Envisioning Ontario's Food and Organic Waste Disposal Ban: A Comparative Case Analysis

By

Brianne Meikle

Supervised by

Dr. Roderick MacRae

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Abstract

Roughly one-third, or 1.3 billion tonnes of edible food produced for human consumption is wasted around the world each year (Gustavsson et al., 2011). The production of food that is ultimately thrown away creates and exacerbates a host of economic, environmental, and social issues, including those related to greenhouse gas emissions, climate change, the depletion of finite resources, and food insecurity. Government, industry, and researchers around the world continue to assess the scope and cause of food waste, and investigate solutions through technology, regulation, and public outreach campaigns. In 2015, almost 3.7 million tonnes of food waste (including foods that could have been eaten and unavoidable waste such as vegetable peels) was generated in Ontario alone, and about 60 per cent of this waste was sent to landfill (Ministry of the Environment and Climate Change, 2018a).

In 2017, Ontario put forward the Food and Organic Waste Framework, which contains an action plan and policy statement identifying how the province will address food waste within its borders. Within the Framework, Ontario states that a food and organic waste disposal ban regulation will be developed and implemented under the Environmental Protection Act, which will prohibit organic waste from ending up in disposal sites. This paper seeks to look at other jurisdictions in Canada that have implemented organic waste disposal bans in order to identify what these experiences can offer Ontario before implementing its own strategy.

The key recommendation articulated throughout this paper is that food waste should be prevented above all other options, as it will have the greatest environmental, economic, and social benefits. This aligns with the frameworks guiding this research, including agroecology, the circular economy, and waste management hierarchy, and also fits within Ontario's Food Hierarchy (which will be discussed later in this paper). Food waste prevention can be best achieved by facilitating coordination across the value chain (Gooch, Felfel, & Marenick, 2010). Ontario can support value chain coordination by funding research, reviewing existing regulations and programmes, and engaging with value chain stakeholders. Food waste prevention efforts would also benefit from developing programmes that shift behaviours at the household level, though this is secondary to value chain coordination.

If food waste cannot be prevented, this paper offers recommendations for how recovered resources should be optimized in order of importance from (1) feeding people, (2) feeding livestock, and then

(3) promoting soil health. These recommendations include additions and adjustments to existing regulations, legislations, and government-funded programmes, the use of tipping fees, reducing plastic contamination in the organic waste stream, and working with the agricultural community to ensure that compost meets their needs and is actively utilized by the industry to foster a viable end market.

Foreword

The courses, internships, and independent studies that I took in partial fulfillment of the Master in Environmental Studies (MES) program allowed me to deeply examine my area of concentration, Policy for Sustainable Food Systems. My area of concentration explored the current agri-food landscape in Ontario in order to assess how, largely through government-led action, it can be more environmentally and economically sustainable while also aligning with notions of food sovereignty. While Ontario was my primary focus, the food system is intricately connected to local, regional, national, and global systems. In order to truly engage with my area of concentration, I had to enhance my understanding of these interconnected layers of the agri-food system.

Through the MES program, I became acutely aware of the global food waste problem. No matter what issue or reality I was exploring related to the food system, whether it be the precarious circumstances experienced by migrant agricultural workers, the decline of pollinator health, or phosphorus loading in the Lake Erie Basin from agricultural runoff, these problems all seemed to be part of a much larger conversation about the sustainability of our food system. Even more so, these issues became exacerbated through a food waste lens: the issues associated with the production and distribution of food are imbedded within a system that ultimately wastes the product being created, which has its own host of problems once landfilled. Regardless of what I was researching, it all seemed to come back to the food waste problem, which is the focus on my Major Research Paper.

My Major Research Paper intersects with all three of the components of my Plan of Study, largely because food waste is the Achilles Heel of the food system (MacRae et al., 2016). Food waste is an outcome of the conventional food system, which operates within a linear economy where waste is perceived as an inevitable outcome (component 1 and learning objective 1). The linear focus places emphasis on driving productivity in an effort to be competitive, without broader analysis of the environmental, economic, and social impacts and externalities of that intensification (learning objective 2). These externalities are a critical component of the introduction of this paper, which sets the stage for why investigating solutions is critical for food system change (component 2).

Eliminating food waste requires action from government, the agri-food value chain, and consumers. While industry-led efforts are tackling food waste across Canada, they "have been sporadic and often developed in isolation" (Uzea, et al., 2014, p.15). Further, the scope of the issue suggests that voluntary actions occurring in silos will ineffectively tackle the systems, regulations, and behaviours

that are core to the food waste problem. Government-led action is needed to truly transform how we approach food waste (relates to learning objective 2 of component 2).

In Ontario, the Ministry of Environment, Conservation, and Parks (formally known as the Ministry of the Environment and Climate Change) has committed to tackling food waste through the creation of the Food and Organic Waste Framework. This has offered me an opportunity to operationalize component 3 of my Plan of Study (food policy), as my MRP offers recommendations involving the state, including adjustments or additions to existing government regulations and programmes (learning objective 1 and 2 of component 3). While this paper focuses on the provincial level, food waste, much like the agri-food system more broadly, is interconnected to national, regional, and municipal politics as well, which will be discussed where appropriate in this paper.

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As I continue on my path, I seek to embody the passion, dedication, and intellect demonstrated by both of my advisors.

I would also like to thank the participants of my research. Without their situated knowledge, support and enthusiasm for this research, this paper would not have been made possible.

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Contents

Introduction

Food and organic waste is usually framed around the economic value of food wasted, climate change, and social justice. In Canada alone, the quantifiable value of food waste is at least $31 billion annually (Gooch & Felfel, 2014). According to the Ministry of Environment and Climate Change (MOECC)[1], this equates to about $868 worth of food wasted each year per Canadian (MOECC, 2018a). The financial losses associated with food waste in Canada cost more than the combined Gross Domestic Product (GDP) of the 32 poorest countries around the world (Gooch, Felfel, & Marenick, 2010). Food waste contributes immensely to greenhouse gas emissions. If global food loss was a country, it would be the third-largest emitter of carbon dioxide after the United States and China (FAO, 2015). When organic material breaks down in landfills, methane is generated and released into the atmosphere; a powerful greenhouse gas that has 25 times the global warming potential of carbon dioxide (Buzby & Hyman, 2012).

Food waste represents a missed opportunity to improve global food security. World hunger affects 11 per cent of the global population and is on the rise (FAO, 2017). In 2016, the estimated number of undernourished people was 815 million, up from 777 million in 2015 (FAO, 2017). As the world population continues to increase, the concerns of food insecurity grow with it. Despite this correlation, global hunger is not a result of an inability to produce enough food for the growing population. The world produces more than enough food to feed everyone (FAO, 2016). According to the Food and Agricultural Organization of the United Nations, "recovering just half of what is lost or wasted could feed the world alone" (FAO, 2016, n.p).

The three pillars of financial losses, climate change, and social justice, have been central to framing the issue of global food waste. What is less emphasized in the literature is how food waste intersects and exacerbates issues pertaining to the conventional global agri-food system. Food production places pressure on the availability of fresh water, land, and other natural resources, and impacts the surrounding environment (Buzby & Hyman, 2012). The misuse of high external inputs such as inorganic fertilizers and pesticides have contributed to the deterioration of soil quality and reduction in agricultural productivity due to nutrient depletion, organic matter losses, erosion and compaction (FAO, 2017). Additionally, the overuse of fertilizers and the improper use and disposal of animal waste has caused considerable pollution of soil and water (FAO, 2017). In Ontario, phosphorus

[1] Now called the Ministry of Environment, Conservation and Parks

loading from agricultural runoff has deeply contributed to algal blooms in the Great Lakes, particularly in the Lake Erie Basin (Canada-Ontario Agreement Partners, 2017). The toxic algal blooms in the western basin of Lake Erie are of particular concern as they can contaminate drinking water, harm aquatic life, hinder economic development, and make it unsafe to swim in (Goucher & Maas, 2014). Further, the issue of phosphorous loading in the Great Lakes is a critical issue given that it is one of the world's largest surface freshwater ecosystems, containing 84 per cent of North America's surface water (Environmental Protection Agency, 2018).

There are several concerns with conventional global agricultural practices, such as those pertaining to soil health, water quality, food safety, and pollinator health, to name a few. Food is being produced with a growing drive to increase output, in ways that can negatively impacts the biosphere, ultimately to be thrown away, which further accelerates environmental and economic issues when landfilled. Taking this wider perspective, it is estimated that in Canada alone the cumulative cost of food waste is $107 billion annually (Gooch & Felfel, 2014). This calculation includes the cost of "the energy, water, packaging and human resources used in production, transportation, retailing/food service and home storage" that goes along with it (Gooch et al., 2010, p.2). The cost of food waste increases the cost of food itself as "businesses will try to factor the cost of food and associated wastes when determining price"(Gooch & Felfel, 2014, p.19). Given that the very cost of food as key contributor in its inaccessibility, food waste indirectly contributes to food insecurity.

In light of the challenges with the modern food system, food waste has been identified as its Achilles Heel (MacRae et al., 2016). The magnitude of food waste and the problems that it creates and exacerbates stresses the need to tackle this issue.

Literature Review

There is no clear agreed-upon definition of food waste in Canada, which has implications for identifying the scope of the issue and its impacts on businesses, communities, and the environment. Researchers at the Value Chain Management Centre define food waste as food fit for human consumption (i.e. edible food) that gets thrown away, whereas other researchers include inedible foods (e.g. meat bones) or foods that are consumed by some people (e.g. potato skin) (Gooch et al., 2010; WRAP, 2015). Grounded in an agroecological framework, MacRae et al. (2016, p.147) define food waste as "any edible food that is not consumed by humans, and human inedible foods that are not used as animal feed or in industrial processes and composting". This particular definition of

food waste is best aligned with the frameworks used in this paper, all of which will be discussed in the next section.

The scope of food waste, and the specific terminology used to describe it, varies across jurisdictions as well. For example, the Province of Nova Scotia (1995) uses the term "compostable organic waste" to describe food scraps, yard waste, and non-recyclable paper products. Interestingly, Nova Scotia does not explicitly define compostable organic waste in its legislation, though, identifies that these are the components it is referring to in other documents. Alternatively, Metro Vancouver (2018) uses the term "food scraps recycling" which includes food waste, food-soiled paper products, and yard trimmings. Ontario uses "food and organic waste" which include "the edible parts of plants and animals that are produced or harvest but that are not ultimately consumed" and "inedible parts of plants and animals, as well as other organic material that may be processed along with food waste" such as yard waste, and compostable products and packaging (MOECC, 2018a, pp. 36 & 38). The varying ways that government define food waste may be related to perceived public acceptance and understanding, or the way in which food waste is being engaged with by that jurisdiction, through lenses such as economics, or less likely, agroecology.

In 2015, almost 3.7 million tonnes of food waste (including edible and unavoidable food waste) was generated in Ontario, 60 per cent of which was sent to landfill (MOECC, 2018a). Households are the leading contributor to food waste, wasting 47 per cent of the food that ends up in landfills, followed by the packaging and processing sector (20 per cent), retail stores (10 per cent), farm fields (10 per cent), the food service sector (9 per cent), and during transportation/distribution (4 per cent) (Gooch et al., 2014). While it is valuable to visualize where this waste is taking place, it does not effectively indicate or identify causes of waste. This is a critical distinction to make when designing initiatives and regulations that seek to reduce food waste.

Research that seeks to understand the type and magnitude of food waste at each point along the value chain is insufficient to empirically quantify food waste in Canada. Using secondary data from Statistics Canada over a 48-year period (1961-2009), Abdulla and colleagues estimate the quantity of food waste in Canada by food category over time to assist policy makers in understanding the root causes of food waste (Abdulla et al., 2016). According to their research, "the highest percentage of waste was found in vegetables and fruits (fresh and processed), while the lowest percentage was in pulses and nuts, where the waste rate remained almost the same over the five decades" (Abdulla et al., 2016, p.141).

Buzby and Hyman (2012, p.561) suggest that food waste is the result of human action or inaction "and is often the result of a decision made farm-to-fork by businesses, governments, and individual consumers". At the farm or production level, waste can occur due to pests, inefficiencies during harvest or post-harvest, difficulties in predicting the number of buyers/consumers, and food safety and appearance standards set by industry or government (Buzby & Hyman, 2012). At the retail level, food waste can occur because of inaccurate predictions of consumer needs, high quality standards, and dents and damages to packaging and foods (Buzby & Hyman, 2012; MacRae et al., 2016). At the consumer level, confusion over 'best before' and 'use by' dates, socio-demographic and seasonal factors, and a general lack of confidence and skill in preparing, cooking, and storing food can contribute to waste (Buzby & Hyman, 2012; MacRae et al., 2016).

While there are several reasons that food is being wasted from farm-to-fork, the greatest factor is a general lack of willingness or inability to coordinate activities along the value chain (Gooch et al., 2010). According to researchers at the Value Chain Management Centre, "regardless of the size of a company, the industry in which it operates, or the type of products or services marketed, significant opportunities exist for individual businesses and entire sectors to improve profitability and reduce waste by adopting value chain management principles" (Gooch et al., 2010, p.7).

The Waste and Resources Action Programme (WRAP), based in the United Kingdom, are world leaders in helping organisations such as Nestle, Tesco and Unilever achieve greater resource efficiency by building the capacity of value chain stakeholders to eliminate waste (WRAP, 2018a). WRAP also coordinates the ground-breaking campaign, Love Food Hate Waste (LFHW), which has reached audiences in the UK, Canada, Australia, New Zealand, and Saudi Arabia to give consumers the information they need to shift key behaviours that contribute to food waste (WRAP, 2018a). The LFHW campaign offers households practical advice on food planning, portions, date labels, leftovers, forgotten foods, and storage (WRAP, 2018b). The campaign also offers resources and materials for local authorities that want to carry out the campaign in their own jurisdiction. These resources include a guide on running the programme, template editorials, web copy, social media strategies, and free communication templates (WRAP, 2018b). Metro Vancouver is the first, and at time of writing, only jurisdiction in Canada that has adopted the Love Food Hate Waste campaign, though the National Zero Waste Council is also looking to adopt it at a national level (A. McPhee, personal communications, July 5 2018).

Once food is wasted, dumping it becomes the most affordable option to most waste generators (particularly in the industrial, commercial, and institutional sector) in Canada due to current legislation, which makes it "too easy and too cheap to dump, and too difficult to do otherwise" (Gooch et al., 2010, p.7). Regulatory changes at all levels of government are needed to effectively reduce and divert food waste from landfills.

According to research conducted by the Provision Coalition (Uzea, Gooch, & Sparling, 2014), Ontario's food value chain is skeptical that regulations will be an effective primary mechanism for reducing food waste. Generally, the value chain does not support a government-led approach (Uzea, Gooch, & Sparling, 2014). The focus on voluntary efforts, as opposed to government regulation, resembles the approach taken by the UK government, who favours the former over the latter (Downing & Carr, 2015). Given the globalized nature of today's food system, voluntary standards make sense in many instances given that most value chains extend beyond one single jurisdiction's reach. There are many food businesses in Canada that are aware of the issues and costs associated with food waste and are working to tackle it without being pushed to do so by government. Although voluntary actions can support company- or industry-specific food waste issues, it is less likely for these efforts to maintain long-term coordination across the value chain to tackle the root causes of waste. To date, industry-led initiatives in Canada to tackle food waste, "have been sporadic and often developed in isolation" (Uzea, et al., 2014, p.15). One role that the Canadian and Ontario government can play in reducing food waste, according to the agri-food industry, is through the introduction of legislation that prevents organic waste from entering landfills (Uzea, et al., 2014).

Ontario's Proposed Food and Organic Waste Ban

In 2015, food and organic waste made up 32 per cent of waste generated in the province (MOECC, 2018a). In recognition of the environmental, economic, and social externalities of food waste, the Province of Ontario is designing numerous strategies to reduce and divert food and organic waste through its Food and Organic Waste Framework (2018a; 2018b). This section outlines government commitments that led to the framework and the subsequent food waste ban (see figure 1).

In June 2016, Ontario put in place a five-year strategy, the Climate Change Action Plan, which identifies the actions the Province will take between 2016 and 2020 to fight climate change, reduce greenhouse gasses, and help Ontario transition towards a low-carbon economy. A goal of the Climate Change Action Plan (2016) is to build the circular economy in Ontario to reduce waste

across the province, and to eliminate all greenhouse gas emissions from the waste sector. This goal led to the Waste-Free Ontario: Building the Circular Economy (2017), which builds on and utilizes legislation passed in late 2016, including the Waste Free Ontario Act and the Waste Diversion Transition Act, in addition to the Climate Change Action Plan, to tackle Ontario's waste problems.

One of the four goals of Waste-Free Ontario: Building the Circular Economy (2017) is to increase waste reduction and resource productivity, which includes implementing an action plan to reduce the volume of food and organic waste going to landfills. The Food and Organic Waste Action Plan (2018a) arose to achieve the Province's goals of eliminating greenhouse gas emissions derived from the waste sector and building the circular economy. The Food and Organic Waste Framework, which includes the Action Plan (2018a) and a Policy Statement (2018b), identifies a suite of regulatory and non-regulatory strategies "that seek to prevent and reduce food and organic waste, rescue surplus food, collect and recover food and organic waste, and support beneficial uses" (MOECC, 2018a, p.10). The Framework will be regulated under the Environmental Protection Act, which is administered by the Ministry of the Environment, Conservation and Parks[2].

[2] Called the Ministry of the Environment and Climate Change when the Framework was published.

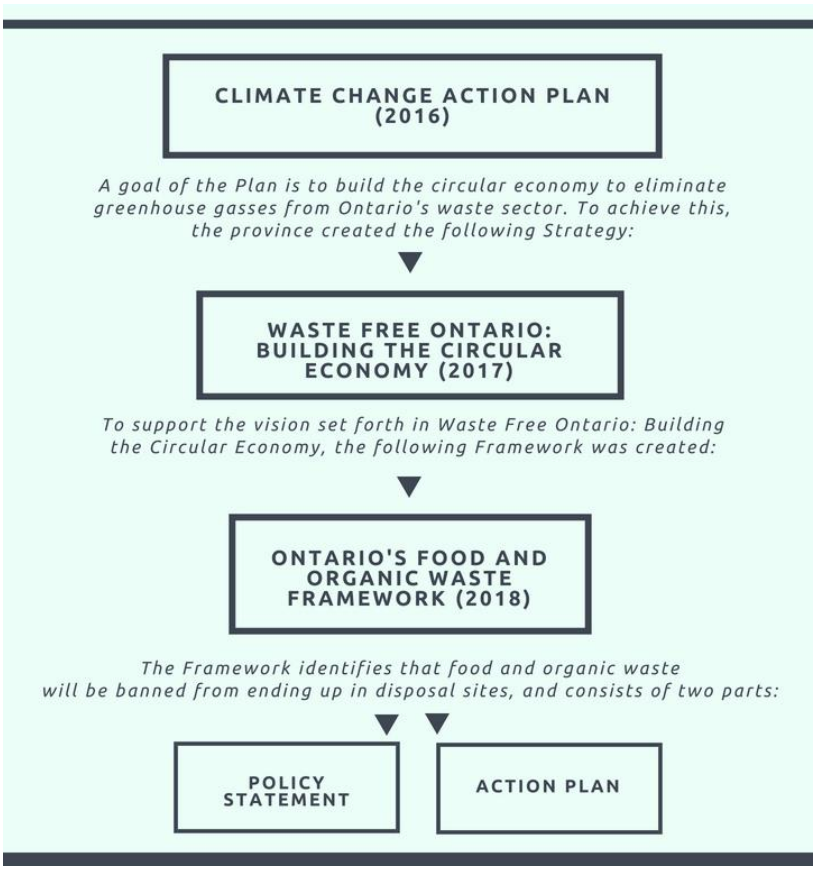


FIGURE 1: COMMITMENTS SET FORTH BY THE PROVINCE OF ONTARIO THAT CONTRIBUTED TO THE CREATION OF THE FOOD AND ORGANIC WASTE FRAMEWORK, AND THE SUBSEQUENT FOOD WASTE BAN.

Food and organic waste bans can dramatically reduce the amount of food in landfills, which increases the lifespan of landfill sites and reduces the production of methane. Organic waste bans can also stimulate economic growth, drive investments in resource recovery systems, create jobs and may facilitate innovation to reduce food waste. Ontario seeks to begin phasing in their food and organic waste ban by 2022 (MOECC, 2018b). The province will consider many factors in designing this ban, including identifying the disposal sites that may be impacted by the requirements and how; the time required for implementation and the necessary steps towards building appropriate infrastructure; the threshold for compliance; allowances and exceptions; and phased-in timelines and geographic application.

Managing waste has historically been a responsibility of local governments (National Zero Waste Council, 2017). While municipalities have spearheaded many of the policy initiatives that aim to reduce food waste, such as organics disposal bans, "the fiscal constraints and limited mandates of local governments means that, acting alone, they cannot achieve the scale of food waste reductions required… other orders of government must be involved with policies that shift Canada towards a

more resource efficient food system" (National Zero Waste Council, 2017, p.4). Ontario's Food and Organic Waste Framework can play a central role in facilitating wide-scale food waste reduction and diversion.

Methodology

There are many jurisdictions across Canada working to design and build better food and organic waste management systems. This paper only engages with a few jurisdictions, drawing out those whose strategies or experiences stood out when applying the theoretical frameworks of this paper, including agroecology, waste management hierarchy, and the circular economy. Both Nova Scotia and Metro Vancouver offered particularly thoughtful analysis of their organic waste management systems considering the lenses used. Both jurisdictions have also implemented organic waste bans as a key component of these systems, further enhancing their applicability to this paper.

Nova Scotia's diversion work has garnered global attention. As the only province in Canada that has implemented a food waste ban, it is valuable to assess the factors that contributed to its design and implementation, and the suite of regulatory and non-regulatory strategies used in the operation of the ban. While Nova Scotia will be the primary jurisdiction engaged in this paper, Metro Vancouver's approach to organic waste management is also assessed due to its integration on waste prevention.

This paper offers insight gained from document analysis, including government reports and strategies, legislation, and work conducted by other researchers who have investigated strategies to deal with organic waste. These documents are assessed to identify the upstream suite of instruments used by the Canadian jurisdictions chosen to be engaged with in this paper, and to evaluate the challenges and opportunities they present to Ontario. Document analysis has been complimented by semi-structured interviews, conducted by the researcher. The purpose of these interviews was to gain a deeper and more qualitative understanding of the experiences of other jurisdictions that have implemented a disposal ban. What are the greatest challenges and opportunities presented by an organic waste ban from the perspective of those responsible for implementing it? How is the success of an organic waste ban monitored and evaluated? How is success being defined? What are the greatest lessons learned that these jurisdictions can offer Ontario as the province looks to follow suit? Semi-structured interviews were utilized as a tool to better engage with these questions. As this research focuses on the State, interviews were held with government employees working within the

realm of organic waste management in the jurisdictions engaged with in this paper. Further, as some jurisdictions have delegated waste management to non-profit organizations, staff of these organizations were also engaged with to gain a greater understanding of food and organic waste management systems. Lastly, to gain further clarification on aspects of waste management, the researcher interviewed other researchers that have done extensive work in this space.

Theoretical Frameworks

The three frameworks utilized in this research include agroecology, circular economy, and waste management hierarchy. There are several Canadian jurisdictions that Ontario can look to in designing their food waste ban, however, this paper only looks at a few of these experiences.

Agroecology

Agroecology is an interdisciplinary science that applies ecological concepts and principles to design and manage sustainable agricultural ecosystems (Gliessman, 1998; Altieri, 2005).

Alteiri (2005, p.2) identifies that systems-design grounded in agroecology integrate these key principles:

1. Enhance recycling of biomass and optimize nutrient availability and balance nutrient flows;
2. Safeguard favourable soil conditions for plant growth, particularly by managing organic matter and enhancing soil biotic activity;
3. Minimize losses due to flows of solar radiation, air, and water by way of microclimate management, water harvesting, and soil management through increased soil cover;
4. Promote species and genetic diversification of the agroecosystem in time and space;
5. Enhance beneficial biological interactions and synergisms among agrobiodiversity components thus resulting in the promotion of key ecological processes and services;

The principles of agroecology are often used to evaluate alternative agri-food systems that mitigate or resolve the environmental, economic, and social problems of the modern conventional system. A main focus of agroecology has been on using organic nutrient sources and integrated pest management to reduce or eliminate the use of, and dependence on, agrochemical inputs, with the ultimate goal of strengthening plant and soil health (Altieri, 2005). According to agroecology, farms can become more sustainable by reducing the use of synthetic fertilizers, increasing on-farm nutrient

cycling, and preventing pests and diseases by building healthy biologically active soil (Ghorbani et al., 2008).

From an agroecological perspective, the best suite of policies would be those that prevent food waste from being created in the first place. When food and organic waste cannot be prevented, agroecology principles would suggest that it go to other beneficial uses, including animal feed and compost that would allow agricultural producers to reduce their dependence on agrochemicals and support soil health.

The Circular Economy

A circular economy framework borrows principles of agroecology. It aims to reintegrate valuable resources into the economy, rather than disposing these materials and extracting new ones to meet the same purpose. In contrast to the existing linear economy where things are created, used, and disposed of, the circular economy "is restorative and regenerative by design" (Hoffman, 2016, p.4), meaning that it keeps materials at their highest utility and value in the long-run (National Zero Waste Council, 2016). In a circular economy, processes are (re)designed to eliminate waste along the value chain and to restore or recover its value to be used again (Hoffman, 2016, p.4). Food waste is a critical feature of a linear economy, whereby large volumes of resources are wasted, "with few opportunities in the process or incentives to prevent waste before it occurs" (MOECC, 2018a, p.4). The three principles of circular economy include: (1) preserve and enhance natural capital; (2) optimize resource yield to keep materials at their highest quality to be continuously circulated within the economy, and (3) foster system-effectiveness by designing out negative externalities (Hoffman, 2016).

Waste Management Hierarchy

A waste management hierarchy binds the two theoretical frameworks above by identifying the optimal steps of managing waste. While waste management hierarchies generally follow a similar structure, including prevention, diversion, and disposal in order of priority, what is included in each of these categories differs. Some hierarchies include recovering waste as an additional layer of the hierarchy, while others include it in diversion. This paper utilizes the above two frameworks as guiding principles for the hierarchy used in this research (figure 2).

FIGURE 2: THE WASTE MANAGEMENT HIERARCHY GUIDING THIS PAPER.

The optimal action is to prevent waste from being created in the first place. Generating less waste means less resources are used in the extraction, creation, distribution, and disposal of those materials. By preventing food and organic waste, the cost of food would reduce as it would not include the built-in cost of food and associated waste. It would also relieve some of the impacts of the conventional food system as there would be less pressure to increase output. The next level of the hierarchy focuses on diverting or recycling waste to serve beneficial environmental, economic, and social purposes. The most beneficial being that it goes towards feeding people through charities or food rescue organizations. The second-tier involves feeding animals where and when possible given regulatory restrictions and institutional barriers. When food waste cannot be diverted to feed people or animals, it should be used to create quality compost. Compost is a nutrient-rich soil amendment, which can support healthy soil given the right conditions. Soil health is the foundation for sustainable crop production (LP Consulting Limited, 2017). High-quality compost may increase plant tolerance and resistance to insects and diseases; help control weeds; improve soil fertility; and improve produce quality (Ghorbani et al., 2008).

Recovering waste is the third pillar of the waste management hierarchy, which includes deriving energy from waste. Anaerobic digestion methods are one way to derive energy from waste, which is achieved by fermenting organic materials (such as food waste, manure, sewage sludge, or forest waste) in an oxygen-deprived environment to produce biogas, compost, and heat (CCME, 2014).

Some hierarchies place waste to energy conversion in the diversion level, and some even prioritize it above composting (CCME, 2014; Environmental Protection Agency, 2017). As the waste management hierarchy being used aligns itself with agroecological, waste recovery is suboptimal. These systems are also typically very costly to build, particularly compared to more basic composting facilities or other options that can achieve better outcomes. Only after all these steps have been exhausted should waste end up in landfill.

Nova Scotia's Solid Waste-Resource Management Strategy

In 1989, the Canadian Council of Ministers of the Environment (CCME) created a national target for waste diversion. Each province had the goal of diverting 50 per cent of their municipal solid waste (MSW) by 2000, yet only one province achieved the national target: Nova Scotia. Nova Scotia diverted more than 320,689 tonnes from disposal sites in 2000 and decreased their disposal rate from 743 kg/person per annum in 1990 to 401 kg/person per annum in 2010 (Wagner & Arnold, 2006; Province of Nova Scotia, 2011). This is particularly significant given that between 1996 and 2010, waste diversion only increased by 1.5 per cent in Canada. Similarly, waste disposal over that period (1996 – 2010) increased nationally by more than 20 per cent, yet Nova Scotia's waste disposal decreased by 34 per cent in that time (Richter et al., 2017).

Nova Scotia's Environment Act (1994-95) adopted the target of 50 per cent diversion of solid waste by 2000 and required the Minister of the Environment to establish a solid waste-resource management strategy for the Province. Nova Scotia's Solid Waste-Resource Waste Management (SWRM) Strategy, promulgated in 1995 and came in effect 1996, contains the legislative framework for waste management in Nova Scotia. The SWRM Strategy has been key to Nova Scotia's success in waste diversion, which had four main goals:

1) Cut Nova Scotia's waste in half through diversion strategies by the end of 2000;

2) Implement new more stringent disposal standards by 2005;

3) Foster greater regional cooperation to reduce costs of diversion;

4) Recognize solid waste as a valuable resource by increasing economic opportunities for end products;

The Province sought to achieve the overarching goals of the SWRM Strategy through a vigorously cooperative effort including 55 municipalities[3] contained within seven administrative solid waste-resource management regions (herein referred to as the seven regions), regional municipal solid waste coordinators, the private sector, a solid waste-resource management office situated at Nova Scotia Environment, the public, and an at-arms-length non-profit corporation established pursuant to Section 5 of the Nova Scotia Solid Waste-Resource Management Regulations, called the Resource Recovery Fund Board[4]. The role of these stakeholders will be discussed later in this paper.

As part of the Strategy, Nova Scotia passed a ban on organics entering landfills in June 1997 (implemented in November 1998), which built on previous legislation in June 1996 that banned leaf and yard waste. More specifically, Schedule "B" of the SWRM Regulations, made under Section 102 of the Environment Act (1994-95) mandates that "compostable organic material" is a designated material "banned from destruction or disposal in landfills, incinerators and thermal treatment facilities". The specific terminology of "compostable organic material" is not defined in the regulations, though elsewhere in government reports it has been used to include food waste, leaf and yard waste, and non-recyclable paper products (LP Consulting Limited, 2017). Nova Scotia was the first and is still at time of writing the only jurisdiction in Canada to implement a province-wide food waste ban.

25 years after the promulgation of the SWRM Strategy, Nova Scotia has the lowest disposal and highest diversion rates in the country (Statistics Canada, 2015; The Conference Board of Canada, 2018). More significantly, according to the Waste Resource Management Institute (n.d.), Nova Scotia's composting rate is nearly 200 per cent higher than the Canadian average. All Nova Scotia residents have access to recyclable curbside collection programmes, and 90 per cent have access to organic curbside pick up programmes (Nova Scotia Environment, n.d.). Municipalities that do not have organic curbside pickup in place, largely due to their size and remote location, are required to have extensive backyard composting programmes. Further, 53 of 55 municipalities offer centralized composting to the business sector (Wagner & Arnold, 2008).

[3] The number of municipalities in Nova Scotia has changed over the years. Currently, there are 50 municipalities, reduced from 55 in 1995. A few publications referenced in this report identify different numbers of municipalities due to the changes over time in municipal government structures. The inconsistency of available data to align the statistics has created some confusion over the current reality of waste diversion strategies in the province.

[4] Now operating under the name Divert Nova Scotia

Nova Scotia's Compostable Organics Waste Ban: A Policy Window

In the early 1970s, there were 100 active dumps across Nova Scotia. Many of these dumps practiced open burning with no air pollution control, and most lacked liners which can contaminate groundwater and surface water (Wagner & Arnold, 2008). By 1989, many dumps had closed, with only 40 active landfills across the province in 1995. However, Nova Scotia's waste management practices were still poor at that time, with only five per cent of the population having access to curbside recycling (Wagner & Arnold, 2008).

Of particular concern in the Halifax Regional Municipality (HRM), the capital area of Nova Scotia, was the Highway 101 Landfill. Contaminants from the Highway 101 Landfill were released into nearby wetlands and ultimately to the Sackville river, largely due to its defective clay liner (Wagner & Arnold, 2008). As the HRM holds 44 per cent of Nova Scotia's population, the Highway 101 Landfill was central to Provincial concerns around waste mismanagement and became a focus of local and provincial media.

Aligned with a traditional waste management paradigm, the issues related to the Highway 101 Landfill (initially scheduled for closure in 1994) led the HRM to determine throughout the 1980's where the next landfill would be located. This became a challenging and politically risky task due to public opposition to the conventional approach to waste management at the time (Wagner, 2007). As a result, the HRM responded by creating a 16-member Solid Waste Management Advisory Committee with a two-year mandate to recommend a solid waste management plan in the first year (1989) and landfill siting criteria for the second year (1990) (Wagner, 2007). The committee's plan identified an interest in implementing centralized composting, in addition to building stronger reduction and recycling strategies to reduce pressure on the proposed sites. Based on analysis of studies conducted by other jurisdictions around the world, the HRM determined that composting was not feasible, instead, a waste to energy incinerator would be more cost-effective (Wagner, 2007). While the incinerator was approved, and a contract was signed for its construction, it also faced strong public opposition, followed by a lawsuit from the Coalition of Citizens for a Charter Challenge (Wagner, 2007). The proposed incinerator was ultimately rejected due to this opposition.

Subsequently, a series of events, including "the New York garbage barge journey, medical waste beach wash-ups, and the Toronto landfill crisis established solid waste disposal as a national problem in Canada and the United States" (Wagner, 2007, p.459). The push from citizens to stray from the

status quo allowed municipal and provincial governments to take a more radical approach to designing their waste management systems without political backlash. In 1994, the strong opposition to the conventional system led the HRM to create a Community Stakeholder Committee to determine how solid waste should be managed in the HRM. The committee was open to all community members, and by the end involved 500 HRM residents (Wagner, 2007). The strategy created by the committee placed resource recovery at the center of the area's approach to waste management, demanding that only those materials that are non-recoverable be disposed of. This allowed politicians at the municipal level to create a system that they would have been unable to present on their own (Wagner, 2007).

On the provincial level, the largest challenge faced by Nova Scotia in achieving the 50 per cent diversion goal put in place by the CCME was the lack of a comprehensive strategy to tackle the problem. The 1989 diversion target, coupled with the disposal crisis in 1993, propelled Nova Scotia Environment to initiate an integrated provincial-municipal solid waste strategy by commissioning a series of province-wide studies that year (Wagner & Arnold, 2008). These studies were completed the following year, in 1994, which is also when the HRM created its Community Stakeholder Committee to begin developing the regional municipality's waste management strategy.

At this time, wide-scale organic waste diversion was a relatively new concept for government to consider. In 1994, the municipality of the district of Lunenburg, the third largest rural municipality in Nova Scotia, became the first jurisdiction in the Americas to implement an organics ban (Ministry of the District of Lunenburg, 2017; Province of Nova Scotia, 2015). The success of the ban in Lunenburg provided the province with evidence that this approach can strengthen waste-resource diversion efforts, while also offering a starting point on how to design and operationalize an organics ban (Nova Scotia Environment personnel, personal communication, June 1 2018).

Implementing Nova Scotia's Compostable Organics Waste Ban

Achieving ambitious diversion targets and complying with appropriate environmental standards requires increased expenditures for resource recovery and solid waste management (Province of Nova Scotia, 1995). In order to build expertise, realize efficiency, and administer funds judiciously, Nova Scotia identified that regional or inter-municipal collaboration and monetary incentives were imperative to the new strategy's success (Province of Nova Scotia, 1995). The benefits of regionalization were identified in the series of province-wide studies commissioned by the province.

By placing all municipalities in seven regions, significant savings were achieved through economies of scale. Each municipality worked within their region (which were created in 1995), and regions worked together alongside the Ministry of Environment to ensure the objectives of the strategy were achieved. Regions collaborate with one another and the province largely through regional chair meetings, with the chairperson from each region meeting 10 times a year with the financial support of Divert Nova Scotia.

The seven regions were delineated based on provincially-sponsored engineering studies, which investigated the demographics, waste management needs, capacities, and geographical positioning of each municipality (Wagner & Arnold, 2008). The seven regions did not serve to create an additional layer of government, but to encourage regional cooperation. In fact, "the regions themselves were not vested with any explicit legal authority by the province with regards to [municipal solid waste], but were used to plan and implement the strategy primarily through funding" (Wagner & Arnold, 2008, p.413).

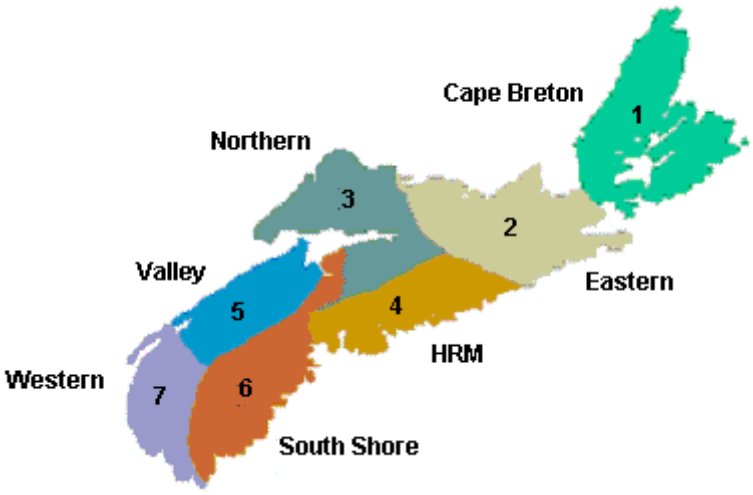


FIGURE 3: THE SEVEN SOLID WASTE-RESOURCE MANAGEMENT REGIONS OF NOVA SCOTIA. SOURCE: DAVIDSON & OWEN, 2013, P.12

Nova Scotia, through the Solid Waste-Resource Management Regulations (1996) required regions and municipalities to achieve the 50 per cent diversion rate, develop regional solid waste-resource management plans, and implement the various bans and environmental requirements under the SWRM Regulations. How they went about meeting these requirements were up to the regions themselves and the municipalities within them. Regional solid waste-resource management plans had several components, including: 1) a description of the roles and responsibilities of each municipality within the region; 2) a public awareness programme; 3) a proposal that identified markets for

diverted materials; 4) source reduction, reuse, recycling, and composting programmes; 5) a method for monitoring progress towards the implementation of the plan; 6) a schedule and projected costs to implement each component of the plan; and 7) a description of fair and equitable cost sharing arrangements made between the municipalities within each region. The province funded the development of these plans, including any studies or audits that were required to create it.

As regions were vested with the ability to develop their own plans and strategies based on the inter-municipal needs, interests, and capacities, waste management systems look different in each region. Some regions play a more critical authoritative role, while others play a more passive one. For example, the Valley Waste Region (Region 5), which includes the counties of Annapolis and Kings, serves as the legal authority for the region, whereas the South Shore Region (Region 6), comprising the counties of Lunenburg and Queens and the District of Wets Hants, plays more of a consultancy role to its municipal members (Wagner & Arnold, 2008). Cape Breton Region (Region 1) is one of the poorest performing regions in terms of waste diversion, and cooperation between municipalities in this region is a key barrier to increased success of their diversion systems (A. McPhee, personal communication, July 4 2018). At time of writing, a governance study is being conducted across Nova Scotia to identify how each of the seven regions and municipalities are implementing the province's SWRM Strategy, and which structures and dynamics are achieving the best diversion rates (A. McPhee, personal communication, July 4 2018). While not available for the purposes of this paper, the governance study should reveal a lot about the kinds of governance structures and regulatory systems that best support resource recovery.

Moreover, 25 years after the formation of the SWRM Strategy, the province continues to support research on how to advance waste-resource recovery. Nova Scotia has identified that households are more likely to appropriately separate their materials for curbside pickup when required to use clear garbage bags (Nova Scotia Environment, n.d.). This approach allows municipal pick up services to visibly see if banned materials are entering the waste stream, which can be followed by several actions such as a refusal by the district to pick up the contaminated waste, administration of a warning, or a fine of the household for not complying with waste regulations. Of Nova Scotia's 53 municipalities, 30 of them require residents and businesses to use clear bags for their garbage which covers 40 per cent of the population (Nova Scotia Environment, n.d.; Wagner & Arnold, 2008). This approach has resulted in a dramatic increase in the diversion of organics and recyclables (Nova

Scotia Environment, n.d.). Typically, municipalities that have a clear bag regulation allow households to use one opaque bag each garbage cycle for privacy reasons (Compost Council of Canada, 2014).

The closure of disposal sites that did not meet strict design and operation standards for landfills, legislated in 1997 across Nova Scotia through the Solid Waste-Resource Management Regulations, was another factor that increased Nova Scotia's diversion efforts. These closures were facilitated by the second goal of the SWRM Strategy (1995), which was to "improved environmental performance at disposal facilities, in an efficient and cost effective manner". This goal, and the route the province took in achieving it, arose from strong public agreement, identified through extensive consultations in the fall of 1994, that waste management facilities needed to ensure appropriate levels of environmental protection (SWRM Strategy, 1995). Nova Scotia established a two-tier system for landfills to transition the province away from unsustainable, environmentally harmful waste management systems. All landfills that did not meet the new guidelines would either have to reform their operations to comply or be shut down by December 31, 2005 (Nova Scotia Environment, n.d.).

The new environmental criteria reduced the number of disposal sites from 40 in 1994 to seven in 2005 (Province of Nova Scotia, 2017; LP Consulting Limited, 2017). There are also currently 19 composting facilities, 15 of which are source-separated organic, across the province (LP Consulting Limited, 2017). While there are seven landfills in Nova Scotia, not all regions are equally positioned to utilize them. Three of the seven landfills reside in one of the smaller regions of the province, Region 6 (A. McPhee, personal communication, July 4 2018). The reduction of landfills across Nova Scotia coupled with the increase in compost facilities, and the particular location of them means that transporting waste to a dump site is more expensive in some municipalities than transporting diverted waste to a compost facility (Wagner, 2007). Alternatively, having access to so many landfills in Region 6 makes it more convenient and affordable for some industrial, commercial, and institutional (ICI) sector stakeholders to dispose of their organic waste than to divert it. The ways in which this may impact the success of an organics ban will be discussed in the recommendations section of this paper.

The Cost of Implementation

Implementing an organics waste ban requires significant resources from the jurisdictions responsible for carrying it out. Managing the substantial increase in supply of food and organic waste at the

residential level, combined with those wastes produced and diverted from the ICI sector, places a significant burden on jurisdictions to deal with that waste. This is especially true in the absence of strategies to reduce waste generation in the first place. Ontario has a cost-competitive advantage, compared to other provinces in Canada, to dispose of waste, which has contributed to the province not meeting the CCME's diversion target (C. Lakhan, personal communication, July 23 2018). This advantage comes from Ontario's proximity to the United States, which takes much of Ontario's waste at affordable rates. In comparison, Nova Scotia's size puts pressure on the province in dealing with its waste, making it financially advantageous for diversion to be prioritized over disposal.

The burden of an organic waste ban is also felt by industry, having to pay for diverting waste directly. In Nova Scotia, the ICI sector was responsible for approximately 58 per cent (206,171 tonnes) of total waste disposed in the province in 2008 (Davidson & Owen, 2013). The residential sector has been more successful in diverting solid waste in Nova Scotia than the ICI sector, which may suggest that the percentage of waste coming from the ICI sector is likely to rise (Davidson & Owen, 2013).

The diversion and disposal of municipal solid waste across Nova Scotia was projected to cost each Nova Scotian $72.00 a year at least until 2005 (projected costs thereafter were not identified), which is an incremental change of $24.00, or $22.3 million from before 1995 (Province of Nova Scotia, 1995). This includes the capital and operational costs of complying with new environmental standards and achieving the province's diversion target (Province of Nova Scotia, 1995). The development and implementation of Nova Scotia's diversion infrastructure and programming was expected to cost $28.2 million. Investing in waste diversion was expected to eliminate $5.9 million in costs incurred annually by the disposal system (compared to 1995 costs). According to an economic assessment of Divert Nova Scotia's work in 2016, the costs avoided by enhanced diversion were even higher than anticipated (Gardner Pinfold Consultants Inc., 2016). The avoided costs of collecting and landfilling beverage containers and used tires, through enhanced diversion and extended producer responsibility, saves municipalities $7.1 million annually compared to the costs incurred in 1995 when these products were sent to landfill.

	1995 (7 percent diversion)	2005 (50 percent diversion)	Incremental Change (1995-2005)
Diversion	$4.7 million	$32.9 million	$28.2 million
Disposal	$39.6 million	$33.7 million	-$5.9 million
Total	$44.3 million ($48/person)	$66.6 million ($72/person)	$22.3 million ($24/person)[5]

FIGURE 4: ACTUAL AND PROJECTED ANNUAL CAPITAL AND OPERATING COSTS OF RESOURCE RECOVERY AND SOLID WASTE-RESOURCE MANAGEMENT IN NOVA SCOTIA. SOURCE: PROVINCE OF NOVA SCOTIA'S SOLID WASTE RESOURCE MANAGEMENT STRATEGY (1995).

According to the Genuine Progress Index Atlantic (2004), Nova Scotia's resource recovery system resulted in economic, environmental, and social benefits between $31.2 million and $167.7 million in the fiscal year 2000-01, when compared to the system in place in 1996-97 (Walker et al., 2004). These savings were gained by the reduced pollution and greenhouse gas emissions, energy savings, fewer landfills, and increased employment of the current system compared to the old one (Nova Scotia, 2015). "This translates into savings of $33 to $178 for each Nova Scotian, rather than a net additional cost" when calculating the operating and amortized capital costs of Nova Scotia's waste management system (Walker et al., 2004, p.iv).

While financially quantifying these benefits is valuable to identify how important a given action is, it does not necessarily alleviate costs for those responsible for developing, implementing, and financing that system. Providing measures that accurately identify the cost of Nova Scotia's SWRM Strategy is challenging given the inconsistencies and discrepancies of what costs and benefits are included in the analysis. Municipalities do provide data on an annual basis to Nova Scotia Environment related to their diversion systems, including details on the costs they incur and their diversion rates (A. McPhee, personal communication, July 4 2018). However, the data has not been used to provide an accurate or consistent assessment of the true implementation cost of Nova Scotia's organic waste ban or the wider diversion strategy (Nova Scotia Environment personnel, personal communication, June 29 2018). While no comprehensive assessment exists, it is still recognized by the province that implementing the food and organics ban was likely costlier than anticipated in their initial assessment (Nova Scotia Environment personnel, personal communication, June 29 2018).

Ontario estimates that collecting and recovering 1,000 tonnes of food and organic waste could generate 60 per cent more GDP and 40 per cent more jobs than disposal (MOECC, 2018a). Additionally, the province highlights that its current efforts in collecting and recovering resources from food and organic waste support approximately 1,700 jobs in Ontario and generates over $100 million in GDP, suggesting that further investment in these systems will generate greater financial rewards and employment opportunities (MOECC, 2018a). That being said, Ontario currently phases significant capacity constraints in implementing an organics ban (C. Lakhan, personal communication, July 23 2018). To overcome these constraints, the province will need to invest significant funds to create enough systems to absorb the amount of organic material being wasted today.

As Nova Scotia's ban on compostable organic material is a province-wide mandate, with waste regions, municipalities, the ICI sector and households having to comply, there are various layers of cost mitigation strategies deployed across the province. As stated previously, residential organic waste diversion programmes are primarily paid for through municipal taxes, while the ICI sector often pays to divert their waste themselves. That being said, some jurisdictions give financial support for the ICI sector to reduce or eliminate the burden of diverting (Nova Scotia Environment personnel, personal communication, June 29 2018).

Depending on what these financial incentives look like, they may not encourage waste generators to change their behaviours, or redesign their systems and processes, to ultimately reduce waste. Tipping fees signal to waste generators that if they want to continue wasting, they have to pay for it. This logic is similar to limiting the number of garbage bags that households can put on their curb, or putting fines in place for households that do not comply with organic bans. If tipping fees are too low, businesses are more likely to pay the price and continue generating the same amount of waste. Alternatively, if tipping fees are too high, municipalities run the risk of households and the ICI sector alike turning to illegal dumping to evade costs (Taylor, 2009). Tipping fees are often used to fund infrastructural development and to support subsequent operations at centralized composting facilities.

The Role of Divert Nova Scotia

Divert Nova Scotia is amongst the most critical agents in mitigating diversion costs incurred by both municipalities and the ICI sector. Two mandates of Divert Nova Scotia are to fund municipal waste

diversion programmes across the province and to develop education and awareness programme (Province of Nova Scotia, 1996). Funding from Divert Nova Scotia primarily comes from Nova Scotia's Beverage Container Deposit-Refund Program. The non-profit arm operates the refund program, which is regulated through Nova Scotia's Solid Waste-Resource Management Regulations (Province of Nova Scotia, 2017b). The program came into effect in 1996 and applies to all ready-to-serve beverages, with a few exceptions such as milk containers. The deposit ranges from 0.05 to 0.20 cents per container, and half of the deposit is refunded when returned to an Enviro-Depot[5] (Province of Nova Scotia, 2017b). The other half of the deposit is used by Divert Nova Scotia to fund waste diversion programmes across the province. The success of Nova Scotia's Used Beverage Container Deposit-Refund Program has enabled the province to have one of the best recovery rates for beverage containers in Canada, at over 80 per cent (Gardner Pinfold Consultants Inc., 2016).

Divert Nova Scotia has several funding streams to support waste reduction and diversion efforts across the province. These include funding towards student research, research and development, value-added manufacturing, Enviro-Depot infrastructure, education and awareness, and funding to the seven regions in the form of diversion credits, enforcement funding, and outreach funding (Divert Nova Scotia, n.d.).

The funding provided directly to waste regions and municipalities totals over $6 million annually: $4.7 million for Diversion Credits, $0.7 million for enforcement ($100,000 per region), and $0.635 million for education and awareness programmes (Divert Nova Scotia, n.d.; Gardner Pinfold Consultants Inc., 2016). This financial support plays a critical role in the delivery of waste diversion programmes in Nova Scotia. Diversion credits fund regions who are responsible for distributing the funds to their member-municipalities to support waste management infrastructure and the delivery of waste diversion programmes (A. McPhee, personal communication, July 4 2018). Representing the bulk of funding provided to municipalities, 70 per cent of Divert Nova Scotia's revenue goes towards Diversion Credits (Divert Nova Scotia, n.d.).

How funding funnels through regions into specific programs and systems is contingent on the governance structure of that particular region (A. McPhee, personal communication, July 4 2018). The amount of funding distributed (the number of credits) is based on a diversion formula that assesses the tonnes of waste disposed and diverted relative to 1989 levels while also accounting for

[5] There are more than 80 privately operated Enviro-Depot locations across the province (Province of Nova Scotia, 2017b).

variances in population growth among other factors (A. McPhee, personal communication, July 4 2018). The more a jurisdiction diverts, the more credits (funds) they are eligible for (Divert Nova Scotia, n.d.; Province of Nova Scotia, 2015).

The diversion formula, set by Nova Scotia Environment, is a point of contention for some regions and municipalities who feel it does not offer an accurate depiction of diversion in their jurisdiction (A. McPhee, personal communication, July 4 2018). A key area of disagreement is that in 1989, when municipalities were required to provide Nova Scotia Environment with their disposal rate, the absence of comprehensive data led some jurisdictions to offer rough estimates which may not have been accurate (A. McPhee, personal communication, July 4 2018). Divert Nova Scotia and some of the jurisdictions that take issue with the diversion formula are looking to identify better ways of measuring diversion to eliminate these discrepancies.

Another challenge presented by Nova Scotia's current diversion credit system is that since it is based on regional diversion rates, it puts some municipalities at a disadvantage. Explicitly, if a municipality is committed to waste prevention and diversion but resides within a region that has not been as effective, its successes may be diluted by its regional rate. This has prevented some municipalities from gaining the funding they would have been eligible for if situated in another region. As a result, some municipalities have requested that they be removed from their respective region, with little success. The only exception was Pictou County. Pictou County, situated in Region 2, was excelling at waste prevention and diversion despite low success rates from the rest of the region (A. McPhee, personal communication, July 4 2018). As such, Pictou County requested that the province split the region in two. In 1998, Nova Scotia Environment accepted the request, splitting Region 2 into Region 2a and 2b (A. McPhee, personal communication, July 4 & July 18 2018). Shortly thereafter, Region 3 also sought to be deconstructed, but Nova Scotia has not recognized the separation.

Divert Nova Scotia has also provided $700,000 annually since 2010 in regional funding to support the seven regions ($100,000 per region) to undertake enforcement and compliance activities related to waste management regulations (Divert Nova Scotia, 2016). Regional representatives identified that this funding is primarily used to pay (partial or full) salaries of enforcement officers and the work that they do related to curbside audits, monitoring at waste separation facilities, transfer station audits, and enforcement activities related to illegal dumping incidents (Divert Nova Scotia, 2016). Depending on the structure of the region, enforcement funding covers between 60 to 100 per cent of total enforcement spending by regions.

Lastly, Divert Nova Scotia funds education and outreach programs administered by the seven regions in the amount of $635,000 annually (Divert NS, 2016b). This programme supports the regions in developing and implementing activities and projects that promote reduction, reuse, recycling and composting. There are restrictions, set by Divert Nova Scotia, on how the funding can be used which are outlined in the education contracts created between each region and Divert Nova Scotia. The education contracts include the objectives and strategic targets of the programme, regional education plans on how funds will be utilized, and a summary of hours spent implementing the identified activities (confidential contract information, provided on condition of anonymity, 2018). The funding is also contingent on the submission of interim and final reports, which contain information on "the activities supported by the stipend, work within the strategic targets, as well as successes, challenges, unique approaches, and other information that may be requested by Divert NS" (confidential contract information, provided on condition of anonymity, 2018). In fiscal year 2015-16, Regional Education Contract activities reached 94,000 Nova Scotians (Gardner Consultants, 2016).

Divert Nova Scotia also finances research conducted by students, institutions, and municipalities that identifies barriers, opportunities, and strategies to effectively reduce and divert waste. For example, they funded the Restaurant Association of Nova Scotia to undertake research that assessed the current generation and management of waste-resources in Nova Scotia's restaurant sector. The research also identified barriers, opportunities, and recommendations to enhance resource recovery (Resource Recovery Fund Board, 2017).

End Markets for Organic Waste in Nova Scotia

Divert Nova Scotia supports a significant amount of research on end markets for the waste recovered across the province. One research project recently published investigates how organic waste can be upcycled into nutritious, high value protein feeds that can be used in pet food, aquaculture, and agriculture (Mason, 2016; Divert Nova Scotia, 2018). The research identifies that further investigation is needed for the novel bio-conversion method to build high value marketable output commodities in Nova Scotia. Another project is trying to use compost to transform an active shale pit into a fully remediated wetland, and another that is developing an organic compost tea to extend the life and quality of cut flowers (Divert Nova Scotia, 2016).

Nova Scotia's Solid Waste-Resource Management Regulations (1996) define compost as "a product of composting which is used or sold for use as a soil amendment, artificial topsoil or growing medium or for some other application to land". While it is beneficial to define and implement compost and associated processes in waste diversion legislation as a leading end market for organics, it is the only explicit product named in the regulations for organic waste; there is no mention of other end products. This may create barriers for strategies that respect the waste management hierarchy, a circular economy and agroecological practices, as such frameworks and practices are not clearly supported in the regulations.

Until recently, composting in Nova Scotia was seen as a civic service that reduces demand on landfill space and greenhouse gas emissions. There has been little focus on fostering system-wide waste prevention strategies, largely due to the amount of emphasis required by the diversion system. That being said, there are opportunities to build on existing legislation in Nova Scotia to enhance waste reduction efforts through the Solid Waste-Resource Management Regulations. Similarly, a mandate of Divert Nova Scotia is to develop education and awareness of source reduction and reuse which can be applied to food waste.

The market price for composted organics is relatively low in Nova Scotia. On the other hand, collecting, hauling, and processing organic waste can be quite expensive, meaning that the cost of diverting waste often exceeds the direct financial gains of the system. The average gross cost of turning organic material into compost at centralized composting facilities (including operating and amortized capital costs) was $80 per tonne in 2006 (Wagner & Arnold, 2008). This is not a net cost as it does not include revenue generated from sales of composting materials. However, generating revenue from the end products of waste has been a challenge across Nova Scotia.

While "agriculture has the acreages required for the tonnages produced by municipalities" in Nova Scotia, the use of compost as a soil amendment has been relatively low for various reasons (LP Consulting Limited, 2017, p.3). Most compost facilities in Nova Scotia do not have a working relationship with the agricultural sector to understand how their compost can meet the farm needs, including crop-type, acreage, and soil conditions within their respective regions. Other factors include the perception held by farmers that compost has low fertilizer value, plastic contamination, equipment and labour costs to apply compost, and the challenges presented in maintaining consistent carbon nitrogen ratios due to product inconsistency (i.e. seasonal peaks in certain kinds of food waste, such as pumpkins in the fall) (LP Consulting Limited, 2017). It is also unclear how much

of the compost generated in Nova Scotia meets the requirements needed for it to be used on agricultural land. Currently, most of the compost produced in Nova Scotia is used by the landscaping industry (Divert Nova Scotia, 2018). Some composting facilities have reported giving away compost for free depending on local demand, in order to move it off-site (LP Consulting Limited, 2017; Cape Breton Regional Municipality, 2016).

It is challenging to test the usability of compost due to different reporting and testing protocols used in Nova Scotia (LP Consulting Limited, 2017). The reports and test results greatly differ depending on whether it is being tested as a soil amendment or soil medium, yet there is limited transparency or awareness around what is actually being tested, and the differences in the testing protocols (LP Consulting Limited, 2017). Research on Nova Scotia's compost industry "identified that reports from the same lab were quite different depending on how the product was identified, as a compost or a manure" and some test results do not clearly identify if they are assessing total nutrient content of compost or other amendment products (LP Consulting Limited, 2017, p. 16). The results of these tests cannot be effectively interpreted without knowing these details, and as such, the value of compost to the agricultural community cannot be fully identified.

Differences and Similarities Between Ontario and Nova Scotia

Ultimately, strong media focus, public opposition to conventional waste management systems, pressure on land availability and rising costs of disposing waste, and a premier interested in diverting waste were the key contributors to Nova Scotia's ban coming to fruition. It is not entirely clear if any, of these factors exist within the Ontario.

Role of the Media

The local, provincial, and national concern around traditional waste management systems was a critical feature of the policy window that ultimately led to Nova Scotia's current waste management paradigm. This was seen at the national level with CCME's adoption of waste reduction and diversion goals, and at the provincial and local level with the Highway 101 Landfill, and contamination from other landfills in Nova Scotia. Media attention is a critical component of policy windows, as it elevates the public's attention. Following, "media attention tends to be event driven, rather than issue oriented" (Wagner, 2007, p.2007). The Highway 101 Landfill is a key example of

how an event fostered enough public attention for policy makers to design and implement entirely new approaches to waste management without threatening their political careers.

There are currently no events in Ontario that have fostered enough public concern around food waste that would facilitate the implementation of the proposed food and organic waste ban. Waste is less of an financial issue Ontario, and is less visible given the competitive advantage held in the province to dispose waste. While food waste has been more visible in the media in Ontario and nationally recently, it does not appear to be a great enough public concern for there to be widespread demand for a new waste management paradigm.

Government Support

As the Food and Organic Waste Framework was developed under Ontario's Liberal government, it is unclear how the recent provincial election will impact the implementation of the framework, now that Ontario has a Progressive Conservative government.

Divert Nova Scotia has played an instrumental role in the success of Nova Scotia's diversion efforts. This includes their role in coordinating regional chair meetings, funding municipalities to undertake resource recovery work, and funding research that seeks to build better resource recovery systems. The Government of Ontario has created the Resource Productivity and Recovery Authority to advance a circular economy and achieve a waste-free Ontario, as outlined in the Strategy for a Waste-Free Ontario: Building the Circular Economy. This includes the responsibility to "enforce the requirements for producers to be responsible and accountable for their products and packaging at the end of their life cycle, as outlined in the Resource Recovery and Circular Economy Act, 2016" and to oversee "the ongoing operation of current waste diversion programs and the orderly wind up of those programs and associated industry funding organizations under the Waste Diversion Transition Act, 2016" (Resource Productivity and Recovery Authority, 2018, n.p.). As the Food and Organic Waste Policy Statement gives direction to prevent and reduce food and organic waste at each stage of the food supply chain, the Resource Productivity and Recovery Authority may play a similar role as Divert Nova Scotia. However, given the ambiguity of how the new provincial leadership will move forward with the Food and Organic Waste Framework, the Resource Productivity and Recovery Authority has not started working with food waste at time of writing (W. Lee, personal communication, July 4 2018).

Geography and Economies of Scale

The economies of scale that took place through the seven regions was critical to the achievement of Nova Scotia's Solid Waste-Resource Management Strategy. Regionalization enabled for resource and knowledge sharing, practical solutions to common diversion challenges, and allowed successes that would not have been achieved if each municipality was required to develop their own waste management programs and infrastructure. Nova Scotia has a large rural population spread out through the province, with an overall population of 923,598 in 2016 (less than 3 per cent of Canada's population) occupying only 0.6 per cent of Canada's land area (53,3378 km^2) (Statistics Canada, 2016; McGill University, 2007). In comparison, Ontario holds roughly 38 per cent of Canada's population (12,447,494 people in 2016) over a total area (km^2) of 1,076,395 (10.8 per cent of the national total area) (Statistics Canada, 2016; McGill University, 2007). These differences suggest that regionalization and other implementation strategies that were effective in Nova Scotia may not be as transferable to Ontario.

Following, there is a total of 416,801 employer businesses operating in Ontario, compared to 29,922 operating in Nova Scotia (Government of Canada, 2016). Even if we were only looking at large employer businesses (ones that employ more than 500 people), Nova Scotia has 68, whereas Ontario has 1,189, meaning a significantly greater number of institutions that would need to be regulated under this ban and the amount of waste being diverted will be considerably greater from both the household and ICI sector (Government of Canada, 2016). This may pose additional challenges to achieving high organic waste diversion rates in Ontario. Even more challenging, Ontario is known for leaving the ICI sector out of the purview of legislation on resource recovery (C. Lakhan, personal communication, July 23 2018). For example, only about 10 per cent of restaurants in Ontario are required to recycle (C. Lakhan, personal communication, July 23 2018). The province will need to incorporate legislation specific to the ICI sector to ensure the success of an organic waste ban, which will likely be faced with opposition.

Additionally, Nova Scotia does not have as many high rise, multi-residential buildings as Ontario does. The anonymity offered to residents of multi-residential buildings makes it easier to dump their waste, even if it is illegal to do so. This anonymity also makes it more challenging to use fines or warnings as a way to engage residents that contaminate their organics bin or throw out their organics. The design of most multi-residential buildings also makes dumping food waste more

convenient with garbage chutes on each floor. This is not to say that there is no way to enhance diversion from multi-residential units, but they do add layers of complexity.

While multi-residential buildings are expanding across the HRM, the pre-existence of waste management regulations, which these buildings are required to comply with, allow property owners to work with building designers to consider source separation when designing their buildings. The City of Toronto offers green bin programmes to roughly 65 per cent of its multi-residential buildings (Lee-Shanok, 2018), however, the design of these buildings, coupled with the lack of behavioural shifts at the individual level, are not conducive to residents of these buildings using this service fully.

Furthermore, Toronto's Long-Term Waste Management Strategy, approved in July 2017, looks to build and enhance waste reduction and recycling programmes in the city, drawing on the Resource Recovery and Circular Economy Act to ensure provincial alignment. Through this Strategy, Toronto is looking to create greater accountability from multi-residential buildings to separate their garbage, recyclables and organics. Jim McKay, the manager of solid waste at the City of Toronto, identified at an Open House and Consultation in March 2018 that recycling trucks may refuse to pick up overly contaminated recycling bins and instead send over a garbage truck to haul it. The building is then charged for the cost of garbage pick up. The threshold for contamination leading to refusal to pick up was not identified. Should an organic waste ban be implemented in Ontario, this process could be applied to green bin compliance in multi-residential buildings.

The City of Toronto reserves the right to refuse or discontinue collection services to properties that do not adhere to the requirements contained in the city's by-laws and regulations. The Toronto Municipal Code identifies that businesses (Chapter 841) and residential properties (Chapter 844) receiving organic collection services shall sort and set out organic materials without contaminating this waste stream. As such, the City of Toronto has the legal authority to turn away loads if they are contaminated. This would be an important regulatory tool to ensure compliance that the City could use should an organics ban be implemented at the provincial level.

In contrast to Nova Scotia, Metro Vancouver's organic waste ban does not prohibit the disposal of food and organic waste, but instead focus on tipping fees to increase diversion rates. According to Metro Vancouver, tipping fees encourage recycling, without the use of strict regulations that may incentivize illegal dumping (K. Storry, personal communication, June 12 2018). Refusing loads presents more severe consequences to waste generators for noncompliance, and may lead business

and households alike to change their behaviours more rapidly. Alternatively, the use of tipping fees offers opportunities for waste generators to continue operating as they had before the ban, so long as they are willing to pay for it.

Metro Vancouver's Food Scrap Recycling Ban

As Metro Vancouver's population is 2.5 million and on the rise (Saltman, 2018), the amount of solid waste was reaching proportionately high levels, when local government decided to implement an organic waste ban. The regional body recognized that much of the waste being disposed of in Metro Vancouver included valuable resources that could have been conserved, reused, recycled, or composted, and implemented a food waste ban in 2015. To enhance the success of the programme, Council adopted the Zero Waste 2040 Strategic Plan in 2016 to help Metro Vancouver's long term goal of being a zero waste community by 2040. The Plan consists three interconnected priorities: 1) to build a zero waste community, 2) to value resources, and 3) to support the circular economy. The first of these priorities focuses on fostering behavioural and cultural shifts to build resilient communities that share and engage with one another to reduce waste, and find inherent value in their possessions (City of Vancouver, 2018 & 2018b). This primary focus challenges systems of waste production and seeks to change behavioural patterns primarily at the household level, which is primarily done through the adoption of WRAP's Love Food Hate Waste campaign. The LFHW campaign aims to build the capacity of households to reduce waste. This includes engaging citizens to build their awareness of and skill sets in purchasing, storing, cooking, and utilizing food to avoid waste. Much of the emphasis of the campaign is around how consumers can save money by utilizing WRAP's strategies and tips, rather than encouraging them to reduce food waste for environmental reasons. While Metro Vancouver does some work with the ICI sector to reduce food waste, their primary focus has been on consumer behaviour. Although a beneficial components of food waste prevention, it does not help the ICI sector adopt value chain management principles, which would be a better focus area.

Using a phase-in approach, Metro Vancouver's food scraps recycling ban came into effect January 1st, 2015. From January to June 2015, the ban was enforced through education, and no penalties were put in place for non-compliance (Metro Vancouver, 2018). During this initial phase, all business and residential buildings were encouraged to create and introduce food scraps recycling programs. When loads of waste were delivered to disposal facilities that contained over 25 per cent

organic waste, the hauler was provided with information about the new regulations (Metro Vancouver, 2018). The educational phase was an important part of Metro Vancouver's waste ban, not only in supporting compliance once financial penalties were administered, but also in debunking critics who claim a disposal ban is a cash grab (K. Storry, personal communication, June 12 2018).

The ban began to be enforced through fiscal penalties on July 1st 2015. From July 1st – December 31st, 2015, waste loads containing more than 25 per cent of visible food waste were surcharged at 50 per cent of the cost of disposal (Metro Vancouver, 2018). For example, food waste comprised more than 25 per cent of a load that cost $100, the hauler of that load would be charged $150 (Metro Vancouver, 2018). From January 1st, 2017 onwards, the allowable limit for food scraps in garbage was lowered to five per cent. The gradual tightening of allowable thresholds was an important part of Metro Vancouver's ban. By the time that the threshold was lowered to five per cent, both ICI and residential sectors had built the capacity and knowledge needed to reduce and divert food waste, allowing the stricter threshold to be implemented without significant backlash (K. Storry, personal communication, June 12 2018).

Metro Vancouver identifies that household compliance was enhanced through the development and dissemination of educational guides, public outreach campaigns including Love Food Hate Waste and Food Isn't Garbage, and visual resources that make it clearer to people what waste goes where (K. Storry, personal communication, June 12 2018). While the LFHW campaign focuses primarily on providing residents with accessible actions and strategies to reduce food waste, the Food Isn't Garbage campaign focuses on educating multi-residential buildings and reducing the amount of plastic bags (both biodegradable and nonbiodegradable) entering into the green bin. According to composting facilities, plastic (primarily plastic bags) are the primary contaminant in the organic waste stream, making the Food Isn't Garbage campaign an important way for Metro Vancouver to support private composting facilities to produce better quality end products (McIllfaterick, 2017).

Subsequently, Metro Vancouver subsidizes roughly half of the cost of backyard composters, which Vancouver residents can purchase for 25 dollars. Metro Vancouver encourages households to use backyard composters in combination with curbside pickup programmes and offers resources on how to implement this system. There is insufficient evidence to determine how many residents actively compost in their backyard in Metro Vancouver.

For the ICI sector, Metro Vancouver developed and distributed guides and resources that support businesses set up organics programs and to partake in food waste analysis to benefit their business

(K. Storry, personal communication, June 12 2018). The threshold allowed in the waste stream is assessed annually, and may be modified by updating Metro Vancouver's tipping fee bylaw (K. Storry, personal communication, June 12 2018). Based on case studies conducted by Metro Vancouver, some restaurants have already been able to save additional funds by reducing and diverting their food waste through the food scraps recycling ban (K. Storry, personal communication, June 12 2018). These savings have been gained largely by measuring, tracking, and analyzing food waste in their restaurants, in order to understand how and where food waste is being created. Once these dynamics are understood, some restaurants have taken actions to reduce food waste, including issues related to over-purchasing and spoilage (Metro Vancouver, n.d.).

Metro Vancouver has tested one food waste tracking technology called Lean Path in local restaurants to support industry looking to reduce food waste. Lean Path records the types and weight of food wasted over a period of weeks, calculates the dollar value, and offers various forms of analysis to help tackle food waste (Metro Vancouver, n.d.). While there was some success in this technology, it was not widely adopted[6] (K. Storry, personal communication, June 12 2018). Restaurants continue to utilize various forms of technology that measure, track, and analyze food waste in order to support their decision-making around purchasing, storage, and preparation.

In the first year of Metro Vancouver's waste ban, 60,000 more tonnes of organic waste were diverted from landfills (Jones, 2017). This diversion is significant given that the first six months was an educational period, in which no penalties were administered. Metro Vancouver seeks to assess how much food waste is prevented through their food scraps ban, though it has not begun the process of doing so yet (K. Storry, personal communication, June 12 2018).

Composting facilities are operated by private businesses in Metro Vancouver. All of the facilities that participated in an evaluation conducted by Metro Vancouver identified that they were able to sell the compost and compost products they produce, though with inconstant quality due to varying levels of investment in value-adding strategies for compost diversification (McIllfaterick, 2017). Most of the compost created is used as a soil amendment for the landscaping industry and other commercial sectors. Residential and agricultural sectors currently under-utilize compost largely due to varying compost quality and limited awareness of its characteristics (K. Storry, personal communication, June 12 2018; McIllfaterick, 2017). While Metro Vancouver recommends that composting facilities

[6] There is insufficient information to determine why the technology was not widely adopted.

address the issues that limit the utility of compost from the agricultural and residential sectors, they do not appear to be as engaged with bridging this gap as Nova Scotia has, likely because Nova Scotia's facilities are run by municipalities as opposed to private businesses.

Two major challenges experienced by Metro Vancouver so far in their food scraps recycling efforts include a lack of compliance from multi-residential households and plastic contamination. While food and organic waste make up six per cent of single-family households garbage, this is a drastically larger problem for multi-residential households, with 79 per cent of organic waste being food and organic waste (McIllfaterick, 2017). This has been an important observation for Metro Vancouver, which they are utilizing to better target sectors and to address their specific challenges. Plastic contamination will be explored further in the recommendation section of this paper.

Edmonton's Mixed-Waste System

In the late 1980s, Edmonton's landfill was nearly reaching capacity. Facing a waste crisis coupled with strong public opposition to the city's search for a new landfill site, Edmonton had to rethink their approach to waste management. Consequently, the city developed a waste facility, with a compost facility on site, that is the largest of its kind in North America by volume and size (Taylor, 2009; City of Edmonton, 2018). Prior to building these systems and plans, Edmonton had a 14 per cent diversion rate. In 2007, the city boasted the highest diversion rate in Canada, at 60 per cent (Turner, 2008). The compost produced is utilized by the agricultural and horticultural sector.

While Edmonton does not have an organic waste ban, it is an important approach to at least mention in this paper. The reason for Edmonton's success in waste diversion is primarily a result of requiring zero effort from citizens to change their consumption or disposal behaviours by implementing a mixed-waste system (Taylor, 2009). Edmonton residents do not have to separate their garbage from their compost or recyclables. When residents put all materials into a single container for curbside pick up, it gets taken to the Edmonton Waste Management centre, where the organic portion is separated and turned into compost at the Edmonton Composting Facility on site (City of Edmonton, 2018).

Despite the ease in complying with this approach, residents pay a lot for this system through municipal taxes. The capital cost of Edmonton's diversion programme was an estimated $100 million, whereas Halifax's food waste diversion program had capital costs of $50.5 million (Taylor, 2009). Further, the operating costs of this diversion system is $202 per person per year in

Edmonton, compared to $86 per person per year in Halifax (Taylor, 2009). Mixed-waste systems require resource-intensive separation at the facility and do not guarantee that all waste is separated accurately. Edmonton currently has a diversion goal of 90 per cent (including recyclable and organic materials) which has been difficult to achieve with the system in place. More specifically, wet food scraps being tossed into residents' garbage is contaminating materials that could otherwise be recycled, puts pressure on composting facilities due to contamination, and makes it challenging to turn waste into biofuels due to the need for these materials to be dry (Stolte, 2017). This does not create any incentives for households or the ICI sector to reduce waste in the first place, and presents immense financial costs, making it an undesirable approach to waste management.

Supporting Stronger Food and Organic Waste Strategies in Ontario

There is a need for further analysis to truly understand what Ontario can learn from the municipal and provincial initiatives discussed, as the province looks to design an organics waste ban. Some of these informational gaps are due to the time constraints of this research, while others are due to a lack of information available. For example, Nova Scotia has not focused on food waste prevention, so data on how the ban and broader food waste initiatives in the province have contributed to this goal is minimal. Also, the relationship between each municipality and their region is challenging to truly understand because of the political dynamics at play, particularly as an outsider. As Divert Nova Scotia is currently funding research on how municipalities' waste management practices are correlated with waste diversion rates, in order to identify best practices, some of these questions may be answered in the near future. Similarly, Metro Vancouver has not conducted research on how its efforts have contributed to food waste prevention, though it does intend to at some point in the future (K. Storry, personal communication, June 12 2018). While the LFHW campaign contributes to Metro Vancouver's food waste prevention focus, the lack of evaluative data makes it challenging to determine its impact. Although many strategies can be borrowed or learned from by both of these jurisdictions, there has been an overall lack of attention to food waste prevention, particularly through value chain coordination, which is a clear contravention to the hierarchy and overall frameworks used in this research.

Using the guiding frameworks, the greatest economic, environmental, and social benefits are reaped when food is not wasted in the first place. Nova Scotia's efforts in resource recovery have led the province to become global leaders in waste diversion. Ontario could use its Food and Organic

Waste Framework and related commitments to become global leaders in waste prevention. The waste management hierarchy guiding Ontario's food waste work will be critical to achieving this, which is referred to as the Ontario Food Recovery Hierarchy in the Food and Organic Waste Policy Statement (Ontario, 2018b). The hierarchy consists of the following steps in order of importance (Ontario, 2018b, p.9):

1. Reduce: prevent or reduce food and organic waste at the source;
2. Feed People: safely rescue and redirect surplus food before it becomes waste;
3. Resource Recovery: recover food and organic waste to develop end-products for a beneficial use;

The policy statement goes further in clarifying that "although energy from waste and alternative fuels are permitted as waste management options, these methods are not considered resource recovery" (Ontario, 2018b, p.31). This aligns with the waste management hierarchy of this paper. Despite this being explicitly stated, the Food and Organic Waste Framework still places more emphasis on diversion than prevention, which is counter to their own Food Recovery Hierarchy. Only one of the Framework's four main objectives focuses on reduction; the remaining three are focused on resource recovery. Further, the objective around reducing food waste is not very robust or comprehensive, as will be seen below.

Preventing the Production of Food and Organic Waste

Focusing on waste prevention offers a strong first step to ensuring that the province not only eliminates organics entering landfills, but that a broader, more holistic approach is taken to tackle the systems and practices that generate waste. The recommendations offered below follow the structure of the waste management hierarchy, first looking at prevention and following the levels down to resource recovery, with some variations for consistency.

Reducing Food Waste Through Value Chain Coordination

Consumers contribute to 47 per cent of food wasted across the food value chain (Gooch et al., 2014) which has led many researchers and policy makers to focus on households when presenting solutions. While it is true that consumers waste the most, researchers urge that there is a need to "stop conflating the location with the cause of waste" (MacRae et al., 2016, p.163). This is to say that

just because consumers waste the most, does not mean that consumers ought to be the leading agents of change to reduce food waste.

It has been recognized that a small number of agri-food manufacturers and grocery chains dominate the global food system, and their business practices can largely influence and affect the generation of food waste (MacRae et al., 2016; Gooch & Felfel, 2014). The layout of grocery stores, as well as sales and advertising strategies are all critically influential to how much, and what, consumers purchase (MacRae et al., 2016). As a result, retailers may be better positioned to support the reduction of food waste from farm-to-fork, but ultimately, a value chain-wide approach is most needed.

MacRae and colleagues (2016) offer extensive recommendations on how to reduce food waste by changing policies, programmes, and legislation/regulation. Their strategic approach does not focus on industry-led voluntary actions, but rather, creates "a regulatory environment in Canada that supports many of the positive undertakings, but essentially forces most actors to participate in a way that addresses root causes of the problems" (MacRae et al., 2016, p.162). The recommendations outlined herein could be supplementary to the many recommendations offered by MacRae and colleagues (2016).

In their Food and Organic Waste Framework, the Ministry of the Environment and Climate Change recognizes that promotion and education are critical to prevent and reduce food waste. This is also a lesson learned from Nova Scotia, as the regional education programmes have been critical to the success of their waste diversion efforts. Currently, the Food and Organic Waste Framework suggests that the province will work with partners to develop education tools and resource that "could be tailored for various audiences" to reduce food waste (MOECC, 2018a, p.12). However, more than this is needed to truly shift behaviours towards waste reduction in the long-run. Since waste reduction is the first goal in Ontario's Food Recovery Hierarchy, education and outreach could be the most critical component of the Strategy. Developing audience-specific resources (which audiences in particular is not identified in the Framework) moves away from a food value chain approach, which is critical to foster the greatest long-term impact on reducing food and the resulting environmental, economic, and social improvements.

In its Food and Organic Waste Framework, the Ministry of the Environment, Conservation and Parks (2018a, p.16) has identified that Ontario will support "academic research aimed at reducing and recovering food and organic waste", which includes projects in collaboration with the agri-food sector, academics, and research institutions. In particular, this research would be supported through

existing knowledge mobilization programs facilitated by the Ministry of Environment, Conservation and Parks' and the Ministry of Agriculture, Food and Rural Affairs (OMAFRA). Funding for waste prevention research, whereby value chain coordination is the main objective, should take precedence over research on company-specific food waste assessments or diversion research. Furthermore, Canadian policy and legislation at both the provincial and federal levels have unintended consequences on the level of waste in the value chain (Gooch & Felfel, 2010). There is a need for further research to identify the causes and ways that policies, regulations, and the structure of government support programmes that contribute to food waste by looking at the entire value chain. This would be another critical component of research funded by Ontario related to the Food and Organic Waste Framework.

Determining how to encourage and sustain appropriate levels of behavioural changes, both at the individual and institutional level, are a pressing challenge for policy makers (Barr, Gilg, & Shaw, 2011). Many policy makers look towards strategies that shift the behaviour of individuals or specific groups of individuals using conventional marketing techniques (Barr, et al., 2011). This relates to a key theme within policy debates – many policy responses favour strategies that target individual change makers, while some policymakers believe that there is a need for fundamental structural change (Hargreaves, 2011). Within the UK, policy responses favour the former over the latter (Hargreaves, 2011), which may also be the case for Ontario, as the Food and Organic Waste Framework places emphasis on consumers as individuals, and educating specific audiences, as opposed to fundamentally shifting the system towards waste prevention.

Environmental psychologists continue to research ways to shift collective behaviours to become more sustainable, which would be more aligned with a coordinated approach, rather than approaches that are more individualistic in nature. For example, social practice theorists focus on social practices across space and time, rather than the individual actors who perform them (Hargreaves, 2011). Social practice theory does not focus on "individuals' attitudes, behaviours and choices, but instead on how practices form, how they are reproduced, maintained, stabilized, challenged and ultimately killed-off; on how practices recruit practitioners to maintain and strengthen them through continued performance, and on how such practitioners may be encouraged to defect to more sustainable practices" (Hargreaves, 2011, p.84). Ontario should build on their interest in creating stakeholder-specific resources by incorporating more collaborative, value chain-wide outreach programmes that align with social practice theory, or other societal/collective

behavioural change models. Doing so would more effectively shift behaviours towards waste prevention.

Ontario, likely through the Resource Productivity and Recovery Authority, could offer funding, either stand-alone or through cost-sharing programs to municipalities, industry, and non-profit organizations to undertake education programmes and research that looks to build collaboration across the value chain in an effort to reduce food waste. Nova Scotia's regional education contracts could be a model for Ontario. That being said, there are ways for Ontario to enhance the success of the contracts, including requiring prospective grantees to create a logic model and/or theory of change to understand how the projected activities will lead to the expected outcomes. Additionally, the contracts could require more ambitious qualitative and quantitative indicators related to the projected outcomes and strong key performance metrics. Depending on the level of capacity, the Resource Productivity and Recovery Authority could conduct audits on education programmes, particularly those that are doing well, or those that are facing significant challenges to assess the opportunities and barriers presented and transfer those lessons learned into best practices where applicable. The contracts could also benefit from allowing longer periods of project duration, rather than funded annually to build programs that truly shift cultural norms and behaviours around food waste, as these are most effectively tacked and measured in the long-run.

Reducing Food Waste at the Household Level

The province identifies that it will take action to reduce food waste within "school communities" (MOECC, 2018a, p.12). Finding ways for food waste to be incorporated into curricula could be one way to promote food waste reduction at the household level. If children become skilled in preparing, storing, and handling food, have confidence in their skills, and understand why food waste matters, this could serve to prevent food waste in the long-run. Children are frequently a target audience for environmental education, "as attitudes towards the environment start developing at an early age and once formed do not change easily" (Damerell, Howe, & Milner-Gulland, 2013, p.2). Further, a growing body of research suggests that children can impact their parent's environmental knowledge, attitudes and behaviour (Damerell et al., 2013), which suggests that educating children about food waste can inform parents' household decisions around the purchasing and disposal of food.

Ontario could build a household-specific outreach strategy by incorporating relevant aspects of the Love Food Hate Waste (LFHW) campaign, in combination to wider value chain wide initiatives.

According to an evaluation report of the campaign in West London (2014), avoidable food waste decreased by 14 per cent in just six months of implementation. Though significant, this statistic does not necessarily tell us how impactful the campaign has been at shifting those behaviours in the long-term. The campaign focused on building awareness of the issue of food waste locally, implemented activities that offered individuals easy, everyday solutions to reduce food waste, and undertook community engagement activities to influence behaviours.

LFHW also aims to reduce waste by encouraging people to change how they shop for food. In particular, they encourage households to create a shopping list before going to the store, to avoid "Buy One, Get One" deals, and offer tools for people to plan how much food they will need given the size of their household (LFHW, 2018). It is unclear to what extent the LFHW campaign actively spreads these narratives, beyond having them on their website, and which specific strategies they focus on most. Further, it should be noted that Ontario would likely receive pushback from the retail industry if they strongly advocated that households buy less food. Lobbying efforts may be strong enough to prevent this kind of approach from taking place, given that three grocery chains (Sobeys, Metro, and Loblaws) dominate Ontario's retail market (Kucharsky, 2013).

WRAP has traditionally focused on broadly scoped campaigns that utilize shocking statistics and generic narratives on issues like leftovers. While this can make headlines and play a role in putting food waste into the public consciousness, it does not do the best job at allowing people to see that they themselves are contributing to this issue, and that they can directly benefit from reducing waste (Behavior Change, 2018). As such, LFHW's team has worked to develop new strategies and communication techniques to create "a more personalised approach which allows people to diagnose their own food waste habits and get help in changing them" (Behaviour Change, 2018, n.p.). Ontario should ensure that any campaign should heavily incorporate local realities of food waste, as what worked in the UK or in Metro Vancouver may not work as effectively in Ontario. The campaign should be multi-faceted, with different narratives, activities, and approaches depending on the household demographic.

Reducing and Diverting Food Waste Through Existing Policy and Legislation

In addition to creating education and research programmes to reduce food waste across the value chain and at the household level, the Food and Organic Waste Framework will require the Ministry of Environment, Conservation and Parks to work with other governments to ensure that existing

policies, programmes, and approaches succeed. In lieu of research that identifies how current policy and legislation exacerbate waste generation across the value chain, the recommendations below are broad in scope, and include minor suggestions to adjust existing legislation and programmes to support the mission of the Framework.

New Horizons: Ontario's Agricultural Soil Health and Conservation Strategy comprises a long-term framework to guide soil-related research, investments, and activities in the province. Focusing on building soil organic matter that ultimately bolsters the agricultural sector in Ontario, the prevention of waste can be integrated into the Strategy. Setting targets and promoting practices that facilitate food waste prevention could be incorporated into Best Management Practices (BMPs). BMPs are "a practical, affordable approach to conserving a farm's soil and water resources without sacrificing productivity" (OMAFRA, 2016, n.p.). BMPs support farmers in understanding environmental issues in the context of their operations, identify options for addressing those issues, design environmentally responsible management practices, increase efficiencies, and more (OMAFRA, 2016). Food waste relates to these benefits and the overall purpose of BMPs. Food waste prevention could become its own BMP, while diversion can be integrated into existing BMPs. Naturally, given the objective of the Soil Strategy, many BMPs focus on rejuvenating and safeguarding soil health. Those that could incorporate recourse recovery include soil remediation, which includes the practice of restoring soil; soil testing to keep records and adjust nutrient management programs according to the results; and adding organic amendments. Composting is already identified as a BMP with regards to adding organic amendments, but it could be enhanced to promote on-farm composting or to support markets for local facilities where appropriate.

Further, the Soil Strategy identifies that policy makers and farmers alike need access to high quality and relevant information to support decision-making. Research and innovation can be supported through the Soil Strategy to prevent food from being wasted or lost on the farm. These projects could be specific to farm-related food waste to align with the Soil Strategy and could include research on innovative technologies, farm practices, and business and communication strategies that help farmers do more with what they already produce. The findings could support the development of the food waste prevention BMP.

There are also ways for the soil strategy to be used to enhance the sustainability of Ontario's resource recovery system. The first goal identified in the strategy is for "soil management practices [to] sustain and enhance soil health and productivity for economic, environmental and societal

needs" (p.6) and one of the actions to achieve that goal is to build the usage of compost and other organic soil amendments where appropriate. An organics ban in Ontario would mean a substantial increase in organic material which could create nutritional, quality compost for the agricultural sector. However, there are many logistical and financial challenges in getting and applying compost on agricultural land and various challenges in creating quality compost. Ontario's Soil Strategy could be a key agent in building an end market for compost generated through the ban, while also working to support research and development on how composting facilities can create an end product that meets the needs and price requirements of Ontario's agricultural sector. The strategy could also support research that identifies how different stakeholders can reduce the logistical and financial barriers that get in the way of the utilization of compost on agricultural land.

The Agricultural Soil Health and Conservation Working Group played a significant role in developing the Soil Strategy. The working group could collaborate with OMAFRA and the Ministry of Environment, Conservation and Parks, among other provincial governments and municipalities to determine if and where there are opportunities to build resource recovery facilities near agricultural communities to reduce the cost of transporting this valuable material to farms. Programs could provide financial incentives to farmers to begin introducing compost into their farm management practices, as the financial gains that enhancing soil health offers are not experienced in the short-run.

To see food waste reduction take place across the food value chain, the Canadian Agricultural Partnership (CAP) must be heavily involved. Replacing Growing Forward 2 in April 2018, CAP "is a five-year, $3 billion investment by federal, provincial, and territorial governments to strengthen the agriculture and agri-food sector" (CAP, 2018, n.p). In Ontario, $1.1 billion of CAP funding is being allocated for Business Risk Management (BRM) programmes, which consist of four programmes: AgriStability, AgriInvest, AgriInsurance, and AgriRecovery. The BRM suite of programs aims to provide producers with effective tools to manage business risks and improve competitiveness. The BRM suite represents more than one-third of total funding in Ontario alone (OMAFRA, 2018).

There are various reasons to believe that BRM programs and varied marketing regulations may exacerbate producers' ability to reduce food waste at the farm level. The BRM suite alters farms' needs to respond to market signals, and may alter market signals themselves; they weaken "farmers' needs to communicate meaningfully with downstream members of the value chain, or ensure that their operations reflect customer and consumer requirements"; and some of these programs may

incentivize intensive production without critical assessment of how that may also indirectly promote environmentally precarious farm practices (Gooch et al., 2010, p.7; Meikle, 2017). BRM suite and CAP more broadly should be holistic in their design to ensure that food waste or other environmental issues are not directly or indirectly resulting from these funding and support structures.

CAP can also be used to advance Ontario's food waste work through Environmental Farm Plans (EFPs). EFPs are assessments voluntarily prepared by farm families to increase their environmental awareness in up to 23 different areas on their farm (OMAFRA, 2016b). EFP workshops (which already exist) could be designated around waste prevention and diversion. Once an EFP is established, it "can then be used in conjunction with cost-share programs to begin implementing their action plans" (Ontario Soil and Crop Improvement Association, 2018, n.p.). This could build the capacity and skill set of producers to reduce food waste and to create compost or purchase it from nearby composting facilities where appropriate and available.

Should the Ontario Cap and Trade program survive or be reinstated, farmers could receive greenhouse gas credits when food waste is prevented (against standardized targets) or when a certain amount of compost is used (since methane was prevented by transitioning organic waste into compost). Of course, this is just one direct way that food waste reduction reduces greenhouse gas emissions.

Ontario's Food and Organic Waste Framework identifies that the province will work with the federal government to reduce food waste. This may be advanced through Canada's proposed Food Policy for Canada (2017, n.p.), which would set the "long-term vision for the health, environment, social, and economic goals related to food, while identifying actions we can take in the short-term". The food policy covers interconnected pillars of increasing access to affordable food; improving health and food safety; conserving soil, water, and air; and growing more high-quality food. Food waste intersects heavily with all of these pillars.

The federal government, through the Food Policy for Canada, could publicly set and widely promote a national food loss and waste target. As food waste is primarily a local and provincial matter, the federal government would play largely a supportive role, rather than being the leading change maker. The Government of Canada could support other levels of government to create a common harmonized policy framework, in order to support businesses that operate across

jurisdictional lines in Canada to avoid confusion, duplication and inefficiency (National Zero Waste Council, 2018).

A key benefit of an organic waste ban is that it offers jurisdictions the ability to create a standardized, streamlined approach to assessing and dealing with food waste. Prior to 2011, no systematic province-wide waste audits had been conducted in Nova Scotia. While municipalities conducted audits for their own purposes, the methodology and categorizations varied. Metro Vancouver had a similar experience, having done baseline research before the implementation of their ban in order to gain a more comprehensive understanding of the tangible impacts of their approach. A benefit of these bans is that they allowed for more standardized methods to be used, and more meaningful engagement with waste audits. Gaining a greater understanding of waste generation, disposal, and diversion, from standardized methods, would allow Ontario to better understand how all stakeholders across the value chain can work to reduce food waste.

Currently, few food waste initiatives have been evaluated and few tools have been developed to identify the best parameters for conducting food waste audits (Sustain Ontario, 2016). More waste audits, behavioural studies, and overall research is needed to understand the quantity and type of food being wasted, where this waste is generated along the value chain, why the waste is occurring, and how it can be effectively mediated. Municipal budgets are typically insufficient to absorb the costs of a food waste audit (Sustain Ontario, 2016). The provincial government should consider creating a funding stream for Ontario municipalities to conduct waste audits, according to a standardized methodology, to get more comprehensive baseline data on food waste prior to the implementation of the ban. Waste audits should be updated over time to compare waste practices in the long run and to assess the success of prevention and diversion strategies. The data captured will enable a greater contextual understanding of food waste and this knowledge can be used to create more fruitful programming to prevent and divert waste.

Ontario does require some industrial, commercial, and institutional entities to undertake waste audits through the Ontario Regulation 102/94 (O. Reg. 102/94 – Waste Audits and Waste Reduction Work Plans). O. Reg. 102/94 identifies the minimum requirements for conducting waste audits and preparing waste reduction work plans for ICI entities. Food and organic waste are included in these regulations. There are four basic steps to implement a waste reduction program as required under O. Reg. 102/94:

1. Conduct the waste audit;

2. Develop the waste reduction work plan;
3. Implement the waste reduction work plan; and
4. Update and implement the waste audit and waste work plan, annually;

All entities that are obligated to comply with the regulation must complete a waste audit and waste reduction work plan within six months of becoming subject to the regulation, and they must be updated at least once a year. An establishment that is required under the regulation to prepare a waste audit or a waste reduction work plan shall submit these documents to the Director[7] upon request. The owner of retail shopping establishments[8], retail shopping complexes[9], office buildings[10], restaurants[11], hotels and motels[12], public hospitals, and other large establishments with conditions and exceptions[13], must comply with the regulation within six months of fitting within the requirements.

This regulation can be seen as a stepping stone to more streamlined, and effective waste prevention and diversion efforts in Ontario. For example, O. Reg. 102/94 could apply to multi-unit residential buildings. Waste reduction plans must be placed somewhere visible to employees and the full reports must be made available to them upon request. In the context of multi-residential buildings, should they be required to comply with O. Reg. 102/94, building management could be required to put their plans up around the building so that residents can hold management accountable to the plan and offer feedback when possible.

Further, requirements for waste audits and reduction plans could be more rigorous, allowing for greater prevention and diversion of waste. The Waste Reduction Work Plan requires establishments to identify the current activities they have in place related to reducing, reusing, and recycling waste, and any assessments they have done to identify the achievements in those activities. Work Plans also request establishments to determine why waste is being generated; identify areas for greater waste reduction, reuse, or diverse and to create waste reduction targets. These could be requirements for establishment of a certain size, rather than recommended components. The requirements around

[7] Appointed under section 5. R.S.O. 1990, c. E.19, s. 1 of the Environmental Protection Act
[8] with a floor area of at least 10,000 square meters
[9] with a floor area of at least 10,000 square meters
[10] with a floor area of at least 10,000 square meters
[11] with annual gross sales for all restaurants operated by the owner in Ontario $3 million or more
[12] with more than 75 units
[13] For specifics on which businesses and institutions are required to comply with O. Reg. 102/94, see section 3.0 of the regulation: https://dr6j45jk9xcmk.cloudfront.net/documents/3939/ici-guide-revised-july-08.pdf

how they will reuse and recycle the waste could also be stronger. Currently, it is sufficient for businesses to say that they will collect wastes from receptacles and empty them into recycling carts for pick up. The government could offer various forms of support to industry to build more critical, systemic waste reduction work plans. One concern would be to ensure that these Work Plans do not significantly stump local businesses by being too overbearing.

As businesses only need to submit these reports when requested by the Director, it is unclear what the compliance rate looks like (i.e. how often businesses comply with the Regulation, or how often these plans lack substance) or how often, or why the Director requests businesses to submit their documents. O. Reg 102/94 could require automatic reporting to the ministry to promote compliance. Should the government have the capacity to audit these reports, there could be an additional requirement that upon updating audits and work plans, industry complying with O. Reg. 102/94 must demonstrate some sort of progression towards prevention and stronger diversion or have a good explanation for why they have not. Lastly, there could also be a requirement that upon request, work plans and audits be made available to the public to enhance transparency. This standardization could be beneficial in Ontario to gain a greater understanding of the dynamics of food waste disposal and diversion efforts: where it works, where it does not, and the conditions which have led to the outcomes.

These recommendations, coupled with those outlined by MacRae et al., (2016) can drastically reduce the amount of food that may end up getting wasted, placing less pressure on resource recovery systems.

Diverting Food and Organic Waste

The waste management hierarchy places diversion as the next best option when food and organic waste cannot be prevented. Diversion is being arranged here into three sublevels. Once food is going to waste, it should first be used to feed other people, then animals, then to create quality compost that benefits soil health, particularly for the agricultural industry.

Diverting Food to Feed People

Redistributing food that would otherwise be wasted to feed people reduces the burden placed on municipalities and regions in preparing for and implementing an organic waste ban. It also helps assist, though it does little to tackle the systemic causes of, food insecurity and poverty. There are

already two existing laws and programs in Ontario that support the redistribution of food, including the Ontario Community Food Program Donation Tax Credit for Farmers and the Ontario Donation of Food Act. Although the framework identifies that "the province will work with partners across sectors to help ensure that surplus food does not become waste" (Ontario, 2018a, p.15), there is little information on how they will actively do this. The Ministry of the Environment, Conservation and Parks (2018) does support the work of Second Harvest, Canada's largest food rescue organization by investing funds to support their programming and to assist them launch an online platform to make donating surplus food easier for local businesses in Ontario. Lori Nikkel, the Director of Programs and Partnerships at Second Harvest, is a member of the Stakeholder Working Group, where she advises on the development of the Food and Organic Waste Framework. While the Framework is vague in identifying the strategies, the province will employ to enhance the redistribution of food to people, it may be that this is strengthened down the line with the support from Second Harvest.

There is a need for further research to ensure that food rescue does not incentivize waste generation. This is not to say that the donation of food should not be incentivized, but that Ontario's approach should not encourage retailers, food service providers, or other agri-food stakeholders to generate large quantities of food waste (rather than encouraging them to eliminate that waste in the first place) in order to receive some form of tax break. Aligning with the circular economy, food and the valuable resources that are used along the value chain should be kept at the highest quality at all times. As such, retailers and other food markets should be discouraged from allowing food to become nearly inedible before they donate or offer it to consumers at a discounted rate.

Diverting Food and Organic Waste to Feed Animals

Moving on to the next level of resource recovery, when food waste cannot be prevented or redistributed to feed people, it should be used to feed animals wherever possible. Feeding animals food that is inedible or wasted by humans is "a time-old solution" (Coulter-Low, 2016, n.p.) that can save agricultural producers money, as less food will be sent to composting facilities and less animal feed would be purchased. This option can support agriculturally viable northern and remote communities to contribute to the goals of Ontario's Food and Organic Waste Framework, given the barriers faced in these spaces to build resource recovery infrastructure or to benefit from regionalization.

There are various challenges faced by agricultural producers in using their food waste to feed animals, many due to the livestock feeds regulations in Canada. Ontario can support the agricultural industry to feed agricultural waste to animals where and when appropriate and in alignment with food safety regulations. In recent years, Divert Nova Scotia has supported studies looking at how organic waste can be processed into animal feed, including livestock and aquaculture feed. Ontario could assess these studies, in addition to other innovative bioconversion technology being developed across Canada to identify where these systems could be built in Ontario.

Diverting Food and Organic Waste to Promote Soil Health

When food and organic waste cannot be diverted to feed people or animals, it should be used to promote soil health. Ontario has identified in the Food and Organic Waste Framework (2018a & 2018b) that soil amendments need to be particularly accessible to farmers in order to support long-term agricultural productivity and create nutritious food in the long run. To achieve this, the province is proposing to review approaches and guidance related to soil amendments.

When Nova Scotia began implementing their compostable organic waste ban, it was decided that a few rural jurisdictions would be allowed to evade curbside collection programmes, provided that they implement backyard composting programmes. The rural exemption was later identified as being a flaw in the implementation of Nova Scotia's Solid Waste-Resource Management Strategy as many of these areas failed to achieve the 50 per cent diversion target (Wagner & Arnold, 2008). Additionally, backyard composting is seen as being less effective than centralized composting facilities because many organic materials are not conducive to backyard composters, such as fish, meat, and dairy waste. While backyard composting may not be the most effective approach as a stand-alone waste diversion mechanism, there are benefits to having it compliment green bin programming.

As such, Ontario should follow Metro Vancouver by creating a hybrid approach. This would include subsidizing and supporting households in integrating backyard composting and supporting community-based composting efforts, while continuing to promote curbside pickup for those materials that cannot be composted at the household level. This may be less viable for communities with severe pest issues such as racoons, or those with large rental markets or multi-residential buildings. The province could support municipalities and non-profit organizations to develop programming that educates households on vermicomposting, which involves using various kinds of

worms to break down organic waste and generate compost, and offer resources for getting them started and maintaining this system. Vermicomposting can take place in small indoor areas, making it more viable to dedicated citizens without a backyard.

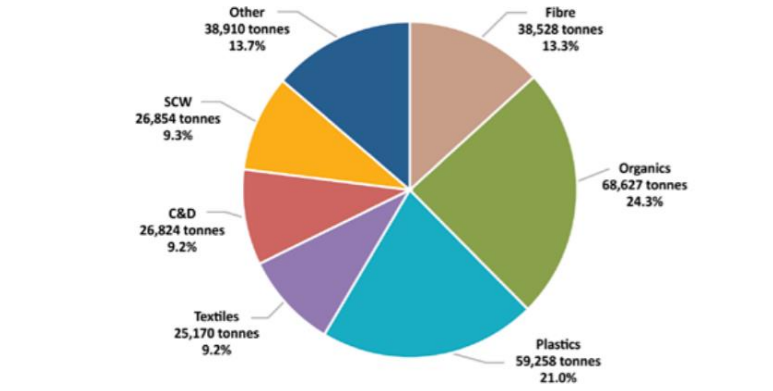
Moreover, Ontario could also use a hybrid approach to regionalization, so it is taken up where and when it makes sense to do so. Regionalization may not be a viable option in some parts of Ontario, such as remote northern communities or large municipalities that already have large systems in place, but could help alleviate costs and build capacity in other regions.

Moreover, a food and organic waste ban will require the ICI sector and households to engage in source separation programmes to eliminate valuable resources from entering landfills, requiring support from governments to ensure compliance and success. Many jurisdictions in Ontario that have implementing green bin programming have found that despite the utility of these services, households continue to throw away materials that could have been placed in their green bin. More education and public outreach is needed for people to use their green bins to their full potential.

It is unclear at what point support structures eliminate an opportunity to create systemic behavioural shifts towards prevention. For example, in Nova Scotia, some municipalities compensate the ICI sector for sending their organics to compost facilities. Depending on what these compensation programs look like, it is possible that they enable businesses to continue operating as they always have, with little or no incentives to change their behaviour towards waste reduction. Tipping fees can play a significant role in supporting behaviour change towards waste prevention while also enhancing resource recovery systems. Firstly, money generated through tipping fees enables composting facilities to maintain and enhance their operations. Secondly, they can serve to challenge waste generators behaviours by providing an incentive not to waste in the first place. If tipping fees are administered when a waste generator tries to dispose of organics, it at the very least provides incentive to divert their waste rather than dispose of it, enhancing compliance with an organics ban.

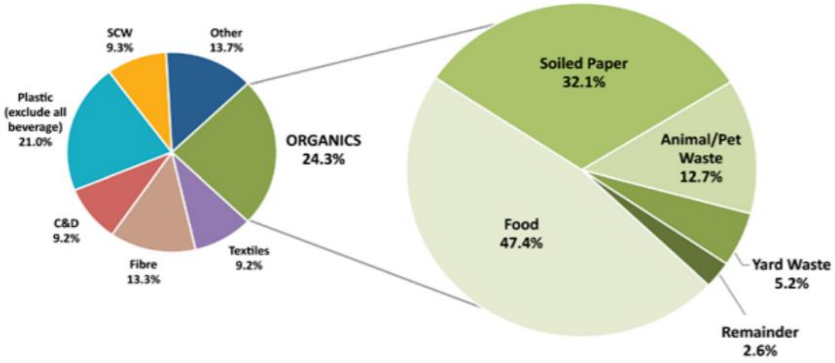
Identifying how regulations can promote diversion without being too stringent or too lax that behaviours remain unchanged or changed in a negative way (e.g. illegal dumping) will be key for Ontario's organic waste ban to support the prevention of waste and the success of the ban. Metro Vancouver's ban still allows waste generators to throw away food scraps, so long as they pay a financial surcharge for doing so. If this was the case in Nova Scotia, some waste generators from the ICI sector may find it more affordable to pay the disposal fee than to spend the time, transportation costs, and tipping fees on diverting that waste, should the landfill be much closer than the resource

recovery facility. Nova Scotia's Solid Waste-Resource Management Regulations (1996) prohibit the destruction or disposal of compostable organic waste, and also require municipalities and disposal sites to deny compostable organic waste from entering their facilities. Despite these requirements, nearly one quarter of the waste ending up in landfills is still organic waste, most of which includes materials explicitly banned in Nova Scotia (see Figures 5 and 6 for details) (Divert Nova Scotia, 2018b).



Abbreviations: C&D – Construction and Demolition waste; ICI – Industrial, Commercial and Institutional waste; SCW – Special Care Waste
Due to rounding, percentages may not add up to exactly 100.0%

FIGURE 5: DISTRIBUTION OF MATERIALS IN LANDFILLS PROVINCE-WIDE (FROM BOTH RESIDENTIAL AND ICI SECTOR) IN 2017. SOURCE: DIVERT NOVA SCOTIA, 2018B, P.5.



NOTE: ORGANICS is comprised of line items 21 through 30 inclusive as detailed in Appendix E.

Abbreviations: C&D – Construction and Demolition waste; ICI – Industrial, Commercial and Institutional waste; SCW – Special Care Waste
Due to rounding, percentages may not add up to exactly 100.0%

FIGURE 6: BREAKDOWN OF ORGANIC MATERIAL IN LANDFILLS PROVINCE-WIDE (FROM BOTH RESIDENTIAL AND ICI SECTOR) IN 2017. SOURCE: DIVERT NOVA SCOTIA, 2018B, P.6.

Both the ICI sector (23.3 per cent of waste) and residential sector (25.2 per cent of waste) are major contributors of disposed organics (Divert Nova Scotia, 2018b). This suggests that more can be done in Nova Scotia to increase compliance with existing regulations that completely ban organic waste,

among other materials, from entering landfills. It also demonstrates that regulations that ban organics from entering landfills do not in and of itself necessitate the behavioural changes required for it to be successful.

As many municipalities in Ontario have no green bin programming at time of writing, and even those that do will be required to expand these systems given the intake of more waste, the province will play a key advisory role in supporting the development of resource recovery infrastructure. There are several different organic waste management systems that can be utilized; some are more financially taxing, such as the one in Edmonton, and others that are less expensive such as most of the basic windrow facilities in Nova Scotia. There are benefits and downfalls to each type of system, including quality of the end product created, the impacts of contamination, and the operating costs to name a few. For regions with less capacity and a smaller population, basic facilities would likely be the easiest to implement. Regions that already have composting facilities could assess the benefits and overall impact of those facilities to determine if they should be scaled up to meet the increased supply of waste going through the facilities, or if new systems would work better.

Regardless of the facilities utilized to divert waste, Nova Scotia and Metro Vancouver demonstrate the challenges presented in developing valuable compost due to plastic contamination.

All seven regions in Nova Scotia prohibit plastic from entering the organic waste stream, yet plastic communication is still a challenge across the province (Nova Scotia Environment personnel, personal communication, June 28 2018). The decision made to ban plastic is particularly significant as it was not a provincial requirement. Alternatively, some Ontario jurisdictions that have green bin programmes do allow plastics in varying degrees. In Toronto, households can line their green bins with plastic bags (both biodegradable and non-biodegradable bags), which the City removes during the processing of organics and sends them to landfills as residual waste (Toronto Environment, n.d.). Ottawa is looking to include plastic bags in their green bin programmes by 2020 (CTV Toronto, n.d.).

There are concerns with allowing plastic into the organic waste stream. Plastic reduces the quality of compost and can complicate the composting process as it does not break down and gets stuck in the machinery, depending on the type of facility (City of Ottawa, 2018). In Metro Vancouver, some compost facilities do not accept food waste due to the additional costs imposed by high levels of plastic contamination (McIllfaterick, 2017). Issues surrounding single use plastic have a strong presence in the media and government decision-making in recent years, and they play into the food

waste story in at least two ways. Firstly, while plastic wrap can enhance the shelf life of food, it can also contribute to unnecessary waste when being used on goods that do not benefit from them. When food is wasted, the single-use packaging is also wasted. Secondly, when plastic ends up in the green bin, it can impact the composting process, and reduce the quality of the end product created. Not only does plastic waste get created and wasted along with food, but it also impacts the ability for jurisdictions to manage organic waste most effectively and sustainably.

As some jurisdictions in Ontario allow plastic in their green bin programming already or seek to in the near future, this may challenge the province in eliminating the financial, operational, and environmental costs of this contamination. The province may be able to utilize the current media emphasis on single-use plastics to build awareness of how this material impacts compost and encourage behavioural change. A reason that some municipalities allow plastic to enter the organic stream is due to the perceived convenience it provides households and the ICI sector in complying. For example, Ottawa suggests that by allowing both compostable and non-compostable plastic to enter green bins, dog owners will be able to more easily recycle animal waste (CTV Toronto, n.d.).

Despite the convenience that plastic may provide, it can reduce the quality of compost provided, preventing it from being used for the most beneficial uses. This convenience also prevents facilities from generating revenue from their end product, as the reduced quality limits the industries they can sell their products to and the value of that product. Ontario should be wary of supporting systems that allow plastics (including both biodegradable and non-biodegradable) in the organic waste stream and should build this into their public outreach programming to reduce the potential for contamination. If Ontario does not want to ban plastic contamination, the province should at least treat it like energy from waste systems: although an option for jurisdictions to consider, it would not be a priority for the province, meaning that no incentives or support would be in place to develop these systems. If public outreach succeeded in framing the issues on plastic, particularly by riding on the single-use plastic media wave, it is possible that public pressure could discourage municipalities from allowing plastic into the organic waste stream.

The final recommendation offered in this paper is the implementation of an organic waste ban requires robust preliminary discussions and system-wide thinking to build and sustain end markets for the products created from organic waste, such as compost. Nova Scotia's experience demonstrates the challenges presented by cost, contamination, variations in compost batches, public misconceptions, the need for extensive research on agricultural needs, soil nutrition levels, and

more. Nova Scotia has had their organic ban in place for 20 years, and the province is still trying to determine how to sustain beneficial end markets for their diverted organic waste (LP Consulting Limited). While the economic and environmental benefits of composting are well recognized, governments can find it challenging to effectively promote and market them to the agricultural sector, particularly given the vast resources of the inorganic fertilizer industry. Municipalities compost as a means of managing waste, whereas fertilizer companies are private businesses that sell products (Nova Scotia Environment personnel, personal communication, June 29 2018). Waste diversion is primarily a public service, not a business in Nova Scotia.

There is a need for Ontario to identify potential early adopters of compost, and work with municipalities and other levels of governments to support producers in using compost, as the benefits of it are often not seen in the short term. In Nova Scotia, "farms located within 75-100km from the compost facility provide the most opportunity for compost sales based on trucking costs… [as they] should be between $8-12/tonne to be cost effective for this type of product" (LP Consulting Limited, p.18). Early adopters would not only be those agricultural producers who would benefit the most from using compost, but also that can afford it relative to the projected financial benefits of using it. As long-term trends suggest that fertilizer prices will continue to increase, and soil nutrient levels are in decline, compost will likely become an affordable and sustainable option to maintain and revitalize one of the earth's most valuable resources; soil (LP Consulting Limited, 2017). Ontario's large agricultural market may support the province in sustaining a viable end market to the increased supply of organic waste that a ban creates.

Concluding Remarks

Ontario's Food and Organic Waste Framework is a strong first step toward advancing waste prevention and diversion efforts in the province. If done right, the Framework offers Ontario an opportunity to become a global leader in food waste prevention. Building the capacity of all waste generators to eliminate waste from being generated is where Ontario needs to focus more of its attention, rather than focusing on the bottom levels of the waste management hierarchy. Although the province identifies prevention as being their main priority in the Food and Organic Waste Framework, the strategies outlined to achieve Ontario's Food Recovery Hierarchy are very diversion-heavy.

Reducing waste offers the greatest environmental, economic, and social benefits, while also reducing stress on resource recovery systems and the jurisdictions that are responsible for sustaining them. The recommendations offered in this paper heavily focus on preventative strategies to achieve these benefits. In particular, food and organic waste will most effectively be reduced in the long run by facilitating coordination across the value chain, which the government can foster through funding research and reviewing existing legislation and regulations that may hinder coordination. Existing policies, programs, and approaches can also be utilized to shift existing behaviours towards waste prevention and increase resource recovery.

A key element of Nova Scotia's waste diversion strategy is that solid waste is reframed from a valueless residual to a valuable resource. While the province continues to determine how best this can be achieved, it does not seem that the regulatory and non-regulatory approaches taken in Nova Scotia have instilled this mindset into the producers of organic waste themselves. If people, businesses, and institutions saw food and organics as valuable resources, rather than something to be disposed of, less waste would be generated, less contamination would take place, and better resource recovery could occur. This paradigm shift requires a transition away from our throwaway culture that values convenience and disposability towards one where materials are seen as valuable. Education, research, capacity building, regionalization, tipping fees, and other compliance-related strategies are all key to creating the conditions necessary for food and organics to be reduced, and then used for the most beneficial purposes when unavoidable waste is created.

After implementing an organic waste ban and the broader Solid Waste-Resource Management Strategy, Nova Scotia's efforts were almost entirely focused on dealing with resource recovery (Nova Scotia Environment personnel, personal communication, June 29 2018). This has contributed to Nova Scotia's lack of focus on waste prevention until recently. As Ontario has not yet implemented their organics ban, the province is presented with an opportunity to begin developing food waste prevention strategies and approaches before beginning to mandate resource recovery systems across the province. The ban could be phased-in over a longer period of time so that the province still maintains capacity to support the prevention of waste, rather than being bombarded with the needs of a diversion-focused system. A phased-in ban also allows municipalities, regions, and waste generators the opportunity to build capacity and adjust programmes and bylaws based on their own experiences to enhance compliance and overall success.

Upon implementing an organic waste ban, Ontario should consider hybrid approaches to regionalization, in order to create economies of scale and build the capacity of municipalities that would independently be unable to achieve the necessary requirements imposed on them. A hybrid approach could also be taken towards household diversion efforts. More specifically, the province should encourage backyard composting, vermicomposting and community-based composting in conjunction with curbside pick up programmes. Banning plastic, or at the very least discouraging it from entering into the organic waste stream would also be beneficial to ensure that waste is used for the most beneficial purposes while also reducing challenges faced by composting facilities in dealing with contamination.

This paper investigated other jurisdictions that implemented an organic waste ban in Canada, to determine what they can offer Ontario as they look to do the same. There are many lessons that Ontario can learn from these examples, even in the absence of data on various topics as identified throughout this paper. While strong diversion systems are needed to eliminate organics from ending up in landfill, an organic ban is not the sole tool government can use to reduce food waste and to reduce its presence in landfills. Public outreach and food value chain coordination are a key instrument to be utilized to reduce and divert food waste. Ample research, consultations, programming, funding, provincial support, and behavioural shifts will be needed for an organic waste ban to be successful in Ontario, and for the food waste issue to be eliminated.

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