



**CIRCULAR
ECONOMY
GLOBAL
SECTOR BEST
PRACTICES
SERIES**

BACKGROUND MATERIALS FOR
CIRCULAR ECONOMY SECTORAL ROADMAPS

AGRI-FOOD
FEBRUARY 2021



**Smart Prosperity
Institute**

About Smart Prosperity Institute

Smart Prosperity Institute is a national research network and policy think tank based at the University of Ottawa. We deliver world-class research and work with public and private partners – all to advance practical policies and market solutions for a stronger, cleaner economy.

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Any errors or omissions remain the sole responsibility of the authors.

ABOUT THE CIRCULAR ECONOMY GLOBAL SECTOR BEST PRACTICES

This publication series aims to provide a starting point in the journey towards a circular economy. These materials are intended to be used as a background resource and rich reference source for future efforts to engage Canadian firms and innovators in this transition, and to build sector-based roadmaps to a circular economy in Canada.

Twelve core strategies for *rethinking* resource consumption and *optimizing* the use of resources to transition to a circular economy are detailed in the Introduction to the series. Real-world practices supporting these strategies are being catalogued for seven sectors, each profiled in its own document:

1. Minerals and Metals
2. Electronics
3. Agri-food
4. Construction
5. Plastics
6. Bio-economy
7. Automotive

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AGRI-FOOD

3.1. Introduction to Agri-Food

The Circular Economy Global Sector Best Practices series aims to provide a starting point, background resource, and rich reference source for future efforts to engage Canadian firms and innovators in the journey towards a circular economy, and to build sector-based roadmaps to a circular economy in Canada.

This report profiles the agri-food sector. It begins with an outline of the economic and environmental importance of the sector, including data on economic potential of waste resources where available. It then profiles the existing circular practices that were identified in the sector, organized according to a common framework for circular economy approaches and strategies developed in 2018 by L'Institut EDDEC in collaboration with RECYC-QUÉBEC, and described in the Introduction to the series. This profile begins with a high-level summary of the circular practices found in each sector, and snapshots of these practices in application, and then moves on to list applied, real world examples for each of these strategies and practices. It provides a list of additional resources for researchers, practitioners, and policy-makers, as well as selected global public policies, and an annotated bibliography of key reports specific to circularity for agri-food.

3.2. Background

Food demand will grow significantly as the world's population grows: feeding a world population of 9.1 billion in 2050 will require food production to increase by 70% from 2005 levels.¹ The demand for animal-based products is also expected to grow by 70% by 2050.² Yet, a third of all food produced globally is wasted each year, amounting to about 1.3 billion tonnes annually,³ enough to feed 3 billion people and worth an estimated C\$1.3 trillion.⁴ Additionally, the agri-food industry is responsible for almost one quarter of global greenhouse gas emissions.⁵

Currently, 56% of food waste occurs in developed countries.⁶ North America and Oceania waste the most calories per person, per day, more than twice as much as Europe, and more than 3 times as much as South and Southeast Asia.⁷ In Canada, 58% of all food produced is lost or wasted, amounting to 35.5 million metric tonnes.⁸ Of this waste, 11.2 million metric tonnes, worth C\$49.5 billion, could be prevented.⁹ Avoidable food loss and waste occurs throughout the supply chain. The top three sources of avoidable food loss and waste in Canada are manufacturing (23%), households (21%), and processing (20%).¹⁰ Preventing food waste in the supply chain could reduce the cost of food to

Canadian consumers by 10%,¹¹ avoid 56.5 million tonnes of CO₂ equivalent,¹² and reduce Canada's blue water footprint by 1.4 billion tonnes.¹³

Given the quantum of waste generated by the agri-food industry, there exists tremendous potential to reduce waste through more circular practices. Businesses have a large role in this transition. Globally, 50% of every dollar spent in the food industry is related to restaurants,¹⁴ and as the popularity of restaurants has grown, the restaurant industry has been a growing contributor to food waste. In Canada, restaurants and institutions waste food valued at C\$7.4 billion annually.¹⁵ In the United Kingdom restaurants generate nearly one million tonnes of waste every year, and three-quarters of this waste is edible food.¹⁶ This food waste costs the United Kingdom's hospitality and restaurant industry C\$4.3 billion annually.¹⁷

By 2050, 80% of food is expected to be consumed in cities. Cities therefore have a unique role in transforming the circular economy of food.¹⁸ For example, cities can collaborate with local food producers to source substantial amounts of food from peri-urban areas, which already hold 40% of the world's cropland, and increase the resilience of urban food systems.¹⁹ Cities can also enact municipally-run programs to educate their residents on the costs of food waste, as well as how to support circular economic practices and build relationships with local food producers.²⁰ Shorter supply chains can also be achieved through the development of urban hydroponic farms that deliver produce directly from rooftops to consumers.²¹

If cities were to enhance local and regenerative food production, use food waste and by-products efficiently, and provide easier access to more nutritious foods, an estimated C\$3.6 trillion in global annual benefits could be generated by 2050, including

over C\$920 billion in economic benefits.²² These approaches would also reduce greenhouse gas emissions by 4.3 billion tonnes of CO₂ equivalent and prevent the degradation of 15 million hectares of arable land.²³

There are also many improvements that can be applied to reduce both inputs and waste products in food production. In the UK, for example, all 1.6 million fields that provide agricultural goods are monitored for agricultural data to ensure that they are being managed in the most sustainable way possible.²⁴

3.3. Overview of Circular Economy Practices in the Agri-Food Sector

Agri-food companies have begun to invest in researching and implementing circular solutions to address food loss and waste. Figure 3-1 summarizes the specific practices employed in the agri-food sector, organized according to the four objectives for a circular economy and twelve core supporting strategies described in the Introduction to this publication series. Some of these are highlighted below. This is followed by a listing of applied examples of these strategies and practices, with hyperlinks to additional information. Canadian examples are denoted by a red superscript (^{CDN}).

Objectives, Strategies, and Practices

In the agri-food sector, a key focus of circular economy objectives is **REDUCED** resource consumption. One way to do this is by integrating **ecodesign** elements into corporate mandates. For instance, Arla dairy farmers have begun to design farms that reduce carbon emissions and improve sustainability through increased energy efficiency. Another way to reduce resource consumption is increased production efficiency through **process**

Figure 3-1. Circular economy objectives, strategies and practices found in the agri-food sector



Intensified product use



Responsible consumption and procurement



Consumer awareness



Discounting soon expiring food



Sustainable food choices



Sustainable procurement



Sharing economy



Cooperative supermarket



Food sharing



Short-term renting

None found



Maintenance and repair

None found



Donating and reselling



Surplus food recovery



Re-appropriation of surplus food



Refurbishing

None found



Performance economy



Meal subscription service



Industrial ecology



Agricultural industrial eco-park



Recycling and composting



Green bins



Nutrient recovery



Re-appropriation of food waste



Energy recovery



Biogas and electricity



Biofuel

Giving resources new life

optimization. Applications of process optimization include **shortening supply chains** to match supply to consumer demand thereby creating less unwanted food, and reducing transportation needs. Finnish restaurant Ultima, for example, grows its ingredients on its restaurant premises to eliminate waste packing and transport impacts. The use of agrimetrics yield trackers and food waste trackers are some other applications.

Responsible consumption and procurement, promoted through **consumer awareness** of sustainable food choices, can also help push forward circular economic practices. For example, WRAP's 'Love Food Hate Waste Campaign' in the UK, launched in 2007, was able to cut food waste by 21% in its first five years. This campaign was also launched in Canada, in 2018, by the National Zero Waste Council.

Other practices in this sector look to **OPTIMIZE** resource use through **intensified use of products.** One effective strategy to achieve this is by creating **sharing economies.** For example, **food sharing** projects, like the Community Fridge in Ottawa, provide an app-based platform for households and businesses to share surplus food with others to pick up, instead of it being wasted.

The agri-food industry is responsible for almost one quarter of global greenhouse gas emissions

Due to the perishable nature of food products, there exist limited ways of **extending their lifespan.** However, food can be diverted from landfills by **donating and reselling** surplus food. For example, Canadian grocery chain Metro applies the practice of surplus food recovery by donating 6 million meals to community organizations in 2018 through its food recovery program. Recently, the practice of meal subscription services has gained momentum and created opportunities for the **performance economy** in the sector. HelloFresh is one example of a subscription-based meal service that delivers fresh, pre-portioned ingredients and recipes to customers every week.

Finally, the agri-food sector has long been a leader in practices to **give resources new life** such as **recycling and composting programs.** The City of Guelph, for example, collects 10,000 tonnes of food products each year with its **Green bin** composting program, diverting 32% of organics from landfill. **Re-appropriation of food waste and surplus** is another technique. This can be done in a number of ways such as being made into fabric, as Orange Fiber is doing with orange peels, or turning food not fit for human consumption into animal feed. **Energy recovery** is yet another strategy used by the agri-food sector to give resources new life. Maple Leaf Foods diverted 5,486 metric tonnes of packaged meat waste to biodigesters in 2017, producing 2.1 million kWh of green electricity that was fed back into the Ontario electrical grid and that prevented 1,473 tonnes of CO₂ emissions. McDonalds France collects used cooking oil from its restaurants and transports it to a processing plant to make biofuel.

Agriprotein: Using insect agriculture to address food waste

Agriprotein is a South African company that uses insect agriculture to address food waste. Agriprotein feeds Black Soldier Fly larvae organic food waste. The Black Soldier Fly is able to increase its weight 200 times in ten days. Once the fly larvae reach their maximum size, they are dried and milled to remove fat and turned into an organic animal feed called MagMeal. Their fat is then converted into an oil used as a health supplement for animals, or as a biofuel. Remaining organic materials are transformed into nutrient rich compost and sold to local farms. Agriprotein can process 250 tonnes of organic food waste each day with their larvae (90,000 tonnes per year). This produces 5,000 tonnes of Magmeal, 2,000 tonnes of MagOil and 20,000 tonnes of MagSoil.²⁵

Loblaw: Reducing retail food waste

In 2018, Canadian grocery retailer Loblaw committed to reduce or divert their store-generated food waste by 50% before 2025. Loblaw has developed a wide variety of methods to achieve this goal including:²⁶

- Investing in inventory systems to ensure that the correct amount of food is ordered and cut down on unpurchased goods
- Expanding their network of food banks, donating more than 8.5 million pounds of food in 2018
- Directing stale or expired grocery goods to use in the making of grain-based animal feed
- Feeding trimming from produce and inedible organics to anaerobic digesters to generate electricity that can be used locally or be fed back into electrical grids
- Converting used cooking oil into biodiesel
- Investing in low-carbon intensive micro-livestock, like cricket flour

Ostara Nutrient Recovery Technologies: Converting wastewater nutrients into fertilizer

Ostara Nutrient Recovery Technologies is a Vancouver-based company that uses a unique nutrient recovery strategy that can be easily integrated into bio-based wastewater plants. Their 'Pearl Nutrient Recovery Process' captures up to 85% of the phosphorus and up to 15% of the nitrogen in wastewater. These captured nutrients are then transformed into pure fertilizer granules and used to make a nutrient rich fertilizer called Crystal Green. This fertilizer is a continuous release, root-activated product, which only releases nutrients when certain acids are given off by growing plant roots. Using Crystal Green in lieu of an equivalent standard fertilizer can eliminate up to 10 tons of CO2 emissions per one ton of fertilizer used.²⁷

Specific Examples: Objective 1, Reduced Resource Consumption



Ecodesign

Agroecology



- [Mulberry Fish Pond](#) model²⁸ in Southern China uses a traditional Vietnamese technique of farming that maximizes land and nutrient use. It integrates mulberry cultivation, sericulture, and fish farming to create a highly efficient human-made ecosystem with minimal waste.
- [Zero Budget Farming](#)²⁹ in India aims to reduce the risk of debt for smallholder farms. It has four pillars: create soil that contains beneficial microbes; prevent crop disease through natural seed coatings; protect and enhance topsoil through mulching; and make better use of water. Applying these pillars has reduced farming costs and improved crop yield by upwards of 40% for the 160,000 farmers practicing the technique. By 2024, they aim to scale up to 6 million zero-budget farmers.
- [Agroforestry](#)³⁰ is an agriculture technique widely used in Brazil and other parts of South America. It refers to any technique that combines forestry with agriculture or livestock. Forest management, e.g., pruning, produces organic matter that nourishes the soil and helps crops grow. The resulting system is highly biodiverse and productive.

- [Seawater Farming](#)³¹ is an innovative technique that addresses the lack of freshwater and undesirable soil conditions in coastal regions. The technique was successfully applied to create a productive fish farm in Eritrea.
- [3D Ocean Farming](#) by GreenWave³² is an American organization spearheading vertical farming made possible by 3D printed structures to grow scallops, clams, oysters, seaweeds, and kelps at different depths of the water column. Thimble Island Ocean Farm applies this technique and produces 30 tonnes of seaweed and 250,000 shellfish every five months. Farming less than 5% of US waters with this technique could sequester 135 million tons of carbon and 10 million tons of nitrogen.

Energy efficiency



- [Arla Foods dairy farm](#)³³ in Denmark uses the heat of milk to heat the underfloor of the farmhouse. Warm air is generated when the fresh milk from the cows is cooled from 37°C to 4°C. It is then pumped from the milk tank to the farmhouse.

Zero waste grocery stores



- [Nu Grocery](#)³⁴ is an Ottawa-based grocery store that strives to eliminate packaging waste. Customers bring reusable containers to the store which they can then fill with the exact quantity of goods they wish to purchase.

Zero waste grocery delivery



- [Loblaw Companies Limited and Loop](#)³⁵ CDN launched a pilot program in 2021 that will deliver select products in reusable containers right to the door of customers. When finished with the product, the packaging is collected, cleaned, and refilled by Loop.

The Ideal

- Sustainable agricultural production techniques are mainstreamed
- Packaging waste and food waste are eliminated from the food supply chain



Process optimization

Shorter supply chains



- [Lufa Farms](#)³⁶ CDN is a Montreal-based urban farming company that runs three commercial rooftop hydroponic greenhouses. They deliver food from these rooftops directly to company partners and homes.
- [Ultima](#)³⁷ is a Finnish restaurant that grows its ingredients on its restaurant premises to eliminate waste packing and transport impacts. The restaurant is an eating space and a productive lab for hydroponic and aeroponic cultivation systems.

Digital food waste tracking



- [Winnow](#)³⁸ is an international software company that enables large commercial kitchens to monitor their food waste. It helps identify why and where waste is happening so that appropriate operational decisions can be made to minimize it. IKEA installed Winnow in 35% of their kitchens and saved an estimated 1 million meals within a few months.³⁹

Agrimetrics yield tracking



- [Field Explorer](#)⁴⁰ is a data product by Agrimetrics, a leading UK company in agriculture data. It provides data on all 1.6 million fields in the UK including field facts, field trends, and field forecasts. This tool ensures the most sustainable and efficient management and use of agricultural fields.

Quality control



- [The Provision Coalition](#)⁴¹ CDN is an organization in Guelph, Ontario that aids food and beverage companies increase their revenues through the implementation of sustainable practices. This is done through increasing revenue streams, finding methods to reduce costs and elevating brands through greater transparency.
- [The Calgary Italian Bakery](#)⁴² CDN is one of the largest independent bakeries in Western Canada. They are working on improving their bread line dough transfer and English muffin quality consistency (approx. 50% of their English muffin waste is characterized as deformed or misshaped). If fully realized, they will save 50,000 kg of bread dough per year.

The Ideal

- Continued growth in each of these practices.
- Food systems move away from a produce, batch, and queue standpoint to a lean production chain. This approach would match capacity to customer and consumer demand and reduce cycle time.
- Improved forecasting of consumer demand.
- Build gleaning networks to recover vegetables and fruit that would otherwise be left to rot or turned under in-field.
- Ensure that inventories in the food supply chain are appropriately sized and stored in ways that rescue spoilage.



Responsible consumption and procurement

Consumer awareness



- [The 'Re-Imagine Food' Campaign](#)⁴³ CDN by the City of Guelph aims to educate residents on the real costs of food waste, boost demand for circular economy productions, and build stronger relationships between food producers and consumers.
- [Waste and Resources Action Programme's](#) (WRAP) [Love Food Hate Waste Campaign](#)⁴⁴ is a UK food waste reduction campaign introduced in 2007 that helped cut 21% of household food waste in its first five years. Since its launch, it has helped save UK consumers 13 billion pounds by teaching people how to reduce food waste.
- [Metro Vancouver](#)⁴⁵ CDN partnered with WRAP UK to launch the first Canadian branch of the Love Food Hate Waste campaign. The campaign aims to help people reduce food waste at home, provide storage tips to elongate food life, help with portion calculation to determine how much of each ingredient to buy, and provides seasonal menus. The campaign has numerous partners, including Sobeys.

Discounting soon-expiring food



- [Walmart](#)⁴⁶ CDN offers discounted repacked bruised or peak freshness produce through their \$1/\$2 Bag Program. They also reduce prices through their Customer Value Program to allow for the quick sale of fresh meat, bakery, dairy, and produce items approaching their best before dates. Walmart is committed to achieving zero food waste by 2025.

- [Loblaws](#) partners with Flashfood⁴⁷ ^{CDN}, an app that allows customers to purchase food items nearing expiration at a reduced price of up to 50% off at select Loblaws grocery stores.
- [We-Food](#)⁴⁸ is a charitable organization in Denmark that operates a supermarket selling food that is past the best before date. Operated by volunteers, We-Food has diverted an estimated 125 tonnes of food by 2016 from Danish landfills.
- [FoodHero](#)⁴⁹ is an app run in partnership with IGA that allows customers to purchase food that is nearing expiry. The app also tracks the amount of money saved by the customer from purchasing discounted food, as well as the amount of CO₂ emissions that have been curbed from avoiding food waste.

Sustainable food choices



- [Loblaw](#)⁵⁰ ^{CDN} has been selling cricket flour since 2018 in its stores across Canada. This is an option for consumers who want to lower the environmental impacts of their consumption.

Sustainable procurement



- [Westbury Street Holdings](#)⁵¹ is a firm in the UK that facilitates supply chain management from agricultural suppliers to restaurants and grocery stores with sustainability at the forefront. They do so by working with producers that meet or exceed environmental standards as a part of accreditation schemes.

The Ideal

- Continued growth in each of these practices, especially in sustainable food choices.
 - Limit the number of labels in use. As suggested by the Consumer Goods Forum, the ideal labeling codes are: 'best if used by' as a quality-based date and 'use by' for food with safety concerns.
 - Promote the purchase of imperfect looking fruits and vegetables.
 - Include motivational messaging on packaging to motivate sustainable behaviour.
 - Use storage advice on packaging where possible (i.e., for bananas 'store in a cool, dry place').
-

Specific Examples: Objective 2, Intensified Product Use



Sharing economy

Cooperative supermarket



- [BEES Coop](#)⁵² in Brussels is a cooperative supermarket where the customer is a co-operator. The co-operator commits themselves to working 3 hours per month within the supermarket and in return can shop at the supermarket. The supermarket gives priority to local producers, ecologically-grown products, and seasonal products. They promote bulk food to reduce packaging waste and promote food saving behaviour.

Food sharing



- [FoodSharing](#)⁵³ is an online platform that saves and distributes surplus food in Germany and Austria. It is entirely volunteer run. Any individuals, retailers and producers can offer or collect food that would otherwise be thrown away. Food must be passed on for free before its expiry date.
- [The Community Fridge](#)⁵⁴ ^{CDN} is a pilot program by Food Sharing, a non-for profit organization in Ottawa, Canada. The fridge will enable residents and businesses to share surplus food and for anyone to help themselves to quality food that would otherwise be wasted. Vegetables, bread, and sandwiches are all accepted. Raw meat, fish, or eggs are not. 'Home cooked' food is not accepted, only food prepared and cooked in registered food businesses.

The Ideal

- Continued growth in each of these practices.
-



Short term renting is not significantly addressed by the sector.

The Ideal

- Given the nature of agriculture and food, this strategy is not applicable to this sector.
-

Specific Examples: Objective 3, Extending Life of Products and Components



Maintenance and repair is not significantly addressed by the sector.

The Ideal

- Given the nature of agriculture and food, this strategy is not applicable to this sector.
-



Donating and reselling

Surplus food recovery



- [Food Mesh](#)⁵⁵ CDN is a tech platform that connects, coordinates, and tracks food recovery through their online marketplace and food recovery program. Retailers donate their perishables to Charity 'Hubs' that share their donations with other charities and local farmers.
- [Bourse aux Dons](#)⁵⁶ is a digital platform in Brussels, Belgium that matches fresh produce collected by the DREAM project to over 50 charities across the city. The DREAM project collaborates with 20 professional merchants from the early morning market in Brussels to collect over one ton of excess fruits and vegetables every day.
- [Metro](#)⁵⁷ CDN has, through their food recovery program One More Bite, donated the equivalent of over 6 million meals in 2018. This is equivalent to more than 3,000 tonnes of food, a 90% increase from 2017.
- [La Tablée des Chefs](#)⁵⁸ is a Montreal-based program that began in 2012 by providing culinary educations to youth but quickly expanded to developing a food recovery program. They launched programs in Vancouver, Calgary, France, and Mexico, recovering almost 250,000 portions of food in 2013 alone.

Re-appropriation of surplus food



- [Toast Ale Beer](#)⁵⁹ is a British company that uses surplus bread from bakeries all over London to make their beer.

- [Loop](#)⁶⁰ is a Finnish restaurant that collects 600kg of surplus food each day from six suppliers and supermarkets. It uses this collected food to create high quality canteen food, gourmet meals, and artisanal ice cream. Any remaining edible food is directed to charities or composted.
- [Boomerang](#)⁶¹ CDN is a Canadian company that produces flour from from brewing residues. In addition to reducing food waste, this product reduces the transportation, agricultural land and water required for flour production, thus reducing its carbon and water footprints

The Ideal

- Set up food hubs to help reduce distribution distance and reduce food spoilage due to transportation.
 - Reduce risk of liability which may disincentivize businesses from donating food.
-



Refurbishing is not significantly addressed by the sector



Performance economy

Meal subscription service



- [HelloFresh](#)⁶² is an international subscription-based meal service that delivers fresh, pre-portioned ingredients, and recipes every week. By pre-portioning ingredients, they help reduce household food waste.

The Ideal

- Meal subscription services deliver more nutritious and affordable meal boxes and reduce their packaging waste
-

Specific Examples: Objective 4, Giving Resources New Life



Industrial ecology

Agricultural eco-industrial parks

- [National Economic Technological Development Area](#) (NETD)⁶³ in Zhengzhou, China is an agri-industrial park. It produces small- or medium-sized and low-emission farm vehicles and agricultural machinery, and processes agricultural products from regional rural areas. It also provides technical guidance and information services to meet the demand for rapid development of agriculture.

The Ideal

- Agricultural Eco-Industrial Parks are still very much a theoretical concept. The ideal park would be a region of industrial symbiosis involving various types of agriculture-related enterprises, cooperative organizations, farmers, villages, and farmland.



Recycling and composting

Green bin program

- [The City of Guelph's Green Bin Program](#)⁶⁴ ^{CDN} collects 10,000 tonnes of food by-products each year, diverting 32% of organics from landfill.

Nutrient recovery

- [Ostara Nutrient Recovery Technology](#)⁶⁵ ^{CDN} is a Vancouver-based company that recovers 85% of the phosphorous and up to 15% of the nitrogen in wastewater, transforming these recovered materials into a high value fertilizer product called 'Crystal Green'.
- [Lystek Inc.](#)⁶⁶ ^{CDN}, contracted by the City of Guelph, converts and manages the 4,500 tons of biosolids generated each year by the city's wastewater treatment facility. It converts these biosolids into commercially viable liquid organic fertilizer.

Re-appropriation of food waste

- [Oreka Solutions](#)⁶⁷ ^{CDN} is a Wellington-based company that collects food waste and feeds it to black soldier flies. It then converts the flies into three products: a solid fertilizer that enhances the soil's microbiome, a liquid biofertilizer for aquaponic growing solutions, and a feedstock for fish, pigs, and chickens.
- [Agriprotein](#)⁶⁸ is a South African company that uses Black Soldier fly larvae fed on discarded organic waste material to produce highly nutritious feed, nutrient rich compost, and oil.
- [Orange Fiber](#)⁶⁹ uses 50% cellulose fibre from orange peels collected from organic waste that would otherwise be sent to landfill. The patented fabric is being used by Italian brand Salvatore Ferragamo.
- [Arla Foods](#)⁷⁰, a dairy company in Scandinavia, sends 100% of their food waste no longer fit for human consumption from their largest factory to animal feed instead of anaerobic digestion.
- [BioBean](#)⁷¹ in the UK is the first company to industrialize the process of recycling waste coffee grounds into biomass heating briquettes and pellets. It heads the world's first coffee recycling factory⁷² and is researching biochemicals made from coffee grounds.
- [Loblaws](#)⁷³ ^{CDN} directs stale or expired grocery goods to be used in the making of grain-based animal feed.

The Ideal

- Continued growth in each of these practices.
 - Directing nutrient flow from wastewater, strengthening soils, and reducing reliance on artificial fertilizers.
 - Improving access to green bin and composting programs.
-



Energy recovery

Biogas and electricity

- [Maple Leaf Foods](#)⁷⁴ CDN diverted over 5,486 metric tons of packaged meat waste to StormFisher bio-digesters in 2017 to generate electricity. This produced over 2,178,000 kWh of green electricity that was provided back to the Ontario grid. This prevented over 1,473 tons of CO₂ emissions and produced over 390 metric tons of organic fertilizer.
- [The Billund Biorefinery](#)⁷⁵ in Denmark treats organic waste from agriculture, industry, and local households. It generates biogas and transforms it into electricity and heat. The leftover nutrients are then used to make an effective organic fertilizer.
- [Sainsbury superstore](#)⁷⁶ in Cannock, UK runs entirely on power produced from the food waste the store generates. A cable links the store to the nearest anaerobic digestion facility, providing a direct supply of renewable energy.

Biofuel

- [McDonalds France](#)⁷⁷ collects used cooking oil from its restaurants and transports it to a processing plant to make biofuel. The trucks that collect the cooking oil run on the produced biofuel.
- [Rothsay](#)⁷⁸ CDN is a Wellington-based company that turns old cooking oil, grease trap maintenance, and meat by-products from restaurants, retailers, processing facilities, and livestock raising into biofuel.

The Ideal

- Continued growth in each of these sectors
 - Improved energy infrastructure to better suit flows of organic waste to be turned into biogas and electricity.
-

3.4. Additional Resources

The following are additional resources that researchers, practitioners, and policy-makers can draw on to further advance awareness and understanding of opportunities for circularity for Canada's agri-food sector.

Selected Global Public Policies Supporting Agri-Food Circularity

- *Italian Gadda Law*: Passed in 2016, this law encourages businesses to give surplus food away for free through tax breaks, campaigns, and the streamlining of bureaucracy.⁷⁹
- *EU's Landfill Directive*: Created in 2003, calls for a reduction in the amount of biodegradable municipal solid waste disposed to landfill.⁸⁰
- *EU's new Circular Economy Action Plan*: Adopted in 2020, contains a section specifically pertaining to how circular economic practices can be implemented to better Europe's food, water, and nutrient resources.⁸¹
- *Nova Scotia's landfill ban*: Announced in 2017, placed a landfill ban on compostable organic material.⁸²

Selected Documents on Circular Economy and Agri-Food Sector

Understanding international food waste and the global circular economy of food

Commission for Environmental Cooperation. (2017). *Characterization and Management of Food Loss and Waste in North America*. Retrieved from <https://web.archive.org/web/20201016234500/http://www3.cec.org/islandora/en/item/11772-characterization-and-management-food-loss-and-waste-in-north-america>

With the goal of reducing food waste in the North American commercial, industrial, and institutional sectors, this comprehensive report proposes wide-reaching strategies to reduce and recover food loss and waste throughout the supply chain. It provides estimates of food loss and waste, and its environmental and economic impacts for Canada, the United States, and Mexico, and outlines opportunities and considerations for each of these countries in efforts to reduce food waste.

Ellen MacArthur Foundation. (2019). *Cities and Circular Economy for Food*. Retrieved from <https://web.archive.org/web/20201207132248/https://www.ellenmacarthurfoundation.org/publications/cities-and-circular-economy-for-food>

This report, first presented at the World Economic Forum Annual Meeting in 2019, outlines a vision for a new, global food system for cities, where 80% of all food is projected to be consumed by 2050. Built upon circular economy principles, this report pictures a system in which food is produced locally in a way that regenerates natural systems, the economy makes use of food by-products, and healthier food is produced. The report predicts that achieving these goals could create global benefits worth over C\$3.5 trillion per year.

Understanding Canadian food waste and the Canadian circular economy of food

City of Guelph & County of Wellington. (n.d.). *50x50x50 by 2025: Creating Canada's first circular food economy*. Retrieved from https://web.archive.org/web/20201207132631/https://guelph.ca/wp-content/uploads/SmartCities_Booklet.pdf

The City of Guelph and County of Wellington aim to be Canada's first circular food economy through their 50x50x50 by 2025 initiative, which sets targets for increasing access to affordable, nutritious food, creating circular economy businesses in the food sector, and increasing revenue by recognizing the value of waste. This plan, which won C\$10 million in Infrastructure Canada's Smart Cities Challenge, outlines specific projects to help achieve each of these goals, and aims for the city and county to be a place where stakeholders can collaborate to implement circular economy principles within the food sector.

National Zero Waste Council. (2018). *A Food Loss and Waste Strategy for Canada*. Retrieved from <https://web.archive.org/save/http://www.nzwc.ca/Documents/NZWCFoodLossWasteStrategy.pdf>

Building on previous submissions of a strategy to the federal government, the strategy presented in this report achieved broad support during consultations with over 900 stakeholders. It calls for a national effort to halve per capita food waste in Canada by 2030 through policy change, innovation, and behavior change. The report identifies key actions, which include implementing a national target for food loss and waste reduction, harmonizing government policies, and developing new markets and products, while emphasizing the need for collaboration between stakeholders.

Nikkel, L., Maguire, M., Gooch, M., Bucknell, D., LaPlain, D., Dent, B., . . . Felfel, A. (2019). *The Avoidable Crisis of Food Waste: The Roadmap*. Second Harvest and Value Chain Management International. Retrieved from <https://web.archive.org/web/20201207133115/https://secondharvest.ca/research/the-avoidable-crisis-of-food-waste/>

In consultation with over 700 food industry experts, this first-of-its-kind report measures and identifies key causes of food loss and waste throughout the Canadian supply chain, from production to end-of-life for all food types. Finding that almost 60% of food in Canada is wasted, and that the value of potentially rescuable food is nearly C\$50 billion, the report identifies potential solutions at each stage along the supply chain, which include, for example, removing insurance clauses that prevent farmers from donating damaged but still edible crops. It also introduces immediate and future solutions and actions for industry, industry organizations, and governments.

Communicating the importance of reducing food loss and waste

Further with Food. (2019). *Overcoming Resistance to the Measurement of Food Loss and Waste*. Retrieved from <https://web.archive.org/web/20200925224521/https://furtherwithfood.org/resources/overcoming-resistance-measurement-food-loss-waste/>

In their efforts to set targets to measure and reduce food waste, businesses can experience resistance from staff and suppliers while adjusting to this cultural change. This diagnostic tool outlines common concerns during a transition to measuring waste, and suggests possible responses to alleviate specific concerns by communicating the rationale for measurement and the potential benefits to be gained.

3.5. Conclusion to Agri-Food

This global scan of best circular economy practices in the agri-food sector reveals that selected firms and operations are already implementing a wide range of practices that support circular economy objectives and strategies, whether or not these practices are explicitly identified as circular. However, a more widespread adoption of such strategies and practices will be key to reduce the current levels of food loss and waste, while also meeting the growing demand for food. With over half of the food produced in Canada currently lost or wasted, the sector has tremendous potential to recapture lost economic value and become more circular.

In cataloguing these examples, our intent is to demonstrate real-world strategies and practices that offer a starting point in the journey towards a circular economy. This information is offered as a background resource and reference source for future efforts to engage Canadian firms and innovators in the journey towards a circular economy, and – ideally – to begin building a Canadian agri-food sector roadmap to a circular economy.



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