



# PROVISION COALITION

PROCESSING FOOD SUSTAINABLY

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## Food Loss and Waste Solutions: Innovative Technologies and Best Practices

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## Introduction

According to the United Nations Food and Agriculture Organization (FAO), more than one third of all food produced globally is wasted or lost ( Food & Agriculture Organization of United Nations, 2016). In Canada, the equivalent of 30 to 40 per cent of the food produced is lost or wasted along the value chain, with the majority ending up in landfill or composting. This food waste is worth an estimated \$31 billion each year (Uzea, Gooch, & Sparling, 2014).

Food waste refers to the food that is lost at the end of the food value chain (wholesale distribution, retail, foodservice and in households). Food loss refers to food that gets spilled or spoiled before it reaches its final product (Uzea, Gooch, & Sparling, 2014).

Currently, existing literature discusses the food waste problem and the significance surrounding it, however, there is very limited literature discussing the solutions to these problems. With more education and awareness being placed on the issues surrounding food waste, emphasis has been placed on finding and developing strategies and solutions to food waste at all levels of the value chain. This identifies significant opportunities for businesses along food value chains to streamline their operations, reduce food waste, and increase profit, while making better use of scarce resources, managing risk, and reducing their environmental footprint (Uzea, Gooch, & Sparling, 2014).

## Objective

This paper seeks to identify the opportunities, innovative technologies and best practices that are available or will become available in the marketplace to address food loss and waste. Food waste is a priority to Provision Coalition and we have identified it as an opportunity to create transformational change in the food and beverage sector. Throughout this paper, Provision's work in food waste will be highlighted including our food waste toolkit and pilot studies that have been or are currently being conducted.

## Motivation in Research

The motives behind this paper include the following:

- There is a need for literature that identifies solutions rather than being limited to the problem of food waste. This paper will help provide this much needed data on food waste solutions.
- Solutions and best practices within this paper can be tabled at Canada's 2017 Food loss & Waste Forum | Finding Solutions, which is to be held in April 12, 2017.
- Businesses need help collaborating and identifying solutions that can reduce the amount of waste they produce and thus minimize their environmental impact.

## Scope and Delimitation of Study

### *Geographical*

The majority of the solutions presented in this paper are based in Canada or North America. However, since food waste is a global issue and it is highly feasible for international solutions to be applied at a national level, international solutions are also presented in this paper.

### *Value Chain*

This paper will discuss food waste solutions for all members of the value chain. There is a need for a value chain approach to addressing food loss and waste since it occurs at all levels of the value chain. Therefore, the responsibility for addressing food waste lies with all members of the value chain. Having a value chain approach also has the potential to produce economic, environmental, and social benefits that go beyond those which can be achieved by individual businesses working in isolation (Uzea, Gooch, & Sparling, 2014). Since different

factors influence food loss and waste at different stages of the value chain, this paper will identify what member of the value chain each solution is ideal for.

The first section of each part of the solutions will discuss general solutions and best practices for all members of the food value chain with the exception of manufacturers. The second section will discuss solutions and best practices for manufacturers in particular. The manufacturers have a separate section to help Provision Coalition's members easily identify the solutions most relevant to them.

### *Food Loss and Waste Solutions*

The food loss and waste solutions and best practices are split into three parts: solutions in food waste reduction, solutions in food waste diversion, and solutions in food waste composting. The waste management hierarchy and the waste recovery hierarchy were used as a basis for the creation of these three parts. Both hierarchies emphasize the priority of waste reduction, or in other words, addressing the sources and causes of waste. When food waste cannot be avoided, efforts should be made to redistribute the food waste. Hence, the second part of the paper will focus on food waste solutions in diversion. The third part of the paper is based on the third best option in the hierarchy, which is to recycle through composting or anaerobic digestion.

## **Methodology**

The method that has been used in this research paper is literature review. The paper will have applied research rather than fundamental research. Meaning this paper does not intend to focus on the details of the food waste issue itself - as there is already a substantial amount of literature surrounding this topic. Instead, the paper aims to find solutions for the food waste issue facing society and businesses.

In addition, this paper is descriptive in nature; focusing on listing and providing a description of the various solutions and best practices. There will also be a section discussing the barriers to adoption for these solutions, and recommendations for the better implementation of solutions.

## **Part 1: Solutions in Food Waste Reduction | Innovative Technologies and Best Practices**

This section of the paper will focus on food waste solutions at the source reduction level of the waste recovery hierarchy. The main objective of the source reduction level is to reduce the volume of surplus food generated. The most optimal solution to food loss and waste is preventing the loss from happening in the first place. There are many solutions available to help both businesses and individuals learn to effectively prevent the flow of wasted food.

### **General solutions/best practices:**

#### ***Solution 1: FoodFully App***

More information available at: <http://foodful.ly/>

Foodfully is an app that allows the consumer to put their grocery items into an app which will then notify them when the items in their fridge are close to spoilage. The consumer is also able to prioritize food in the app in relation to how quickly they will spoil. The app can take this information and create a list of recipes, which help consumers eat food that may have otherwise spoiled. In addition, the Foodfully app calculates the worth of food that has been registered in the app. If the food spoils, it will notify the individual of the cost of food they have thrown away. This is to incentivize consumers to be more conscious of the amount of food they purchase and the expiration on those items.

#### ***Solution ideal for: Consumers***

### ***Solution 2: Best Practice: Consumer education campaigns***

More information available at: <http://www.refed.com>

Retailers may benefit from increased consumer education as consumers have a direct impact on reducing food waste. With increased awareness, consumers may demand businesses to operate more sustainably and make more conscious decisions when it comes to producing food waste. Media campaigns in retail stores, such as signage and messaging related to waste, can provide consumers information about products and packaging that contribute to food waste, and potential measures that can be taken to prevent food waste. For instance, in 2015, Walmart had set up a video campaign in their checkout lanes to explain to consumers the various methods they could use to reduce food waste in their own homes.

***Solution ideal for:*** Retailers

***Barriers specific to this solution:*** Consumer behavior change for food waste or any issue requires a long time and may also be difficult to track impact. This makes it difficult to make the initial investment into these campaigns.

### ***Solution 3: Best Practice: Reduce portion sizes at restaurants***

More information available at <https://www.refed.com/>

Directly and indirectly reducing portion sizes has many benefits as it allows for a reduction in food waste and the potential for food providers to save money. In addition to restaurants and other retailers offering larger portion sizes, it may be a beneficial practice to also offer smaller portion sizes at a lower price. This approach would allow customers who may have smaller appetites to produce less food waste as they have the option to order less food. In addition, it would also lower the costs to restaurants as there would be less cost associated with preparation of the smaller meals. In addition, retailers can also post informational signs in buffet-style retail stores. These signs can be focused on reminding customers to take only as much food for which they have the appetite.

***Solution ideal for:*** Retailers, Food Service

### ***Solution 4: Nanotechnology – application of hexanal***

More information available at <http://news.uoguelph.ca/>

The Ontario Agricultural College at the University of Guelph has researched into a nanotechnology-based application of hexanal that can help keep fruits fresh longer. The research was conducted by Jay Subramanian, plant agriculture professor and his team of biotech scientists that converted the hexanal, a natural plant extract that prevents fruit spoilage, into a food spray. This enzyme-inhibiting hexanal slows ripening by preserving a fruit's cellular walls. This can result in an extended shelf life of as much as 50 per cent. In their studies, they have also calculated how long certain fruit can be kept fresh up to. For instance, they determined that mangoes can be kept fresh up to 23 days, bananas up to 40 days and peaches and nectarines last another 10 days beyond their current single week.

***Solution ideal for:*** Producers

### ***Solution 5: Flashfood App***

More information available at: <http://flashfood.com/>

Flashfood is an app that is meant to be like a “discount food rack on your cellphone”. Grocery stores, restaurants and food vendors are able to resell their surplus food through the app preventing retailers from throwing this food away. Consumers can also use this app to purchase the surplus food and pick it up later that day. The specific logistics of the app are reportedly remaining in the works. The tech startup's ambitious plan is to eventually expand throughout Canada and then go global.

**Solution ideal for:** Retailers, Consumers

### **Solution 6: Ubifood App**

More information available at: <http://www.ubifood.ca/>

Ubifood's founder, Caroline Pellegrine, created an app that connects consumers and retailers. The app can be used by retailers to register any surplus food they may have. This food is then advertised and available for consumers to purchase. The app is also able to provide consumers with personalized offers based on their preferences and location as the app has capabilities to provide consumers with geolocation-based real-time push notifications on discounted food in their area. It is currently exclusively in Montreal, but there are plans for the App to expand throughout Canada.

**Solution ideal for:** Retailers, Consumers

### **Solution 7: Arctic Apple**

More information available at: <http://www.arcticapples.com/>

Arctic Apples are the first approved biotech apple that is able to resist browning when sliced or bruised. This is due to the genes that trigger the oxidization process being replaced with non-browning ones. There are very limited safety concerns with Arctic Apples, as the Canadian Food Inspection Agency has said that Arctic Apples are as safe and nutritious as traditional apple varieties. Similarly, Health Canada concluded the GMO apple is safe for consumption and still has all its nutritional value, so therefore does not differ from other apples available on the market. They're scheduled to begin distribution in North America in 2017 and 2018.

**Solution ideal for:** Consumers, Retailers

### **Solution 8: Bluapple**

More information available at: <http://www.thebluapple.com/>

Bluapple products are recent innovative technologies that help consumers extend the shelf life of their produce. Bluapple products are able to absorb ethylene gas which is the gas responsible for ripening fruits and vegetables. When Bluapple products are placed in the refrigerator or other storage areas, they are able to absorb ethylene gas allowing fruits and vegetables to remain fresh longer. Bluapple is able to absorb ethylene gas for three months in a typical setting, and once it has reached its capacity it can be refilled or replaced.

**Solution ideal for:** Consumers

## ***Solution 9: Misfits Program***

More information available at: <http://www.misfitsproduce.ca/>

The Misfits program allows farmers to sell imperfect produce that does not meet strict grocery store standards. For instance, apples may be slightly bruised or misshapen, but are still nutritious. This imperfect produce is then sold at retail locations at a 30 – 50 percent discount. The Misfits program is currently available in some Shoppers Food & Pharmacy stores, all Save-On-Foods in Alberta, Saskatchewan and Manitoba, and is expanding to other retailers. With the Misfits program, farmers have an outlet to sell more produce, and customers have an opportunity to save money and help reduce waste.

***Solution ideal for:*** Producers, Retailers and Consumers

## ***Solution 10: Best Practice for Retailers – Improving Inventory Management***

More information available at: <https://www.refed.com/>

There is an opportunity for retailers to make adjustments to improve their inventory management. Retail inventory management systems should be able to track the average time a product is able to stay on the shelf before it needs to be taken off (a product's remaining shelf-life). This can help inform efforts to reduce how long an item has gone unsold. Retailers can increase the effectiveness of inventory management systems by adding data on food donation levels as well as the quantity of any food waste and reasons for food being disposed of. In addition, retailers can use inventory systems to help set corporate, individual buyer and store manager goals to reduce waste levels. In addition, they can develop better forecasting and share the data transparently throughout the supply chain to better match supply and demand.

***Solution ideal for:*** Retailers

## ***Solution 11: BBH Ventures***

More information available at: <http://www.bbhventures.com>

BBH Ventures primarily seeks out B2B solutions for fragmented market segments. Currently, they are working towards reducing food waste and improving efficiency within the food value chain by developing a dynamic web based portal, known as [www.shelflifefoods.com](http://www.shelflifefoods.com), to connect suppliers to buyers of short-dated, surplus and time sensitive food. This allows buyers to have access to products that were previously not available to them.

***Solution ideal for:*** Producers, Retailers

## ***Solution 12: Sustain Ontario: Food Waste Toolkit for Households***

More information available at: <https://sustainontario.com>

Sustain Ontario has developed and launched a toolkit directed at helping minimize food waste. This toolkit, "Reducing Household Food Waste: A Municipal Regional Toolkit", is a resource that is not only targeted towards households and consumers, but is also available for municipal and regional government, food policy councils community groups and other not-for-profit organizations. The toolkit focuses on providing information about existing initiatives and suggests methods for reducing household food waste.



**Solution ideal for:** Consumers

### **Solution 13: Waste and Resources Action Program (WRAP)**

More information available at: [wrap.org.uk](http://wrap.org.uk)

The Waste and Resources Action Programme (WRAP) works with several entities, including governments, business and consumers, to improve resource efficiency by providing practical solutions. WRAP helps businesses and the community by educating them on food waste and their consumption/food wastage patterns, methods they can implement to reduce their food waste, and how to achieve greater resource efficiency in general.

**Solution ideal for:** Consumers, Retailers

### **Solution 14: FoodKeeper App**

More information available at: [foodsafety.gov](http://foodsafety.gov)

The FoodKeeper app is designed to help households better understand food and beverage storage. It educates the user on how long various food categories, such as baby food, baked goods, and dairy products can be safely stored in the refrigerator and freezer. With a greater understanding of how to store food and beverages, users are able to maximize the freshness and quality of items, preventing early food spoilage and reducing waste.

**Solution ideal for:** Consumers

### **Solution 15: Creabox Inc.**

More information available at: <https://www.creabox.ca/en/> and <https://www.adevorer.ca/en/>

Creabox Inc. offers creative, innovative and sustainable solutions for businesses. The Montreal based team is working with retailers to reduce food waste and boost store revenues. One of the products, called Devourit! (À dévorer!), uses proprietary technology to automatically create delicious recipes with food nearing expiry that retailers would normally have to waste. These recipes are then turned into healthy and easy to prepare meal kits for consumers to buy directly in stores. Creabox offers a solution tailored to individual stores' needs and product availability while making it easy to scale across entire retail chains to have a greater impact.

**Solution ideal for:** Retailers and consumers

## **Solutions and best practices specific to manufacturers**

### **Solution 1: Best Practice: Standardizing date labeling system**

More information available at: <https://nrdc.org/>

There is a need within the food and beverage industry for best practices associated with date labelling. At the current moment there is no standard date labeling system. Although policy makers will need to develop a

standardized labeling system, manufacturers can help initiate this action. Current date labeling practices on food packaging cause confusion with “sell-by,” “best-by,” “use-by,” and “best before” dates, leading up to 90% of Americans to occasionally throw out still-fresh food. These dates all refer to food quality or the flavor of the food, not food safety, which measures whether or not the food could potentially cause illness when eaten. However, since consumers may not be aware of the difference between the labelling terms, they often misperceive these dates to be a measure of food safety. This misperception may lead consumers to throw away edible food they believe is no longer safe to eat. Manufacturers and retailers may be able to pressure change as to what types of dates appear on a package. In particular, labels that provide additional clarity to consumers are essential. Furthermore, manufacturers of food products could move to a “closed date” system, which would replace a “sell-by” date with a code that can be scanned or read by the manufacturer and retailer, but not by the consumer. This would prevent consumers from misinterpreting a date on a package and throwing the item away prematurely. Since there would be no date to misinterpret, consumers would instead rely on their own assessment of the food.

### ***Solution 2: Evaporative coolers***

More information available at: <http://www.fao.org>

Evaporative coolers extend the shelf life of food and avoid spoilage by keeping food at lower-than-room temperatures without having to use electricity. This low-cost, low-energy technique provides an opportunity to store perishable foods longer in areas that lack electricity infrastructure or have low-income farmers. When air passes over a wet surface, water from the surface evaporates into the air. As the water evaporates, it withdraws heat from the surface, creating a cooling effect upon that surface. An example of an evaporative cooler is the zero energy cool chamber (ZECC), which consists of two brick walls, one nested inside of the other, with the cavity between the two filled with wet sand. The external wall is submerged in water before construction in order to soak the bricks and then is removed for construction. The chamber has a cover constructed out of bamboo and an awning to avoid direct sunlight or rain.

### ***Solution 3: Purdue improved cowpea storage***

More information available at: [ag.purdue.edu](http://ag.purdue.edu)

Damage from pests is a major source of food loss during the handling and storage phase of the supply chain. For instance, cowpeas are important for many smallholder farmers due to the cowpeas’ ability to adapt to dry, hot conditions. However, damage to cowpeas from insects can result in lower prices for farmers and even in outright loss of the crop. Researchers at Purdue University in the United States have worked to reduce this damage by developing a simple reusable plastic storage bag, the “Purdue Improved Cowpea Storage” (PICS) bag. PICS uses three bags nested within each other, with the innermost bag holding the crop being stored. After the bag has been filled and tied, an airtight seal is created that cause any remaining pests in the bag to have a very limited and finite amount of oxygen. As oxygen is depleted, the insects stop feeding on the cowpeas and become inactive, eventually drying out entirely and dying. Crops are able to be in storage for several months with very limited degradation in quality because of PICS bags.

### ***Solution 4: Best Practice: Plastic Crates***

More information available at: <http://www.wri.org>

When transporting fruits and vegetables, there may be a loss in quality due to the common storage containers used during the transportation. Common containers often do not have the additional lining in them to protect the quality of the produce. This can result in produce getting crushed or bruised. A plastic crate’s rigidity leads to

less damage from impact during transport, since the crate limits the amount of collision between the goods, and the smoothness of the material precludes the need for linings to reduce friction. In addition, they can last longer than traditional transportation crates.

**Barriers specific to this solution:** There is a possibility that plastic crates, similar to all reusable storage technologies, can carry and spread crop-eating insects or illness-causing microorganisms when improperly cleaned between uses.

### ***Solution 5: Hyperspectral Chemical Imaging***

More information available at: [ppo.ca](http://ppo.ca)

One solution to reducing food waste may be hyperspectral chemical imaging technology for production line grading and sorting of leafy greens, carrots and potatoes. The initiative is a collaboration between Ippolito Fruit & Produce, Riga Farms, EarthFresh Foods and Amazing Grains working with Ontario chemical imaging company, P&P Optica and industrial equipment company, Axiom Millwrighting & Fabrication. Through hyperspectral chemical imaging, P&P Optica has been able to successfully sort and grade produce, which in turn will reduce food waste.

### ***Solution 6: Provision Coalition's Food Waste Toolkit***

More information available at: <https://www.provisioncoalition.com/tools>

Provision Coalition's Food Waste Toolkit helps manufacturers quantify its avoidable food waste to allow for cost effective reduction strategies to be developed and implemented. The toolkit allows manufacturers to measure avoidable and unavoidable food waste, identify the root causes of food waste, analyze the data to address the waste and evaluate possible solutions. In addition, it helps manufacturers implement the solutions and it provides suggestions on how to resolve any issues that may arise. Lastly, it monitors the solutions and measures and evaluates the effectiveness of the solutions that have been implemented.

### ***Solution 7: Aquapak Polymers***

More information available at: [adilttd.co.uk](http://adilttd.co.uk)

Aquapak Polymers have developed a packaging polymer that is both 100% recyclable and 100% biodegradable in standard waste management facilities. The polymer, which is still in the demonstrative phase, can be used as an alternative to less-biodegradable plastic film solutions. The polymer recently was FDA-approved and is non-toxic to marine life. In addition, if recovery for recycling is not required, the material is fully dissolvable in water treatment processes and can be washed away safely with wastewater.

### ***Solution 8: Best Practice of Line Optimization***

More information available at: <http://www.refed.com>

There is an opportunity for manufacturers to adjust their best practices through optimizing their line production. Manufacturers should target systemic and sporadic waste generation by optimizing equipment operating conditions. Manufacturers should attempt to determine the most efficient run settings, addressing production line design flaws, modifying production schedules to minimize changeovers, and identifying novel ways to repurpose discarded food for sale. Manufacturers can have internal action teams that are able to identify waste reduction opportunities, including holding competitions among facilities that incentivize workers to reduce waste. In addition, they can enhance existing worker training programs to include a food waste identification component and develop programs to reward proactive employee behavior.

### ***Solution 9: Packaging best practices – adhesives***

More information available at: <http://www.adhesives.org>

The use of adhesives decreases food waste by providing reduced permeability, or barriers, to gases or moisture. Adhesives have historically provided significant heat and cold resistance for storage of produce and frozen foods. To avoid piecemeal solutions, there must be a systems approach to packaging materials and processes. This includes identifying adhesives as a major contributing factor to success. While adhesives are only a small fraction of the overall packaging materials, they can have a significant impact on the sustainability and efficacy of packaging. Testing before final production can also limit piecemeal solutions. Manufacturers can test substrates and/or application equipment on pilot scales at facilities.

### ***Solution 10: IceCOLD***

More information available at: <https://www.ecocoolworld.com/>

IceCold Technology increases the efficiency of your heat exchange process through its innovative engineered synthetic formula. The synthetic formula is designed specifically to improve operational performance, thus reducing spending on cooling services. The “primary catalyst” improves efficacy of the heat exchange by removing oil foiling. It is non-toxic, non-hazardous and only needs to be installed once. Once it is installed, it lasts for the life of the system.

### ***Solution 11: Smart Earth Lubricants***

More information available at: [smarteearthlubricants.com](http://smarteearthlubricants.com)

Smart Earth Lubricants are developed from renewable raw materials and sustainable natural oils, and are capable of replacing the petroleum base lubricants in machinery. Smart Earth Lubricants have low toxicity levels and are readily biodegradable. In addition, they are long lasting, can displace moisture effectively, can penetrate and lubricate hard to reach places, and can prevent corrosion.

## **Part 2: Solutions in Food Waste Diversion | Innovative Technologies and Best Practices**

The second best option to food loss and waste recovery following source reduction is food waste diversion. The first priority in food waste diversion would be to donate extra food to people (food banks, soup kitchens, shelters, and so forth). If food cannot be diverted to people, it should then be used as animal feed. Opportunities for diverting excess food is not only limited to food manufacturers. Other members of the value chain, such as retailers or foodservice operators should also consider this practice. In addition to reducing food to landfills and

the potential to generate revenue, this practice can also create good will in the local community by building and enhancing relationships among farmers and business owners. This section will provide solutions to help businesses divert food waste.

## **General solutions/best practices:**

### ***Solution 1: Solutions for issues within redistribution***

More information available at: <http://www.refed.com/>

The transportation obstacle for food redistribution can be difficult to address. However, many efforts have been put in place to help various members of the value chain redistribute their food. One solution is establishing additional food bank locations, which could lessen travel distances and make redistribution easier for many farmers and retailers. In addition, an adequately-funded nonprofit organization could run scheduled retrieval services, driving to farms and retail stores, picking up donated goods, and delivering to food banks. To address the legal obstacles, governments can pass “Good Samaritan” laws which limit the liability of donors in case redistributed food unintentionally harms the consumer. These laws generally do not protect against gross negligence or intentional misconduct, but instead assure food donors that they will not be penalized for redistributions made in good faith. An example of this type of law that has been passed is the Bill Emerson Good Samaritan Act in the United States, enacted in 1996. This law protects food donors from civil and criminal liability if the product they redistributed in good faith to a charitable organization later causes harm to the needy recipient. It also standardizes donor liability exposure—donors no longer have to accommodate various liability laws in different states. To help address the economic obstacles, governments can introduce tax incentives for food donations. In the United States, California, Arizona, Oregon, and Colorado each have passed state laws providing tax credits for food redistribution to state food banks, but there is currently no federal tax incentive for food donation.

***Solution ideal for:*** Producers, Manufacturers, Retailers

### ***Solution 2: Best Practices into Research***

More information available at: <http://www.refed.com/>

There is a need for further research and development into how food waste can be repurposed into another valuable source. For instance, in South Wales and North London, they have completed G59, (a regulation regarding the connection of any form of generator device, which runs ‘in parallel’ with the main utility grid) using food waste produced by local householders, food manufacturers and retailers. Agrivert, an anaerobic digestion and composting company in the UK produce a total of 13 MW of renewable electricity yearly, which is enough to power approximately 25,000 local homes.

***Solution ideal for:*** Producers, Retailers, Manufacturers, Consumers

## **Solutions and best practices specific to manufacturers:**

### ***Solution 1: Enterra Feed Corporation***

More information available at: <http://www.enterrafeed.com/>

Enterra Feed Corporation has created technology to turn consumer food waste into a sustainable byproduct. Food waste that may have otherwise gone to landfill is fed to indigenous black soldier flies. From there, the subsequent insect larvae is turned into nutrient-rich protein meals and feed oil. Through this sustainable process, a natural fertilizer is also created as a byproduct.

### ***Solution 2: Spoiler Alert***

More information available at: <https://www.spoileralert.com/>

This app offers a marketplace solution, helping organizations to buy and sell surplus food inventory. The company also offers an accounting and reporting tool to capture tax benefits and track financial, environmental, and social metrics. Food businesses and farms post surplus food to the platform, which triggers real-time notifications to potential recipients. Then, interested organizations claim the post and coordinate logistics with the supplier via in-app, email, or text messages. Both parties receive automated receipts to track transactions, aggregate data, and assist with capturing tax benefits.

## **Part 3: Solutions in Food Waste Composting | Innovative Technologies and Best Practices**

In some circumstances, it is not possible to reduce food waste at the source or divert food waste. This leads to the third best option available for food waste: composting. Similar to yard waste, food waste scraps can be composted. Sometimes, even when all actions have been taken to use wasted food, certain inedible parts will still remain. Remaining food waste can be turned into compost to feed and nourish the soil. Composting food waste creates a product that can be used to help improve soils, grow the next generation of crops, and improve water quality.

### **General solutions/best practices:**

#### ***Solution 1: California Safe Soil***

More information available at: <http://www.calsafesoil.com/>

California Safe Soil is able to convert wasted food into a usable and beneficial biostimulant, which provides an alternative solution to the food waste issue in the U.S. One of its main products, Harvest-to-Harvest™, is a stabilized food hydrolysate that is derived from recycled supermarket organics. The term “food hydrolysate” simply indicates that it is the product of the digestion of food with enzymes into a liquid fertilizer. Harvest-to-Harvest™ contains complex forms of nutrients, including: carbohydrates, amino acids (proteins), organic acids, and fats. These complex sources of nutrition are a great source of nutrients and energy for soil organisms and plants.

***Solution ideal for:*** Producers, Retailers

#### ***Solution 2: WISErg***

More information available at: [wiserg.com](http://wiserg.com)

WISErg is a startup company that composts large amounts of food scraps to help retailers reduce their environmental impact. One of their main products is a self-contained machine that processes large volumes of landfill-bound food scraps from grocers - including solids like bones and cherry pits - into a liquid fertilizer that is approved for use on certified organic crop production.

**Solution ideal for:** Retailers, Consumers

### **Solution 3: LeanPath**

More information available at: <http://www.leanpath.com/>

Leanpath provides tools to measure food waste on a consistent, daily basis leading to food waste prevention. It produces the LeanPath 360 System for high-volume operations like colleges, hospitals and hotels and the LeanPath Zap for restaurants, coffee shops and other small-midsized operations. LeanPath is also able to track everything that is being thrown out and monitor the waste being thrown out to educate consumers and provide them with opportunities to reduce their food waste impact.

**Solution ideal for:** Retailers, Consumers, Food Service

### **Solution 4: BioHiTech Solutions**

More information available at: <http://www.biohitech.com/>

BioHiTech has several solutions and technologies that help compost food waste. One of its technologies is the Eco-Safe Digester that focuses on disposing and digesting. It is able to eliminate up to 2,500 pounds of food waste per day, convert food waste into nutrient-neutral water and transport the water safely through standard sewer lines. Another technology is the HiTech Cloud which focuses on measuring and optimizing. It is able to measure key metrics to optimize the waste disposal process, identify portfolio-wide operational efficiencies, and provide an accurate audit trail to support environmental directives. The Eco-Safe Digester is also cost-effective, self-contained, and discharges to a standard sewer line.

**Solution ideal for:** Producers, Retailers, Consumers

### **Solution 5: EcoMaine**

More information available at: <http://www.ecomaine.org/>

Ecomaine, a nonprofit solid-waste corporation collectively owned by more than a dozen southern Maine municipalities, aims to help the Maine region remove food material from the waste stream. Ecomaine has developed a technology that is capable of collecting and storing food waste. This food waste is then shipped to Exeter Agri-Energy, which converts the waste into methane-rich gas used to produce energy. Ecomaine can be used as an example for many start-up Canadian companies that have a similar mandate.

**Solution ideal for:** Consumers



## **Solutions and best practices specific to manufacturers:**

### *Solution 1: BWE – Organic Food Waste Containers*

More information available at: <http://www.bwe-nc.com>

Bakers Waste Equipment Inc. (BWE) designs and manufactures organic food waste containers for the composting and feed industries. BWE recognized the growing trend of redirecting food waste from the landfills, and developed special collection containers to properly contain the semi-liquid waste content. These metal containers are heavy duty and built to last in bucket-lift and front-end load truck applications. A special epoxy, protective coating is applied to the interior to protect the metal surfaces against the highly aggressive organic waste.

### **Solution 2: Food Cycle Science**

More information available at: <https://nofoodwaste.com/>

Food Cycle Science has developed an innovative technology, “The Food Cycler”, which is capable of recycling organic food waste on-site. The Food Cycler can dehydrate and convert food waste into a sterile biomass. This sterilization process is capable of reducing food waste volume by 85-93%. After the sterilization process is complete, the Food Cycler then converts the food waste into compostable humus-rich, high-carbon organic particles. The byproducts of the process can be reused as soil amendment, compost accelerant, biofuels, animal feed, pet food and potable water.

### **Solution 3: SAFE (Sustainable Alternative Feed Enterprises)**

More information available at: <http://www.forktofeed.com/>

Sustainable Alternative Feed Enterprises (SAFE) handles food scraps separately from all other components of the waste stream. SAFE patented equipment is used to facilitate the collection, preprocessing and processing of food scraps, transforming them into a high-protein animal feed, and also capturing distilled water and all of the Fats, Oils, and Grease (F.O.G) contained in the source food. The extraction equipment converts the raw food scraps into a mash while expelling non-foods such as paper and plastics. This equipment can be located at any suitable site including an existing transfer station or Material Recovery Facility (MRF). SAFE mash is transferred to a regional production facility in sealed tanker trucks. The production facility houses SAFE drying and processing equipment in a clean environment.

### **Solution 4: Full Cycle Bioplastics**

More information available at: <http://fullcyclebioplastics.com/>

Full Cycle Bioplastics is able to take organic waste and break it down until it becomes a biodegradable plastic called polyhydroxyalkanoate (PHA). This involved a three step process, where firstly, the waste is broken down into feedstock for PHA. Once the feedstock is perfectly adjusted, it is dosed into an environmentally conditioned tank of naturally occurring bacteria, where it is consumed and converted into PHA. There are no Genetically Modified Organisms (GMOs) used in this process. This significantly lowers the production costs and eliminates the need for expensive laboratory grade sterility or containment. The PHA is then dried and processed into a finished resin product, which can then be used for compounding.



## ***Solution 5: AMEC Foster Wheeler Solutions***

More information available at: <http://www.amecfw.com/>

AMEC Foster Wheeler offers a wide range of solutions that can be implemented in food waste composting. AMEC Foster Wheeler designs systems that combine innovation with proven methods of waste management, treatment and disposal. AMEC Foster Wheeler's team includes specialists in planning, environmental science, engineering, geology, hydrogeology, chemistry, biology, environmental management, economics and social development.

## ***Solution 5: CCI BioEnergy***

More information available at: <http://www.ccibioenergy.com/>

CCI BioEnergy is an alternative energy developer that deploys on-site solutions to transform a broad array of organic waste generated in a food or beverage facility into renewable energy for internal use. In addition, they collect and process organics in the areas manufacturers are located and are able to implement many technologies, including composting organic food waste. A major benefit of Anaerobic Digestion (AD) is the production of biogas. With its patented AD techniques, the BTA Process produces biogas rich in methane content (approximately 65%), which is a valuable resource to produce multiple forms of community based renewable energy. In addition, the level of emissions when implementing these solutions is limited.

## **Barriers to Adoption**

Due to the recent awareness and recognition of the impact of food waste, various solutions have become available to members of the food and beverage value chain. However, although solutions exist in the food and beverage industry to reduce food waste, there are barriers to adoption that may prevent the successful adoption and implementation of these solutions.

### **Education and awareness**

Although there is increased awareness of the issues surrounding food waste and the importance of reducing and minimizing waste, much of the public is still unaware of their impact as it is still a relatively new topic. This lack of education has resulted in consumers being responsible for roughly half of all food waste. Since they are not aware of the importance of this issue, there is a strong possibility much of the public may also not be aware of the solutions that exist. Similarly, businesses may also lack awareness of the solutions available to them. As such, although many food waste solutions exist, if the public and businesses are not aware of them, they cannot be implemented.

### **Cost**

One of the major barriers to adoption is the cost associated with the solutions. The costs may include equipment, infrastructure, implementing a strategy, additional infrastructure, hiring a subject matter expert, tracking and monitoring the success of the solution and so forth. If corporations cannot see the return in investment, whether it is a financial return (being economically feasible) or a social sustainability return (positive branding and image), the company may not implement the solution as there may not be an incentive for the solution to be implemented.

## **Infrastructure required**

Businesses may need certain infrastructure to implement certain solutions. This infrastructure varies depending on the business and the solutions they are planning to implement. New infrastructure and changes to existing infrastructure will come at an additional cost the business. In many cases, it may not be possible to build new infrastructure if the business is located in an area where it is not feasible.

## **Accessibility**

Similar to the last two barriers, a solution may not be implemented due to accessibility issues. A business may not have accessibility to the right technology they need to reduce food waste. For instance, certain farmers in rural areas may not have access to technology that may keep their crops in storage longer. As a result of this restriction, they may choose to continue with business as usual.

## **Incentive to implement solutions**

Some businesses may believe there is little incentive to implement food waste solutions. Companies may be aware of the issue of food waste and the need to minimize it; however, if they cannot see the benefits or how the solution will be profitable for their company, they may not implement the solution. Businesses may believe the solution would do little to lower their costs or increase their revenue. In addition, there may be little incentive to implement food waste solutions if businesses believe there are risks associated with the implementation. For instance, they may believe it is a risk to install a certain technology or equipment because they may have doubts about its effectiveness. If the technology is not effective, the business is risking their investment in its implementation.

## **Recommendations**

### **Education**

There is a need to further educate the general public and businesses about the issue of food waste, their responsibilities, and the solutions available to them to help minimize their impact. With an increase in food waste awareness and solutions, there is potential in reducing the impact of food waste.

### **Policies and Legislations**

Governments also have a role in improving the rate of implementation of food waste solutions. Since the cost of implementing food waste solutions is a concern to businesses, the government can offer more funding options to help offset the costs. They can also incentivize businesses by offering pilot or test projects similar to Ippolito Fruit and Produce.

In addition, the government can create policies to create a standardized date labeling system. This will encourage and incentivize manufacturers and other members of the value chain to collaborate and create an effective system that reduces confusion amongst consumers.

### **Partnership/Collaboration**

There is a need for partnerships and collaboration within the food and beverage industry. Many businesses are not aware of the research happening in other businesses or research institutions. In addition, food loss and waste happens throughout the value chain with every member having an impact and responsibility. Food waste is an extremely complex issue and the most effective solutions will only come from the collaboration of ideas, sharing of best practices and merging of solutions.

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