Food Waste – Challenges and Opportunities

Is There a Light at the End of the Tunnel?

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Image Courtesy of the University of Maine

Food Waste: A Worldwide Problem in Multiple Ways

It is estimated that over a third of all food produced worldwide is wasted. That amounts to about 1.3 billion tons of food being wasted in a world where an estimated 1 billion people do not have sufficient food to eat. The waste is enough to feed about 2 billion people.

In addition, surplus food accounts for 16% of land used for food production in the US, 22% of all fresh water used, and 24% of what goes into landfills.

There is another side of Food Waste that many people are unaware of: food that ends up in landfills creates methane - a greenhouse gas ***that is more than 25 times as potent as carbon*** **dioxide** at trapping heat in the atmosphere. It is estimated that wasted food accounts for about 8% of global greenhouse gas emissions (GHG) – and about 6% of US GHG. In the US, the carbon footprint of Food Waste is equivalent to that produced by about 80 million automobiles - and greater than that of the airline industry.

In other words, Food Waste represents a major challenge that needs to be addressed in the US and around the world if we are going to deal with worldwide hunger and address climate change.

Before discussing what can be done – and what is being done - to address this issue, let's begin with a review of where Food Waste is happening and of the elements contributing to it.

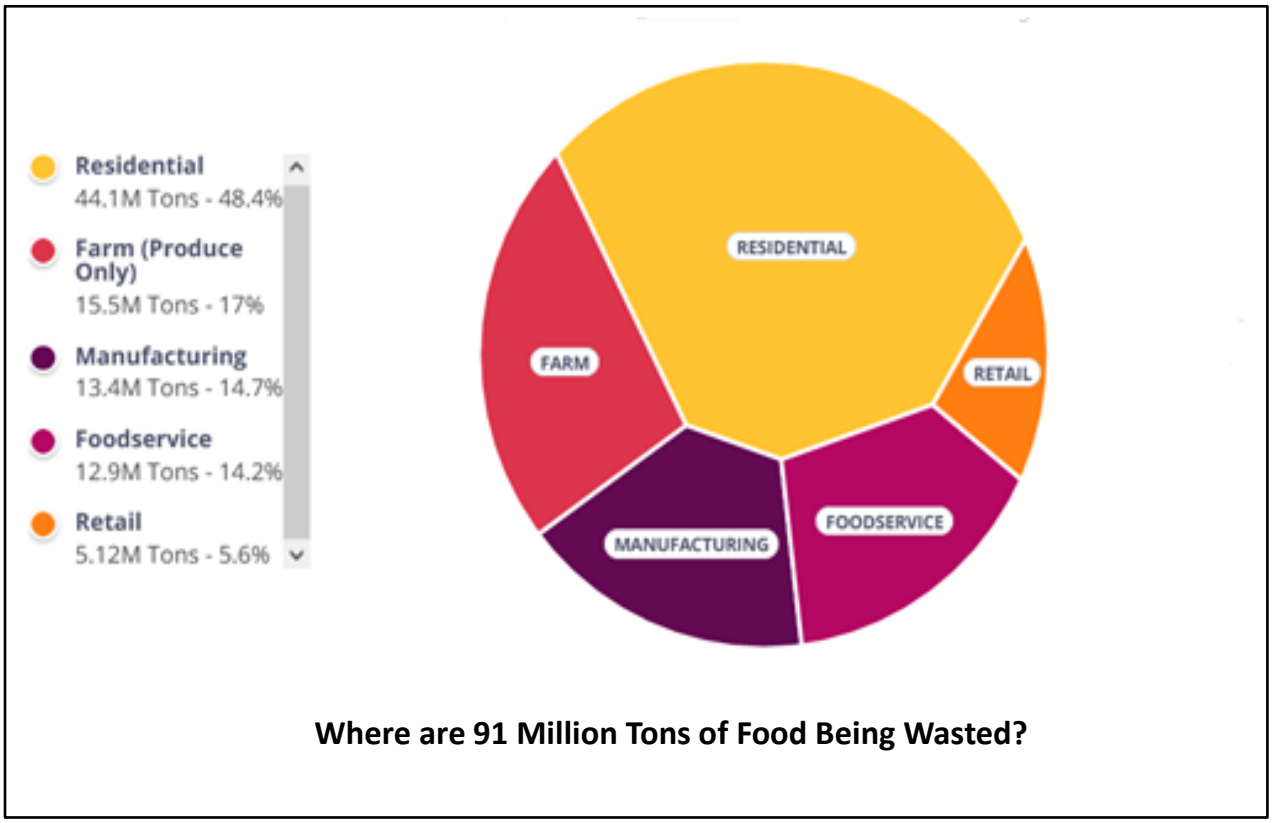
Where is Food Being Wasted?

The reality is that there is a considerable amount of waste at every step in the food journey from "Farm–to–Fork". That includes farms, food manufacturers/processors, distributors, transportation, food retail, food service (restaurants and other places that serve food) and consumers.

There are different estimates of exactly how much is wasted at each step in the process (more on that later), but let's start with a recent report released by ReFED. ReFED is a national nonprofit whose mission is to end food loss and waste across the system. ReFED utilizes a range of data-driven approaches that highlight supply chain inefficiencies, connects supporters with others that can help them take targeted actions, and leverages capital to spur innovation and enable initiatives that can have an impact on Food Waste. They describe their goal as achieving a sustainable food system that optimizes environmental resources, minimizes climate impacts, and makes the best use of the food that is grown. In other words, they seek to address all of the negative impacts of food waste.

They have recently released information that updates previous data and reports that 91 million tons of food were wasted in the US in 2001– or 38% of total food production. (ReFED has reported that 90% of surplus food – i.e., food not sold at each stage of the journey - actually ended up as Food Waste as defined by the EPA. Only 20% of the portion not considered waste – or just 2% of the surplus – ended up being donated).

The breakdown below of where food is being wasted is taken directly from ReFED's "Insights Engine".



Where are 91 Million Tons of Food Being Wasted?

As you can see in the chart, while food is being wasted at every stage of the journey, by far the largest source of food waste occurs in the home.

The second largest group was farms, but ReFED has reported that they believe that they did not capture all of the waste at farms and that the total farm contribution is even higher.

ReFED also reports that total US Food Waste decreased .6% from 2019 to 2021 (1.7% when measured per capita) so while there has been no meaningful reduction in the last couple of years at least we are not seeing increases in this country and appear to be headed ever so slowly in the right direction.

As noted earlier, there are some inconsistencies between different sources of data on Food Waste. For example, ReFED and the EPA have jointly noted disparities between their data. EPA has not released updated data for the past couple of years, so the most recent comparison is for 2019. While ReFED reported 91 million tons of US Food Waste – or a total of 75 million with Farms excluded - the EPA reported 106 million tons of Food Waste excluding Farms. Moreover, while ReFED reports 55% of waste occurring at the Residential level when Farms are excluded, and almost 18% occurring at the manufacturing level, the EPA reported 25% and 38% respectively. Both ReFED and the EPA point to the difficulties inherent in measuring Food Waste as the reason for the discrepancies.

The differences in estimates of total Food Waste above are not insignificant, but regardless of which number is more accurate the bottom line is that there is a major problem with Food Waste in this country – and around the world. Differences in where on the journey Food Waste is happening are more significant because they may affect where attention needs to paid to addressing the problem. But the reality is that we need to address the problem at every step of the food journey **regardless** of what the actual breakdown is across that journey.

It is worth noting that despite food loss and waste being addressed by numerous initiatives at both the government and private sector levels, seafood ("fish-to-fork") seems to be left out of nearly all conversations about Food waste. Yet, according to the FAO (Food and Agriculture Organization of the UN) between 30% and 35% of seafood caught is either lost or wasted, It is estimated that US fishermen discard approximately 20 percent of what they catch, amounting to as much as 200,000 tons each year. And US consumers discard over 100,000 tons of seafood annually. So, this is an area that needs to be addressed as part of the discussion of – and initiatives on – Food Waste.

What are the Causes of Food Waste?

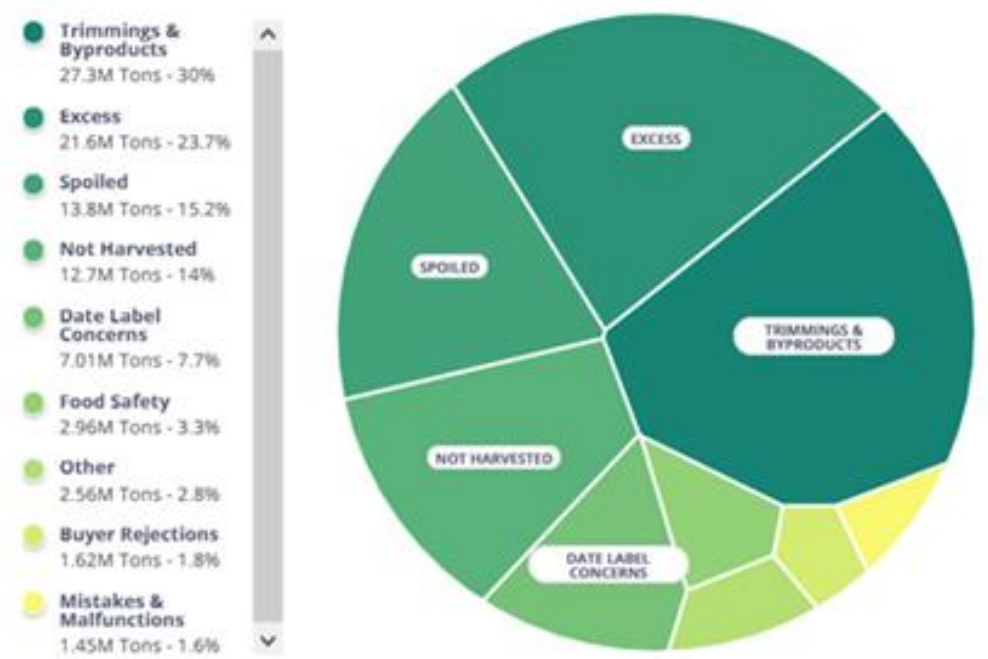
Digging a little deeper, let's review the underlying causes of Food Waste.

ReFED breaks out the causes of Food Waste as shown in the chart below.

Based on this analysis, the largest source of Food Waste – about 30% - comes from the inevitable byproducts of food, including trimmings, eggshells, bones, and other things that can't be eliminated – but can be dealt with in better ways than landfills, as will be discussed below.

The second largest cause – almost 24% - comes from excess at all stages of the journey. This includes food that is not sold at the farm, distributor, food service, or food retail level or simply purchased but not eaten by the consumer. This is obviously an area the needs to be addressed. Please note that this is separate from the 15% of food that ends up being spoiled and almost 8% that is thrown out because of concerns about its age (again at multiple levels of the process). Plus, there is an estimated 14% that is

simply not harvested. So, there is considerable room for reducing waste – again at all stages of the journey.



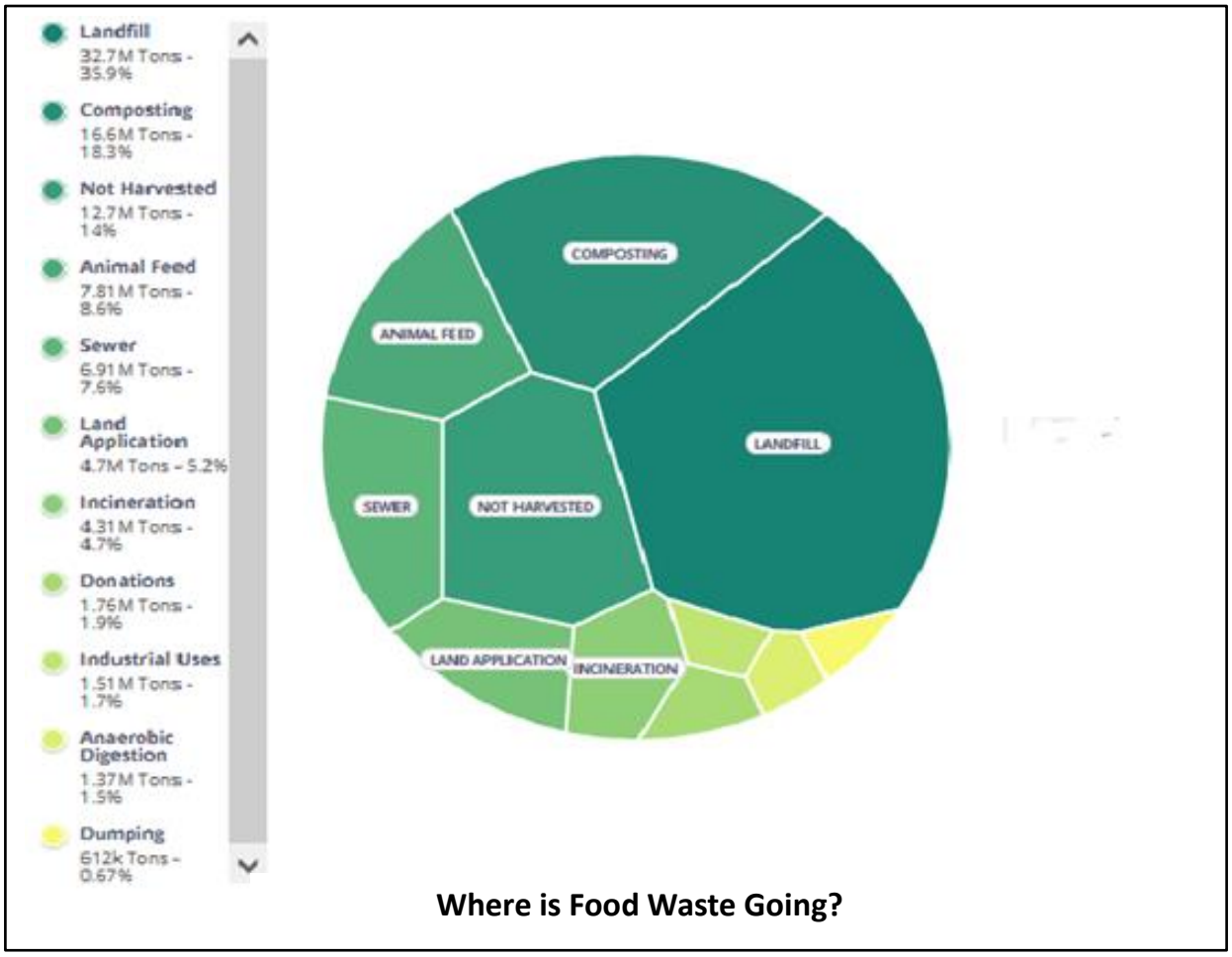
What is Causing 91 Million Tons of Food Waste?

Where is Food Waste Going?

Where is all of the wasted food currently ending up? According to ReFED, the largest portion of Food Waste in the US – some 36% - goes to landfills. Less than 2% goes to donations! The chart below from ReFED breaks down the destinations.

Interestingly, there has been a huge increase in composting in the US over the past several years; it now represents the 2nd largest destination, accounting for over 18% of all food waste according to ReFED. Composting produces significantly less in the way of methane emissions than landfills. Compost can then also be used to reduce the need for chemical fertilizers while at the same time promoting higher yields of agricultural crops.

There are also some other Food Waste destinations that are not that problematic – including Food Waste used for Animal Feed, Industrial uses, and Anaerobic Digestion[1].



Where is Food Waste Going?

Again, there are differences between the ReFED and EPA data for 2019 in terms of Food Waste destinations as well. Excluding waste from Farms, ReFEd reports 44% of Food Waste ending up in landfills, 21% as compost, and 8% as animal feed. EPA reports 38% in landfills, only 4% as compost, and

[1] Anaerobic Digestion (AD) is a process through which bacteria is used to break down organic matter without oxygen. AD takes place in a sealed vessel (reactor) which contains complex microbial communities that break down/digest the waste and produce Biogas (which can be purified and used as an alternative fuel) and Digestate (which can be used as animal bedding, nutrient-rich fertilizer, bio-based products (e.g., bioplastics), organic-rich compost, and soil enhancer).

14% as animal feed. The EPA also reports over 16% ending up as Anaerobic Digestion, while ReFED reports AD as representing less than 3%. And also again, these differences do not in any way impact the significance of the Food Waste problem.

Interestingly, EPA reports on Food Waste destinations at each stage of the journey – and the results are quite disparate. Perhaps the most interesting is what is reported by EPA for the Manufacturing and Processing sector – reproduced below:

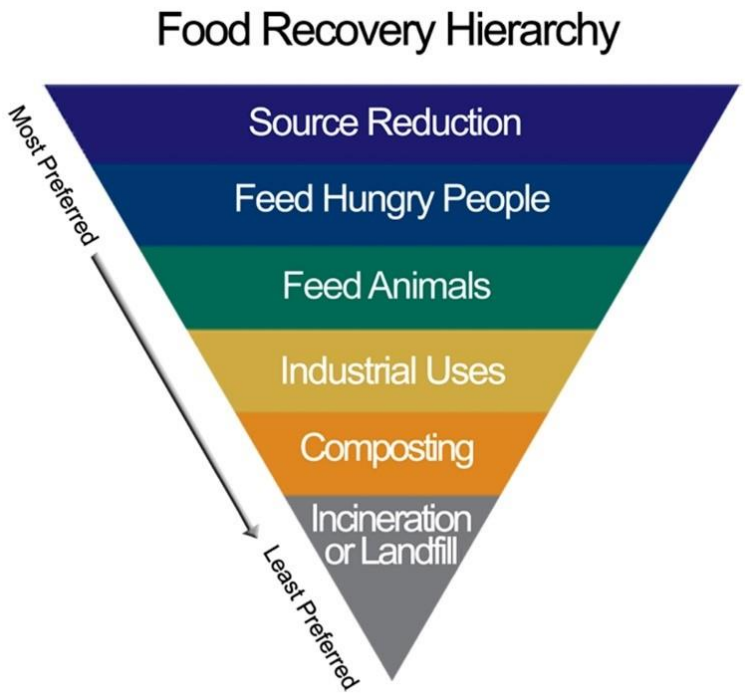
Food Waste Destinations From the Food Manufacturing and Processing Sector (Source: EPA)

Destination	Tons	Percentage
Anaerobic Digestion	**17.1M**	**42.6%**
Animal Feed	**13.7M**	**34.2%**
Land Application	**5.2M**	**12.9%**
Donations	**2.2M**	**5.5%**
Landfill	**0.9M**	**2.3%**
Composting	**0.6M**	**1.5%**
Controlled Combustion	**0.3M**	**0.8%**
Biochemical Processing	**0.1M**	**0.2%**
Sewer/Wastewater Treatment	**0.0M**	**0.0%**
TOTAL	**40.1M**	**100.0%**

This table suggests that this sector clearly need not be the focus of efforts to address Food Waste, since most of the waste is being handled effectively and only 2% ends up in landfills.

The EPA data can be found in a report entitled *2019 Wasted Food Report*.

The EPA has also put together a powerful diagram of what the goal should be in terms of food waste destinations – starting with reducing food waste at the source.



What is Being Done to Address Food Waste?

Steps are being taken at many levels to address Food Waste.

In 2015, the U.S. Department of Agriculture (USDA) and EPA announced the U.S. 2030 Food Loss and Waste Reduction goal which seeks to cut food loss and waste in the US in half by the year 2030.

The EPA and USDA, as well as the Food and Drug Administration (FDA) formed a Federal Interagency Collaboration aimed at reducing food loss and waste which works with communities, organizations, and businesses, along with state, tribal and local government, to take actions that will lead to the goal.

Multiple states – starting with Vermont – have introduced legislation aimed at curbing Food Waste, and many communities across the US have been introducing composting programs and encouraging residents to separate food waste from garbage.

This past January at the North American Leaders Summit (NALS), the US, Mexico, and Canada included addressing Food Waste as one of six climate initiatives, confirming growing recognition of the serious climate impacts of Food Waste.

And non-profit organizations such as ReFED have sprung up in the past several years to play an important role in tackling the Food Waste challenge, including funding companies that are tackling Food Waste.

But we still clearly have a very long way to go. The United Nations Environment Program, which is playing a role in the transition towards sustainable food, stated last September (right after the UN had held an inaugural Food Systems Summit aimed at uniting global leaders in a mission to find novel ways to produce healthy food without harming the environment) that "the global fight to tackle food waste has only just begun".

Clearly there needs to be a major emphasis on consumers, since even with the lower EPA estimates they represent a major source of Food Waste. In the US there has definitely been a push towards composting that looks like it will start having an impact at least on where the waste ends up. But much more still needs to be done to educate consumers about what can be done to avoid wasting food. (A 2020 study of more than 40,000 adults in the US reported by the Nutrition Journal found that the average family spends about $1,300 a year on food that doesn't get eaten).

The good news is that in addition to seeing governments across the world beginning to address the issue and multiple non-profits being created to focus on Food Waste, a slew of for-profit companies that are attempting to address Food Waste issues across the entire food journey have also been launched. Some of these companies – and what they are focusing on – are identified below.

Companies Addressing Food Waste at all Levels

Ironically, very few of the for-profit companies in the Food Waste space address consumers, but there are a handful. For example, **Fridgely** is an app that tracks what food a consumer has purchased and when and provides alerts when food is getting close to expiring. It also presents recipes based specifically on the food that is in the home.

Israeli start-up **Silo** has developed a vacuum sealing container that they believe can extend food freshness for at least twice as long. It has a built-in scale that measures food weight and connects to Alexa which asks the consumer to identify what is in the container. The associated app can tell the user how much of the product remains, how long it will remain fresh, and when it is time to re-purchase.

There are several companies that sell composting units designed for in-home use that breaks food waste down. For example, **FoodCycle Sciences** (based in Canada) offers a system which pulverizes the toughest food scraps into fine powder which can be used as a nutrient-rich soil amendment. **Lomi** offers a unit that speeds up the natural decomposition process by grinding, aerating, and heating the waste material leaving users with a nutrient-rich material that's good for gardening. **Mill Industries** provides consumers with a substitute for a compost bin that shrinks food waste and removes odors, allowing it to be comfortably kept in the kitchen for extended periods. Mill provides consumers with bags to send the waste back to Mill, which then converts it into chicken feed.

On another front, in addition to numerous non-profit organizations working to get surplus food to people who need it before the food needs to be discarded there are also a number of for-profit companies addressing this problem in different ways. For example: **Copia** connects restaurants, hotels, and other businesses that have surplus food with non-profits that need it, managing all aspects of the transportation; **Food Haven** offers an app that allows restaurants to sell surplus food to consumers; **Hungry Harvest** buys fruits and vegetables at risk of being wasted from farms and delivers them at low prices to consumers and/or donates them to non-profits; **Spoiler Alert** provides an online marketplace for food processors that facilitates real-time food donations, discounted sales, and organic byproduct redistributions; and **Misfits Markets** operates an on-line consumer discount marketplace and delivery

service for surplus food. (They have reportedly raised over $500M in financing over 5 years and delivered over 100 million pounds of food).

These companies, all of which are based in the US, have counterparts in other countries. For example: **Flashfood** – based in Canada - stores discounted food at supermarket locations and provides a consumer app that makes them aware of availability and price; **FoodCloud** – based in Ireland - connects businesses that have surplus food with charities and community groups that need it; **Karma** – based in Sweden – has an app that connects consumers to food retailers with excess food, making the food available at a discount; **Phenix** – based in France – enables food retailers of all types to bundle and post unsold food nearing expiration dates at a discount in themed "baskets" (produce, pastries, fully cooked meals, etc.), and enables consumers to reserve and pay for what they want, and alerts the retailer that the consumer is on their way for a pickup; and **Too Good to Go** – based in Denmark - connects consumers to restaurants and food retailers offering surplus food at a discount.

A range of companies offer food coating or enhanced packaging to keep food fresh longer, mostly aimed at farms but some for transport and others for restaurants and food retailers. Companies doing this in the US include: **Akorn Technologies**; **Apeel Sciences**; **Blu Wrap; Hazel Technologies;** and **Produce Patch.** Companies addressing this in other countries include **COEXPAN** in Spain and **Keep it Fresh** in India.

Then there are a group of companies providing restaurants and food retailers with tools to help them predict demand and therefore adjust ordering to avoid food surplus and waste. In the US these include **Afresh**, **ClearCOGS, Shelf Engine**, and **Upshop.** Overseas companies include: **eR4u** – based in India; **Fresh Flow** – based in Germany; **NeuroLabs** – based in Romania; **Predict HQ** – based in New Zealand and **Tenzo** – based in England

Other companies offer related services including inventory management systems, project expiration date alerting, and dynamic pricing aimed at avoiding waste. Companies in the US include **Goodr**, which provides alerts to restaurants when food is close to expiring, and **Metafoods** which tracks consumption at restaurants and uses data analytics to assess consumption trends and generate purchase guidance. Outside the US: **Algoretail** – based in Israel – offers automatic ordering, inventory management with expiration date tracking and manages shelf restocking; **Wasteless** – also based in Israel – offers an AI-based pricing model that adjusts pricing as perishable goods approach end of life; **Smartway** – based in France – helps retailers identify which products are nearing their expiration date, decides whether the expiring item should be discounted or donated, and recommends pricing for these being discounted; and **Total Ctrl** – based in Norway – tracks inventory and offers automated expiration forecasts.

A range of companies provide sensors that monitor food at various parts of the journey to try to help avoid Food Waste. For example, at the farm level: **Centaur Analytics** uses smart sensors and AI to offer visibility and insights into stored and transported crop conditions; **Telesense** (which focuses on grains) uses wireless sensors for temperature, humidity, & CO2 monitoring along with machine learning algorithms to develop actionable insights for quality preservation**; Clarifruit** uses photos of fruits and vegetables along with advanced computer-vision technology to look for visible produce defects. Clarifruit also serves wholesalers and distributors, along with some food retailers. **Evigence**, which is based in Israel but also has offices in the US, serves farms, food processors and restaurants, and uses sensors and scanners along with advances algorithms to determine the state of the food.

There are also quite a few companies that install temperature sensors at restaurants, typically in refrigeration equipment, with a focus on food safety but which also help Food Waste. Players in this space include **Compliance Mate, Cooper Atkins, Nuvi Labs** and P**owerhouse Dynamics**. The Powerhouse Dynamics platform (transparency alert; I was the founder and CEO of Powerhouse Dynamics) digitally

connects to virtually any piece of kitchen equipment, including ovens, food warmers, fryers, and dishwashers, and therefore is able to help avoid waste throughout and beyond the cooking process.

A number of companies combine smart scales, cameras, image processing, and Artificial Intelligence (AI) to measure the amount of food restaurants and other food service organizations throw away and what they are discarding to help them better plan food purchases. Companies in the US doing this include **DeWaste Networks**, **Leanpath**, **Phood Solutions** (which also monitors what foods are being used for food preparation). Companies outside the US tackling the same problem include **Kitro** in Switzerland, **Nuvi Labs** in South Korea, **Orbisk** in the Netherlands, and **Winnow** in the UK – which also calculates the financial and environmental cost of discarded food to help their customers adjust purchasing.

This is not intended to be a comprehensive list of companies in the Food Waste space but to provide a sense of the range of companies offering differing approaches to mitigating Food Waste across the food journey and across the world. The table below organizes the North American companies referenced above by the type of service provided and prime (but not necessarily exclusive) target market represented by the stops in the food journey as laid out by ReFED.

Sample North American-Based Food Waste-Related Companies

	Farm	Manufacturing	Restaurant	Retail	Residential
Waste Containers					FoodCycle Lomi Mill Industries
Coating and Sealing	Akorn Apeel Hazel Technologies	Blu Wrap	Produce Patch	Produce Patch	
General Marketplace	Full Harvest		Choco		
Surplus Marketplace		Hungry Harvest Spoiler Alert	Copia Food Haven	Flashfood Misfits Market	
Forecast/Inventory/ Expiration Alerting			Afresh Goodr	ClearCOGS Shelf Engine upshop	Fridgely
Dynamic Pricing				Smartway Wasteless	
Sensors/Food Monitoring	Centaur Analytics Telesense	FloVision Solutions SafetyChain	Compliance Mate Cooper Atkins Metafoods Nuvi Labls Powerhouse Dyn		
Cameras/Scales Waste Monitoring		Leanpath	Leanpath Kitro DeWaste Networks	Food Solution	

Bottom Line

The good news is that there is significant activity happening at all levels – government and private; for-profit and non-profit – attempting to address the Food Waste problem.

The bad news is that there is clearly still a very long way to go. The fact that so little surplus food ends up with people that could really benefit from it remains a major issue. The fact that almost twice as much Food Waste ends up in landfills than composting is quite problematic. The fact that the majority of Food Waste is caused by consumers creates an ongoing challenge.

Positive things are happening, and one could argue that there is a glimmer of light at the end of the tunnel. But lots more needs to happen at all steps in the food journey. And everyone needs to do what they can personally to address this major worldwide challenge.