



The Gross and Growing Problem of Food Waste

Trends, Stats & Solutions to Help the Global Food Supply Chain Reduce Waste

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The Gross and Growing Problem of Food Waste

Pretend that you were to take all of the food and drinks in your home and gather it into one big pile on the middle of the floor. You remove everything from the refrigerator shelves and empty the crisper. Then you do the same for the freezer, all the way down to the last ice cube in the tray. You clear out your pantry, top to bottom. All the fruit in your basket gets poured in. Then, for good measure, you add the butter in the dish near the toaster and all the spices from the rack.

What next? Imagine shoveling up one-third or more of the food and beverages. Taking it to the backyard. And burying it.

As you head back into the house to put everything back, you observe a few houses in your neighborhood going hungry, uncertain about when their next meal might be. Other neighbors are arriving home from a hard day's work in food production. You notice also that the air quality has seemed to worsen and that the thermometer reads a little warmer than ordinary.

The next morning, you get up, buy more food at the store... and go through the exact same routine all over again. Only this time, you throw away just a little more than before.

Picture this happening in millions upon millions of American homes, so many that your cumulative food waste could fill up 320,000 jumbo jets.¹ Now stop imagining. Because this is essentially reality.

What a Waste

Make no mistake: Food waste is a gross and growing problem.

“Gross” because experts speculate that in the U.S. alone some 35 million tons of food annually are thrown out rather than eaten up, destined for landfills and incinerators, not taste buds and stomachs. Much of our food and beverage is lost because we’ve grown accustomed to an “over and out” approach to production. We overproduce what’s needed and simply toss out the excess. This inefficiency and disposal occurs in the face of food-related challenges, thumbing its nose on our environment, economy – and millions of Americans who classify as food insecure.



“Growing” because we’re clearly wasting more... and more... and more. Food loss reduction was included in the Food and Agriculture Organization (FAO) mandate when it was established in 1945 by the USDA and the United Nations. But that was in the wake of the Great Depression and World War II, when food and beverages were scarcer and costlier for the average family. When food was available, many deliberately bought less to leave more for soldiers and allies involved in world conflict.

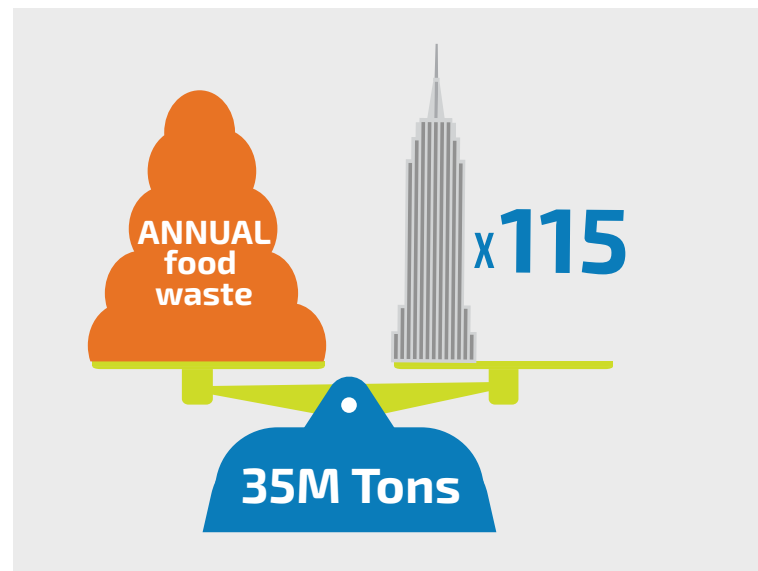
Over the next few decades, advancements in agricultural and production practices expanded the food supply in the developed world to the point where it became available to a degree that many took it for granted. A study conducted in 1987 found that people over 65, many of whom lived through either the Depression or World War II, wasted half as much food as other age groups. This proliferation of waste has only intensified over the years. Today, the average American throws away 50 percent more food than in 1970.

This white paper, written with the refrigerated foods and beverages industry especially in mind, illuminates the real but not un-addressable epidemic of escalating food waste. We’ll look at what food waste is, how it directly and indirectly affects the quality of life for us and our future generations, where it occurs and how top experts recommend we stymie it. We’ll also discuss the beneficial role High Pressure Processing (HPP) can play in this process, and the messages and misnomers refrigerated food and drink producers in particular can disseminate and debunk to play a vital part in reducing the growing food waste dilemma.

Defining Food Waste

The FAO defines food waste as food and beverage that’s “fit for consumption” yet discarded, mainly at retail and consumer stages.² It treats food waste as a sub-component of another term, “food loss,” which involves any edible amount of food, postharvest, that’s available for human consumption but for some reason not consumed. Food loss, therefore, also involves foods that are damaged during transportation or otherwise lost in the handling and hand-offs of the upstream supply chain process. Most food waste and loss that is discarded is ultimately landfilled, but it’s also true that some food fitting this definition is used for productive purposes like bioenergy.

The gray area between food waste and food loss is not always clear, but professional research has increasingly regarded some food waste as “preventable,” or at least “partly avoidable” whereas other waste (for example, the bones of many meat products or the rinds of watermelon) is referred to as “inevitable” because it’s not really edible.



Each year the U.S. wastes 35 million tons of food, as much as 115 Empire State Buildings.

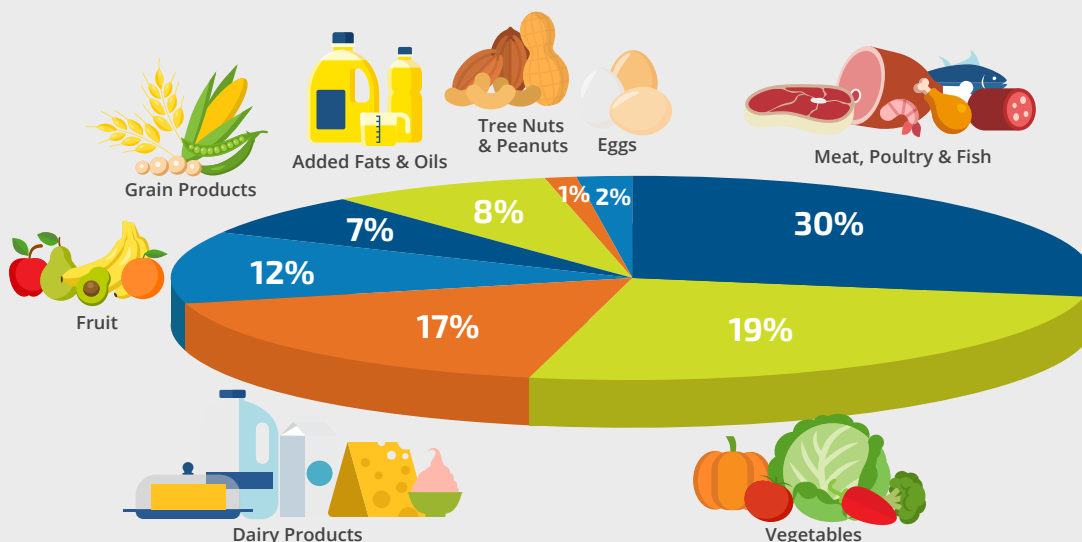
While the line is blurry, partly avoidable waste generally involves some habit or custom that conceivably can make inevitable waste avoidable. Take, for example, bananas – fruit that has been described as a “perfect food.” A banana peel, while technically edible, is typically removed and discarded by almost every person (and primate) in the world; therefore it constitutes inevitable waste. On the other hand, if the perfectly fine banana within is discarded by a consumer this constitutes, of course, avoidable waste. An overripe banana could be regarded as partly avoidable because, while the average American wouldn’t eat a grossly overripe banana, it could be used to make banana bread, muffins or banana cream pudding.

Food waste does still need to originate from a plant or animal. Questions sometimes arise as to whether food packaging is food waste. Since it’s not fit for consumption per se, packaging isn’t technically food waste. However, it certainly plays a big role in the food waste problem as defective packaging is a common reason people dispose of food.

Genetically modified foods qualify as they are still derived from plants and animals, they’ve simply had their DNA modified. It’s less clear whether completely synthetic foods, however, constitute food waste. Synthetic foods are entirely new organisms, typically algae or bacteria, created with DNA sequences in a lab from whole cloth and are used to produce commodities such as oils and flavorings. While the amount of synthesized food that enters the supply chain is miniscule, certain producers have made completely artificial offerings ranging from vanilla to saffron to stevia, the sugar substitute.

The top three food groups in terms of share of total value of food loss are meat, poultry, and fish (30 percent); vegetables (19 percent); and dairy products (17 percent). The remainder is comprised of a mixture of cereals, roots and tubers and oilseeds and pulses.³ Refrigerated foods and beverages comprise a significant portion of worldwide waste, and this trend is particularly acute in developing countries that often have warm and arid environments, yet lack widespread

Food Waste by Category



cooling technologies and equipment. It is estimated that one-fourth of all wasted food and drink in developing countries could be eradicated if these countries were to adopt the same level of refrigeration infrastructure as developed countries.

Food Waste by the Numbers

Food and its supply chain is often referred to in the United States as “farm to fork,” but fewer people consider that multitudes of food instead go from “farm to landfill.” The U.S. currently does not have a single, all-encompassing baseline estimate of food loss and waste within the country. Instead, there are two very different measures describing these levels.

First, the United States Environmental Protection Agency (EPA) last estimated that food comprises a little less than 15 percent of all municipal solid waste, tipping the scales at almost 77 billion pounds. That analysis, conducted in 2014, suggests that food is the second highest component of landfills, trailing only paper and paperboard. But after those paper products are recycled, food waste becomes the single biggest amount of municipal waste categorized by the EPA, with more than one-fifth of the total.⁴

Additionally, in 2010, the United States Department of Agriculture (USDA) most recently estimated the amount of food loss and waste from the food supply at the retail and consumer levels to be 31 percent of the food supply, equating to 133 billion pounds not consumed of 430 billion pounds produced.⁽¹⁾ This suggests that the average American tosses around 300 pounds of food each year, roughly 1.7 times the average body weight.⁵ This wasted food also translates into 141 trillion lost calories, which equates

to over 1,200 calories wasted per person per day.^{3(p18)}

Neither estimate provides a comprehensive evaluation of food loss and waste in the United States. And, neither statistic takes into account the amount of food lost at the growing stage. Indeed, billions more pounds are likely lost at the farm or field when, for example, fruits and vegetables aren’t harvested for one reason or another and become plowed over. The University of Arizona estimates that 29 percent of citrus crops, 18 percent of vegetables and 12 percent of apple crops never leave the farm level each year in the United States.⁶

Big picture, experts agree that one-third of all food worldwide goes to waste, and that the average is comparatively larger in the United States. The levels of waste are staggering when you visualize them. Each and every day, Americans alone waste enough food to fill Pasadena’s Rose Bowl Stadium.

Globally, it’s been estimated that wasted food occupies almost 1.4 billion hectares, roughly 28 percent of the world’s total land area. If the food that is grown but not eaten were to become its own country, it would be the second largest one in the world behind only Russia.⁷



Global food waste could cover 28 percent of Earth’s land area.

Concerned by these staggering numbers, the USDA and the EPA have set a national target to reduce food waste, challenging the U.S. to cut levels in half by the year 2030. This latest target builds on the Food Recovery Challenge launched in 2013 with the goal of reducing food waste, feeding the hungry and using waste for industrial purposes and composting.⁸

Food Waste's Ripple Effect

Wasted food has implications beyond what meets the eye. Regardless of the reason, trashing food and throwing away beverages results in numerous environmental, economic and social repercussions.



Environmental Impact

First, food that is harvested or raised only to end up in the landfill contributes greatly to the degradation of the environment and the depletion of precious, finite resources. Growing food that is never eaten uses excessive agricultural inputs, which significantly affect global climate change. These inputs include, but are not limited to, fresh water, fertilizers, pesticides and fossil fuels for growing crops and raising animals and for fueling farming equipment. And from an output perspective, food production exacerbates global warming, water and air pollution and more. According to the United Nations Environmental Programme (UNEP), agriculture gives off between 10

and 35 percent of all global greenhouse gas emissions.⁹

In addition, decomposing food that's tossed into landfills further contributes to climate change. Rotting food releases 3.3 billion tons of carbon dioxide, which accelerates the rate of climate change.¹⁰ What's more, it emits methane – a greenhouse gas 23 times more potent than carbon dioxide.¹¹ Food in landfills presently contribute to 23 percent of all methane emissions in the United States⁴ – a substantial burden on our depleting ozone layer.

One way to divert food waste from being buried or incinerated at municipal landfills and prevent so much greenhouse gas from being emitted is through composting. Composting intentionally combines organic waste with microorganisms like bacteria and fungi that break down the waste. The resulting compost can be used as nutrient-rich fertilizer or soil amendment.

While composting typically occurs on the individual level, there are commercial composting facilities and a growing number of 200+ noncompulsory community composts.¹² The City of San Francisco, an early adopter in civic composting more than 20 years ago, has set a goal to send no waste to landfills or incinerators by the year 2020.¹² While these goals are positive, composting isn't necessarily the solution of first choice (see the EPA's Food Recovery Hierarchy on Page 19) and Americans have a long road to go. Data suggests that only 3 percent of food today is actually diverted from landfills by being composted.¹³

Fresh water usage is another important factor. Estimates show that more than one quarter of fresh water use is accounted for

by wasted food. Agriculture is far and away the largest user of fresh water, guzzling up 70 percent of everything used.¹⁴ This water is used to grow our crops and to care for and feed the animals we eat. These uses are, of course, important. However, what we must remember is that when we waste food – whether it’s plant or animal-based – we’re also wasting water. And the research indicates that about 25 percent of the total amount of freshwater used for agriculture in the U.S. goes to produce food that does not ultimately serve its intended purpose of being consumed.¹⁵

In terms of energy, researchers estimate 30 percent of global energy consumption is accounted for by the agri-food system when you factor in agricultural machinery, fertilizer, transport, processing, manufacturing, packaging, retail and household refrigeration, cooking and more.¹⁶ Some 300 million barrels of oil (4 percent of all consumption) are expended annually in the U.S. just to make wasted food.¹⁵ The further food and drink travels through its supply chain, the more of a drain it has on energy usage. Household losses are responsible for eight times more than the average energy toll on all post-harvest food waste due to the energy used along the full supply chain and in food preparation at home.¹⁷



Economic Toll

Food waste is not only detrimental to the environment but costs consumers, businesses and taxpayers substantial sums of money. An American family of four throws

out an average \$1,484 worth of edible food every year. The estimated total value of food loss at the retail and consumer levels in the United States was pushing \$162 billion (estimated at retail pricing) in 2010, and food waste costs roughly \$1.3 billion just to landfill.³ The top three food groups in terms of share of total value of food loss were meat, poultry and fish (\$48 billion); vegetables (\$30 billion); and dairy products (\$27 billion).³

Obviously, the financial repercussions of wasted food vary by commodity and pricing, but it’s easy to overlook the financial drain caused by production inputs. Consider that about 10 percent of the United States’ entire energy budget is used towards producing, distributing, processing, preparing and preserving consumable plant and animal matter.¹⁹ Globally, it’s interesting to note that as certain developing countries take on more protein-heavy diets, these energy inputs and costs will be prone to significant increases. The number of British thermal units required to produce a pound of meat, poultry or fish is roughly four times that of producing a pound of a grain-based product.

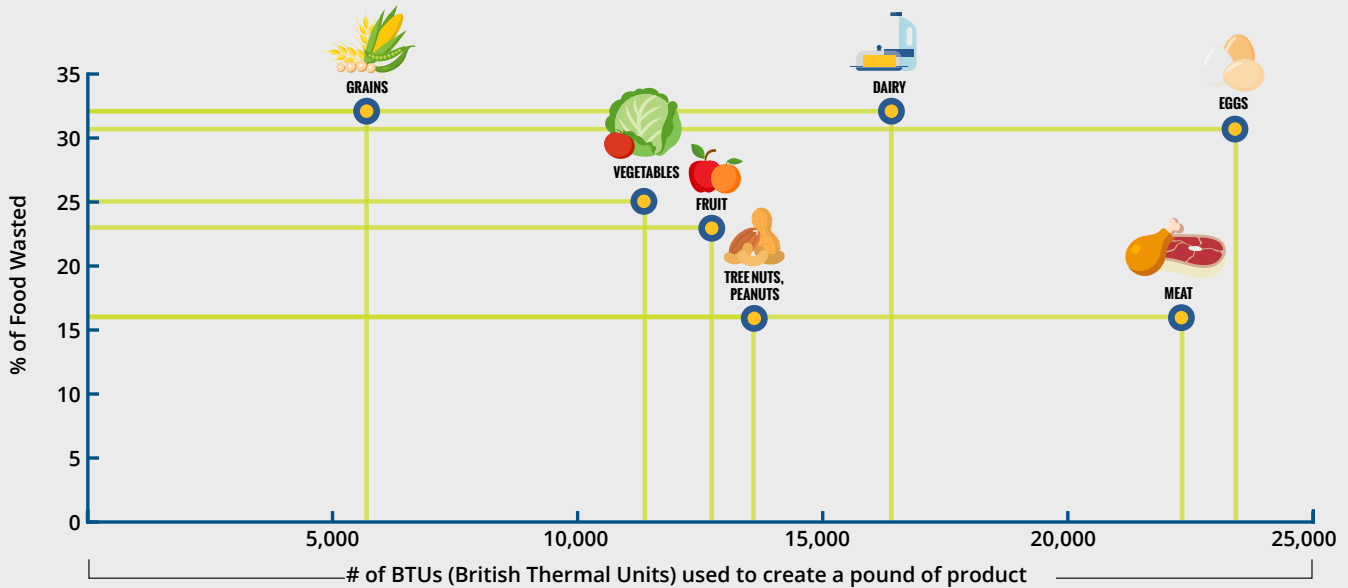
Ultimately, the world economy suffers \$940 billion per year by losing one-third of the food it produces to waste.²⁰ Conceivably, saving that amount of money could construct nearly 16 million Habitat for Humanity homes.



Waste in the Face of Despair

Finally, food waste also has severe societal consequences, contributing a vicious, spiraling circle of unfortunate events that take the dignity,

Food Waste in Comparison to Energy Use



Not only do different kinds of foods experience different levels of waste, they require varying amounts of energy

health and in many cases lives of people and cultures in need. In the U.S. specifically, more than 14 percent of U.S. households experience food insecurity, meaning that at some point during the year, these families couldn't provide enough nutritious food and drink for all their members because they lacked the resources.²¹ It's worth noting that food insecurity is often a lack of nutrients, not just a lack of calories, which is tragic because the food that is wasted is often the most nutritionally dense. Feeding America puts the number of U.S. residents who live in a food insecure home over the course of a year at a whopping 50 million.²¹ This huge number exists despite the fact that 200 food banks across the country — and 63,000 affiliated pantry and shelter agencies — distributed more than 2.5 billion pounds of food.²² In light of the 133 billion pounds wasted in 2010, it's obvious that some of that unnecessary waste could help to reduce the amount of food insecurity in the U.S. Reducing food losses by just 15 percent would be enough food to feed more than 25 million Americans every year.²³ Globally, the number of food-insecure people

surpassed 800 million in 2012.²⁴ In Africa, nearly 40 million persons require immediate food assistance, some of whom are battling outright starvation.²⁵ These persons' food security stems from multiple causes. It's not uncommon for croplands to be destroyed or food production to be otherwise interrupted intentionally. Sadly, ensuing food aid is sometimes then hijacked by warring parties who use food and beverage as a control point, rewarding would-be supporters, starving opponents and keeping conflict in play. When people in need flee to refugee camps and similarly find food scarcities, violence often breaks out yet again, further perpetuating conflicts that involve food imbalance.

With the world population expected to grow from 7.5 billion today to 9.3 billion by 2050,²⁶ prognosticators say a 70 percent increase in food production will be needed to sufficiently meet all basic hunger needs. To make that happen, more efficiencies will be needed along the food supply chain because feeding people requires resources that are finite and depleting.

When 38 percent of our ice-free land and 70 percent of our fresh water is already being used for farming and food production,²⁷ growing more food, and continuing to waste as much, to feed more people isn't an equation that adds up.

Food Waste Through the Supply Chain

Increasing the efficiency of the U.S. food and beverage system is a triple bottom-line solution that requires a multifaceted, collective and communicative approach by decision-makers at every rung in the supply chain.

Farming

It starts with efficient farming in which the agriculture community reduces the amount of unharvested food and mitigates food loss between harvest and sale. This loss is most acute for fresh produce, which is subject to damage from pests, disease, weather, labor issues, economics and in some cases, concerns or perceptions relating to food safety. Growers may produce more crops than there's demand for in their market as a hedge against these concerns. But if they end up producing a bumper crop and demand doesn't keep up, it often results in food loss – sometimes with entire fields of food left unharvested and re-plowed. Even fields that are harvested may contain significant amounts of food left behind. Workers are trained to harvest selectively, leaving any produce that won't pass minimum quality standards relating to shape, size, color or time to ripeness.

From an environmental perspective, while nutrients from unharvested food return to the soil, it's still a lost opportunity to provide nutrition to humans and it's not an efficient

use of the water, energy and chemicals that go into growing those crops.

All told, approximately 7 percent of planted fields in the United States go unharvested each year.²⁸ This number can vary widely and can occasionally be upwards of 50 percent for a particular crop or operation. According to an estimate by Feeding America, more than 6 billion pounds of fresh produce go unharvested or unsold each year.²⁹

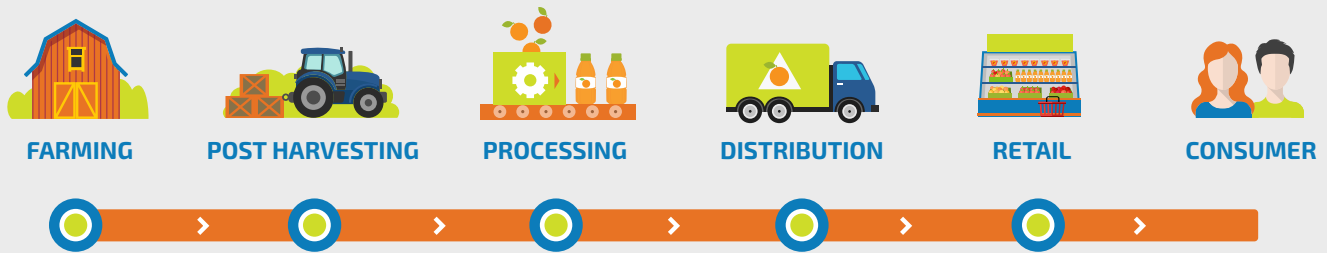
Post Harvesting

Once crops have been harvested, culling, i.e. removing products based on quality or appearance criteria such as size, color, weight or blemish level, can also lead to fresh produce loss. Culling quantities vary significantly by product and situation, but individual farmers have estimated that fewer than half of all vegetables grown actually leave a farm and that 75 percent of produced crops culled before sale are edible.³⁰ A large tomato-packing house reported that in mid-season it can fill a dump truck with 22,000 pounds of discarded tomatoes every 40 minutes.^{29(p229)} Similarly, a packer of citrus, stone fruit and grapes estimated that 20-50 percent of the produce handled is unmarketable despite being perfectly edible.³¹

Processing

Processing facilities remove both inevitable food (bones, pits) as well as edible portions (skin, fat, peels, end pieces) from food through their trimming processes, which of course adds to food loss. One food plant engineer has been quoted as saying that "the rule of thumb in processing potatoes is that 50 percent of the potato goes out the back door as finished product."³² Though not necessarily indicative of all foods, this example shows that processing waste can be significant.

Food Supply Chain



Ultimately, more analysis is needed to determine the impact of processing on food loss for both produce and other foods, factoring in the implications for packaging and bottling, nutrition and other variables. Several good questions are raised, and the answers aren't always clear. For example, is the food loss that occurs from trimming at the processing level less wasteful than if those products were to be trimmed at home? Is more food lost from trimmed produce rather than whole produce because it spoils more quickly? Or is the opposite true, because trimmed produce is more protected in transport?

Distribution

Much of our food, especially fresh food, is wasted at the distribution level on through to consumption. In terms of distribution, sometimes food and beverages can be damaged in transit and in storage as a result of poorly conceived transportation networks, improper preservation methods, human accidents or inattention to the conditions and needs of certain kinds of foods.

Another significant problem in distribution relates to rejected shipments or when distribution centers become inundated with surplus product because retail stores don't need all they'd forecasted. Rejected shipments

of perishable products can, unfortunately, be dumped if alternative buyers cannot be found in time. The clock is ticking on these products' lifespans, so even if these perishables do make it to a store, they have comparatively shorter shelf-lives and are more at risk of waste.

Sometimes, excess product is brought to food banks if those services have capacity to take them. However, even food banks sometimes reject these loads because they cannot necessarily put to use the large truckloads of specific food types that suddenly become available.

Retail

Retail is a powerful player within the food supply chain, holding significant sway both upstream (producers and suppliers) and downstream (consumers) in the process. Upstream, large commercial food and beverage buyers can demand tough contract terms including quantity guarantees and the ability to change orders at the last minute. Going all the way back to the farm-level, growers often overplant beyond their contracts for fear of not fulfilling them. And downstream of the retailer, much food waste at the consumer level actually begins with choices made at the grocery store. Bulk discounts, merchandising and promotions that encourage

impulse buys, and high-volume promotions such as buy-one-get-one-free all contribute to consumers' purchasing items or quantities of food that they may not consume.

In the developed economy of the United States, approximately 80 percent of food loss takes place at or after the retail level of the supply chain.³³ Cumulatively, in-store food losses in the United States have totaled an estimated 43 billion pounds.³ Most of that retail loss is in perishables—produce food and drink items, meat, seafood, baked goods and, increasingly, ready-made foods. One industry consultant wagered a guess that one in seven truckloads of perishables delivered to supermarkets is thrown away. The USDA estimates stores lose \$15 billion annually in unsold fruits and vegetables alone.³

These losses are propelled by a variety of factors, including America's mindset to have product displays over-stocked with food, often food that is cosmetically perfect in terms of shape, color and the absence of blemishes. Preset pack sizes often exceed a store's need, forcing a retailer to take on more than they'll likely be able to sell. Products are also discarded due to products or packaging that are damaged or seem out of date due to seasonality factors. In addition, many of the 19,000 or so new food and beverage products placed on grocery store shelves each year prove unpopular with consumers and get discarded when they fail to sell.³⁴

Consumer

Research is lacking in the United States, but anecdotal evidence suggests that drivers for household food losses include the facts that American families are under-aware of, or at least undervalue the impact of food waste. More than likely, this is a result of the

fact that food has become more readily and cheaply available in America. In addition, consumers can become confused by the differences in varying label dates ("use by..." "sell by..." etc.) and prematurely dispose of food and drink items. Consumer-level food also spoils from temperature abuse, poor visibility in refrigerators, less-than ideal meal planning, unnecessary impulse spending or simply having bigger appetites than stomachs.

Considering the Cold Chain

Proper transport and handling of foods as well as beverages is critical throughout the supply chain. But it's particularly crucial with perishable goods requiring cold conditions. The International Institute of Refrigeration forecasts that incompleteness with the cold chain causes almost 20 percent of food loss globally.⁴⁰ This trend is disproportionately experienced in hot and resource-starved developing nations that could save their food if they were only able to improve their refrigeration capabilities. India for example loses as much as half of all perishable food due to inadequate or non-existent cold chain, resulting in an economic miss-out of \$4.5 billion U.S. dollars.³⁵

In America and other developed nations, inconsistent refrigeration is less of a problem today than in the past. But it still occurs when trucks malfunction or get in accidents. Refrigerated products can also be kept at improper temperatures for too long during hand-offs on loading docks at cold storage facilities or in queue to be tested at ports or other stops.

Today's cold chain, i.e. the network that transports and stores perishable foods like meat, fish, dairy and produce under proper temperature conditions to avoid spoilage,

involves technologies like marine container refrigeration, truck-trailer refrigeration, cold storage warehouses and rooms, and at the retail-level, display cases. Improvements to the cold chain can mitigate food waste, so whether it's large transportation vessels that work in the cold or tiny time and temperature indicators that affix to packaging, companies are trying to think differently about how they can innovate and expand the process. Doing so in a way that isn't unnecessarily taxing on the environment requires problem-solving too. That's why the industry has been lauding the benefit of natural refrigerants and other energy-efficient technologies, as well as antimicrobial films and guards and ethylene adsorption freshness strips that are keeping food cool with lessened impact on our environmental footprint. With the emergence of the Internet of Things (IoT), tracking temperature-sensitive foods has never been more convenient. Processors and their supply chain partners can continually verify temperature conditions through a medley of RFID, GPS or other low-energy wireless technologies that work in real-time.

The Role of HPP

One technology for refrigerated foods that has taken off in recent years is high pressure processing (HPP), a method that uses water pressure to inactivate foodborne pathogens and spoilage organisms. In contrast to traditional food and beverage processing methods like thermal pasteurization or irradiation, HPP uses a cold pasteurization process to not only enhance food safety, but significantly extend product shelf-life.

HPP transitioned from the lab to the production floor in the 1990s, and it has become so intriguing within the food and beverage industry that it was recently voted



Expert Q&A John Mandyck

John Mandyck is chief sustainability officer for United Technologies Corporation, a global leader in the aerospace, food refrigeration and commercial building industries. He co-authored the book "Food Foolish", which explores the connection between food waste, hunger and climate change.

Q: How would you summarize the significance of the cold chain to our global problem of food waste?

A: Two thirds of all losses occur at the production and distribution level of the global food chain, while five of the top six lost and wasted food categories are perishable foods that supply humankind with a majority of its necessary vitamins and nutrients.

Despite this, only 10 percent of global perishable foods are refrigerated--the very foods that can benefit most from refrigeration technologies that are readily available today. So the cold chain is essential to extending the world's food supply. An expanded cold chain also has additional climate benefits, because research shows that for every ton of carbon eliminated by growing the cold chain in emerging economies, there is a 10-ton reduction in GHG emissions associated with food loss and waste.

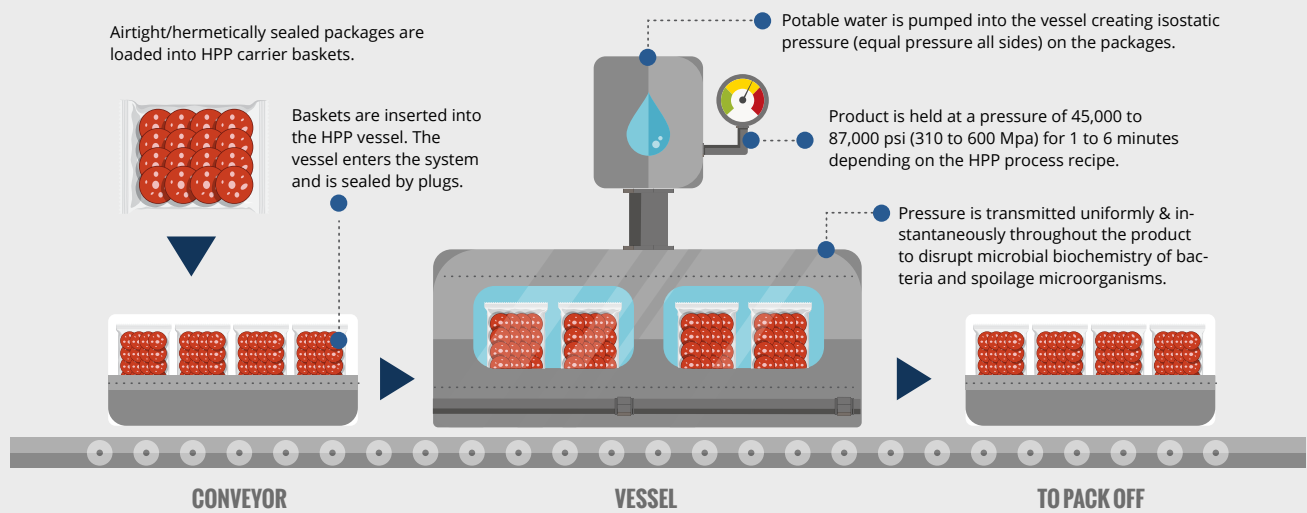
Q: What is the most common misnomer about food waste companies in the cold chain should work together to dispel?

A: Many people believe food waste is a consumer issue alone. While it's true that the top place we waste food in the U.S. is in the household, globally two-thirds of food is wasted at the production and distribution level – mostly in emerging economies – where implementation of the cold chain can play a big role.

Q: Does government regulation do enough to ensure proper temperature handling?

A: Governments can help in three ways: Provide awareness on the scale and consequence of food waste; Encourage food safety measures that have the additional benefit of avoiding waste; and Work with international finance bodies to provide access to capital to small holder farmers to invest in technologies that can extend food supplies.

How HPP Works



the No. 1 most important food technology for both North America and Europe over the next decade.³⁶ Though not the solution for every single food, the technology has broad application across many refrigerated food categories, including raw and ready-to-eat meats, fresh juices and smoothies, deli salads, dressings, dips, sauces, soups, salsa, ready-to-eat meals, cheese and other dairy products, fruits and vegetables and even raw pet foods.

How exactly does HPP work? Food already contained in airtight, hermetically sealed packages (hummus in deli cups, beverages in plastic bottles, meat chubs, ready meals in a tray) are loaded into carrier baskets that, in turn, are inserted into a large HPP vessel. Potable water is pumped into the vessel, creating isostatic pressure of the packages. The product is held at a constant high pressure (45,000-87,000 psi) for 1-6 minutes depending on the refrigerated food and HPP process recipe. This pressure is transmitted uniformly and instantaneously throughout the food product, disrupting the microbial biochemistry of foods' bacteria (including vegetative pathogens like *E. coli*, *Salmonella* and *Listeria monocytogenes*) and

spoilage organisms (fungi like yeasts and molds that grow on and accelerate decay). After completing its dwell time, the product is released. Since the pressure is transmitted uniformly, the food maintains its shape.

Both the USDA/FSIS and FDA recognize HPP as a legitimate lethality step, and for this reason, many producers have incorporated HPP as a preventative food safety measure in their HACCP plans. Some have even started to reference using HPP in their product positioning, marketing and on their labels as a way of not only protecting, but advancing their brands in today's food safety-concerned marketplace.

Additionally, HPP products often see their shelf-lives double. This shelf-life extension occurs without the use of chemicals, heat or preservatives that can compromise nutritional value and alter the natural flavor profile. The fact that products stay fresher longer cuts down on waste and spoilage and increases the profits of food and beverage manufacturers, retailers and food service providers. And prolonging the lifespans of

| | Non-HPP Apple Juice | HPP Apple Juice |
|--|--------------------------|--------------------------|
| Original Source | 100 pounds of apples/day | 100 pounds of apples/day |
| Processing Output After Juicing (Assumes 50% loss) | 50 pounds of juice | 50 pounds of juice |
| Shelf-Life | 3-5 days | 30-50 days |
| Post-Processing Food Waste After 30 Day (Assumes 10% loss) | 100 pounds | 10 pounds |

High Pressure Processing minimizes spoiled food by keeping it on the shelf longer.

food means that it can be shipped further, opening certain fresh products to brand new geographies and audiences.

Additionally, using the benefits of HPP, refrigerated food and drink producers are also able to offer health-conscious customers foods with enduring nutrients, unaltered proteins, natural flavors and less preservatives or sodium. These “cleaner-label” products have enabled many processors to differentiate themselves in an era when foods and beverages with more natural and better-for-you qualities have become increasingly popular.

From a retail perspective, the more that grocers can work with food producers to leverage shelf-life extending cold chain technologies like HPP, the less likely they are to bear the heavy chore and burden of throwing out food. Moreover, to be able to do so in a way that eliminates the use of preservatives gives customers a food that’s not only better for the environment, but more natural and better for them. HPP and cold chain innovations are so enticing that certain retailers are relocating cooked food that used to exist on their shelves to fresher, cleaner-level offerings that can live in refrigerators.

Target, for example, has moved some fridges to its infant aisle to stock HPP baby food that offer families longer-lasting products with cleaner labels.

The trend towards fresh, cleaner label, refrigerated food rather than frozen food packed with preservatives also extends to quick service restaurants. Fast casual chains like Five Guys and In-N-Out Burger that use fresh, refrigerated meat have grown in popularity, but the growth in this area isn’t limited to smaller companies. Wendy’s national franchise has used their, “fresh, never-frozen beef” as a differentiator for nearly 50 years, and competitors are catching on. In response to consumer demand, McDonald’s announced plans to use fresh beef on many of their Quarter Pounder burgers by 2018.

HPP + OJ

Take the example of oranges, the number one fruit consumed in America when considering its fresh as well as processed usages. Processing purposes comprise nearly 80 percent of orange use, with most processed oranges used to make juice.³⁷ Annual orange juice consumption per person in the United States was estimated to be 31.3

Spoiler Alert: Spoilage Organisms Addressed by HPP

Penicillium

These soil fungi, often responsible for food spoilage, prefer cool and moderate climates. They can thrive in low humidity conditions and colonize rapidly on seeds and other stored foods while conditions are moist.

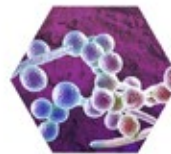


Rhodotorula mucilaginosa

Comparatively less dangerous than other common infections, but it can still be deadly in immunocompromised persons. Has been known to cause pneumonia and upper respiratory tract infections.



ORANGE JUICE



Candida

A type of yeast common in beverages that gives off a foul odor. It thrives in high-sugar environments like wine or fruit juices.



Saccharomyces

Some of these yeasts species serve useful purposes in food and beverages – for example in the production of beers, wines and even kombucha – but when they exist in sugar-rich foods such as juice, they cause spoilage.

pounds, or 3.6 gallons, in 2014 according to the USDA.³⁸

Yet highly consumed perishable foods like oranges are also often highly wasted products. Millions of tons of oranges are lost in fields, warehouses, packaging, distribution, supermarkets, restaurants and fridges each year. And from an environmental standpoint, juicing an orange juice in particular can be quite taxing. One glass of O.J. requires 45 gallons of water for irrigation, processing and other purposes, so it's important to minimize the amount that's wasted.³⁹

Orange juice is offered in various forms: made-from-concentrate, not-from-concentrate and freshly squeezed. Made-from-concentrate juice undergoes a process in which all the water (and much of the flavor) is removed whereas not from concentrate juice traditionally heat-pasteurizes and de-aerates the liquid before storing them in huge tanks for close to a year. Because these processes strip natural flavors from the juice, most companies chemically flavor the juice

later when it's ready for packaging in order to make it taste fresh again.

On the other hand, Universal Pure, the largest HPP services provider in the U.S., has been able to apply HPP to freshly squeezed orange juice stored in flexible plastic bottles. The processing not only would be effective for dismantling any presence of bacteria such as *Bacillus cereus* or *Serratia* and fungi like *Aspergillus flavus*, but it alleviates the need for extra flavoring to be added because the juice maintains its fresh taste. High pressure processing enhances the safety of the beverage and preserves the natural taste without necessarily destroying the orange's health-enhancing phytonutrients like thermal pasteurization methods do.

The bonus is that it extends the shelf-life by inactivating spoilage organisms. Freshly squeezed O.J. with no preservatives has a refrigerated shelf-life of 1-2 weeks. Flash pasteurizing the juice (via heat) brings the refrigerated life of the product up to 20-30

days – better. But applying HPP to fresh orange juice typically extends shelf-life in the fridge all the way to between four and six months. This gives families (and all of the preceding entities in the supply chain that brought the product to them) more time for the carton to be finished down to the last drop.

Triple Bottom Line Mentality

Despite the obvious benefits to our world and environment, it's important to note that some companies further upstream in the supply chain will view a reduction in food waste as having a negative impact in that it carries the potential of lost revenue. These parties know that most of today's retailers frequently place new orders when they have to dispose of product that has reached the end of its shelf-life.

But if you examine this issue more thoroughly from an economic standpoint, wasted food and beverage means wasted investments in resources, wages, processing and supply all throughout the chain. This drain, as well as the stigma among regulators, watchdogs and certain consumers especially concerned about this issue of food waste amidst diminishing resources and an expanding population, undoubtedly takes its toll on business success and profitability.

Food and beverage supply partners must weigh the trade-off between responsible retailing and making as much short-term money as possible. Customers and shareholders find it very important that their business interests make a profit, but they also expect a mentality of social benefit. This means embracing the economic, environmental and social layers of sustainable development commonly regarded as the triple bottom line of planet, people and profit.



Companies can become more marketable by showing how continual and comparative reductions in their food waste and related carbon footprint exist as a part of their brand essence and holistic commitment to sustainability. Companies who tackle this issue head on become leaders in guiding responsible purchase and consumption habits and lauding the small steps that cumulatively make big differences.

That includes promoting acceptance of foods that are nutritious if not delicious, but tend to get discarded because of slight imperfections in color, shape or other appearances.

An increasing number of retailers and produce delivery companies are starting to invest in so-called “ugly” or “inglorious” fruits and vegetables that were previously tossed for failing to meet cosmetic criteria. The benefits of changing consumer mentalities about the aesthetics of acceptable food – from discolored meat to bruised or misshapen vegetables – extends all the way back to the beginning of the supply chain, starting with farmers who are encouraged to plant less because they can reap more “off-grade” items.

A Food Pyramid for Diverting Food Waste

For the past decade, the EPA has recommended, through its Food Recovery Hierarchy, a set of prioritized actions for maximizing food use and minimizing food waste. This blueprint helps direct waste to more preferable locations than landfills or incinerators and seeks to educate the industry and consumers about the differences between various destinations excessive food can go to.

Source Reduction

The first tier of the EPA's hierarchy is source reduction, or minimizing the amount of food and beverage generated in the first place. The key to really making a dent into food waste is to start from the source. Reducing the unnecessary production of food and drink is the best thing anyone can do to minimize the impact from food waste.

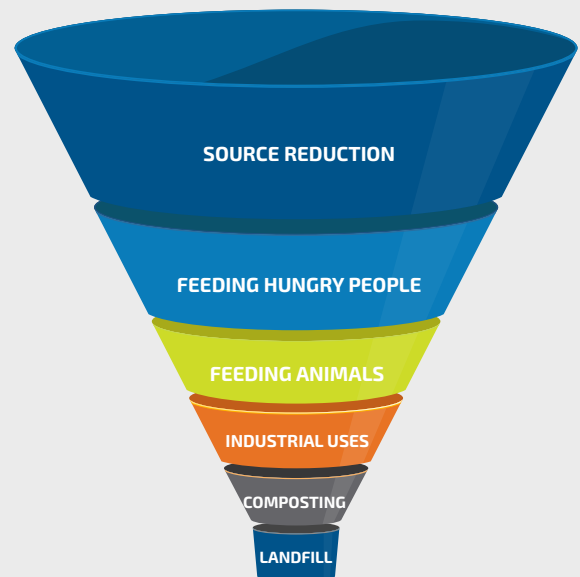
Feeding Hungry People

The second step in the Food Recovery Hierarchy is feeding hungry people. Food banks and food donation programs provide healthy, nutritious food to 14 percent of Americans in food insecure households across the nation. While retailers are legally protected when donating food to non-profit organizations such as soup kitchens, food pantries and shelters, many choose to forgo food donation or limit donations to foods less likely to spoil fast. This is done to prevent negative publicity should donated food ever be found unfit for consumption.

Feeding Animals

Animal feed, the third tier in the hierarchy, is a form of food recycling in which either unsellable food scraps are collected to feed livestock on local farms, zoos and other sanctuaries or in which proteins are blended

EPA Food Recovery Hierarchy



Many people think composting is the remedy for food waste. In reality, the solution starts with producing less food.

into animal feed additives for pet food. It's worth noting that regulations regarding food recycling for animal feed vary by state.

Industrial Uses

The fourth tier relates to industrial uses for food waste. The main such use is anaerobic digestion, the process in which microorganisms break down food and other organics and create biogas. Comprised mostly of methane and carbon dioxide, biogas can be used in many of the same applications in which natural gas is used including the production of heat, electricity and fuel. Remaining solids from the anaerobic digestion process can be composted and/or used to fertilize or amend soil.

Composting

Many people believe that composting is the first and best practice to minimize food waste, but in fact, it's the hierarchy's next-to-last tier. It closes the loop by creating a nutrient-rich material that farmers can use to nourish crops and it diverts methane from being emitted in landfills. Compost can be used to remediate soils contaminated by hazardous waste and to destroy volatile organic chemicals (VOCs) in contaminated air.

Landfill/Incineration

The last resort for the disposal of food waste should only be used in the event food is unfit for any of the above diversion methods.

Legislation and Initiatives to Watch

Multiple solutions have been proposed through the lawmaking process and as a result of industry collaborations. Here are a few specific developments that the refrigerated foods industry may be wise to follow:

Food Date Labeling Act

In an effort to reduce the billions of pounds of food waste in the United States, the U.S. House of Representatives introduced the Food Date Labeling Act (H.R. 5298) in its 2016 legislative session. Lawmakers plan to reintroduce the bill to the new 2017 Senate as of this writing. The bill calls for standardized quality date labeling to a uniform "best if used by..." tag and, in the case of ready-to-eat foods, "expires on..." label. Foods that would be included in the expiration date requirement would be poultry products as defined in section 4 of the Poultry Products Inspection Act, meat products as defined in

section 1 of the Federal Meat Inspection Act, egg products as defined in section 4 of the Egg Products Inspection Act, and raw foods or foods eaten without need for further processing.

The Food Date Labeling Act intends to reduce waste caused by confusion over inconsistent and imprecise directions for when a food should be discarded. If passed as proposed, the act would also ban states from preventing grocers or manufacturers from donating foods that have passed their quality dates, but are still safe to consume to pantries, homeless shelters and other services for those in need. To follow this pending law, interested parties can visit <https://www.congress.gov/bill/114th-congress/house-bill/5298>.

Food Recovery Act

The Food Recovery Act (H.R. 4184) aims to cut food waste on the farm, in stores, in schools and at home. Similar to the Food Date Labeling Act, it proposes the adoption of uniform labels to combat confusion among consumers and put an end to the patchwork of voluntarily enforced labeling language. But it also aims to sponsor a national marketing campaign raising awareness of food waste's impact and would create an infrastructure fund to support large-scale composting and food waste-to-energy facilities. Furthermore, it intends to create an Office of Food Recovery to coordinate federal activities related to measuring and reducing food waste. And not only would it instill tax relief to members of the food supply chain that donate surplus product and strengthen the Good Samaritan Food Donation Act, which insulates food donating organizations from liability, it would require government contracting food

companies to donate surplus foods in order to do business with Uncle Sam. Among additional measures, it also would require the USDA to establish a standard for how to estimate the amount of food wasted from grower and direct the agency to develop new technologies that enhance the freshness and lifespans of food. To track this proposal, interested parties can visit <https://www.congress.gov/bill/114th-congress/house-bill/4184>.

Cold Pressure Council

In March 2017, a group of refrigerated food producers and food safety and shelf-life technology and services companies including Universal Pure formed the Cold Pressure Council, which seeks to lead, facilitate and promote industry standardization, user education and consumer awareness of high pressure processing. The Cold Pressure Council aims to formalize industry best practices to achieve more benefits when it comes to safety and extended shelf life of fridge foods and drinks. Interested individuals can learn more at www.coldpressurecouncil.org.



Directory of Food Safety Resources

| Organization | Website | Phone/Email |
|--|--|--|
| Feedback | feedbackglobal.org | hello@feedbackglobal.org |
| Feeding America | feedingamerica.org | (800) 771-2303 |
| Food and Agricultural Organization of the United Nations | fao.org | (+39) 06 57051 |
| Food Marketing Institute | fmi.org | (202) 452-8444 |
| Food Policy Action | foodpolicyaction.org | (202) 997-3266 |
| Food Tank | foodtank.com | (202) 590-1037 |
| Food Waste Reduction Alliance | foodwastealliance.org | fwra@gmaonline.org |
| Forum for the Future | forumforthefuture.org | +44 (0)20 7324 3630 |
| Global Cold Chain Alliance | gccca.org | (703) 373-4300 |
| Grocery Manufacturers Association | gmaonline.org | (202) 639-5900 |
| National Resource Defense Council | nrdc.org | (212) 727-2700 |
| National Restaurant Association | restaurant.org | (800) 424-5156 |
| Produce Capture Institute | producecaptureinstitute.org | (651) 282-0856 |
| ReFED | refed.com | (978) 290-1681 |
| Spoiler Alert | spoileralert.com | info@spoileralert.com |
| Sustainable America | sustainableamerica.org | (203) 803-1250 |
| United Nations Environment Programme | unep.org | (254-20) 7621234 |
| U.S. Department of Agriculture | usda.gov | (202) 720-2791 |
| U.S. Environmental Protection Agency | epa.gov | (703) 347-0239 |
| Water Environment & Reuse Foundation | werf.org | (571) 384-2100 |
| World Economic Forum | weforum.org | (212) 703-2300 |
| World Resources Institute | wri.org | (202) 729-7600 |
| World Wildlife Foundation | worldwildlife.org | (202) 293-4800 |

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While the issue of food waste is a grave global problem, we all have a piece of the puzzle to solve it. The United States set an aggressive goal of cutting food waste in half by 2030. By reducing the amount of food produced, rethinking the over and out mindset, and inactivating spoilage organisms to extend product shelf-life, producers, retailers and consumers can work together to achieve it.



To learn more about how Universal Pure can help advance your food safety and food waste reduction initiatives, support cleaner label efforts or otherwise strengthen your brand equity, email info@universalpure.com

