as topics and issues that impact a broad base of current and potential stakeholders. The output of our research programs will support the development of future standards solutions, provide interim guidance to industries on the development and adoption of new technologies, and help to demonstrate our on-going commitment to building a better, safer, more sustainable world.

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