Monitoring and Measuring Food Loss and Waste in Canada | A Snapshot

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1.0 Executive Summary

Food loss and waste is an important issue that is gaining more attention by governments (at all levels) in Canada as well as food businesses as it has significant environmental and economic impacts. To effectively address this issue and reduce food loss and waste at a national, provincial and territorial, municipal, agri-food sector, industry, and individual business level, it is crucial to know how much uneaten food is being lost or wasted in these different contexts. These numbers are not only important for establishing a baseline to know how much food is being wasted where, but also to motivate and evaluate food waste reduction efforts. Before we can even get to this stage though, it is important to understand who is monitoring and measuring food loss and waste (and who is not) throughout the agri-food system as well as which measurement practices are being used by different agri-food actors.

The purpose of this report is to gain insight into the different methods that are currently being used in Canada to monitor and measure food loss and waste and to identify some of the barriers and opportunities for improving this monitoring and measurement activity. To gain these insights, 11 key stakeholders were interviewed, including leaders from industry and government.

The findings for this report show that there is no uniform definition for food loss and waste among the key stakeholders who were interviewed. Instead, definitions differed according to the scale and scope of focus (e.g., entire agri-food system versus end of the supply chain), types of food items included or excluded (e.g., liquids and edible/inedible foods), and end destinations included or excluded (e.g., landfill, compost, food donation). These definitional differences are important for establishing boundaries around what gets measured and what does not. The findings also show that monitoring and measurement is not a widespread practice throughout the agri-food system. For those that do measure their food loss and waste, their practices vary significantly according to the scale of focus (e.g., country versus individual business), the type of data available at different sectors of the agri-food system (e.g., shrink data, tonnage, volume), and the number of resources available (e.g., time, labour, space, money). This report explains some of these measurement practices as they apply to measuring food loss and waste within government jurisdictions (at all levels) and food industries and businesses.

This report also identified barriers to improving monitoring and measuring food loss and waste in Canada as well as key stakeholder suggestions for tackling these barriers. These barriers include lack of uniform definitions and practices, lack of accountability, lack of resources, and reluctance to share data and measurement practices.

This report concludes with suggested strategies for improving monitoring and measuring. By improvements, this means both in the sense of encouraging more agri-food actors to take on these practices, as well as collecting and aggregating this information so that it can be used towards making meaningful reductions to food loss and waste. These suggested strategies are split into those for government and those for businesses. For government, the suggestions are to:

1. Set mandatory food loss and reduction targets
2. Establish national guidelines to help businesses and government (at various levels) define food loss and waste within the scope of their operations
3. Develop national guidelines to help businesses monitor and measure their food loss and waste
4. Develop national guidelines to help governments monitor and measure their food loss and waste
5. Create (or support a non-governmental organization that wants to create) a system where businesses can report their food loss and waste data
6. Create (or support a non-governmental organization that wants to create) a system for government to report their food loss and waste data
7. Create a collaborative space for government and industry to come together to discuss food loss and waste monitoring and measurement
8. Create a collaborative space for governments to come together to discuss food loss and waste monitoring and measurement
9. Provide funding for municipalities looking to monitor and measure their food loss and waste
10. Provide funding to food insecurity charities and redistribution organizations who are willing to measure food loss and waste-related donations from food businesses

For businesses, these suggestions are to:

1. Develop corporate social responsibility and brand promises related to food loss and waste reduction
2. Develop operation-specific food loss and waste definitions and measurement practices
3. Communicate food and loss waste promises and practices to all staff
4. Work with other businesses and industries to develop monitoring and measurement standards
5. Work with government (and/or non-governmental organizations) to establish guidelines for monitoring and measurement and reporting systems for food loss and waste

This report makes an important contribution in providing a detailed snapshot of monitoring and measurement in Canada and insights into what is preventing governments and food businesses from measuring their food loss and waste. It also offers ways forward in encouraging the uptake of these practices and the development of more accurate, granular data systems. The hope is that this report will move the conversation forward on the issue of monitoring and measurement.

2.0 Glossary

Anaerobic digestion A process that can turn organic materials into nutrient-rich soil, energy, gas and/or oil, among other products. Anaerobic digestion facilities are one of many end destinations for food waste.

Animal feed The use of food waste (both edible and inedible) for the purposes of creating feed for farm animals and/or pets. This is one of many end destinations for food waste.

Compost A process that can turn organic materials into nutrient-rich soil that can be used for things like growing vegetables. Compost facilities are one of many end destinations for food waste.

Corporate social responsibility The idea that businesses should prioritize social and environmental concerns, rather than just financial. Prioritizing all three concerns is sometimes referred to as the triple bottom line.

Edible food In the context of food waste, this refers to the parts of food items that are edible (i.e., chicken meat, apple flesh and skin). Sometimes distinguished from inedible food (i.e., bones, apple seeds). The distinction can be subjective and based on cultural, personal, and contextual preferences.

Efficiency evaluations A method for evaluating the behavioural, technological, and procedural practices of a business to determine how it can be more efficient in terms of its energy and water use, its waste generation, and other factors.

End destination The options for where food can go after it is no longer saleable or wanted by the consumer. These options include: donation to food security organizations, animal feed, value added (or secondary use), anaerobic digestion, compost, and landfill. The term 'end destination' does not necessarily indicate that it is the final resting place for food loss and waste, as sometimes food can move from one destination to another depending on its condition.

Food diaries A method used to determine how much food waste is being generated within a household. This method typically involves someone in the household recording information about what type and how much food is being waste within a given time period.

Food loss Food that is grown for human consumption but goes uneaten. Sometimes distinguished from food waste by focusing on uneaten food at the production, processing, transportation, and distribution stages as opposed to the retail and consumption stages.

Food redistribution The process of collecting surplus, edible food from businesses and redistributing it to food security charities and people who are food insecure.

Food rescue charity A type of charity that collects unsold, edible food from businesses and redistributes it to food security organizations and people that are food insecure.

Food security organization A type of organization that supports people who are food insecure. In the context of this report, this refers to organizations that accept unsold, edible food from businesses or food rescue charities to help feed people who are food insecure.

Food waste Food that is grown for human consumption but goes uneaten. Sometimes distinguished from food loss by focusing on uneaten food at the retail and consumption stages of the agri-food system, as opposed to the production, processing, transportation, and distribution stages.

Industrial, commercial, and institutional sector Sometimes referred to at the ICI sector, this sector in the context of the agri-food system, includes food manufacturing and processing facilities (e.g., industrial), the grocery stores, restaurants, and other hospitality businesses (e.g., commercial), and places like nursing homes, schools, prisons (e.g., institutional). This is often differentiated from production and residential sectors.

Inedible food In the context of food waste, this refers to the parts of food items that are not edible (i.e., bones, apple seeds). Sometimes distinguished from edible food (i.e., chicken meat, apple flesh

and skin). This distinction can be subjective and based on cultural, personal, and contextual preferences.

Mass balance A method that utilizes administrative data to determine how much food waste is generated within a given jurisdiction. At the country level, for example, this can involve determining how much food waste imported and exported from a country and how much was grown in a given time period, then determining and subtracting loss factors (i.e., loss of food items when grain is milled in a food processing plant) at the various industry and sub-sector levels of the agri-food system.

NAICS codes North American Industry Classification System codes is a set of codes often used to classify and differentiate between types of businesses. These codes are often used for the purpose of collecting statistics on these businesses.

Organic waste Organic waste is a broad category to describe all types of waste that can break down over time and be reintegrated back in the earth. This category can include things like agriculture waste, yard waste, compostable products, and food waste.

Residential sector This refers to citizens and their home lives. This is often differentiated from the production and ICI sector.

Secondary non-food use The use of food waste by-products for the purpose of creating non-food products, such as using cow hide or salmon skin to manufacture leather. This is one of many end destinations for food waste.

Shrink calculation A method used to calculate how much food is being generated by a business, typically in the retail sector, in a given time period. The calculation involves subtracting the amount of food purchased by customers from the amount of food that entered the business within the same time period, with difference being the unsold (or wasted) food.

Source separated organics A waste collection system that involves organic waste being separated into its own bin before it is collected and then driven to its end destination, often being an anaerobic digestion or compost facility.

Surplus food Food that is edible and safe to eat but can no longer be sold by a business. This term is often used in the context of food redistribution.

United Nations Sustainable Development Goals A set of goals developed by the United Nations to improve sustainability throughout the world by 2030.

Waste characterization audit A method used to determine how much and what types of waste are generated within the context of a business, household, or municipality. This involves collecting waste at the source of generation (i.e., business or household) or at its end destination (i.e., landfill), sorting it into pre-determined categories, and weighing each category. Audits can be done on all waste streams (waste, recycling, organics) or a single stream.

3.0 Introduction

In Canada, approximately 58% of all food that is produced (or imported) for human consumption goes uneaten every year (Gooch et al. 2019, 23). This has expensive repercussions, costing the economy $49.5 billion, or 3% of Canada's gross domestic product, on a yearly basis (Gooch et al. 2019, 5). This financial loss not only affects governments, but also negatively affects the profitability of individual food businesses throughout Canada's agri-food system, as well as individual disposable incomes. When food goes uneaten, it wastes all the water, soil, nutrients, fertilizers, labour, and other resources that were used to grow, process, and transport this food (Gustavsson et al. 2011). These finite resources are needed to continue growing food and supporting our society. Furthermore, when this uneaten food sits in the landfill, decaying, it releases methane, which is a greenhouse gas that exacerbates the climate change affects we are seeing throughout the world. The Food and Agriculture Organization (2013) has stated that methane emissions from uneaten food globally are so significant that if it were a country, it would be the third highest emitter of these gases (6).

3.1 Government Action on Food Loss and Waste

What is being done to tackle the issue of food loss and waste in Canada by the various levels of government?[1] The federal government has joined other countries in a voluntary agreement, under the United Nations Sustainable Development Goals, to reduces its food loss and waste by 50% by 2030[2] (Environment and Climate Change Canada 2019). Environment and Climate Change Canada (2019) has produced a report with key stakeholders to begin the process of figuring out how to make these reductions and Agriculture and Agri-Food Canada has recently initiated the "Food Waste Reduction Challenge" to incentivize food

businesses and non-governmental organizations to develop innovative methods and technologies to reduce food loss and waste.[3] Some provincial and territorial governments have banned organic waste in landfills, incorporated food waste in their environmental agendas, offered incentives to donate surplus food, and created toolkits for reducing waste at the municipal, business, and household levels. In addition to this, some municipal governments have instituted source separated organic collection systems, initiated awareness programs to teach residents about food waste, and are debating the creation of food loss and waste-related regulations for the industrial, commercial, and institutional sectors to reduce their waste.

3.2 The Importance of Monitoring and Measurement

Despite the momentum towards addressing food loss and waste by governments at all levels in Canada, how do governments know where to prioritize their time and resources to have the most meaningful impact? How do governments (and food businesses) know if their current/future initiatives are effective? How do we as Canadians know if the overall quantity of uneaten food that Canada generates on a yearly basis is decreasing? And finally, how do we know if we are on track to meet our goal of reducing Canada's food waste by 50% by 2030?

To answer these questions, we need to know how much food loss and waste we generate throughout the agri-food system at all levels of government. The statistic of 58% of all food going to waste is a best guess based on administrative data and consultations with members of the agri-food system. To tackle the issue, we need more granular, context-specific data at the industry, sub-sector, individual business, provincial/territorial, and municipal level. Before we can get to this point,

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1 This paragraph contains findings from Chloe Alexander's ongoing PhD research that examines federal, provincial, territorial, and municipal food waste policies in Canada.

2 This refers to goal 12.3 "[to] halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses." For more information, see https://sdgs.un.org/goals/goal12

3 For the business model challenge: https://impact.canada.ca/en/challenges/food-waste-reduction-challenge ; For the technology challenge: https://impact.canada.ca/challenges/food-waste-reduction-challenge-novel-tech/the-challenge

though, it is important to know what the current state of monitoring and measurement is in Canada, including who is (or is not) measuring food loss and waste, what practices they are using, and what barriers and opportunities are preventing agri–food members from starting to measure their food loss and waste.

3.3 Purpose of This Report

The purpose of this report is to gain insight into the different methods that are currently being used in Canada to monitor and measure food loss and waste as well as to identify some of the barriers and opportunities for improving this monitoring and measurement activity. To gain these insights, 11 key stakeholders were interviewed, including leaders from industry and government. The main audience for this report is government (at all levels), with food businesses being an important secondary audience. The hope is that the findings of this report will move the conversation forward on the importance of monitoring and measuring food loss and waste.

4.0 Methodology

This report was informed by key stakeholder interviews. Potential interviewees were chosen based on snowball sampling, which means that they were known players in the world of food loss and waste in Canada and/or were suggested by known players or fellow interviewees. There was an attempt to have a representative sample of all the types of key players (e.g., provincial/territorial, municipal government, agri-food consulting company, food processor/producer, etc.), but not all types are represented in this report because of short timelines and non-response from certain types of key stakeholders. This report is therefore a "snapshot" of monitoring and measurement in Canada, rather than representation the full range of measurement types and barriers and opportunities.

Of the 18 people contacted, 11 agreed to participate in the research. The interviewees, which have been anonymized, are listed below using descriptions that they have chosen themselves. These interviewees include:

- a top-level employee at an industry supply chain organization
- an employee of a U.S. food waste non-profit
- a city employee of a municipal government
- a company executive for a food waste solutions provider/policy implementation tool/support system for food security programs
- a city coordinator for a food rescue charity
- a food waste consultant and waste reduction planner for a consulting company[4]
- a policy analyst for a provincial government
- a leader of sustainability for a national food processor and producer
- a director for a food insecurity organization
- an executive chef for hospitality services for a university
- a CEO of an agri-food consulting company

Each interviewee participated in an hour-long interview,[5] where they were asked about their organization, how they define food loss and waste, the causes of food loss and waste, effective strategies to address the issue, their monitoring and measurement practices, and barriers and opportunities to improve these practices in Canada. They were also given an opportunity to discuss anything related to the topic that did not come up during the question period.

The interviews were transcribed and then coded using in-vivo coding, which utilizes the interviewees' own words to capture the main idea in sentences/paragraphs in the transcripts (Saldãna 2011). These codes were broken down into themes of causes, effective strategies, definitions, monitoring and measurement, and barriers and opportunities. This report focuses specifically on the last three themes.

Interviewees were sent a draft of the report and given the option to provide feedback within a two-week period on the accuracy of how their organization was portrayed in the report as well as their overall impression of the report. Based on this feedback, corrections about how interviewees' organizations define, monitor, and measure food waste were incorporated into the final report.

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[4] This describes two interviewees who work together and were therefore interviewed together.
[5] One interviewee chose to respond with written responses because of scheduling constraints. Also, one interview had two interviewees, who agreed during the interview to stay an extra half an hour.

5.0 Findings

The findings for this report are divided into three main sections: food loss and waste definitions, monitoring and measurement practices, and barriers and opportunities. The definition section explores how the key stakeholders interviewed for this report define food loss and waste within the context of their organization, business, or government. The monitoring and measurement practice section explores the range of practices that stakeholders use for measuring food waste within a government jurisdiction (at all levels) and within a food industry or business. Finally, the barriers and opportunities section details what key stakeholders said in terms of the barriers that hold agri-food actors back from monitoring and measuring their food waste and how to improve not only the uptake of these practices, but also the collection and quality of data at the federal, provincial and territorial, municipal government, sub-sector and industry levels.

5.1 Definitions

A main finding of this research report is that there is not a single, uniform way to define food loss and waste. Key stakeholders' definitions, listed in Table 1, varied significantly—this variation even included stakeholders that belonged to the same sector of the agri-food system and/or industry. In the next few sub-sections, this report explores the differences in scale and scope of focus (e.g., entire agri-food system versus end of the supply chain), types of food items included and excluded (e.g., liquids and edible/inedible foods), and end destinations that are included/excluded (e.g., landfill, compost, food donation). These definitional differences are important for establishing boundaries around what gets measured and what does not.

5.1.1 SCALE AND SCOPE OF FOCUS

Key stakeholders for this report varied significantly in the scale that they approached the issue of food loss and waste. Stakeholders that focused on the entire agri-food system typically defined food loss and waste by distinguishing between "food loss" and "food waste", with food loss including food that is lost during the production, processing, transportation, and distribution stages of the supply chain and food waste being food that goes uneaten after reaching the retail and consumer stages of the supply chain. This distinction was made by a top-level employee of an industry supply chain organization, whose mandate is to improve the efficiency (including a reduction in food loss and waste) of one industry from the point of production through the retail stage and stops before it reaches the consumer.[6] A CEO of an agri-food consulting company and a food waste consultant and waste reduction planner for a consulting company work with clients throughout the agri-food system and therefore also distinguish between

Figure 1. The agri-food system, broken down by stages

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[6] This organization does research and awareness campaigns to reduce its consumers' food waste, but the definition in terms of monitoring and measurement stops at the retail stage.

Table 1. Terminology and Definitions for Each Interviewee

Key Stakeholder Organization	Definition
Industry supply chain organization	**Food loss**: "any food meant to be produced and moved through the supply chain to the consumer that doesn't reach the final point of sale that's lost at some point in the supply chain" **Food waste**: "once it has left the supply chain to the consumer or retail food service"
U.S. food waste non-profit	They are agnostic & do not have a definition. They do distinguish between **food waste** and **food surplus** (still edible, donatable).
Municipal government	**Food scraps**: To emphasize the inedible portions of food waste and discourage residents from putting edible food in green bins.
Food waste solutions provider/ policy implementation tool/ support system for food security programs	**Food waste**: "Food that can't be sold through standard sales channels & needs to be disposed of in some way"
Food rescue charity	**Food waste**, **food surplus**, **food that would not otherwise be eaten**: They do not differentiate between when to use these terms.
Consulting company	**Food loss and waste**: Food that is not eaten by humans. Distinguishes between loss and waste the same as interviewee #1. **Surplus food**: Food that is edible, donatable.
Provincial government	**Food waste**: No definition.
National food processor and producer	**Food loss and waste**: Food that is lost or wasted within the boundary of their organization (from primary processing through to distribution). Distinguishes between loss and waste the same as interviewee #1.
Food insecurity organization	**Edible, excess food**: Food that can be eaten by humans, donated.
Hospitality services for a university	**Food waste**: Any food not used by the organization.
Agri-food consulting company	**Food loss and waste**: "inefficient use of natural resources." Distinguishes between loss and waste like other interviewees.

the term food loss and waste. Interestingly, a sustainability leader for a national food processor and producer who distinguishes between food loss and waste, excludes the production, retail, and consumer stages from its definition. Although they are involved in the production stage, they do not include this in their definition because food loss and waste is challenging to monitor and measure at this stage compared to others. They also exclude retail and consumer stages because it outside the scope of their business.

A city employee for a municipality and a policy maker for a provincial government do not distinguish between food loss and food waste even though there are a variety of agri-food sectors operating within their jurisdictions. Important context for this is that the municipality has focused their efforts on consumer (or residential) food waste to date, but the municipality is in the process of developing policies to tackle food waste in the institutional, commercial, and industrial sectors. The industrial sector could be considered "food loss", but they did not mention food loss at the production stage of the supply value chain. The provincial government, who has jurisdiction over food waste issues through the agri-food system, admitted that they do not have a definition and therefore, they did not distinguish between food loss and waste

The rest of the stakeholders do not focus on the production, processing, transportation, or distributions stages of the supply chain and, as a result, do not distinguish between food loss and waste. Most of the stakeholders prefer to use the term "food waste", with a city employee for a municipality opting for the term "food scraps" to target the residential sector in awareness campaigns for using green carts for disposal. A few stakeholders that work in the arena of food redistribution, prefer to distinguish food waste from excess, edible food. One of these stakeholders whose organization works with the hospitality sector to redistribute their excess, edible food prefers this term instead of food waste because food waste has a negative connotation that makes it seem unsafe. This idea of using a different term to distinguish 'waste' from 'still edible' food is echoed by other interviewees, arguing that from a food dignity perspective, it is improper to call food that is being given to food insecure people waste. One food security organization acknowledges this argument, but because their aim is to only rescue food meant for the compost

or landfill, they want to emphasize that it would have become waste to highlight the environmental consequences of it.

5.1.2 TYPES OF FOOD INCLUDED OR EXCLUDED

Key stakeholders differed on what types of food they included or excluded in their definition. One point of contention was whether liquids (e.g., juice, pop, oil, blood) should be included. For some stakeholders, such as those that deal with fresh produce, this question was not relevant as they do not deal with liquids at all. Quite a few stakeholders do count liquids as food waste though, with some arguing that it requires food inputs to create those liquids. On the other hand, an executive chef at a university's hospitality service does not count liquid as waste because it is picked up by waste services separately than its organic waste, and therefore not easily measured. Along the same lines, a city employee at a municipality and interviewees representing a consulting company

Questions to consider when developing a food loss and waste definition:

What scale are you focused on? The whole agri-food system, across a few sectors, within an industry, or at an individual business level?

If your operation crosses several sectors, which ones will you be monitoring and measuring?

What type of food items will you include in your definition? Will you count liquids, trimmings, inedible items?

Will you distinguish between edible and inedible food waste?

Will you distinguish between avoidable and unavoidable food waste?

What end destinations will be included in your definition?

maintain that liquids are a grey area in terms of counting as waste. This is in part because it is difficult to measure, but also because the liquids in garbage bags and/or green bins leak, smell bad in the summer, and freeze during the winter.

Key stakeholders also varied on whether they included inedible food waste in their definitions. Edible food waste includes the parts of food items that can typically be eaten by humans, whereas the inedible parts include parts that are difficult to eat or are not typically eaten by humans (e.g., eggshells, bones, some fruit skins). Most interviewees distinguished between these two types of food waste and included them in their definitions, whereas the provincial government, the hospitality services for a university, and one of the food security organizations interviewed did not make this differentiation. A top employee from a national food producer and processor distinguished between the two types of food waste, but only included edible food waste in their definition.

A food waste consultant and waste reduction planner for a consulting firm, an employee for a U.S. food waste non-profit, and a CEO of an agri-food consulting company all pointed out that there is no binary between edible and inedible; rather it is a grey zone. The employee for a U.S. food waste non-profit pointed out that what counts as edible and inedible varies significantly across cultures, within cultures, and across culinary behaviour. The consultant and planner from a consulting firm agreed with this point but said in practice when separating these two categories during waste characterization audits, there was very little that went in the pile between the two categories. They also mentioned that the distinction across clients was quite minimal.

Interviewees were asked if they distinguished between avoidable and unavoidable waste, but this distinction seemed to be the same as the divide between edible and inedible. The CEO for an agri-food consulting firm pointed out using the example of broccoli, that while the head of it is typically edible, and the stem seen as inedible so if the broccoli is thrown out then the unavoidable waste of the stem is also thrown out and could be considered avoidable. They go on to say, "If bread is wasted, you've also wasted the kernel of the wheat during the manufacturing of the flour. So again, another example [that] all waste [. . .] is avoidable to a degree."

5.1.3 END DESTINATIONS INCLUDED OR EXCLUDED

Most key stakeholders included the following end destinations in their definition of food waste: landfill, compost, anaerobic digestion, secondary non-food use, and animal feed. This means if food ended up in any of these destinations, then it was considered food loss or waste. The main disagreement was centered on whether edible, surplus food being donated to food charities should count as food loss and waste. The distinction between whether it should be included or excluded seemed to come down to how the stakeholders interpreted the value of food in their business, government, or organization. For example, a company executive for a food waste solution provider who works with retail to collect their surplus food, classifies food donations as waste because the food does not meet its purpose of generating a profit for retail businesses. This organization does distinguish this surplus food from other food waste though, categorizing it as charity donations.

Stakeholders from the food security organizations and charities, though, typically do not count donated food as waste because they see the purpose of food as feeding humans and therefore fulfilling its purpose. The stakeholders for a consulting firm were on the fence whether it should be included in their definition since they argued that it cannot be guaranteed that the food is eaten after it is donated. They commented that a portion of donated food ends up being sent to the landfill or compost instead of being eaten. For those that focus on food waste at the residential level, the question of whether food donation counts as food waste is not exactly relevant, as they are only dealing with food waste that are in garbage bags, recycling, or green bins. If residents are donating food, they are for the most part unable to capture that in their definitions and measurement activities.

5.2 Monitoring and Measurement Practices

Monitoring and measuring food loss and waste is not a widespread practice in Canada. There are some provincial, territorial, and municipal governments that monitor and measure food loss and waste within their jurisdictions, industries that track their food loss and waste, and individual

Table 2. Measurement Practices for Each Interviewee

Sector Conducting Measurements	Key Stakeholder	Measurement Type
Business/ industry	Top-level employee at an industry supply chain organization	Retail surveys, focus groups
Business/ industry	A leader of sustainability for a national food processor and producer	Weights from scales, shrink data
Business/ industry	An executive chef for hospitality services for a university	Weights from scales
Consultant	A CEO of an agri-food consulting company	Mass balance, efficiency evaluations, focus groups, interviews, surveys
Consultant	A food waste consultant and waste reduction planner for a consulting company	Waste characterization audits, food diaries, surveys, interviews, mass balance
Non-profit	An employee of a U.S. food waste non-profit	Secondary data (from government, proprietary, business, public, academic, waste haulers sources), modelling
Non-profit	A company executive for a food waste solutions provider/policy implementation tool/support system for food security programs	Weights from scales, some shrink data
Non-profit	A city coordinator for a food rescue charity	Estimates of weight, weights from scales
Non-profit	A director for a food insecurity organization	Estimates of container volume
Government	A policy analyst for a provincial government	Rely on municipal data collection
Government	A city employee of a municipal government	Waste characterization audits, food diaries, surveys, interviews, secondary data

businesses (particularly grocery stores) that collect data to calculate how much of their food goes unsold. Considering those that do monitor and measure, a main finding of this research report is that there is no single, uniform practice to monitor and measure food waste across these difference contexts. This is because the agri-food system is incredibility diverse. Table 2 lists the measurement practices for each interviewee, highlighting a range of practices that utilize administrative data to ones that use direct, weight-based measurements. These practices vary according to the scale of focus (e.g., country versus individual business), the type of data available at different sectors of the agri-food system (e.g., shrink data, tonnage, volume), and the number of resources available (e.g., time, labour,

space, money). The next two sub-sections focus on monitoring and measurement practices that try to assess food loss and waste within a government jurisdiction (at all levels) and practices that try to assess it within a food industry or food business.

5.2.1 PRACTICES FOR DETERMINING FOOD LOSS AND WASTE WITHIN A GOVERNMENT JURISDICTION

Monitoring and measurement practices at the government level are typically conducted by governmental departments, consultants, and academics. These practices differ according to what level of government you are focused on. At the

federal level, measurement practices can involve conducting a mass balance[7] to determine how much food that is produced for human consumption is imported into the country and exported from the country during a particular time period (using government data from departments like Agriculture and Agri-Food Canada) and then determining and calculating out loss factors (e.g., food items that are lost while milling grain to make bread) in different sectors of the agri-food system. These loss factors can be determined (and tested) through surveys, interviews, or focus with members of the agri-food system.

At the provincial and territorial level, it is possible to also do a mass balance or waste characterization audits. The policy analyst for a provincial government mentioned that they do not measure food loss and waste within their jurisdiction but, rather, rely on municipal data to try to establish these numbers.

At the municipal level, there are a variety of practices that are used. Often these techniques are different for determining residential and institutional, commercial, and industrial food waste

within a municipal jurisdiction. For residential waste, these practices include conducting waste characterization audits, surveys, interviews, food waste diaries, and using secondary data to make inferences about waste levels. Waste characterization audits at this level typically involve collecting waste from all streams (e.g., garbage, recycling, and green bins) either from households or at the source of

disposal and sorting through it into pre-established categories (e.g., plastic, paper, metal, food waste) and weighing each category. Waste characterization audits are usually done at one point in time but can be done multiple times to compare changes in food waste levels. A city employee mentioned that their municipality conducts these audits approximately every three years as it has been built into their waste strategy. Self-report practices, like focus groups, interviews, and surveys involve asking residents to estimate and report their food waste during a given time period. Food diaries are a more involved version of a self-report practice that requires residents to weight, possibly take photos of, and write down each food item that they dispose of. Lastly, using secondary data to make inferences involves using data from provinces or territories or municipalities that have similar economic and industrial profiles to make inferences about a particular municipality's food loss and waste levels.

To determine institutional, commercial, and industrial food waste within a municipal jurisdiction, it is possibly to use waste characterization audits at the point of disposal, especially if a municipality owns waste services. Only one participant, a food waste consultant for a consulting firm, mentioned conducting waste characterization audits for a municipality so that they could understand how much and what types of waste the institutional, commercial, and industrial sector was generating within the municipality's jurisdiction. This study involved collecting waste samples directly from select food businesses, sampled using North American Industry Classification System (NAICS) codes, and weighing this waste according to specific categories, one of which was organic waste that was sub-divided into compostable food waste and donatable food waste, among other non-food categories. This data was then used to extrapolate the amount of total waste different business categories (e.g., manufacturing) generate on a yearly basis.

Rather than using waste audits, a city employee for a municipal government stated that their government had utilized secondary data from another municipality and adjusted for differences in employment profiles between the municipalities to make an estimate of how much food waste the industrial, commercial, and institutional sector produced. They also used data from another municipality that

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[7] This type of practice can also be used on a continent and international level.

conducted an audit of their industrial, commercial, and institutional sector's waste and again adjusted the data, so it fit their employment profile. The third practice involved using provincial waste data per capita and the municipalities waste characterization audits to 'back out' the amount that the industrial, commercial, and institutional sector was responsible for generating. The city employee further explained that the average of these three techniques is what they use for their municipality.

5.2.2 PRACTICES FOR DETERMINING FOOD LOSS AND WASTE WITHIN AN INDUSTRY AND/OR FOOD BUSINESS

Monitoring and measurement practices at the industry and business level are often conducted by industry organizations, businesses, consultants, and food redistribution/charity organizations. At the industry level, it is possible to use a lot of the same practices that the municipal level uses to determine residential food loss and waste—waste character-ization audits, self-report measures, and secondary data to make inferences about waste levels. One key stakeholder for this report that focused on the industry level was an industry supply chain organ-ization. This organization works with a particular industry from production to retail but focuses its attention on trying to estimate food waste at the retail level. It conducts a survey every two years where it asks its industry members to report its shrink numbers – a calculation that determines food waste numbers by subtracting the amount of product that is purchased by customers from the amount of product that enters a food business. The amount leftover represents the food that was not sold (and therefore wasted). This organization has an efficiency tool that uses this information to establish a baseline for the industry at the retail level that grocery stores can use to compare their stores to. This key stakeholder also mentioned that their industry utilizes Agriculture and Agri-Food Canada data on wholesale pricing of products to calculate food waste levels.

An employee for a U.S. food waste non-profit uses government datasets, proprietary datasets from food businesses and data companies and solution providers, and public datasets to create models to estimate how much food loss and waste occurs in different sectors throughout the agri-food sector. These datasets come from surveys, case studies,

academic literature, among other methodologies. This is not being used in the Canadian context but may be in the future.

At the food business level, measurement types can include shrink calculations, efficiency evaluations, metrics/modelling, and weighing (or estimating) food loss and waste. Shrink calculations were described earlier and are used most often at the retail level. In terms of efficiency evaluations, a CEO for an agri-food consulting firm works with individual businesses (as well as industries) to identify, measure, and address inefficiencies, such as food waste, to improve their profit margins. This involves determining what improvements can be made within a business's operation as well as from the customer's perspective and then choosing

metrics to put in place to measure these improve-ments. The specifics of this vary according to the client and inefficiency issue.

The U.S. food waste non-profit has run a pilot project with grocery stores in the US to create a desktop calculator for food businesses to use. This calculator takes shrink data as well as data regarding tonnage, waste rates, and end destinations and con-verts it into waste data, then factors out the weight of packaging and inedible parts of food by using different datasets. A company executive for a food solution provider has also created a metric––– one that can take dollar values of unsold food and uses an equation to convert it into weight to estimate the tonnage of food waste that is generated on a store basis for a grocery store chain. This metric uses

waste hauler data for landfill, compost data, weights from food donations from their charity partners and farmers, shrink data, among other data sources to create a benchmark for the average store broken down on a department level (e.g., fresh produce, bakery) and location so that stores can compare their food waste levels to other stores.

One of the last measurement practices involves weighing (or estimating the weight of) food loss and waste. This practice varies in terms of its accuracy and granularity. A food rescue charity that redistributes food waste from food businesses, requires volunteers to either weigh each donation or estimate the weight of it, and fill this information into their app along with information about its condition and food type (e.g., baked foods, fresh produce). Similarly, food insecurity organization that redistributes excess, edible food from the hospitality sector, requires volunteers to estimate the volume filled of different container types and these numbers are then converted into weights on their website. A food waste solution provider has a bit more accurate measurement practice, where it gets its food charity partners and farmers to weigh with a scale all the food that they receive from grocery stores according to departmental category (e.g., fresh produce, fresh meat, bakery). Going a step further, a national food producer and processor has worked extensively with its employees throughout its vertically integrated business to weigh and record its food waste and align these numbers with its yield measurements and its finance accounting metrics.

5.3 BARRIERS AND OPPORTUNITIES FOR IMPROVING MONITORING AND MEASUREMENT

A main finding from this report is that there are lot of barriers to improving monitoring and measurement in Canada, both in the sense of encouraging more agri-food actors to take on these practices, as well as collecting and aggregating this information so that it can be used towards making meaningful reductions to food loss and waste. This section is broken down into lack of uniform definitions and practices, lack of accountability, lack of resources, and reluctance to share data and measurement practices. Each section discusses the specifics of these barriers as well as opportunities to tackle these barriers.

5.3.1 LACK OF UNIFORM DEFINITIONS AND PRACTICES

This research report has shown that key stakeholders use a diversity of definitions for food loss and waste that set different boundaries around the scale and scope of their focus as well as the types of food items and end destinations that are included or excluded. Similarly, this report has also shown that key stakeholders use a variety of practices to monitor and measure their food loss and waste, demonstrating a range in terms of accuracy and granularity. The lack of uniform definitions and monitoring and measurement practices not only makes it incredibly difficult to compare and aggregate results from different agri-food actors, but it also makes it challenging to understand how much food loss and waste is being generated at the national, provincial, territorial, municipal, agri-food sector, and industry level. This complicates decisions regarding where to prioritize resources to make the most impactful reductions, how to develop baselines at these levels, how to evaluate the effectiveness of reduction efforts and how to measure progress over time. At the federal level, this is especially problematic, as the government has committed to reduce its food loss and waste by 50% by 2030 under the United Nations Sustainable Development Goals and currently has no baseline and a limited ability to measure its progress in reaching this goal.

It also makes it difficult to compare results from different measurement practices, leading to a potential conflict in what can be claimed as food loss and waste reductions and what can not. For example, a CEO for an agri-food consulting firm mentioned that some food businesses have claimed dramatic food loss and waste reductions by simply moving the boundaries of what counts as end destinations, rather than preventing and/or reducing the amount of food waste that they generate in the first place. For example, one business simply stopped counting food that they sent to composting, anaerobic digestion, and animal feed as food loss and waste, thereby making it appear on paper that they had drastically reduced the amount of food loss and waste that they had generated.

While it is not possible to create a single uniform definition or monitoring and measurement practice because of the diversity of agri-food system, some key stakeholders suggested the need for a standardized approach for developing

context-specific definitions and practices that allow for comparison. Several of these stakeholders mentioned that they use the World Resource Institute's food loss and waste protocol guidelines[8] to help them develop food waste definitions and develop a plan on how to monitor and measure their food loss and waste. This protocol sets a global standard that allows for consistency in measurement so that different measurement efforts can be compared on an "apples-to-apples" basis, rather than a "potatoes to peas" effort. This protocol is important for advancing the conversation on monitoring and measurement, but it is not without its criticisms. A CEO for an agri-food consulting firm as well as a waste reduction planner for a different consulting firm both mentioned that the protocol does not

You can't fix what you don't measure. There are lots of benefits to monitoring and measuring your food loss and waste:

For municipalities: it could lead to less waste in landfills, including less costs for operations and infrastructure.

For food businesses: it could lead to higher profits. Information from monitoring and measurement can help you reduce your waste and therefore reduce your disposal fees.

provide guidance on how to actually measure food loss and waste, which makes it difficult to put into practice. A national food producer and processor also mentioned that the protocol does not have any advice on measuring food loss on the farm level,[9] which means that their business cannot count food loss generated during the production stages of their operation.

At the household level, a food waste consultant for a consulting firm suggested that municipalities looking to develop food waste definitions and measurement practices look at the National Zero Waste Council's measurement guide, *How to*

Measure Food Waste: A Guide for Measuring Good Waste from Households in Canada,[10] which gives guidelines on household waste audits and may bring some uniformity to measurement practices at this level.

5.3.2 LACK OF ACCOUNTABILITY

Key stakeholders for this report stated that they were not aware of any government policies at the federal, provincial, or territorial levels of government requiring municipal governments to monitor, measure, or report food loss and waste data within their jurisdiction. Similarly, there were no policies or regulations at these levels, or the municipal level or industry level requiring any food businesses to report the food loss and waste that they generated. A waste reduction planner for a consulting firm also mentioned that there is no one in the private or public sector, that they are aware of, that is pushing to establish a baseline in food loss and waste. The lack of reporting requirement means that there is no accountability or incentives for the municipalities and food businesses to be aware of or keep track of their food loss and waste levels.

An employee for a U.S. food waste non-profit explains that "What has several owners has no owners [. . .]" and goes on to say that accountability for food loss and waste is not located in one place, but instead is spread throughout the agri-food system. Because of this lack of ownership, there is no accountability or incentives for any one food business to tackle this issue. This is complicated by the status quo idea that food waste is the cost of doing business. Businesses expect to lose or waste some food and therefore build it into their budgets. One key stakeholder emphasized that the retail sector (as well other sectors) has industry-set shrink levels that allows them to waste a certain amount of food in their individual businesses. If they are reaching this shrink level, then there is no real incentive or return on investment for putting in the effort to measure and try to reduce the amount of food loss and waste that they generate.

Many of the stakeholders that were interviewed for this report are exceptional cases because they

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[8] See Appendix A for this protocol document.
[9] This may have changed since this interview took place.
[10]   See Appendix A for this document.

are motivated to monitor and measure their food loss and waste. A company executive for a food waste solution provider said that most of the clients that they collect and redistribute food from have corporate social responsibility policies and brand promises that motivate them to use their services and have the food that they donate monitored and measured. They mentioned that they had a hard time recruiting other food businesses that did not have these policies and promises, as these businesses often felt that they did not have a problem. Similarly, the sustainability lead for a national food producer and processer said that their business is also influenced by its corporate social responsibility initiatives, particularly the voluntary agreement they have with a few other food businesses to reduce their food waste levels in a given time period. This agreement motivated them to work with World Resource Institute, using

their food loss and waste protocol, to create and operationalize a definition for food loss and waste within their operation. It also motivated them to work with people throughout their operation to implement a system to monitor and measure the food waste they generate and the progress they make in reducing it.

Stakeholders for the food insecurity organizations and food rescue charity were all motivated to prevent their clients' food waste from ending up in the landfill and to measure this waste to show the impact that their organizations is having (also helpful when applying to grants) and give their clients' an idea about how much food waste they are generating.

In terms of motivating agri–food actors to start to monitor and measure their food and loss waste, one stakeholder mentioned the need to build public pressure so that food businesses include

food loss and waste in their corporate social responsibility and brand promises and are held accountable for showing progress on reducing their waste. Other stakeholders suggested the need for government intervention, although they varied in their suggestions. For example, a policy maker for a provincial government stated that there needs to clear leadership when dealing with an issue like food waste that is, "ubiquitous, multi-jurisdictional, and multi-sector in nature". An employee for a U.S. food waste non-profit contends that the government could help food businesses, "move en masse to new solutions that remove a competitive advantage that may be keeping [them] from doing that." A food waste consultant and a waste reduction planner for a consulting firm also believe that the federal government should actively work towards creating a baseline and trying to achieve its commitment to the United Nations Sustainable Development Goal related to food loss and waste. They were unsure of whether monitoring and measurement should be influenced by government or grassroot initiatives, contending that the government could be valuable for motivating agri-food actors to monitor and measure through providing consistency in measurement standards and reporting.

A CEO for an agri-food consulting firm mentioned that the federal government could incorporate food loss and waste monitoring and measurement standards under its carbon tax law. Another suggestion by a top-level employee at an industry supply chain organization was that the federal government could help provinces and territories create harmonized regulations, that would reduce the burden on food businesses operating in multiple jurisdictions and help these businesses adopt and/or deliver on their corporate social responsibility policies. Along the same lines, one stakeholder argued that lots of governments at different levels are working on the issue of food loss and waste, but there needs to be an explicit political directive to get everyone moving in the same direction. Some stakeholders suggested guidance, standardized tools, and funding to encourage food businesses to monitor and measure their food loss and waste instead of laws and regulations. They expressed concern about the administrative and financial burden these potential laws and regulations could add to food businesses, some of which are already operating with thin margins.

5.3.4 LACK OF RESOURCES

Most of the stakeholders mentioned lack of resources as a major barrier to monitoring and measurement. At the municipal level, a lack of money, time, and labour data were mentioned as reasons for inconsistent monitoring and measurement and less granular data. A city employee for a municipal government mentioned a few initiatives at the residential level that had to be cut short because of budget and time constraints. Even though they had committed to waste characterization audits of residential waste, their budget only allowed for one to two food waste categories rather than being able to break it down into food types, which would have allowed them to make more targeted interventions for reducing household food waste. The food waste consultant and waste reduction planner for a consulting firm who often work with municipalities echoed these budget constraints. The city employee suggested the option of increasing residential utility rates to increase the municipal budget to improve these audits but said that it would not be received well by residents. At this level, some stakeholders mentioned that it might make sense for the federal or provincial and territorial governments to provide funding for municipalities so that they can conduct waste audits at a more granular level.

For the key stakeholders in the non-profit arena, they mentioned that a lot of their measurement work relies on volunteers, who are unpaid for their work. One food rescue charity argued that it is difficult to get volunteers to take a scale with them to measure the weight of donations, rather than just estimating it. A food solution provider that works to redistribute surplus food from grocery stores pays its food charities to monitor and measure the food they redistribute, arguing that it is extra work, and the work deserves to be compensated.

A lot of food businesses and those that work with food businesses argued that it takes a lot of time, labour, and money to regularly monitor and measure food waste. An executive chef for hospitality services for a university has their food waste weighed by a non-profit organization and a sustainability department on campus. They argue that some of the big hospitality organizations, will use a technology platform like Leanpath that tracks ordering and food waste levels. They mentioned that they would rather train staff to prevent food waste in the first place, then put all the money and

time and labour into buying and using a technol‐
ogy system like that.

5.3.5 RELUCTANCE TO SHARE DATA AND MEASUREMENT PRACTICES

A reoccurring barrier throughout the stakeholder interviews was the resistance to share data and measurement practices. A top-level employee for an industry supply chain organization stated that, "[. . .] our biggest challenge and barriers that diversified, fragmented, siloed system across all food that we need to bring together to see where [. . .] the synergies [are] to be able to map that out and, you know, build a better mousetrap."

Food businesses were cited as being hesitant to share data on the food loss and waste that they generated. This hesitancy is in part for competitive reasons, that they do not want their data to be used by their competitors to learn about what they are and are not selling. They also do not want the government to use this information against them to create restrictive, burdensome regulations. Similarly, some stakeholders cited a reluctance of private waste haulers to share their data on food loss and waste. A food solution provider suggested using food charities to report aggregated meas‐urement data on food donations, as it will not be associated with specific food businesses. Along the same line, one stakeholder mentioned that the agri-food industry could adopt a similar approach to the oil and gas industry, where they voluntary report their data to Statistics Canada, who can anonymize and aggregate this data. They contend that this could potentially counters the competitive and regulatory issues that industry have with shar‐ing their data. This stakeholder mentioned that by

the oil and gas industry reporting their data, they can then use this source to measure, benchmark, and compare their progress on their corporate social responsibility initiatives. A waste reduction planner and food waste consultant for a consulting firm suggested that maybe Canada could adopt a monitoring and measurement reporting system like WRAP[11] in the United Kingdom. This system is a non-profit organization that collaborates with government and food businesses to collect, aggregate, and analyze food waste data from various

> ### An example of collaboration
>
> The Ontario Food Collaborative is an example of collaboration among stakeholders. Their mandate is to improve healthy eating and reduce food waste through various means.
>
> **See Appendix A for the food waste audit guide that this collaboration produced.**

sources throughout the agri-food system. This approach prevents government access to data on specific food businesses but enables them to know what sectors to prioritize their resources when tackling the issue of food loss and waste.

Another connected barrier is the reluctance to sharing measurement practices. Every municipality, consultant, and food business has their own monitoring and measurement practices and there is no central guiding document or database to figure out how to get started. Food businesses are reluctant to share their practices for the same reasons listed above related to data. Consultants, often (but not always) are required to keep the reports, including the measurement practices, confidential. This means that every agri-food actor that wants to monitor and measure their waste would likely need to start from scratch to figure out what practice they can use. A food waste consultant shed light on this issue when they stated that, "There's not really a practice with the people who are doing measurement to openly share everything. And [. . .] if there was then you can actually be more resource efficient because you could say, hey we really like that method that so-and-so did for

the city. We are going to use it instead of creating something new."

There are some useful documents to use as a starting point, such as the World Resource Institute's and the National Zero Waste Council's documents mentioned earlier. One stakeholder mentioned that it would be good idea moving forward to get food waste categories in some guiding document like Section 2 (Methodologies for Characterizing Residual MSW) in Environment and Climate Change Canada's (2020) *National Waste Characterization Report: The Composition of Canadian Residual Municipal Solid Waste*. This same stakeholder argues that more actors should share their measurement practices, highlighting CalRecycle[12] who has made all of their findings and practices public, so others do not have to start from scratch. This speaks to the importance of a broader need for better communication across stakeholders to share practices and data. Several of the stakeholders who have been pushing the monitoring and measurement conversation forward have prioritized collaboration.

Equally important is communication within a single organization, business, and/or government. For example, an executive chef for a university's hospitality service says that they have a student committee who they meet with regularly to understand students' needs and interests. Similarly, an employee for a U.S. food waste non-profit stresses the importance of building measurement into an entire business, including financial departments, rather than keeping the issue isolated to the sustainability department, which can often be under-resourced and not have much of a say in business decisions. The sustainability lead for a national food producer and processor is an example of what a sustainability office can do when it is properly supported. This office worked with the top-level executives, plant managers, on-the-ground employees, and financial departments, among others to ensure that everyone prioritized measurement and were following the same protocol.

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11   This refers to the Waste and Resource Action Program.
12   CalRecycle refers to the California Department of Resources Recycling and Recovery.

6.0 Discussion

In this section, this report makes suggested strategies for the government (at different levels) and food businesses to push forward the conversation about how we can improve monitoring and measurement in Canada. The report then concludes by summarizing the content of the report and looking to the future.

6.1 Suggested strategies

This report has several suggested strategies for how to improve the uptake of food loss and waste monitoring and measurement by food businesses and governments who are not currently engaging in these practices, as well as the collection and quality of data at the federal, provincial, territorial, municipal, sub-sector, and industry levels in Canada. These strategies are based on the findings of this report and reflect steps that can be taken now, in Canada's current political and economic context, to better monitoring and measurement. These suggested strategies are divided into two categories: those aimed at the government (at various levels) and those aimed at food businesses.

6.1.1 SUGGESTED STRATEGIES FOR GOVERNMENTS

1. **Set mandatory food loss and waste reduction targets**
   While the federal government has indicated in its 2015 *Taking Stock: Reducing Food Loss and Waste in Canada* report (page 1), that is has committed to reducing its food loss and waste by 2030 as part of the United Nations Sustainable Development Goals, this is a voluntary agreement. This means that there is little or no consequences or accountability for not reaching this goal. The voluntary nature of this goal can make it difficult to prioritize food loss and reduction as an issue, create policies to tackle it, or justify spending money and using other resources to ensure that Canada reaches this goal.

   By setting and committing to a mandatory reduction target, the federal government can further demonstrate that they believe that food loss and waste is a serious issue that needs to be addressed. It will also make them accountable on the international stage and to Canadian citizens to ensure that they reach this target, which will help make food loss and waste an issue that they can prioritize, create policies for, and justify the allocation of more resources for. For the federal government to effectively reach whatever reduction goal it sets, it is also important for provincial and territorial governments to set their own reduction goals within their jurisdiction if they have not done so already. These provincial and territorial reduction goals will help motivate governments at this level as well as the municipal level to also prioritize this issue and allocate resources to it. Mandatory goals at all levels will also encourage regular monitoring and measurement, baseline setting for how much food loss and waste is generated within the various jurisdictions, food waste reduction programs and policies implementation, and tracking of progress towards these goals.

2. **Establish national guidelines to help businesses and governments (at various levels) define food loss and waste within the scope of their operations**
   As the report has shown, there is currently no uniform definition for food loss and waste throughout the agri-food system. Definitions vary significantly, within even the same sector or industry, according to organizational mandates, the values placed on food, the level of effort put into creating definitions, and the reasons for establishing a definition in the first place. Definitions are also highly contextual in terms of which types of food items an operation has, how those items can be processed or used, and what end destinations they can be sent to. With that being said, it is not realistic to create a uniform or national definition for food loss and waste as it would not be applicable in many operations throughout the agri-food system and, therefore, would not be helpful when it comes to monitoring and measuring food loss and waste in those operations.

   It is possible, however, to create national guidelines for how to define food loss and waste within governmental jurisdictions and food

businesses that consider the contextual factors of each sector or industry while, at the same time, allowing for comparison within and across sectors. This is important for the development of baselines at the government, sector, and industry level. The World Resource Institute's food loss and waste protocol is a good starting point for a national guideline as they have worked with governments and industry throughout the world to create an international standard on how food loss and waste should be defined and measured throughout the agri-food system. Several interviewees also utilized their protocol to develop (in whole or part) their own food loss and waste definitions. If Canada were to adopt this protocol and adapt it to its own agri-food system, its food loss and waste data could also be compared to that of other countries to evaluate its progress relative to others.

This suggested strategy is best instituted by the federal government as it is a national guideline. It is important that the federal government collaborate with provincial, territorial, municipal governments, and food businesses so that these parties are engaged and motivated to implement these guidelines in their own operations. This collaboration is also important for contextual factors, like those listed above, to be incorporated in these guidelines to ensure that the definitions reflect reality and can be implemented in practice.

3. Develop national guidelines to help businesses monitor and measure their food loss and waste

As this report has shown, there is no standard method for food businesses to monitor and measure their food loss and waste. There are currently little to no government policies, laws, or regulations that require businesses to measure the food loss and waste that they generate. This has resulted in businesses either opting to not monitor and measure or to create their own measurement systems. These existing measurement systems often vary not only between sectors or industries, but also within the same industry. This variety makes it difficult to compare data from different sources and to establish baselines at the government, sector, and industry levels.

National guidelines, which again can use the Food Loss and Waste Protocol as a starting point,

will ensure some continuity and comparability between measurement systems. Similar to the previous strategy, the federal government should implement this one in collaboration with food businesses and governments at other levels to encourage the uptake of measurement practices.

4. Develop national guidelines to help governments monitor and measure their food loss and waste

Much like businesses, there is no uniform way to monitor or measure food loss and waste within provincial, territorial, or municipal jurisdictions. There also are little to no government policies, laws, or regulations requiring these governments to monitor or measure their food loss and waste or standards on how to do it.

National guidelines, implemented by the federal government (in collaboration with governments at the other levels and business) would help ensure that data from provincial, territorial, and municipal jurisdictions are comparable and able to contribute to establishing government baselines of food loss and waste. It may also provide the push needed to motivate provinces, territories, and municipalities who are not currently measuring their food loss and waste, to start as they can adopt these guidelines rather than use up their resources trying to create their own system.

5. Create (or support a non-governmental organization that wants to create) a system where businesses can report their food loss and waste data

To establish government, sub-sector, and industry baselines of food loss and waste, compare these baselines, and evaluate the progress of food waste reduction efforts it is necessary for food businesses to report their food loss and waste data. There are currently no policies, laws, or regulations requiring businesses to report their data. There also is no central place where this data can be collected, analyzed, and used to track progress in food loss and waste reduction at the provincial, territorial, sub-sector, or industry levels. A central system for business food loss and waste data is necessary to do all of this.

While the federal government should implement this strategy, it could either develop this system itself or provide resources and support to a non-governmental organization

who would be willing to create it. Several stakeholders expressed concern about sharing business data that could be used to negatively impact their profits--- whether it was from competitors gleaning information that comprises their competitive advantage or governments using it to create strict regulations. The system could collect and aggregate data from food businesses to ensure that their data is protected from competitors. It could also be collected by a non-governmental organization instead of the government, who would share only the aggregated data with government (at the different levels) to inform food waste management strategies and policies within their jurisdiction. This system would be implemented in collaboration with the other levels of government and food businesses. This would encourage dialogue between these different stakeholders in terms of what this reporting system would look like and how it would work on a practical level. The development of this system may also encourage businesses to proactively start to monitor and measure their food loss and waste.

6. **Create a system (or support a non-governmental organization that wants to create) a system for governments to report their food loss and waste data**
Like businesses, there is not a central place where governments can report their food loss and waste data so that it can be collected, analyzed, and used to create baselines and evaluate progress. There are also limited to no laws, policies, or regulations that require provincial and territorial or municipal governments to measure their food loss and waste and report this data to the government above them. This system should be operated by whoever operates the system for businesses so that data can be collected and analyzed together. This can be the federal government or the non-governmental organization that they support. It could either involve governments at all levels sending their data to the operator of this system or municipal governments sending their data to their respective provinces and territories, where it will be compiled and sent up to the federal government. This intermediate step would allow for provinces and territories to analyze data to establish their baselines and create their own food loss and waste management strategies.

7. **Create a collaborative space for government and industry to come together to discuss food loss and waste monitoring and measurement**
This report has shown that there is some secrecy around how food loss and waste is defined and measured by different agri-food actors. This is due, in part, to these actors being hesitant to share their data for fear of losing their competitive advantage or being subject extra regulations or public scrutiny. It is also due to the siloed nature of the agri-food system where agri-food actors are developing and implementing their own monitoring and measurement systems separately. This siloed approach is resource intensive, sometimes utilizing an unnecessary number of resources to develop and test measurement and reporting systems. This is especially problematic, given that lack of resources was cited as a main barrier to food businesses and government monitoring and measuring their food loss and waste.

To create guidelines on monitoring and measurement and to encourage those hesitant (or lacking resources) to create their own systems, it is necessary for the federal government to develop a collaborative space where government and food businesses can come together to share practices, experiences, and discuss barriers and opportunities that they have faced. This space, which can take the form of something like a yearly conference, is crucial for getting everyone on the same page. This form of knowledge sharing is also crucial to reduce the number of resources needed to create monitoring and measurement systems. It may also motivate some food businesses and government, who are hesitant or lack resources, to implement these systems within their operations.

8. **Create a collaborative space for governments to come together to discuss food loss and waste monitoring and measurement**
Similar to the previous recommendation, governments at all levels can be siloed from each other when it comes to food loss and waste. This can lead to resources being used unnecessarily to create their own measurement systems and regulations, a mismatch of measurement systems between governments, and inaction on the issue of food loss and waste.

A collaborative space provides governments

of different levels to learn from each other and share experiences, practices, data, and resources. It also provides a space to discuss the development of strategies to reduce food loss and waste, including how to establish baselines or food loss and waste reduction regulations development regulations within their jurisdictions. This can encourage resource sharing and action on this issue. This strategy can be implemented by the federal, provincial, territorial, regional governments, or municipal governments. There can be multiple collaborative spaces, rather than a central one to allow for variety of connections to be made.

9. **Provide funding for municipalities looking to monitor and measure their food loss and waste**

This strategy acknowledges the limited resources and siloed nature of regional and municipal governments and how these factors create barriers to more widespread food loss and waste monitoring and measurement. Under The Constitution of Canada, provincial and territorial governments are responsible for waste issues within their jurisdictions, but this responsibility is often (but not always) downloaded to the municipal level. Unfortunately, this level often has the least number of resources to tackle issues of food loss and waste. This can result in food loss and waste not being monitored or measured, or being incorporated into broader waste measurement efforts, that either puts food loss and waste weights in a much broader category of "organic waste" or has limited categories allocated to food waste (e.g., do not have edible/inedible or types of food). This can lead to less granular data, which can make it challenging to create targeted, jurisdiction-specific food waste management strategies.

Funding provided to municipal governments by the federal, provincial, and territorial governments can help motivate municipalities to monitor and measure their food loss and waste. It can also lead to detailed measurement practices and this can, in turn, result in more accurate data that can be used to establish national, provincial, and territorial baselines and management strategies.

10. **Provide funding for food insecurity charities and redistribution organizations who are willing to measure food loss and waste-related donations from food businesses**

Food charities and redistribution organizations are uniquely positioned to have access to one end destination (e.g., donations of surplus food) from a variety of sectors within the agri-food system. While some of these organizations do measure and report on this data to the businesses or to grant agencies (for funding for their organization), it is not generally shared with the government.

The federal, provincial, or territorial government should provide funding to these groups to encourage them to measure their food loss and waste and to share it with the government. This is a low-hanging fruit in terms of being able to measure food loss and waste from these businesses. It can also be aggregated by these organizations (so that the businesses are anonymous) and shared with governments to inform food loss and waste baselines and reduction strategies.

6.1.2 SUGGESTED STRATEGIES FOR FOOD BUSINESSES

1. **Develop corporate social responsibility and brand promises related to food loss and waste reduction**

As this report has showed, food businesses that set corporate social responsibility and brand promises specific to food loss and waste were motivated to monitor and measure their waste as well as actively find ways to reduce the amount that they generated and/or sent to landfill. In today's political climate, consumers are concerned about environmental impact that businesses are having. Food loss and waste is not only an issue that consumers are becoming more concerned with, but it is a form of inefficiency that by addressing it, businesses can reduce their environmental impact and potentially increase their profits. By setting public-facing reduction targets, this will hold businesses accountable for prioritizing food loss and waste in their operation and finding ways to actively reduce it. This accountability could help justify the allocation of resources to address this issue and could help motivate staff

members to reduce food loss and waste within a business's operation.

2. Develop operation-specific food loss and waste definitions and measurement practices

To achieve corporate social responsibility and brand promises related to food loss and waste, it is important to establish a food loss and waste definition and measurement practices that are specific to the context of an operation. As this report has showed, there cannot be one single definition or type of measurement practice for this as it is highly dependent on contextual factors, such as the mandate of an operation, the types of food items a business works with, and the types of data a business has access to. It is important to understand what types of food items and end destinations a business wants to include in their definition and are able to measure. Similarly, it is important to understand what kind of data a business has access to that can be used to evaluate how much food loss and waste their business is generating. Creating a food loss and waste definition and measurement practice that is context-specific, but also adheres to industry standards mentioned above, ensures that a business can accurately measure their food loss and waste and compare it to the industry average.

3. Communicate food loss and waste promises and practices to all staff

This report has shown that staff engagement is an important factor that could affect the success and/or failure of a business's attempts to reach its food loss and waste reduction promises. If staff are not aware of these promises, informed of the practices to achieve these promises, or given the proper tools to implement them it will make it difficult for a business to achieve its promises. To be successful, businesses need to consult with staff from all levels of their operation (e.g., managers, financial, maintenance, on-the-ground workers) to get them on board, to help develop practices that are realistic, and to identify any potential barriers (and ways past these barriers) that may prevent the implementation of these practices. This will ensure that the actions of all staff are contributing to the same goal.

4. Work with other businesses and industries to develop monitoring and measurement standards

Food loss and waste monitoring and measurement is a necessary part of achieving reduction goals as it helps establish a baseline for how much food Is lost or wasted within a business's operation. It also helps a business evaluate their reduction programs and policies and shows progress in working towards reduction promises. It can take a lot of money and other resources to establish and implement a monitoring and measurement system, especially if a business is creating it from scratch. By working with other businesses and industries, it can help alleviate some of these costs by sharing best practices and experiences to establish a standard of how food loss and waste should be measured within different industries. These standards will also ensure that others within an industry are measuring their food loss and waste in a similar way, making it possible to create a system where data from different businesses can be aggregated and averaged. This is important information that can help businesses evaluate their food loss and waste reduction efforts relative to others.

5. Work with government (and/or non-governmental organizations) to establish guidelines for monitoring and measurement and a reporting system for food loss and waste

To ensure that government standards for monitoring and measuring and reporting systems work for business (or industry), it makes sense to work with the government (and/or non-governmental organizations) to develop these. Businesses (or industry) can share their experience with food loss and waste, attempts to monitor and measure it, identify potential barriers to monitoring and measurement, and discuss how they would envision these guidelines working. Developing industry monitoring and measurement standards can help think through these issues and contribute to the content of government guidelines for monitoring and measurement. In terms of the reporting system, a business can similarly share their experiences and visions for how this system could work to ensure that it aggregates and anonymizes their data and allows them to compare their business food loss and waste data with the average of the industry (and that of other sub-sectors in the agri-food system).

6.2 Conclusion

Food loss and waste is an important issue that is gaining more attention by governments (at all levels) in Canada as well as food businesses because it has significant environmental and economic impacts. To effectively reduce food loss and waste at a national, provincial and territorial, municipal, agri-food sector, industry, and individual business level, it is crucial to know how much uneaten food is being lost or wasted in these different contexts. These numbers are not only important for establishing a baseline to know how much food is being wasted where, but also to motivate food waste reduction efforts and to evaluate reductions against this baseline. Before we can even get to this stage though, it was important to understand who is (or is not) monitoring and measuring food loss and waste throughout the agri-food system and which measurement practices are being used by different agri-food actors.

This report has attempted to answer the questions of "how is food loss and waste being monitored and measured in Canada" and "what are the barriers and opportunities to improving monitoring and measurement". The findings of this report has showed that monitoring and measurement is not commonplace through the agri-food system or across levels of government in Canada. Furthermore, for those that are monitoring and measuring, there are no uniform definitions or measurement practices that they follow. Instead, food loss and waste definitions vary significantly, especially in the scale and scope of focus as well as in the boundaries they set on food types and end boundaries. Measurement practices also differ, with this report showcasing some of the practices used to capture food loss and waste within government jurisdictions (at all levels) and within industry and individual businesses.

This report also identified several barriers and opportunities to improving monitoring and measurement in Canada. It highlighted how the lack of uniform definitions and practices negatively impacted the ability to compare results across data sets and how some stakeholders called for the creation (or improvement) of guidelines and standards. Lack of incentives as a barrier showed how change to the status quo of thinking that food waste is the cost of doing business can be influenced by providing incentives to monitor and measure food waste, through public pressure,

voluntary agreements, and government reporting regulations. The barrier of lack of resources showed that the resource intensive nature of monitoring and measuring food waste discourages government and food businesses from taking on these practices and how financial incentives and funding have the potential to tackle this barrier. Finally, the reluctance to share data and measurement practices due to competition and confidentiality-based concerns show that when these barriers are removed, and these things can be shared in aggregated, anonymous ways, it may encourage collaboration.

This report concluded with suggested strategies for improving monitoring and measuring at the federal, provincial and territorial, municipal, and food industry and business levels. These strategies are split into those for government and those for businesses. For government, this includes: setting mandatory food loss and reduction targets; establishing national guidelines to help businesses and government (at various levels) define food loss and waste within the scope of their operations; developing national guidelines to help businesses and governments monitor and measure their food loss and waste; creating (or supporting a non-governmental organization that wants to create) a system where businesses and government can report their food loss and waste data; creating collaborative spaces for government and industry (as well as just for government) to come together to discuss food loss and waste monitoring and measurement; and, providing funding for municipalities and food insecurity charities who are looking to monitor and measure food waste. For businesses, these suggested strategies include: developing corporate social responsibility and brand promises related to food loss and waste reduction as well as operation-specific food loss and waste definitions and measurement practices; communicating food and loss waste promises and practices to all staff; working with other businesses and industries to develop monitoring and measurement standards; and working with government (and/or non-governmental organizations) to establish guidelines for monitoring and measurement and reporting systems for food loss and waste.

This report is just one of many different conversations going on about food waste monitoring and measurement in Canada. This report only used 11 key stakeholder interviews to inform its findings, with many agri-food sectors not being represented, such as the production

and institutional sectors. This therefore limits the ability for this report to be representative of all agri-food actors, sectors, industries, businesses, and governments.

With that being said, this report makes an important contribution in providing a detailed snapshot of monitoring and measurement in Canada and gives insights into what is preventing governments and food businesses from measuring their food loss and waste as well as ways forward to encourage the uptake of these practices and the development of more accurate, granular data systems. The hope is that this report will move the conversation forward on the issue of monitoring and measurement.

Future research is important to expand the range of stakeholders involved and to uncover more food loss and waste definitions and monitoring and measurement practices, as well as

to provide more context to the barriers and opportunities for improving these monitoring and measurement in Canada.

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8.0 Appendix A: Resources

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Examples of Food Loss and Waste Measurement for Governments

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INTERNATIONAL

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