

REPORT

WASTED:

HOW AMERICA IS LOSING UP TO 40 PERCENT OF ITS FOOD FROM FARM TO FORK TO LANDFILL

SECOND EDITION OF NRDC'S ORIGINAL 2012 REPORT



Back in 2012, NRDC's work on sustainable agriculture caused us to stumble upon shocking numbers about how much food was going to waste across the United States. The further we dug, the more unbelievable we found the situation. We kept saying to ourselves, "These numbers can't be true, because if they were, everyone would be talking about them." And yet, very few people were. This led us to release a report in August 2012 entitled *Wasted: How America Is Losing up to 40 Percent of Its Food from Farm to Fork to Landfill*. To our surprise, that report landed on CNN's Breaking News headlines and circled the globe in just about every major news outlet. It helped spark a national dialogue about how much food is going to waste and what can be done about it.

Just three short years later, in the fall of 2015, the U.S. Department of Agriculture and the U.S. Environmental Protection Agency announced federal targets to cut food waste in the United States by 50 percent by 2030. This and other markers of progress show us just how far awareness of wasted food has come over a short period of time.

While data are still quite limited, and it's therefore difficult to say whether we are actually wasting less food than in 2012, much progress has occurred. We therefore felt it was appropriate to publish an updated version of our *Wasted* report. Like the original version, this report will answer two questions: "What are the leading drivers of wasted food across the different stages of the supply chain?" and "What can we do about it?" We include updated numbers where available and new examples of emerging solutions. We also chronicle key elements of progress made since the last report was released, five years ago. Finally, we conclude with recommendations on how to further this progress in the years ahead.

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About NRDC

The Natural Resources Defense Council is an international nonprofit environmental organization with more than 2.4 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Montana, and Beijing. Visit us at nrdc.org.

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Executive Summary

OUR GRAND INVESTMENT IN WASTED FOOD

America does not eat 40 percent of its food.¹ If the United States went grocery shopping, we would leave the store with five bags and drop two in the parking lot. And leave them there. Seems crazy, but we do it every day.

All told, America throws out more than 1,250 calories per day per person, or more than 400 pounds of food per person annually.² That's a loss of up to \$218 billion each year, costing a household of four an average of \$1,800 annually.³ At the same time, 42 million Americans face food insecurity—and less than one-third of the food we throw out would be enough to feed this population completely.⁴ To place this in a global context, the average American consumer wastes 10 times as much as his or her counterpart in Southeast Asia or sub-Saharan Africa.⁵

We leave entire fields unharvested, reject produce solely for cosmetic reasons, throw out anything past or even close to its “sell by” date, inundate restaurant patrons with massive portions, and let absurd amounts of food rot in the back of our fridges. In our diverse nation of 322 million people, wasting food emerges as an embarrassing unifier. No matter our age, gender, economic status, or education level, we all waste food.⁶

MORE THAN JUST FOOD

THE U.S. WASTES TONS OF RESOURCES WHEN WE WASTE FOOD

1,250 CALORIES PER PERSON PER DAY
THAT IS HALF OF THE RECOMMENDED DAILY INTAKE FOR ADULTS

19%
OF ALL
U.S.
CROPLANDS
THAT IS MORE
LAND THAN ALL
OF NEW MEXICO

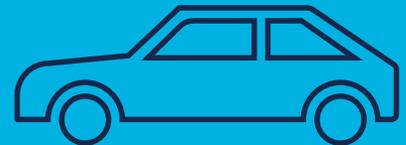
21% OF U.S. LANDFILL
CONTENT



THE NO. 1 CONTRIBUTOR BY WEIGHT

18%
OF ALL
FARMING
FERTILIZER
WHICH CONTAINS
3.9 BILLION POUNDS
OF NUTRIENTS

2.6% OF ALL U.S. GREENHOUSE
GAS EMISSIONS ANNUALLY



37 MILLION PASSENGER VEHICLES' WORTH

21% OF THE U.S. AGRICULTURAL
WATER USAGE



MORE THAN: TEXAS + CALIFORNIA + OHIO

\$218,000,000,000

WHICH IS EQUAL TO 1.3% OF THE U.S. GROSS DOMESTIC PRODUCT (GDP)

And it's not just food going in the trash. Even with the most sustainable practices, our food system uses enormous resources. Food and agriculture consume up to 16 percent of U.S. energy, almost half of all U.S. land and account for 67 percent of the nation's freshwater use.^{7,8,9} Those resources are used in vain if the food is never eaten, wasting up to about one-fifth of U.S. cropland, fertilizers, and agricultural water.¹⁰ Food waste is also a significant contributor to climate change, responsible for at least 2.6 percent of all U.S. greenhouse gas emissions.¹¹ That's equivalent to more than that of 37 million cars, or 1 in 7 cars on the road.¹² The majority of those greenhouse gases are released by growing the food, though a portion is released as methane as food rots in landfills. In fact, food is the number one contributor to landfills today.¹³

The implications of this problem are only going to get worse. The global population in 2050 is projected to demand 1.5 to 2 times more food than we needed in 2005.¹⁴ But that assumes current waste levels. Wasting less food can help stabilize food demand even as population grows, as was demonstrated in the United Kingdom, where the population grew 4.5 percent but total food demand stayed constant (while wasted food declined).¹⁵ Before we convert more undeveloped lands to farmlands to produce the food we'll need, we must make better use of what we have.

Americans can solve this problem. We weren't always this wasteful. In fact, Americans waste 50 percent more food today than we did in the 1970s, which means we could easily waste less today.¹⁶ A 2017 study found it may even be good business to do so, with an average 14-fold financial return on investment for companies implementing food waste reduction efforts.¹⁷ Turning this ship around will require a suite of solutions, including modified supply-chain operations, enhanced market incentives, increased public awareness, and adjusted consumer behavior. While much work remains, the good news is that Americans have made heartening progress toward wasting less food since 2012, and momentum continues to build. This report details the progress made since 2012 and discusses the myriad solutions that can bring us closer to a more efficient food system with less food wasted.

GROWING MOMENTUM

In 2012, NRDC published *Wasted: How America Is Losing up to 40 Percent of Its Food from Farm to Fork to Landfill*, helping to spark a national movement to waste less food. This second edition updates and expands the previous report. And there is much to report. National and corporate goals have been established, policies have progressed, and consumer awareness is spreading like wildfire.



We now have more research on the topic. Many newly published studies are cited throughout this report. In addition, the Food Loss and Waste Protocol established a global standard for quantifying and reporting food waste, thus enabling collection of comparable data in years to come.¹⁸ Unfortunately, though, current data are still quite limited, and it is difficult to say we are actually wasting less food today.

Progress on the policy front, however, has been significant. In September 2015, the U.S. Department of Agriculture (USDA) and the U.S. Environmental Protection Agency (EPA) set a national goal to cut food waste by 50 percent by 2030,¹⁹ aligning with similar targets set in 2015 in the United Nations' Sustainable Development Goals.²⁰ As part of the omnibus budget package that closed out 2015, Congress improved food donation tax incentives and extended them to businesses of all sizes.²¹ A spate of food waste legislation was then introduced. First, the Food Recovery Act, the first-ever explicit food waste bill in the U.S., was introduced to Congress at the end of 2015.²² It was followed by the Food Date Labeling Act and the Food Waste Transparency Act.^{23,24} While none of these were passed into law, their introduction indicates progress. In December 2016, the USDA announced guidance toward a more standardized food date labeling system to help reduce premature disposal of food. In addition, nine states added tax incentives for donating food that would otherwise be wasted.²⁵ Five states required at least some businesses to recycle food instead of throwing it away, and in some cases those laws prioritize food recovery and prevention of surplus.²⁶

The food industry has taken some proactive steps as well. In 2015, the Consumer Goods Forum, a global consortium of more than 400 retailers and manufacturers, committed to halve food waste within the operations of its members by 2025.²⁷ And in 2016, 15 leading U.S. companies were named USDA Food Loss and Waste 2030 Champions when they committed to halve food waste by 2030.²⁸

In January 2017, in line with the USDA's efforts, two leading food industry associations announced voluntary guidelines to standardize food date labels in order to reduce the confusion leading consumers to throw food out prematurely.²⁹ The Food Waste Reduction Alliance, made up of three food industry associations and founded in 2011, made progress by collecting biannual surveys from members and publishing best practice guides for the industry.

In contrast with 2012, when there was little discussion of the topic, wasting less food has become a regular part of the conversation around a sustainable food future. The number of media articles about food waste, for instance, grew 25 percent per year from 2011 to 2016, amounting to almost three times as many articles in 2016.³⁰ The topic had over 90,000 Twitter mentions from October 2015 to September 2016.³¹ In 2015, the issue was even a feature of *Last Week Tonight with John Oliver*, HBO's comedic news program, with nearly eight million live and online views.³²

At the consumer level, a 2015 consumer survey found notable awareness, with 42 percent of respondents having heard or seen something on wasted food in the past year.³³ And 45 percent of respondents correctly identified the most recent estimate of U.S. wasted food (40 percent).³⁴ In a 2016 poll of more than 6,700 adults, 74 percent

reported that the issue of wasted food was personally important or very important to them.³⁵

As an organization, NRDC, too, is stepping up its efforts to reduce wasted food. In April 2016, we partnered with the Ad Council to launch Save the Food, a national public service campaign to reduce wasted food in the United States.³⁶ The digital, video, print, radio, and outdoor assets of the campaign have appeared in countless outlets across the country, including on national television, in Times Square, on buses in Chicago, and on waste trucks in California. As of this writing, the campaign has generated almost \$45 million in donated media. We are also working on models for city governments to address wasted food, collecting original data on residential wasted food, creating tools to estimate recoverable food, and engaging in policy efforts at state and federal levels.

MOVING FORWARD

Yes, we have seen promising momentum and some concrete progress. But there is much work ahead. The scale and complexity of the wasted food issue cannot be ignored, yet we also cannot wait to act. We must now lay the foundation for progress over the years and decades to come.

The benefit of reducing future greenhouse gas emissions, water usage, energy usage, and land-use change by cutting wasted food is massive—especially given growing resource constraints. Below are specific actions that the government, private sector, and consumers can take to make a significant dent in America's food-wasting epidemic.

The federal government should use its administrative tools to meet the national food waste reduction goals. It should prioritize preventing excess food, then feeding people in need, and then recycling food waste. More specifically, the federal government should:

- **Fund** expanded infrastructure and innovative solutions that prevent wasted food by setting aside portions of existing grant funds.³⁷
- **Conduct or fund more detailed studies** to measure and document the extent, nature, and drivers of wasted food along the food supply chain.
- **Provide federal agency parameters** to standardize food date labels at the USDA and Food and Drug Administration (FDA), and update FDA Food Code guidelines with model food safety policies that pertain specifically to donated food.
- **Engage and educate** the public through national public service and school campaigns.
- **Lead by example** by requiring federal agencies to measure and report wasted food, to donate excess food and compost whenever possible, and require similar actions of their vendors.



Congress should pass laws that minimize the amount of food wasted. More specifically, Congress should:

- **Incentivize food waste reduction strategies in the next Farm Bill.** These strategies could include providing funds for pilots, innovation, and improved infrastructure; implementing critical research to better understand issues and develop solutions; expanding value-add processing capacity; and educating consumers and children alike.
- **Standardize and clarify date labels** so that consumers stop throwing out food (and money) due to misinterpretation.
- **Expand and clarify liability protections and tax incentives** to remove barriers to food donation.

State and local governments should:

- Partially or fully **ban food from being sent to landfills or incinerators**, with a **dual goal of reducing the generation of wasted food overall.**
- **Set targets**—like adopting the national goal to reduce food waste by 50 percent by 2030—and establish a baseline to measure progress.³⁸
- **Implement campaigns** that inform people and inspire them to waste less food in their jurisdictions.
- **Engage local businesses and community members** through technical assistance and recognition programs.
- **Incentivize food donations and expand capacity of food recovery organizations** to accept surplus food. Incentives could include tax credits for farmers donating food, grants for added food rescue infrastructure, or community partnerships that expand food rescue capacity while enhancing the nutritional value of donated food.

Businesses should:

- **Conduct food waste audits** to understand the scope and opportunities within their operations.
- **Set reduction goals and publicly report progress.** Setting achievable short-term goals can help motivate and direct action across companies.
- **Focus on reducing meat and dairy waste.** Waste reduction efforts aimed at these food categories will have the biggest ecological and often financial bang for the buck.
- **Align with standardized food date labels.** Companies should align date labels on their products with the guidelines recently established in the food industry.
- **Adopt industry best practices and create new ones.** This report provides recommendations for each stage of the supply chain, but the solutions will need to be customized. In addition, businesses can create new measures to shift procurement, preparation, service, and merchandising practices—and then share the successful approaches with others.
- **Invest in innovative** entrepreneurial efforts and additional research.

Every American can help reduce waste by adopting better food management practices, like learning when food is (and isn't) bad to eat, correctly interpreting date labels, and buying the right amount of food to begin with. We can also take pains to store, cook, and eat food with an eye to reducing waste, and we can teach our children to value food. Many more tips and suggestions are outlined in depth at www.savethefood.com and in the book *Waste-Free Kitchen Handbook: A Guide to Eating Well and Saving Money by Wasting Less Food*.

SUMMARY OF DRIVERS AND REMEDIES OF FOOD WASTE BY SUPPLY CHAIN STAGE

MAIN DRIVERS	POTENTIAL REMEDIES
PRODUCTION	
<p>WEATHER/DISEASE: Natural phenomena harm crops and lead to excess planting to hedge against risk.</p> <p>MARKET CONDITIONS: A crop's price at time of harvest may not warrant the labor and transport costs required to bring it to market.</p> <p>BUYER STANDARDS: Selective harvest for appearance, shelf life, and other requirements leads to crops left in the field.</p> <p>LABOR SHORTAGES: When harvest timing is critical, a labor shortage can lead to lower harvest rate.</p> <p>FOOD SAFETY THREATS: Actual or perceived food safety concerns can lead to huge losses of product.</p> <p>ORDER CHANGES: Unpredictable order fluctuations and last-minute cancellations lead to product without a home.</p> <p>BYCATCH: Unintended and/or unmarketable seafood species are caught during fishing, but not sold.</p>	<p>Broaden cosmetic standards to encompass a wider array of physical attributes.</p> <p>Expand secondary markets for items that do not meet highest cosmetic standards and alternative fish species.</p> <p>Expand farm-level food recovery via paid "concurrent picking", increased tax incentives for donating unsaleable, edible food to food banks, and funding to cover transportation and infrastructure for fresh food donations.</p> <p>Incorporate regional food networks, which can lead to less transport and sometimes less culling for short-lived products.</p> <p>Use targeted gear to reduce bycatch in fishing.</p>
PROCESSING	
<p>TRIMMING: Removal of edible but undesirable portions (peels, stems, skin, fat) along with inedible portions (bones, pits).</p> <p>PROCESSING INEFFICIENCIES: Some steps in operations may lose more edible food than necessary.</p> <p>EQUIPMENT, PACKAGING, AND FORECASTING ERRORS: Mistakes and malfunctions can lead to surplus or unsaleable product.</p>	<p>Reengineer production processes and product designs.</p> <p>Develop secondary uses and new food products from trimmings, peels, and other by-products. If not edible for humans, diversion to animal feed or compost facilities.</p> <p>Optimize product size to accommodate smaller or customized portions.</p> <p>Employ standardized system of date labels to reduce confusion among consumers.</p>
DISTRIBUTION	
<p>IMPROPER HANDLING: Overhandling, improper temperature, lengthy transportation, and disruptions to cold chain can lead to damaged product.</p> <p>FOOD EXPIRATION: Order changes and backups at loading docks and ports of entry can take up precious shelf life, causing product to pass contracted shelf life requirements</p> <p>REJECTED SHIPMENTS: Rejected shipments will have shorter shelf life and limited buyers, making them difficult to sell before spoiling.</p>	<p>Ensure proper training for handling and storage.</p> <p>Establish online marketplaces that facilitate sale or donation of short-life product or rejected shipments.</p> <p>Expand infrastructure enabling food rescue organizations to accept fresh food donations.</p>
RETAIL: IN STORE	
<p>STOCK MANAGEMENT: Large inventories, full shelves, and improper stock rotation can lead to excess, old, or damaged product.</p> <p>DISPLAYS: Excessive product may be displayed in order to create the effect of abundance, which is believed to increase sales.</p> <p>PREPARED FOODS: Perishables in the deli, bakery, and ready-to-eat sections are discarded after a certain period of time.</p> <p>DATE LABELS: Though still consumable, products within 2-3 days of the date on their package are removed from shelves.</p> <p>PACKING: Packaging methods can affect shelf life, and grouped products can be discarded when a single item in the group goes bad. Additionally, inflexible case sizes force smaller stores to order more than they expect to sell.</p> <p>PROMOTIONAL PRODUCTS: The passing of holidays and the high failure rate for new food items lead to increased discards.</p> <p>STAFFING CHALLENGES: With low staffing, there is less labor to prepare food on site and to rotate stock, leading to less flexibility in repurposing minimally damaged products. High turnover and poor training increase mishandling.</p>	<p>Streamline inventory by identifying opportunities to reduce number of items available and/or change ordering patterns.</p> <p>Discount older and slightly damaged items instead of removing them, increasing likelihood of sale and giving willing customers a bargain.</p> <p>Redesign produce, deli, and seafood displays using platforms, smaller bins and bowls, or other props to achieve appearance of abundance with less excess product.</p> <p>Improve packaging methods, such as vacuum-packing meat, to ensure that repackaged product retains quality and shelf life.</p> <p>Allow prepared foods to sell out near closing time without replenishing.</p> <p>Utilize damaged product in prepared food offerings.</p> <p>Improve training of staff on product handling and stock rotation.</p> <p>Increase donations from stores to those in need, including of meat, dairy, and produce.</p>

SUMMARY OF DRIVERS AND REMEDIES OF FOOD WASTE BY SUPPLY CHAIN STAGE

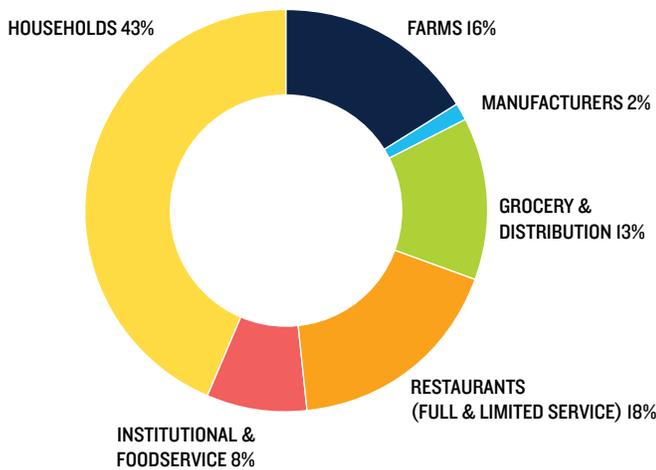
MAIN DRIVERS	POTENTIAL REMEDIES
RETAIL: BEYOND STORE	
<p>CONTRACT TERMS: Rigid contract terms can cause growers to overplant to ensure contracts are filled. Last-minute order changes can leave suppliers with excess product.</p> <p>COSMETIC STANDARDS: Aesthetic requirements imposed by the market lead to unharvested and culled edible produce upstream.</p> <p>REJECTED SHIPMENTS: By the time a shipment is rejected, its contents have a shorter shelf life and may be difficult to sell elsewhere before spoiling.</p> <p>MARKETING AND BULK PROMOTIONS: These can lead consumers to purchase unnecessary goods that are ultimately not eaten once in the home.</p>	<p>Increase flexibility in contract terms and grading standards and share risks of farming and mis-forecasting across supply chain.</p> <p>Experiment with offering lower-cosmetic-grade produce to determine viability.</p> <p>Adjust promotions to avoid excessive purchase of one item, such as offering half off or mix-and-match rather than two-for-one deals.</p> <p>Educate consumers on food quality, safety, and expiration.</p> <p>Enable purchase of smaller or customized portions, such as through bulk bins and staffed deli counters.</p> <p>Hide sale date information on products via codes or otherwise so customers are not confused by “sell by” dates.</p>
FOOD SERVICE	
<p>PORTIONS: Large and inflexible portions lead to diners not eating everything on their plate.</p> <p>EXPANSIVE MENU OPTIONS: Extended menus complicate inventory management and require more ingredients to be kept on hand. All-you-can-eat offerings have particularly high waste.</p> <p>SALES FLUCTUATIONS: Bad weather and unpredictable factors make inventory planning difficult.</p> <p>KITCHEN PRACTICES: Overproduction, trim waste, mishandling, and poor inventory management. High staff turnover exacerbates these problems.</p> <p>RIGID MANAGEMENT: Managers of chain restaurants are often not allowed to adjust for local demand and creative inventory use. Fast-food chains often have strict guidelines about how long items can sit after preparation before they must be discarded.</p> <p>SCHOOL LUNCH RESTRICTIONS: Schools may not implement practices that encourage lunch to be eaten, such as providing adequate or well-timed lunch periods and allowing students to choose components of meals.</p>	<p>Adapt menus to reduce menu choices, use specials to flush excess inventory, and repurpose food.</p> <p>Provide flexible portions through half orders, choice of sides, or smaller portions with optional refills.</p> <p>Scale back production by using smaller batches and pans, cooking to order, using smaller display containers, and reducing end-of-day production.</p> <p>Remove trays in all-you-can-eat cafeterias and buffets to discourage consumers from taking more than they’ll eat.</p> <p>Encourage diners to take home leftovers in low-impact containers.</p> <p>Invest in staff training and engage staff through rewards or incentives to participate in waste reduction.</p> <p>Conduct waste audits to understand patterns of excess.</p> <p>Offer low-waste catering options that have smaller quantity buffers, with clients acknowledging risk of running out.</p> <p>Increase donations and learn about benefits, including liability protections for food donors and tax benefits of food donations.</p> <p>Implement techniques in K-12 school lunchrooms such as salad bars, choice of side dishes, longer and later lunch periods, and share tables that allow sharing of untouched foods.</p>
CONSUMERS	
<p>LACK OF AWARENESS AND INFORMATION: Many consumers are not aware of how much food they waste or its implications. Some also lack information or skills to properly store and “use up” food.</p> <p>CONFUSION OVER DATE LABELS: Multiple dates, inconsistent usage, and lack of education around date label meanings cause consumers to discard food prematurely.</p> <p>POOR STORAGE: Food spoils in homes due to suboptimal storage, poor visibility in refrigerators, partially used ingredients, and misjudged food needs.</p> <p>POOR PLANNING: Consumers may overbuy because they fail to plan meals, fail to use a shopping list, inaccurately estimate what is needed for meal preparation, or decide on impromptu restaurant meals.</p> <p>IMPULSE AND BULK PURCHASES: Promotions encouraging unusual or bulk purchases result in consumers buying foods outside their typical needs, and these foods may not be consumed.</p> <p>OVERPRODUCTION: Preparing more food than needed can lead to waste unless leftovers are saved and consumed.</p>	<p>AT POLICY LEVEL:</p> <p>Simplify and streamline date labels to reduce consumer confusion about product safety.</p> <p>Educate and encourage better food management by consumers, including on meal planning, careful shopping, proper storage, safe food handling, food salvage techniques, etc.</p> <p>Increased infrastructure for curbside collection of compostable food scraps and inedible portions.</p> <p>BY EACH AND ALL OF US:</p> <p>Shop wisely by planning meals, using shopping lists, purchasing accurate quantities, and avoiding impulse buys.</p> <p>Interpret date labels as estimates of top quality rather than end dates for safety (unless the words “use by” appear before the date).</p> <p>Prepare appropriate amounts of food and save leftovers.</p> <p>Freeze food before it spoils, including milk, cheese, eggs, and meat.</p> <p>Declutter the kitchen and refrigerator so that items do not get lost.</p> <p>Share extra food with family, friends, or neighbors through leftover swaps, share tables or fridges, and apps that facilitate exchange.</p>

Food Waste in the U.S. Food System

A BIG PIECE OF PIE: BREAKDOWN OF US FOOD WASTE

Each year in the United States, we leave between 125 and 160 billion pounds of food uneaten, amounting to up to 40 percent of our food supply.^{39,40} This waste occurs throughout our food system’s supply chain. Food is lost on farms; during processing, distribution, and storage; in retail stores and food service operations; and finally in households. Every time a bag of lettuce is tossed aside, much more than spoiled produce goes out the window. It’s also a waste of labor, of vehicle miles, of water, of fertilizer. We’re wasting money, trashing resources, and accelerating the changing of our climate.

FIGURE 1: BREAKDOWN OF FOOD WASTE GENERATION BY SUPPLY CHAIN STAGE, AS ESTIMATED BY REFED FOR 2015⁴³



Note that by-products used for animal feed are not included.

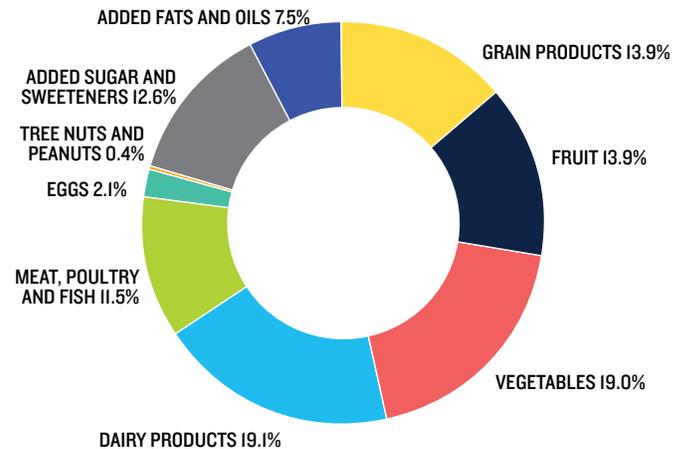
Vegetables and dairy make up the largest portion of wasted food by weight, followed by fruit and grain products.

Not only is that irresponsible—it’s expensive. Growing, processing, transporting, and disposing that uneaten food has an annual cost estimated at \$218 billion—or 1.3 percent of our GDP, as estimated by the 2016 ReFED report (Rethink Food Waste Through Economics and Data), a multi-stakeholder analysis that is one of the few attempts at a full-supply-chain estimate of food waste.⁴¹

As shown in the ReFED estimate, households collectively generate the largest share of food waste, followed by restaurants and other food service institutions, and then farms and supermarkets.⁴²

This report uses the best available data to estimate how much loss occurs at each stage. The various existing studies and the nuances of their estimates are explained in Appendix A.

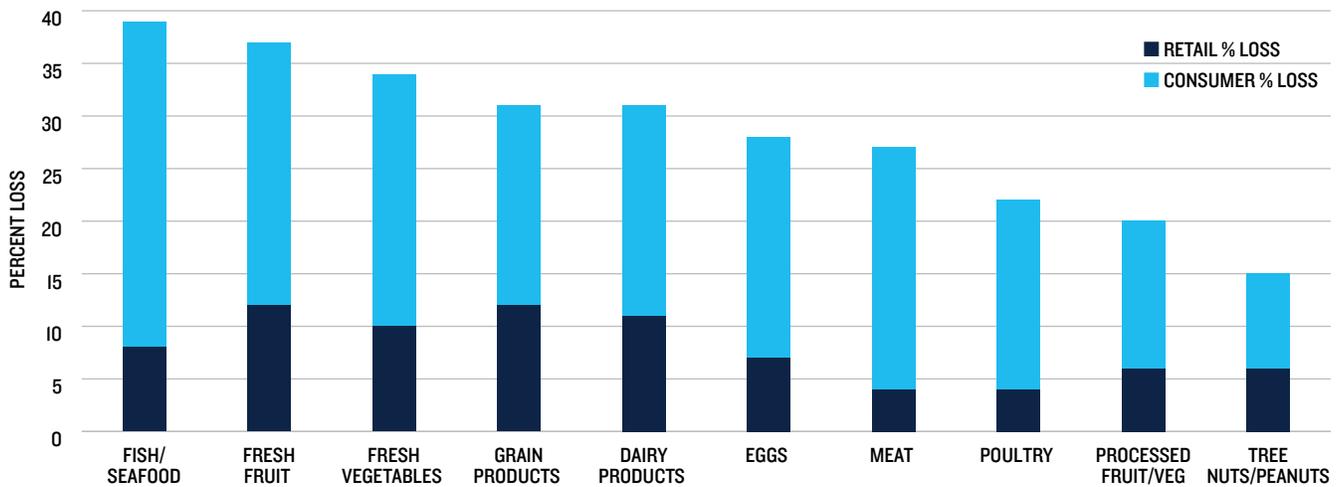
FIGURE 2: BREAKDOWN OF TOTAL FOOD WASTE IN THE UNITED STATES BY FOOD CATEGORY, AS ESTIMATED BY THE USDA FOR THE RETAIL (GROCERY) AND CONSUMER LEVELS COMBINED⁴⁴



Note that added sugars and added fats and oils become ingredients in other food products. Consumer level estimates include both “in and out of home,” meaning that food ordered at all types of restaurants is included as well. Inedible parts of food not included.

Seafood has the highest rate of loss within its product category, followed by fresh fruits and vegetables.

FIGURE 3: RATE OF FOOD WASTE WITHIN EACH PRODUCT CATEGORY, AS ESTIMATED BY THE USDA FOR THE RETAIL (GROCERY) AND CONSUMER LEVELS



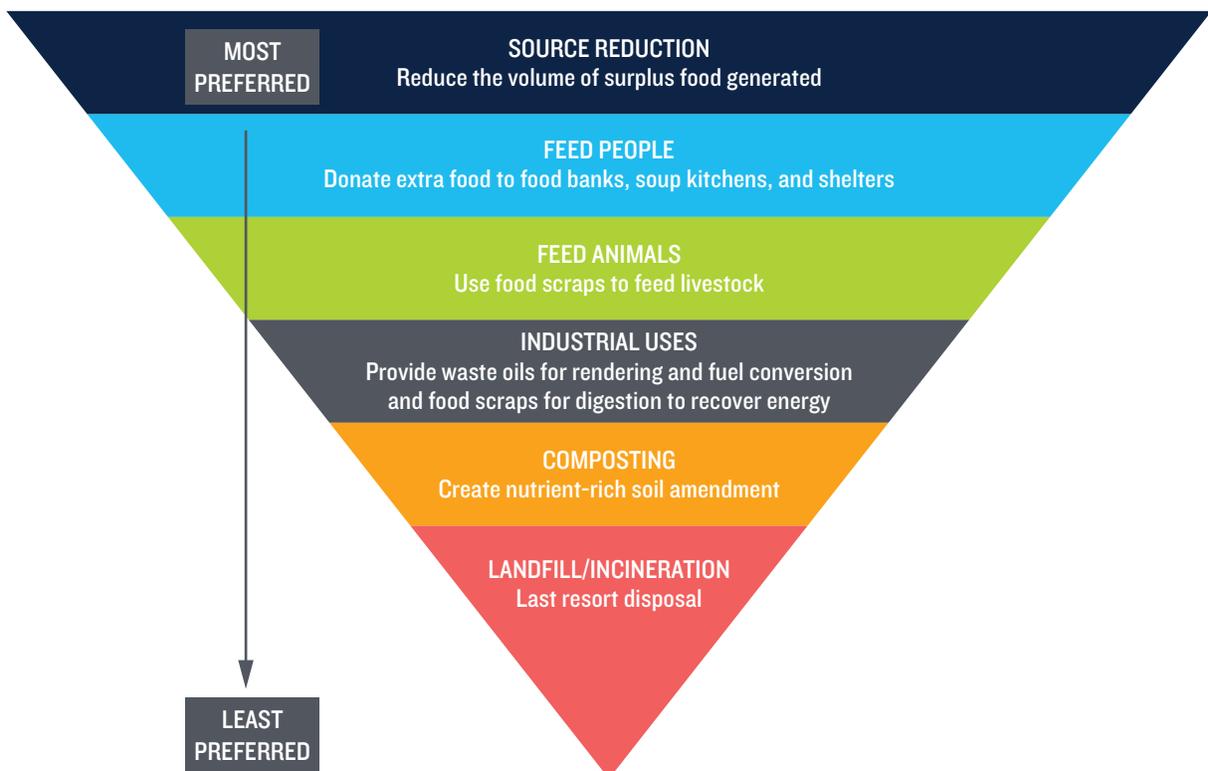
Consumer estimates include both “in and out of home,” meaning that food ordered at all types of restaurants is included as well. Inedible parts of food not included.⁴⁵

THE EPA FOOD RECOVERY HIERARCHY

All waste is not equal, nor is the way we handle our surplus food. The EPA established the Food Recovery Hierarchy to help guide priorities for managing excess food.⁴⁶ It essentially applies the “reduce, reuse, recycle” approach, with a bit more detail. The actions at the

top of the Food Recovery Hierarchy have much greater environmental benefits than do those toward the bottom, and often financial and social benefits as well. See Appendix B for a more detailed explanation of each level of the Hierarchy.

FIGURE 4: EPA'S FOOD RECOVERY HIERARCHY



DON'T CALL IT WASTE!

Determining how to talk about this topic can be complicated. In this report, we have tried to align with the new terminology and protocols set forth by the Food Loss and Waste Protocol, a global accounting standard established in 2016.⁴⁷ However, to allow for easier reading, we substitute the term “food waste” for their term “food loss and waste (FLW)” to mean “food as well as associated inedible parts removed from the food supply chain.” We also, however, use the term “wasted food” in a more conversational way throughout the text. In doing so, we hope to signal a shift in thinking by indicating that it’s good food, not trash.

FROM THE GROUND UP: ECOLOGICAL IMPACTS OF WASTED FOOD

One of the most shocking aspects of wasted food is the enormous loss of “embedded resources”—that is, those that were required to get that food from the seed to the table. The vast majority of these resources are used in the food’s production, by far the most resource-intensive stage of the supply chain. Moreover, a dramatic amount of climate pollution is created in producing all of that uneaten food.

Streamlining our food system today can help avoid further straining our resources to feed ourselves tomorrow. The population in 2050 is predicted to demand 1.5 to 2 times as much food as we needed in 2005.⁴⁸ The most obvious first step toward meeting this demand is to eat the food we already grow (but don’t currently eat). In fact, it’s estimated that halving food losses would amount to enough food to feed 1 billion additional people.⁴⁹ That’s more than the number of undernourished people across the world in 2015.⁵⁰

The EPA’s Food Recovery Hierarchy, described above, rests on the logic that preventing surplus food in the first place will ultimately reduce demand for product that is currently being wasted, thus conserving more resources than donating or recycling food. There is some uncertainty, however, as to how directly preventing food waste will impact demand, given our global economy. For instance, if U.S. consumers waste fewer strawberries, would farmers grow less (using fewer resources) or export more? The United Kingdom did demonstrate that wasting less food correlated with lower per capita demand, but more research is needed.⁵¹ It is clear, however, that recycling food does less to address the inefficiency of our food system, compared with preventing the wasting of food, which has the greatest potential for cost savings and environmental benefits.

From a resource perspective, not all wasted food is equal. As illustrated in Figure 5, meat production requires more water than other products, and this is true for other ecological impacts as well, due to the relatively high amounts of feed needed to produce meat and excessive greenhouse gas footprint of cattle. Of all the crops grown around the world, 37 percent (primarily corn and soy) is used to feed livestock—yet that livestock produces only 11 percent of the global food supply.⁵² While the majority of grains grown for livestock feed are not fit for human

consumption, the land and resources used to produce them could be used to grow crops that directly feed people. Some analysts consider this in itself a form of food loss.

Food waste accounts for the equivalent of 21 to 33 percent of U.S. agricultural water use.⁵³ In fact, throwing out just one hamburger wastes as much water as a 90-minute shower! Producing an egg, on the other hand, requires about as much water as an 11-minute shower. See Figure 5 for more food production estimates in shower-minute equivalents.

FIGURE 5: WATER REQUIRED TO PRODUCE VARIOUS FOOD PRODUCTS, IN SHOWER MINUTES⁵⁴

PRODUCT	QUANTITY	WATER USE EQUIVALENT IN SHOWER MINUTES	 = 10 SHOWER MINUTES
Beer	8 oz/240 ml	4	
Tomato	1 lb/455 g	5	
Wine	4 oz/120 ml	6	
Milk	8 oz/240 ml	6	
Potato	1 lb/455 g	7	
Egg	1 egg	11	
Banana	1 lb/455 g	42	
Apple	1 lb/455 g	43	
Pasta, dry	1 lb/455 g	44	
Rice, white	1 lb/455 g	60	
Personal pizza	26 oz/735 g	67	
Chocolate	4 oz/115 g	90	
Chicken	1 lb/455 g	104	
Cheese	1 lb/455 g	122	
Pork	1 lb/455 g	144	
Beef	1 lb/455 g	370	

Note that these estimates reflect a global average, but water use varies by geography and production methods. These numbers conservatively assume a shower uses 5g/19L per 1 minute, which is twice that of a new showerhead sold today.

Image courtesy of *Waste Free Kitchen Handbook: a guide to eating well and saving money by wasting less food* by Dana Gunders (Chronicle Books LLC).

An area equivalent to between 18 and 28 percent of our cropland is used to grow food that is ultimately not eaten.⁵⁵ Even the conservative estimate is about the size of New Mexico. As food demand increases with population growth, we will need to use more land to grow food, prompting deforestation and other land use changes. These changes would increase the emissions footprint of food waste by 25 to 40 percent.⁵⁶ Beyond that, uncultivated lands play a critical role in filtering air and water, providing wildlife habitat, and preserving biodiversity. Streamlining our use of food so that we don't need to grow more than we actually use is a key strategy for keeping wildlands wild while still meeting our needs.

Food waste consumes the equivalent of 19 to 27 percent of fertilizer used in the United States.⁵⁷ These fertilizers can lead to water pollution when too much is applied and the excess runs off into waterways, and to greenhouse gas emissions from the way the fertilizer interacts with microbes in the soil. Synthetic fertilizer production also consumes enormous amounts of energy. Using compost to fertilize instead can offset the need for synthetic fertilizers while recycling the nutrients in food waste. It also delivers nutrients in a different form, which reduces the likelihood of pollution problems.

Food waste in the United States is responsible for at least 2.6 percent of all U.S. greenhouse gas emissions.⁵⁸ That's equivalent to the emissions of more than 37 million passenger vehicles, or 1 in 7 vehicles on the road.⁵⁹ As with the use of resources, more dramatic climate benefits can be had from preventing food from going to waste than from recycling it. Figure 6 lists the greenhouse gas emissions per pound for several methods of addressing food waste. Note that these estimates do not include the emissions from land use changes from food production, such as deforestation, which, as noted above, could increase the emissions footprint by another quarter.⁶⁰

Food accounts for 21 percent of municipal solid waste, adding more waste to landfills and incinerators than any other product.⁶¹ This does not include food and beverages disposed of in other ways, such as down kitchen drains. Only about 5 percent of all food in the waste stream is currently recycled by composting or anaerobic digestion.⁶²

As food scraps in landfills decompose, they produce methane, a greenhouse gas up to 86 times more powerful than carbon dioxide in terms of its global warming potential.⁶³ Food waste is responsible for a minimum of 11 percent of all landfill-generated methane emissions in the United States—and that's a conservative estimate.⁶⁴ Many landfills are capped to capture and burn methane, but most food scraps decompose within the five-year time frame allowed before landfills are required to do this.⁶⁵ Nevertheless, using this conservative estimate and considering only landfill emissions, food scraps in landfills produce as much emissions as about 3.4 million vehicles and account for about 9 percent of the total greenhouse gas footprint of food waste.⁶⁶

FIGURE 6: NET GREENHOUSE GAS EMISSIONS FOR FOOD WASTE UNDER DIFFERENT MANAGEMENT OPTIONS⁶⁷

FOOD WASTE MANAGEMENT METHOD	METRIC TONS CO ₂ e PER SHORT TON OF FOOD
Prevention (assumes food is not produced)	-3.66
Redistribution to People	-0.43
Anaerobic Digestion	-0.18
Composting	-0.05
Landfill	0.54

GROWING UNEATEN FOOD AROUND THE WORLD

Unfortunately, uneaten food is not an exclusively American phenomenon. A study from the United Nations Food and Agriculture Organization (FAO) estimated that about one-third of the world's food supply never makes it to a mouth.⁶⁸ The FAO found that global food waste is responsible for an estimated 3.3 gigatons of greenhouse gas emissions—that's twice the total greenhouse gas emissions of all vehicles on all roads in the United States in 2010. If global food waste were its own nation, it would be the world's third-largest greenhouse gas emitter, surpassing India and its 1.2 billion citizens.⁶⁹ The same study found that food waste uses more water than any country in the world.⁷⁰ The FAO also calculated the financial, environmental, and social cost of global food waste to be \$2.6 trillion, roughly twice what is spent annually on food in the United States.⁷¹

Falling Through the Cracks: Losses at Each Stage

LOSSES IN PRODUCTION

Production losses—which take place during farming, fishing, or livestock tending—can vary significantly by season or by crop, depending on a variety of factors including weather, disease outbreaks, and market conditions. This significant variation makes it difficult to accurately evaluate just how much food is lost at this stage. As a result, as shown in Appendix A, studies that aim to quantify overall food waste often exclude production losses. From what we know, fresh produce and seafood have the highest loss rates.⁷² And to give a sense of the variation, Tesco, a leading British retailer, found production losses of 17 percent for salad greens and 15 percent for berries, as opposed to only 1 percent for dairy and generally less than 5 percent for meat.⁷³

PRODUCE

The ReFED report estimates that 20 billion pounds of produce is lost on farms each year.⁷⁴

According to the USDA, about 4 percent (66,500 acres) of planted vegetable and fruit fields are left unharvested each year.⁷⁵ However, this number can vary widely by crop, region, season, and operation, and these losses could be significantly higher. For instance, the USDA data show that from 2012 to 2014, an average of only about 1 percent of broccoli fields were left unharvested.⁷⁶ But a small NRDC survey of California farmers found that anywhere from 5 to 20 percent of their broccoli fields may not be harvested in a given season.⁷⁷ That same survey found that 10 to 30 percent of nectarine and plum fields may go unpicked.⁷⁸ Additionally, some product is harvested but goes unsold nevertheless.

Many factors lead to produce going unharvested, including damage from pests, disease, or adverse weather. Growers may overplant to hedge against damage threats, to meet contract requirements, or to speculate on the possibility of higher prices. When prices are low, growers may leave entire fields unharvested if those prices will not cover the costs of bringing the product to market.

Cosmetic imperfection is another significant cause of loss both during and after harvest. Products are often either skipped over in the field or removed at the packing house on the basis of ripeness, size, color, weight, blemishes, and factors such as Brix level (a measure of sugar content). Quantities vary by product and situation but appear to be significant. A recent study in Minnesota found that up to 20 percent of fruit and vegetable production is typically too large, too small, or otherwise too cosmetically compromised to meet prevailing commercial procurement standards.⁷⁹ A California peach grower once explained: “In the middle of the season, I have about 200,000 pounds each week of stone fruit I can’t sell. For 8 of 10 of them, if you looked at them, you couldn’t tell me what’s wrong with them.”⁸⁰

Some surplus or products that do not meet specifications in major fresh markets can be used in the processing sector (e.g., apples may be used for applesauce, apple juice, frozen apple pie). However, many cannot. Most large processors, such as canneries, freezing operations, and prepared food manufacturers, have advance contracts with suppliers as well as strict requirements for the timing of planting and harvesting, seed varieties, and growing practices. Large processors also typically receive product via large semi-trucks and are not equipped to process smaller quantities efficiently. Even if a facility is willing and able to accept the produce, it must be close enough to justify transportation costs, and it must have the capacity to process the product at the right moment, which often conflicts with its existing operations.

The window of time for harvesting is often very narrow. So a poorly timed labor shortage can spell catastrophe for farmers and leave tons of food to rot in fields. In 2011, for instance, the Georgia Fruit and Vegetable Growers Association estimated labor shortages for harvesting and packing cost the state \$140 million in crop losses—about 25 percent of total production value for the affected crops.⁸¹ In 2016, the American Farm Bureau Federation identified farmworker shortages in more than 20 states.⁸²

A recent study in Minnesota found that up to 20 percent of fruit and vegetable production is typically too large, too small, or otherwise too cosmetically compromised to meet prevailing commercial procurement standards.



THE MANY SHADES OF GLEANING

Gleaning is the practice of gathering leftover crops after a harvest. While the amounts rescued tend to be small, gleaning still presents an opportunity to rescue produce and engage people in preventing good food from going to waste. Nonprofits around the country organize volunteers to participate in this age-old practice at nearby farms, and different approaches have emerged. Hungry Harvest, a startup business based in Maryland, sells produce gleaned by the Mid-Atlantic Gleaning Network through a CSA program.^{83,84} Subscribers buy shares based on a “buy one, give one” system that funds free boxes for local underprivileged residents. The California Association of Food Banks’ Farm-to-Family program pioneered “concurrent picking,” which pays farmworkers—who are faster than volunteers and able to spend more time harvesting—to glean unmarketable produce alongside marketable grades in the field during regular harvest, rescuing millions of pounds of produce in times when row crops are grown.⁸⁵ Similarly, Hidden Harvest of Coachella, California, pays underemployed farmworkers to rescue produce left behind in the fields and orchards after harvest.⁸⁶

Food safety scares can also spur crop losses, not only from immediate recalls associated with actual food safety concerns, but also from the hysteria that often ensues. In 2008, for example, the FDA issued a warning about possible salmonella contamination in tomatoes. Although the warning was eventually declared unfounded, consumers developed a negative perception and overall tomato demand decreased. As a result, some 32 percent of total U.S. tomato acreage went unharvested that year, leading to massive losses for tomato farmers and massive waste.⁸⁷ Even warranted recalls lead to much good food going to waste—a tradeoff of keeping our food safe.

Business practices and cosmetic standards in the United States and other large markets can drive farm-level food waste in other countries, too. For instance, a study of export supply chains from Peru to North America and Europe found that, on average, cosmetic specifications resulted in approximately 10 percent of production going to waste for crops under review. In years when there was an oversupply of product in the global market, cosmetic specifications were tightened and waste was higher—as much as 60 percent, for example, in Peruvian yellow onions.⁸⁸ Shipments are rejected before export for several other reasons as well, including last-minute order cancellations, retrospective changes to supply agreements, and unpredictable fluctuations in order forecasts and prices.

Finally, inadequate, improper, or overly lengthy storage after harvest can also cause spoilage. For instance, fresh produce can spoil in storage if a buyer is not found quickly enough. Inadequate cooling before or during shipping can lead to premature spoilage. Even if food is donated, a lack of cold storage and light processing capacity at food rescue organizations can also cause produce losses.

If produce is neither sold nor donated, it is often turned back into the soil, diverted to livestock feed, or composted. For instance, the Minnesota study referenced earlier found an estimated 75 percent of imperfect—but otherwise wholesome—products were dealt with in these three ways. While it is more the exception than the rule, a small portion of unsold produce is sent to landfills. Still, between April and November every year, the Salinas Valley Solid Waste Authority, in the heart of California’s produce industry, sends between four and eight million pounds of fresh vegetables to landfills.⁸⁹

COSMETICALLY CHALLENGED

Farmer David Masumoto once wrote, “If we picked our friends the way we selectively picked and culled our produce, we’d be very lonely.”⁹⁰

Produce that looks a little different—ugly, odd, imperfect, or otherwise—has gone from roundly ignored to celebrated with remarkable speed in the past few years. Retailers around the globe are featuring this alternative-looking food with tantalizing marketing campaigns. New businesses are capitalizing on this reservoir of equally healthy but less expensive produce. Consumers are posting photos to social media by the thousands. In fact, the @uglyfruitandveg account on Twitter has more than 80,000 followers.⁹¹ The editor-in-chief of *Food & Wine*, Dana Cowin, even dedicated her entire 2015 TEDx talk to celebrating “ugly food.”⁹² All of this hype is helping drive a reevaluation of our culture’s expectations for fruits and vegetables.

French retailer Intermarché brought the “ugly fruit and vegetable” issue to a mass audience with its Inglorious Fruits and Vegetables campaign (*Les Fruits et Légumes Moches*). The cleverly marketed initiative sold prepared foods such as soups and yogurts made from lower-grade produce. In addition, the store sold fresh “inglorious” fruits and vegetables at a 30 percent discount. The initial rollout in 2014 saw sales of 1.2 tons per store and a stunning 24 percent increase in overall store traffic in the first two days.⁹³ The program has spread to more stores and expanded to include other items, such as ugly biscuits. However, this program is featured only periodically in order to maintain its novelty and adjust to supply.

Retailers in the United States, 10 European countries, Canada, South Africa, Australia, and the United Arab Emirates have joined this trend.⁹⁴ A French company called Les Gueules Cassées (“The Ugly Mugs”) facilitated retail sales of 12 million products in 5,000 retail locations in its first year.⁹⁵ In Canada, the food retailer Loblaw created a “Naturally Imperfect” label that sells for as much as 30 percent less than traditional produce options in the same store.^{96,97} And American companies including Hy-Vee, Hannaford, Giant Eagle, Whole Foods, and Walmart are now rolling out full or pilot programs.⁹⁸

Food service companies—which run cafeterias and catering operations in schools, universities, hospitals, and other locations—are also making use of cosmetically challenged product. Sysco, the largest U.S. food distributor, whose clients are food service companies, has launched an “Unusual but Useable” line of fresh produce.⁹⁹ In May 2014, the largest food service company in the United States, Compass Group USA, and its Bon Appétit Management Company division launched the Imperfectly Delicious Produce program. This program was conceived after dialogue with suppliers helped identify an abundance of underappreciated items at farms: crooked carrots, loose broccoli florets, small romaine leaves, and hail-damaged apples. Both companies now recover these and other items for use in hundreds of their cafés around the country. To date, the program has rescued more than 2 million pounds of produce in 30 states. It is expected to expand further in the coming year.¹⁰⁰

Launched in July 2015 in the San Francisco Bay Area, Imperfect Produce sells boxes of cosmetically challenged fruits and vegetables directly to consumers. In its first year, the company attracted more than 7,000 customers.¹⁰¹ Hungry Harvest, based in Washington, D.C., has a similar model.¹⁰² Also in Washington, Fruitcycle sells snacks made from dried, imperfect apples and kale, and Misfit Juicery uses flawed produce for its juices, as does Ugly Juice in San Francisco.^{103,104}

Because of the cost savings, schools are getting into the game as well. The Minneapolis Public Schools system has incorporated locally grown imperfect produce into their expansive Farm to School program by broadening its specifications to include cosmetically imperfect products. This keeps the cost of locally grown fruits and vegetables within its budget and help farms sell hard-to-market products. The district now serves Farm to School items every day during Minnesota’s harvest season and weekly during the winter months.¹⁰⁵

Together, these programs are taking a bite out of the enormous amount of perfectly good produce currently going to waste. Equally important, they are increasing consumer awareness and, in turn, paving the way for these products to enter the mainstream.

SEAFOOD

The equivalent of about 7 to 10 percent of the U.S. seafood supply is discarded annually at the fishing stage.^{106,107} This equates to approximately 33 billion grams of protein—enough to meet the dietary protein needs for about 1.6 to 2 million people for a year. Eating this fish instead of discarding it would also provide 290 billion to 1 trillion milligrams of omega-3 fatty acids, enough to meet the daily recommended servings for about 3 million adults.¹⁰⁸

During fishing, unintended aquatic species are often caught by fishing gear; this is known as bycatch. These unwanted fish are often discarded, dead or injured, into the ocean because they either have no marketable value or are not the species being sought. While a full discussion

of bycatch goes well beyond the scope of this report, much of it results from the use of fishing equipment—like 50-mile-long fishing lines and huge nets dragged across the bottom of the sea—that doesn’t discriminate, picking up nontargeted types of fish as well as larger sea animals, such as sea turtles, sharks, marine mammals, and seabirds.

In other instances, fishermen may be going after a given species but in the process catch a different, desirable fish species (such as flounder, croaker, sole, and halibut) that regulations or catch limits do not allow them to take. Those fish get returned to the sea, and some do not survive the process.

Approximately 33 billion grams of protein are discarded during fishing—enough to meet the dietary protein needs for about 1.6 to 2 million people for a year.

Highly targeted gear and real-time information sharing that updates fishery limits can help address losses due to bycatch. However, these procedures can be expensive and complex. Another part of the solution is establishing markets for lesser known species that at times make up that bycatch, such as dogfish, monkfish, and skates.

Estimates of seafood losses do not even capture the full depth of the issue. First, losses in aquaculture (farmed fish operations) are not included. Second, estimates do not include losses due to spoilage and other quality concerns, which can occasionally occur if fish are handled improperly. Third, many foreign fisheries—which provide about 90 percent of the U.S. seafood supply—sometimes report suspiciously low bycatch rates, possibly due to poor monitoring. The overall rate for bycatch from foreign fisheries was estimated at 8 percent in a 2004 FAO paper.¹⁰⁹ However, bycatch is highly dependent on the specific fishery as well as the species being sought. At the high end of the spectrum are bottom-crawling crustaceans; for instance, roughly three-quarters of the catch brought aboard shrimp-trawling vessels in the Gulf of Mexico is discarded as bycatch.¹¹⁰

MEAT, DAIRY, AND GRAINS

According to the FAO, only 3.5 percent of meat is lost at production.¹¹¹ However, impacts at the production stage cause total meat losses to be responsible for more than 20 percent of the carbon footprint for all wasted food.¹¹² The meat industry is relatively adept at finding secondary and tertiary markets for most parts of the animal. Animal mortalities represent the majority of losses in the meat production phase, but animals that die prematurely are usually turned into animal feed or rendered into other products.¹¹³

For dairy, 1 to 3 percent is lost at production.^{114,115} Milk balancing plants exist to help to stabilize the fluctuating supply and demand of milk, which helps keep overall losses low. On occasion, however, producers may end up with surplus production without buyers, which can cause prices to drop significantly. This leads to episodic losses where large volumes of milk go to waste in a particular region. In total, however, these episodes add up to a very small portion of total milk production.¹¹⁶

According to the FAO, just 2 percent of cereal grains are lost during production in North America, thanks in large part to mechanized harvesting and a well-developed infrastructure for processing, selling, and storage.¹¹⁷

Examples of Efficiency in Production

- “Imperfect produce” sales and campaigns celebrate and utilize perfectly good produce that doesn’t conform to cosmetic expectations (see “Cosmetically Challenged” for examples).
- Community-supported agriculture (CSA) arrangements link farmers and ranchers directly with consumers, who share some of the production risk by paying an up-front subscription fee. Subscribers receive whatever is available, which may be influenced by weather variations and other factors. In the past few years, larger companies have adopted similar models. For example, Google promises up front to buy a fixed dollar amount of produce from nearby Pie Ranch for the cafés at its headquarters in Mountain View, California.¹¹⁸
- Instant alerts can help find produce a home. Feeding America’s Produce Matchmaker platform helps connect large produce loads with food banks and enabled 125 million pounds of produce to be donated in 2016 alone.¹¹⁹ On a smaller scale, Cropmobster in California distributes instant online alerts about agricultural surpluses. Since 2013, this tool has helped save more than two million pounds of locally grown, nutritious food in the San Francisco Bay Area.¹²⁰
- State and federal tax incentives encourage farmers to donate their excess food to charitable organizations. An enhanced federal tax deduction was made permanent in December 2015. In addition, several states provide farmers with tax credits of between 10 and 50 percent of the value for food donations. (See Figure 7 for a full list.)
- Food bank networks cover some costs and help with donation logistics. Such efforts enabled the California Farm to Family program, for example, to recover more than 160 million pounds of produce in 2016.¹²¹
- Around the country, there are many types of gleaning programs, by which produce left behind after harvest is gathered and put to use. These programs are typically modest in scale and volunteer-based. (See “The Many Shades of Gleaning,” page 13, for some innovative examples.)
- California seafood company Real Good Fish has a Bay2Tray program that buys grenadier (a bycatch species from black lingcod fishing), processes it, and sells it to school lunch programs at a discounted price.¹²²
- Since 1994, Alaska-based nonprofit SeaShare has donated bycatch and other market-quality seafood to food banks. As of 2015, SeaShare had donated more than 200 million seafood servings.¹²³

FIGURE 7: STATE TAX CREDITS FOR DONATIONS OF FARM SURPLUS¹²⁴

STATE	TAX CREDIT
Arizona	Tax deduction
California	10% of inventory costs (wholesale)
Colorado	25% of wholesale value
Iowa	15% of wholesale value
Kentucky	10% of retail value
Missouri	50% of food or cash value
Oregon	15% of wholesale value
New York	25% of wholesale value
Virginia	30% of wholesale value
Washington, DC	50% of value



RESCUING PRODUCE BY THE SEMI-LOAD

Launched in 2013 as part of Twin Cities-based Second Harvest Heartland, the Produce Capture Institute (PCI) is a peer learning initiative among 10 food banks across the country.¹²⁵ The PCI channels unutilized fruits and vegetables to food banks and ultimately to food-insecure families. The donations include a range of surplus produce of different grades, typically shipped to participating food banks by the semi-truck load. To date, the PCI has helped rescue 10 million pounds of produce, ranging from Michigan apples to green beans from Tennessee to Oregon-grown asparagus and broccoli.¹²⁶

Most individual food banks can't receive and redistribute a semi-truck load's 40,000 pounds of produce quickly enough to keep it fresh, and some may not have enough demand to make use of such a large volume. In response, PCI has launched produce "mixing centers" that break up semi-load deliveries and repackage them as smaller quantities that are easier to distribute. They are then combined with shipments of other fruits and vegetables so that food banks can offer a wider variety.

The first center, based in Minneapolis and run by Second Harvest Heartland and the PCI, was opened in 2016. In its first nine months, this center distributed more than 4 million pounds of fresh fruits and vegetables to 17 food banks in six midwestern states.¹²⁷ Similar mixing centers are now in development in Atlanta, Philadelphia, Indianapolis, and the Rio Grande Valley of Texas.

LOSSES IN PROCESSING

Food processing, or manufacturing, includes everything from canning, freezing, drying, and precutting fruits and vegetables to making cheese, soup, or frozen meals. ReFED estimates 2 billion pounds of food waste is generated at this stage, but this does not include food waste going to animal feed, compost, or otherwise recycled, which is significant.¹²⁸ A British study estimates

that food manufacturers lose about 4 percent of their product during processing—close to half of which is believed to be avoidable through reduced errors, better changeover between production runs, and other improvements.¹²⁹

The British study found an additional 7 percent of product left facilities as a by-product sent to animal feed or rendered into other nonfood products. When they cannot be used in human consumption, feeding by-products to animals is a good solution because it offsets the need for feed grain production. In the United States, it is a fairly common practice, with about 33 percent of the food waste from manufacturing going to animal feed.¹³⁰ However, in some cases, it's possible these by-products—such as juice pulp or potato skins—could in fact be made into food products for human consumption, which would be preferable.

Processing facilities lose food mostly through trimming—the removal of either edible portions (skin, fat, peels, end pieces) or inedible portions (bones, pits). Losses can also occur due to overproduction of processed foods, product and packaging damage, printing errors on packaging, and technical malfunctions during manufacture; these issues may be difficult to avoid. Similarly, there can be a "stop/start" loss whenever a production line switches between products or batches.¹³¹ Sometimes, perfectly edible branded packaged foods are discarded due to brand restrictions that prevent their sale and sometimes even donation.¹³²

Processing has the potential to reduce waste as well, since trimming at this stage can be more efficient than at the consumer level, and there is greater potential to use scrap by-products that are collected in bulk. Furthermore, freezing or canning preserves nutritional content while also prolonging the life of food, which can also reduce waste.¹³³

NOT-SO-SLIM PICKINGS

Like many food manufacturers, ConAgra had long donated distressed or discontinued goods. In 2010, though, the company began to explore ways to reduce waste and found some surprising options, according to its vice president of packaging and sustainable productivity, Gail Tavill.¹³⁴

For example, ConAgra's Slim Jim smoked beef sticks required squared-off tops and bottoms. This was inherently wasteful because, as Tavill noted, "Sausages aren't made with a flat end." Those cosmetically based scraps were adding up to thousands of pounds each week at the plant in Troy, Ohio. At the same time, most hunger relief organizations in the area were struggling to source enough proteins for food-insecure community members. Tavill realized that the Slim Jim ends could be rerouted to fill this gap while eliminating a disposal cost for ConAgra. The company bagged the ends and broken sticks into two- to three-pound packages and distributed them via a mobile food pantry. "They went like hotcakes," Tavill said. ConAgra has been donating its "Slim Jim trim" ever since. Every week, a truck from Detroit-based food rescue group Forgotten Harvest makes the 200-mile trip to Ohio to pick up roughly 20,000 pounds of meat snacks, among other donations. More than 2.9 million pounds of Slim Jim pieces were donated between 2010 and 2014.

PRODUCE

Produce is processed in many ways. It may be fresh-cut (diced tomatoes for salad bars, for instance), processed into manufactured foods (like apple pie), frozen, dried, or canned. It may also simply be packaged, which is sometimes considered a form of processing.

Large-scale canning and freezing operations tend to be highly efficient. Planting and harvesting schedules are coordinated to ensure that products are processed immediately and that the processing plant operates at maximum capacity. Lower-grade product is often sold into secondary markets, such as prisons. Unsellable product is typically diverted to animal feed, leaving relatively little residual waste.

Fresh-cut produce is widely used in the restaurant and institutional food service sectors. Processing facilities often trim and cut produce more efficiently than consumers or restaurants, and they can more readily divert their waste to animal feed or compost since the scraps are aggregated and generally free of

contaminants. Fresh-cut processing can also help reduce waste by using cosmetically imperfect product that isn't typically sold at retail (such as misshapen "chopper" peppers that are widely used in salad bars, stir fries, and other applications).¹³⁵ Cutting methods can significantly influence the levels of waste produced, however. For instance, the waste rate on carrot sticks that must be of a uniform length and width can approach 70 percent of the initial weight of the uncut/unpeeled carrots. The waste rate for shredded carrots is typically closer to 20 percent.¹³⁶ Processors can sometimes repurpose trim waste from larger cuts, like carrot sticks, into smaller cuts, such as shredded or diced carrots.

Over the past decade, precut, ready-to-eat fruits and vegetables have become much more popular in grocery and convenience stores. These "grab and go" products have pros and cons regarding waste. While specialized packaging can help extend shelf life, trimmed produce spoils faster than whole produce.¹³⁷ Furthermore, unlike whole produce, packaged precut items are likely to be discarded after the date on the package passes, even if the quality is not compromised. Precut produce also tends to use more packaging than whole produce, which means more environmental impacts from production and disposal.

MEAT, DAIRY, SEAFOOD, AND GRAINS

A British study found that about half of all manufacturing food waste is from the meat, poultry, fish, and dairy sectors.¹³⁸ These are not the top sectors for avoidable waste, however, because much of the waste product is not edible and is rendered into nonfood products. Tesco's study showed that processing losses accounted for about 15 percent for a variety of bread products, 13 percent for lamb, 10 percent for ham, and only about 1 percent for dairy.¹³⁹

In general, the meat industry is adept at using the entire animal, though not always for food. Many animal parts not widely suited to consumer tastes in the United States, such as chicken feet, are exported to other countries. Others are sent to rendering where they become nonfood products, such as cosmetics. In 2012, it came to light that some ground beef producers were using so-called "pink slime"—lean, finely textured beef made of trimmings such as connective tissue and cartilage—in their products. This was actually a quite efficient use of beef trimmings. Most

Cutting methods can significantly influence the levels of waste produced. For instance, the waste rate on carrot sticks that must be of a uniform length and width can approach 70 percent of the initial weight of the uncut/unpeeled carrots. The waste rate for shredded carrots is typically closer to 20 percent.

of the ensuing controversy focused on the ammonia used to process the product and lack of transparency, but some also centered on whether connective tissue and cartilage were acceptable ingredients for hamburgers. Following the uproar, this lean, finely textured beef was removed from food products for human consumption and is now used primarily for animal feed—a loss in efficiency that could be improved with more cultural acceptance of using those animal parts and alternative methods for processing them.

The dairy industry is, likewise, quite efficient at processing, with losses estimated at less than 2 percent of total production.¹⁴⁰ Greek-style yogurt production, though, presents an opportunity for improvement. Here, only one-third of the milk ends up in the final product; the rest winds up as acid whey, a by-product different from sweet whey that generally goes to waste even though it still has nutritional value. Research is currently being conducted to develop ways to incorporate acid whey into products for human consumption, such as lactose, a widely used food ingredient.^{141,142}

Only an estimated 1.5 percent of seafood is lost during processing.¹⁴³ Culinary norms, such as favoring skinless fillets or cutting a certain distance from the spine, prompt some of this loss. Most larger processing facilities are fairly efficient, using fillet trim in fish sticks and other edible products. The parts not deemed edible become animal feed or can be composted. But at smaller U.S. cutting houses, fillet trim may end up landfilled or incinerated instead.¹⁴⁴

Examples of Efficiency in Food Processing

- In 2012, U.S. food manufacturer ConAgra Foods set an ambitious internal goal to reduce waste generation by one billion pounds.¹⁴⁵ To this end, the company began recycling and donating food and adapted strategies across its operations, including processing. It inserted catch pans to collect excess flour from pot pie dough and began using it to thicken the gravy for the pies. It also set its potato peelers to cut an even thinner layer of skin and switched from lye to steam to peel tomatoes so that the resulting “tomato pumice” by-product was edible. It redesigned its ravioli equipment to save 620 tons of ingredients per year. Instead of discarding the leftover pudding in the machines when switching flavors, the company packaged and sold the mixed-flavor pudding, saving about 1,000 tons of pudding per year.¹⁴⁶
- Baldor Specialty Foods, one of the largest importers and distributors of fresh produce in the Northeast, processes more than one million pounds of produce each week. In late 2015, Baldor began a program to sell SparCs (“scraps” spelled backwards)—trims, tops, and peelings from the company’s processing facility. Each week, 150,000 pounds of SparCs are sold to food processors or sent to pig farms.¹⁴⁷

- In the United Kingdom, Greencore Group implemented efficiency initiatives in 2012 at its sandwich factory. The company now uses tomato ends for diced tomatoes and sausage ends for stuffing. It also replaced machinery to reduce vibration and waste. All together, Greencore cut its waste by 950 tons per year—equivalent to five million sandwiches.¹⁴⁸
- Grocery Outlet, which has more than 210 U.S. locations and sales approaching \$2 billion, sources about 75 percent of its merchandise from inventory that is excess due to packaging changes, over-forecasting, and discontinuation of product, including fresh produce.^{149,150} The retailer sells these items for up to 60 percent off conventional retail prices, creating a market for many products thought to be unsaleable.
- Entrepreneurs are finding the value in high-quality, edible by-products. ReGrained, who’s slogan is “Eat Beer,” makes granola bars from spent distiller grains.¹⁵¹ Renewal Mill is making flour from okara, the fibrous byproduct of soymilk manufacturing, and Coffee Flour is similarly creating flour from the fruit byproduct of coffee bean preparation.^{152,153}

LOSSES IN DISTRIBUTION

While comprehensive estimates are not available, losses during distribution are fairly minimal in the United States. The main causes of losses at this stage are improper transport and handling, expiration of food in storage, and rejected product.

Perishable goods must be kept cold from the packing shed to the retail shelf. Thanks to GPS innovations to monitor trucks and heightened food safety requirements, inconsistent refrigeration is less of a problem today. Yet the cold chain is still disrupted when trucks or their refrigeration units malfunction, when there is a truck accident, or when shipments sit for too long on loading docks. Imported products sometimes wait for days at ports of entry—both on the docks and at the Mexican border—for testing and inspection. And their shelf lives dwindle as a result.

Shipments are also often rejected at loading docks, where inspections are performed according to both USDA and buyer standards.¹⁵⁴ Distribution centers can also reject product to avoid getting saddled with extra shipments when stores need less than they had originally forecast. Typically, buyers reject between 2 and 5 percent of shipments outright.¹⁵⁵ Truckers commonly dump rejected perishable shipments at a local landfill if another buyer cannot be found quickly or if the particular retail label cannot be sold elsewhere (as with a store brand). If these perishables do make it to another outlet, their shelf lives have already been shortened.¹⁵⁶ Sometimes these rejected loads are brought to a food bank if one nearby has the capacity to accept them, but even then they are sometimes turned away or not fully used because the shelf life is too short or the quantity too large to distribute in time.

Examples of Efficiency in Distribution

- Morrisons supermarkets in the United Kingdom reduced waste by improving communication and timing of orders with its ready-meal supplier Kerry Moon, saving the retailer £100,000 in 2010.
- Food Cowboy is an app that helps truck drivers identify nearby food banks so they can donate rejected loads. The app helped find a home for almost two million pounds of food between 2013 and 2015.¹⁵⁷
- Local governments can fund vehicles and storage facilities for food rescue organizations to improve distribution capacity. Between 2006 and 2010, Seattle Public Utilities provided \$394,021 in grants for antihunger agencies to purchase equipment to safely transport, store, and utilize excess edible food.¹⁵⁸

LOSSES IN GROCERY RETAIL

In 2010, the USDA estimated in-store food losses at 43 billion pounds, equivalent to 10 percent of the total retail food supply.¹⁵⁹ ReFED's estimate is much lower, at 16 billion pounds.¹⁶⁰ Either way, though, it's a lot of food.

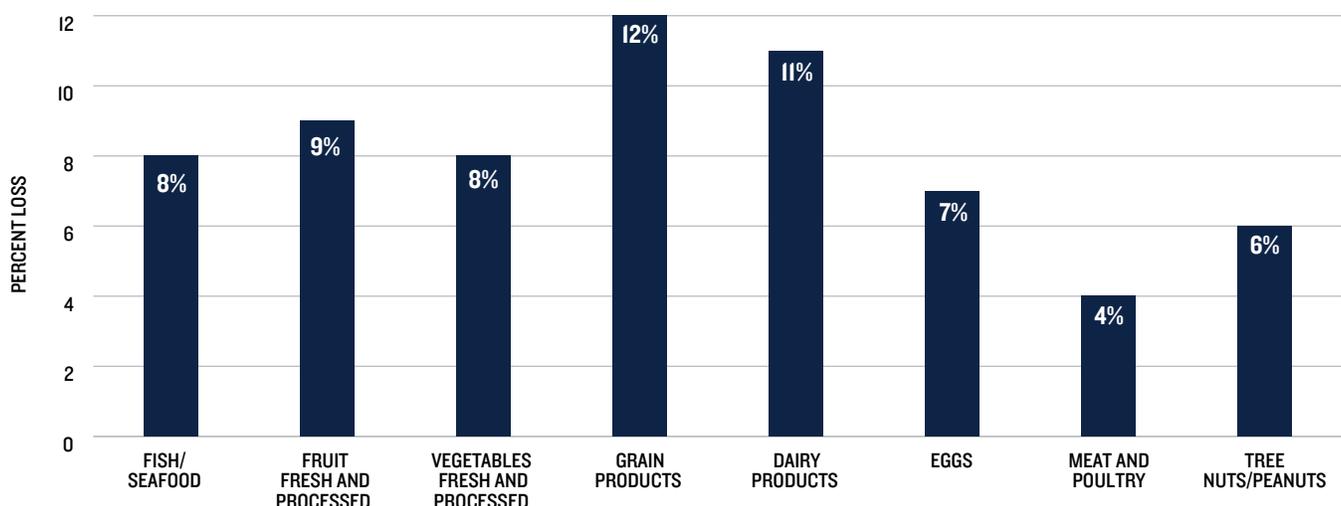
Perishables—baked goods, produce, meat, seafood, and, increasingly, ready-made foods—represent most of the waste in retail operations. According to the USDA's analysis of retail losses in 2011 and 2012, produce alone accounts for \$15.4 billion in losses annually.¹⁶¹ Loss rates averaged 12.3 percent for fruit and 11.6 percent for vegetables. That's enough fruit to meet the government dietary guidelines for more than 5.3 million people and enough vegetables for nearly 3.9 million people every day of the year.¹⁶² Losses vary widely by produce type. For instance, the rate was only 2 percent for sweet corn and 4 percent for bananas versus 43 percent for papayas and 63 percent for turnip greens.¹⁶³

The USDA also reports that approximately 2.7 billion pounds of meat, poultry, and seafood are wasted each year at retail, along with nearly 9.3 billion pounds of dairy products.¹⁶⁵ This is enough to meet the dietary guidelines for more than 2.3 million people for meat, poultry, and seafood and nearly 18 million people for dairy.¹⁶⁶

A survey of supermarket business leaders estimated that 10 percent of revenue is lost to spoilage, age dating, package damage, and markdowns, and that large national chains lose closer to 15 percent of revenue.¹⁶⁷ In a separate study, the industry group Food Waste Reduction Alliance (FWRA) estimated retail-level food waste at 0.01 pound per dollar of company revenue—so a retailer with \$1 billion in revenues typically produces 10 million pounds of food waste.¹⁶⁸ Tesco reported levels of waste under 1 percent for almost all retail commodities.¹⁶⁹

Part of the allure of supermarkets is that they carry a vast array of products at every hour of the day—usually between 15,000 and 60,000 items. While convenient, this bounty presents a challenge for forecasting and inventory management and inevitably leads to waste.¹⁷⁰ Some level of loss is simply considered a part of doing business. Industry executives and managers view a certain level of waste as a sign that a store is meeting quality control and full-shelf standards, meaning that blemished items are removed and shelves are fully stocked. According to a former president of Trader Joe's, "The reality as a regional grocery manager is, if you see a store that has really low waste in its perishables, you are worried. If a store has low waste numbers, it can be a sign that they aren't fully in stock and that the customer experience is suffering."¹⁷¹

FIGURE 8: USDA'S ESTIMATE OF RETAIL FOOD LOSS BY WEIGHT AS A PERCENTAGE OF TOTAL FOOD SUPPLY IN THE UNITED STATES FOR 2010, EXCLUDING INEDIBLE PORTIONS OF FOOD¹⁶⁴



Furthermore, many retail stores operate under the assumption that customers buy more from brimming, fully stocked displays. This leads to overstocking and overhandling by both staff and customers and damages items on the bottom with the accumulated weight.

Overstocked displays are a problem in store delis and seafood cases as well as in produce sections. By one account, 26 percent of whole fish are not sold, yet, they are steadily stocked because stores like how they look in display cases.¹⁷²

LET'S GET DIGITAL—ONLINE-ONLY MODEL CAN VASTLY REDUCE WASTE: FRESHDIRECT CASE STUDY¹⁷³

While many supermarkets offer some sort of online ordering service, the online-only business model can produce significant savings and cut waste. FreshDirect, an online-only retailer that serves much of the Northeast United States, provides an example. The company estimates its loss at about half the industry average.

Direct relationships with farmers and the lack of physical retail outlets allow FreshDirect to shave time off the distribution chain, leading to fresher products with extended shelf lives. In addition, because it does not need to display product, the company avoids damage from customer handling, exposure to ambient temperatures, and use of extra product to improve the aesthetics of the display, as often happens in the retail environment.

FreshDirect uses one facility for storage and processing, which enables it to maintain less inventory and therefore waste less. FreshDirect cofounder David McInerney estimated that his company keeps half the inventory of a typical retailer with the same sales. Similarly, the online model allows FreshDirect to receive orders in advance, eliminating much of the consumer demand guessing game and the resulting need for additional inventory. "If I knew 100 percent of your orders ahead of time, there would be almost no waste," McInerney said.

Finally, customers have come to trust FreshDirect's five-star rating system, which allows the company to promote a product with exceptional taste even if it doesn't look perfect or has only a short shelf life. Its web platform affords unlimited space and the ability to tell the stories of various products, which can help sell nontraditional products. For instance, in the first six weeks that hens lay eggs, the eggs are typically smaller than the market desires. Yet FreshDirect has created a steady demand for these "puller" eggs by working with an organic egg producer and telling this story online. That strategy has brought good value to customers and additional revenue to the producer by allowing them to sell a traditionally unused product.

Stores are also increasingly offering ready-made food in their delicatessens and buffets. These items make up a significant portion of food lost at supermarkets and convenience stores. If these items are made on-site, they may be able to incorporate marginally damaged or nearly expired products. However, many of these products are made off-site or by outside vendors. As with produce, store managers often feel compelled to ensure these displays remain fresh and fully stocked. Rotisserie chickens, for instance, might be thrown away and replaced after four hours on display. One grocer estimated that his store threw away a full 50 percent of its rotisserie chickens, including many from the last batch of the day.¹⁷⁴

Retailers also typically discard products two to three days before the dates on their packages. Almost all of this food is still consumable but may have a limited remaining shelf life. In most states, it is not illegal to sell products after the date on the package, but stores don't do so out of concern that their customers will be turned off. High consumer expectations about produce freshness also lead grocers to discard any items that appear to be past their peak.

Packaging methods can also be a factor in waste levels. For instance, fresh beef placed on a disposable tray and covered in plastic wrap will take on a brown coloring much faster than beef in vacuum packing, which reduces oxygen inside the package. Although the quality of the meat is unaffected, its appearance will typically lead retailers to pull the product from the shelf. Packaging can also protect items, such as produce that is easily damaged from overhandling in the store, and extend shelf life through modified exposure to oxygen and moisture. Although additional packaging can help reduce wasted food and avoid the environmental impacts associated with wasting that food, there are still environmental impacts resulting from that additional packaging.

Products are also discarded due to damaged packaging or concluded promotions. Postholiday discards, such as Valentine's Day chocolate, and other seasonally featured products are often without a home after the appropriate season. In addition, many of the 20,000 or so new food products introduced each year may be discarded when they fail to sell.¹⁷⁵

A survey of supermarket business leaders estimated that 10 percent of revenue is lost to spoilage, age dating, package damage, and markdowns, and that large national chains lose closer to 15 percent of revenue.

Produce arrives in preset quantities according to case size, limiting retailers' ability to purchase the exact amount needed. For example, if a grocer wants 20 pounds of grapefruit but they come only in 42-pound cases, the store will be stuck with more than it can sell. This is particularly challenging for small groceries and convenience stores where product turnover is more limited. A separate problem with grouped products is that if one item in the package—for instance an apple in a bag or one egg in a carton—is damaged, often the whole thing will be thrown out.

Finally, staffing constraints, turnover, and poor training can cause problems. The tight margins of the retail sector have driven stores to reduce employee numbers, leading to fewer staff to perform functions that help keep food fresh and sell product, such as rotating and marking down products. The lower-wage nature of many supermarket jobs leads to high turnover, making it difficult to maintain well-trained staff, which can lead to mishandled product.

BEYOND-STORE INFLUENCE

None of the above retail estimates include the critical role of food retailers in influencing losses both up and down the supply chain.¹⁷⁶ Anecdotally, it's said that large commercial food buyers can demand tough contract terms, including quantity guarantees and the ability to change orders at the last minute. Growers often overplant beyond their contracts to make sure they can fulfill them even in the event of bad weather or pest damage. And, given research that shows that customers select stores largely on the basis of perceived quality and freshness of perishables, retailers feel compelled to stock only produce of perfect shape, size, and color—driving much of the on-farm losses discussed in the production section.¹⁷⁷

A report by U.K.-based Feedback identified last-minute order cancellations or adjustments by European grocery stores and importers as a major contributor to food waste among producers and distributors. Surveyed farmers reported planting and harvesting to comply with the original contract specifications, which the retailers did not always honor.¹⁷⁸ These last-minute changes allow retailers and their intermediaries to transfer financial risk to their suppliers. Consequently, in 2013, the United Kingdom created an independent Groceries Code Adjudicator to enforce fair business practices and shared risk.^{179,180} By sharing the risk of the loss, retailers have more incentive to hone their forecasts as tightly as possible.

Consumers are influenced by their retail experience. Much wasted food begins with choices at the grocery store, which often are influenced by store promotions. Bulk discounts, displays that encourage impulse purchases, high-volume promotions such as buy-one-get-one-free, and large, bulk packages all encourage consumers to purchase more than they need.

TESCO NAMES WASTING LESS FOOD AS ONE OF ITS TOP THREE AMBITIONS

In 2012, Tesco, a large retailer with stores in the United Kingdom, Eastern Europe, and Asia, announced its goal of becoming a world leader in food waste reduction.¹⁸¹ In October 2013, the supermarket became the first U.K. retailer to commit to annually publishing independently verified figures of food waste.¹⁸² The figures showed 56,580 tons of food waste in its U.K. operations alone from 2013 to 2014. Based on 25 major products, Tesco identified food waste “hot spots” along the supply chain and used that information to develop a waste reduction strategy.

In addition to donating thousands of tons of surplus products to charities and community programs, Tesco is working with suppliers and consumers to reduce wasted food upstream and downstream. Since 41 percent of losses occurred in the bakery department, teams were encouraged to bake less bread, request that suppliers extend shelf life for baked goods, and develop promotions to help consumers to waste less. Costa Rican banana farms were able to reduce their waste by two-thirds as Tesco started selling smaller bananas at cheaper prices and using unusually shaped bananas for milk shakes. To reduce consumer waste, Tesco adopted Love Food Hate Waste packages incorporating tips to reduce waste and extended the time frame of dates on eggs and bread. The chain also ended buy-one-get-one-free promotions for fruits and vegetables.¹⁸³

Tesco's reports showed a 2 percent decrease in overall food waste in stores and distribution centers in 2015, followed by a 4 percent increase in 2016, which they attribute to increased bakery and alcohol excess.^{184,185} Nevertheless, the company is still committed to both transparency and action to waste less food.

Examples of Streamlined Retail Operations, In-Store and Out-of-Store

- In 2014, Walmart launched a campaign to waste and damage less food in its supply chain and stores. It optimized forecasting, improved packaging, and altered displays. The company also expanded its Customer Value Program—which systematically discounts items approaching their peak quality date—beyond baked goods. In 2014, this discount program saved more than 30 million food items from becoming waste.¹⁸⁶ It also developed a system to remove only damaged eggs from cartons rather than discarding the whole carton, leading to an estimated savings of 37 million eggs.¹⁸⁷ And as of June 2016, Walmart had converted most of its private label products to carry a uniform “Best If Used By” date instead of the 47 different phrases that were previously used to indicate peak quality.¹⁸⁸

Restaurants and institutional food service providers together generate approximately two to four times the waste of grocery stores, retail supercenters, and wholesale distributors combined.

- Walmart also requires all suppliers of its private label goods to be certified according to one of the Global Food Safety Initiative standards (GFSI) rather than the hodgepodge of previous standards. An internal report showed that after implementation of these standards, which covered all such suppliers by the end of 2009, food recalls decreased by 34 percent and market withdrawals were reduced by 21 percent.¹⁸⁹
- In addition to donating bakery items, Ahold USA freezes meat prior to its expiration and donates it to food bank partners as part of its Meat the Needs program. In 2015, the retailer donated more than \$10 million worth of protein, accounting for one-third of their total food bank donations that year. Ahold also sends some unused food to nearby livestock farmers for feed and recently built its first anaerobic digester in Freetown, Massachusetts, to recycle remaining food waste.¹⁹⁰
- In 2007, Stop and Shop/Giant saved an estimated \$100 million by using alternative display approaches, stocking fewer types of perishables, and improving handling and forecasting. Item-by-item analysis was critical to determining how and when to alter inventory, since higher-level information was not specific enough.¹⁹¹
- In France, the startup Zéro-Gâchis (“Zero Waste”) helps retailers set up shelves of specific products approaching their best quality date and informs consumers about where to find these products through a smart-phone app. The company works with more than 100 supermarkets and rescues approximately 100 tons of food per month. In the first two years of operation, it saved consumers \$1.3 million. Building on its success, Zéro-Gâchis is now working with several major supermarket chains to expand its operations.¹⁹²

LOSSES IN FOOD SERVICE

U.S. restaurants (including full-service and quick-serve) are estimated to generate 22 billion to 33 billion pounds of food waste each year.^{193,194} Institutions—including universities, schools, hotels, health care facilities, and other locations with cafeterias or catering—generate an additional 7 billion to 11 billion pounds per year.^{195,196} Together, these outlets generate approximately two to four times the waste of grocery stores, retail supercenters, and wholesale distributors combined.¹⁹⁷ One industry survey found that only 2 percent of the food discarded by responding national restaurant chains was donated.¹⁹⁸

The USDA does not explicitly estimate waste from the food service sector. This sector is, instead, lumped together with households in the “consumer” category, where combined losses were estimated at 90 billion pounds in 2010, or 21 percent of the total U.S. food supply.¹⁹⁹

Waste in restaurants and other food service can occur either in the kitchen (“pre-consumer”) or after food is served (“post-consumer”). Approximately 4 to 10 percent of food purchased by food service becomes pre-consumer waste.²⁰⁰ Common causes for pre-consumer waste include overproduction, trim waste, mishandling (e.g., overcooking or holding at the wrong temperature), or printed date labels (as with premade sandwiches or prepared salads). Extensive menu choices also hinder proper inventory management since large menus require more ingredients on hand. Unpredictable sales fluctuations also make planning difficult. All-you-can-eat and buffet-style restaurants tend to have higher levels of pre-consumer waste than full-service restaurants, where food is largely made to order and overproduction can be more readily avoided.²⁰¹ Centralized chain-restaurant management can also make it harder to control waste because, despite advanced inventory software, individual restaurants often lack flexibility to use food creatively. In addition, quick-serve restaurants must often adhere to strict time limits for prepared items. For example, McDonald’s has a policy that fries must be thrown out after 7 minutes and burgers after 20 minutes.²⁰²

While data are limited and figures can vary widely depending on the circumstances, post-consumer waste often makes up the vast majority of overall food losses in certain restaurant settings, especially those where there is little on-site food preparation and therefore not much kitchen waste. Post-consumer waste can be caused by excessive portion sizes and service methods such as all-you-can-eat buffets and free drink refills, as well as the inclusion of bread, side dishes, and other items that consumers may not want.

Portion sizes have increased significantly over the past 30 years. From 1982 to 2002, the average pizza slice grew by 70 percent in calories, the average chicken Caesar salad doubled in calories, and the average chocolate chip cookie quadrupled.²⁰³ Today, portion sizes can be two to eight times larger than USDA or FDA standard serving sizes.²⁰⁴ This phenomenon is negatively affecting both how much we consume and how much goes uneaten. Of course, if restaurant patrons don’t finish their portions, they can take them home. On average, diners leave 17 percent of meals uneaten, but 55 percent of these leftovers stay on the table.^{205,206}

Frequent staff turnover never helps, but especially in food service, newer hires may be unfamiliar with the prep and trim techniques that can minimize waste.²⁰⁷ Staff behavior, culinary skills, and kitchen culture can all influence how carefully produce is trimmed or when products are thrown out, for example.

EXAMPLES OF EFFICIENCY IN FOOD SERVICE

Institutional Food Service

- LeanPath waste-tracking software estimates that use of its software cuts pre-consumer wasted food in half, which in turn reduces kitchen food purchases by 2 to 6 percent.²⁰⁸ For example, Michigan Tech University reduced wasted food by 50 percent and saved \$1,000 per week.²⁰⁹ The MGM Grand Buffet in Las Vegas cut pre-consumer waste by 80 percent and saved an average of \$7,500 per month.²¹⁰ Boloco, a small Boston chain, reduced pre-consumer wasted food by 24 percent across its four locations.²¹¹
- Trayless dining in cafeterias has become a real food waste prevention success story in all-you-care-to-eat settings. An Aramark study of 186,000 meals served on college campuses found a 25 to 30 percent drop in wasted food, in addition to water savings of one-third to one-half gallon per person on days without trays, since trays don't need to be washed if they're not used.²¹² A Colgate University study found smaller water savings, at .13 gallons per person per meal.²¹³ Furthermore, energy is saved by not having to heat as much dishwashing water.
- Beginning in the fall of 2013, the State University of New York at Delhi began weighing student food waste and displaying the total amounts of wasted food each hour, day, week, and semester—along with the cost—on a monitor near the dish return area. As a result, student waste decreased by 1,000 pounds per week and 0.2 pounds per student from the pre-scale baseline measure.²¹⁴ This small school of 1,800 students saved \$2,000 per week in food costs.²¹⁵
- In the fall of 2015, Bon Appétit Management Company committed to preventing and reducing waste by following the EPA Food Recovery Hierarchy. Each of its 650-plus cafés around the country launched a month-long waste reduction campaign, making weekly purchases of Imperfectly Delicious Produce or tracking their food waste annually through programs like the LeanPath software mentioned above. Additionally, Bon Appétit pledged that by 2018, 80 percent of its sites will regularly donate their excess, wholesome food to people in need. All sites will divert food waste from landfills through practices like composting or redirecting to animal feed. Bon Appetit has also rolled out a new Food Standards Dashboard to track progress toward these and other company commitments.^{216,217}



- Innovations in K–12 schools, such as salad bars and other “choice” bars, allow children to select their food and reduce waste. Small changes like having recess before lunch to help build up appetites and reduce the incentive to race through the meal significantly reduce wasted food.²¹⁸ Allowing enough time for kids to eat also helps reduce waste while encouraging consumption of healthy items like fruit and vegetables. A study by Provokare showed that children were less likely to waste food if they helped prepare their own lunch boxes. The Smarter Lunchroom movement develops and shares best practices to improve the school lunch experience in the United States, and the USDA has issued guidance on how schools can reduce waste and donate surplus food.^{219,220,221}

Restaurants and Catering

- In 2015, Chef Dan Barber converted his Manhattan Blue Hill Restaurant into the pop-up WastED for a few weeks to showcase that food parts typically deemed unusable in the restaurant world are in fact suitable for consumption. The restaurant served a “rack of black cod” (using bones and fish left over after filleting), deep-fried skate cartilage, broken razor clams, and a veggie burger made with the pulp from a juicing operation. This stunt has inspired a wave of other chefs and restaurants. For example, fast-casual chain Sweetgreen began offering a salad of broccoli stalks, bread ends, and carrot peels.²²² In another example, Ellary’s Greens in New York City serves a salmon burger made from the trimmings of its salmon fillet entrée.²²³
- From 2009 to 2014, the number of small plates and smaller portion items on menus across the country increased by 32 percent.²²⁴ A French restaurant, Les Arcades, offers four meal sizes indicated by four different colors, reducing wasted food by 40 percent.²²⁵
- Several buffet-style restaurants have fees for leftover food or pay-by-weight systems to reduce patron waste.²²⁶ Momoya Sushi in Mountain View, California, charges \$5 for sushi that is uneaten.²²⁷ Similar restaurants have emerged in Japan, Hong Kong, Switzerland, and Saudi Arabia.

LOSSES AT HOME

Households are responsible for the largest portion of all food waste.²²⁸ ReFED estimates U.S. household food waste totals 76 billion pounds, or 238 pounds of food per person annually. This costs \$450 per person, or \$1,800 per year for a household of four.²²⁹ The USDA estimates that 21 percent of the total food supply is lost at the consumer level, amounting to 90 billion pounds. However, the agency's definition includes both households and "out of home" consumption (e.g., in restaurants), as mentioned earlier.²³⁰ Furthermore, total consumer-level losses may be even higher if we include surplus from home gardens, which one survey estimated at an additional 11.5 billion pounds.²³¹

Because it has undergone more transport, storage, and often cooking, throwing food away at the consumer level has a larger resource footprint than at any other point of the food chain. A McKinsey Consulting study reports that household losses are responsible for an average of eight times the energy waste of post-harvest losses.²³²

Estimates vary as to how much of the food discarded in homes is edible. A study of 100 Seattle residents found that about one-third of food wasted in homes was edible, while two-thirds consisted of inedible scraps (such as banana peels, eggshells, and bones). Of the edible portion, about half was unused produce, one-third was uneaten leftovers, and the rest was uncooked other food.²³³

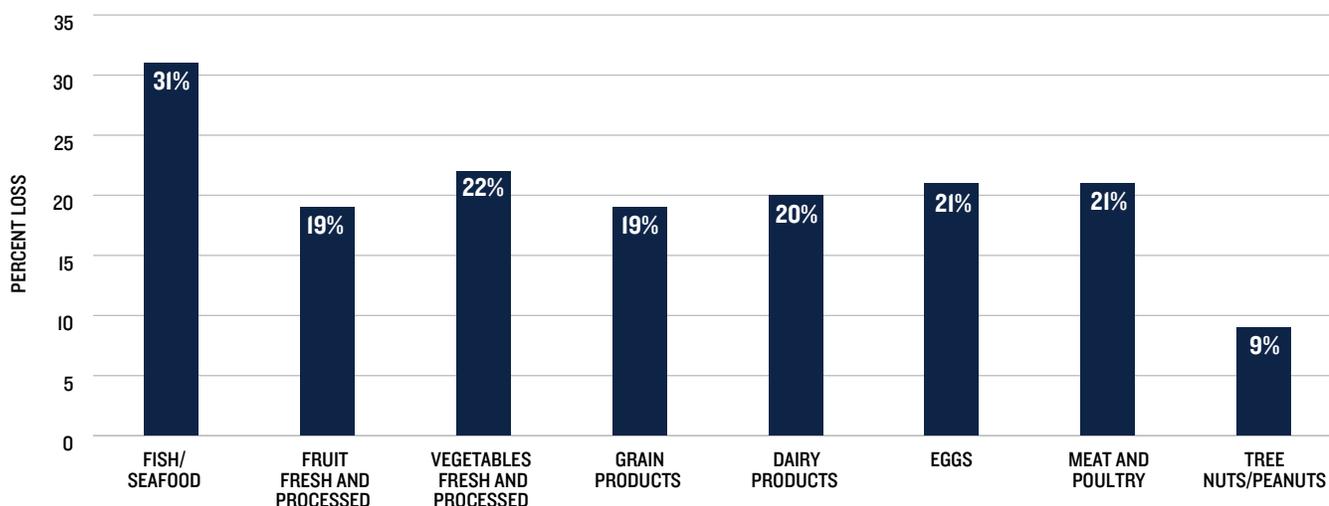
A study of 500 homes in the Vancouver area found that 53 percent of food waste at home was avoidable.²³⁵ NRDC's own research of household food waste across three cities (613 households in Nashville, Denver, and New York) found that up to 68 percent of discarded food was edible, if "questionably edible" items such as potato peels were included.²³⁶

Perishables make up the majority of household food losses due to the high volume of consumption and the tendency to spoil. In terms of total mass, fresh fruits and vegetables account for the largest household losses, followed closely by meat, poultry, fish, and dairy products. By rate of loss, fish and seafood rank highest for consumers, with 31 percent of available pounds going uneaten.^{237,238}

Consumers tend not to notice the food they throw out and to underestimate its implications. Several studies have found that approximately three-quarters of people believe they waste less food than the average American.²³⁹ Furthermore, studies find that even residents who keep daily diaries of their food waste underreport the amount of food they waste by about 40 percent, compared with what can be found in their garbage.²⁴⁰ Cheap, convenient food has promoted behaviors that undervalue fully utilizing purchases. As a result, the issue of wasted food is simply not on the radar of many Americans, even those who consider themselves economically or environmentally conscious.

One key driver of waste is confusion over date labels. Date labels on food are generally not regulated and are not meant to indicate food safety. Multiple dates, inconsistent usage, and lack of education around date labels cause consumers to discard food prematurely. In the United States, more than 80 percent of consumers report that they discard food prematurely due to confusion over expiration dates.²⁴¹ Meanwhile, U.K. findings indicate that about 20 percent of avoidable wasted food in households is the result of date label confusion.²⁴²

FIGURE 9: USDA'S ESTIMATE OF CONSUMER FOOD LOSS BY WEIGHT AS A PERCENTAGE OF TOTAL CONSUMER-LEVEL FOOD SUPPLY IN THE UNITED STATES FOR 2010



Note that this includes both "in home" and "out of home" purchases²³⁴

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NOTHING BUT A NUMBER: REDUCING DATE LABEL CONFUSION

Despite widespread belief to the contrary, “best by” and other date labels are simply manufacturer suggestions for peak quality and typically are not meant to indicate a food safety risk.²⁴³ These labels are not federally regulated, with the lone exception of infant formula. With that lack of federal oversight, a complicated web of state and, occasionally, local regulations dictate which food items must have labels. Currently, 41 states plus the District of Columbia require date labels on at least some food items, though the type of item and rules differ.²⁴⁴ Furthermore, city regulations sometimes conflict with state rules. For example, Baltimore’s forbids the sale of food past its labeled date.²⁴⁵ Even when a product is regulated, the specific rules vary across states. Take milk, for instance. Florida requires that all milk and milk products “be legibly labeled with their shelf-life date,” though this date is never defined. In Montana, milk must have a sell-by date within 12 days of pasteurization, while Pennsylvania requires it within 17 days. In New Hampshire, a sell-by date is required for cream but not milk. On the other hand, New York, Texas, Wisconsin, and other states have no requirements for date labels on milk or dairy.²⁴⁶

It’s not surprising, then, that consumers are confused. In fact, a 2016 survey found that only 1 percent of consumers understood that date labels are regulated only for specific foods, with 36 percent falsely believing date labels are federally regulated.²⁴⁷ Given that confusion, consumers often err on the side of caution and discard food as soon as it reaches the labeled date. Industry convention is to use the term “sell by” to indicate when a product should be sold, building in time for that product to have top-quality shelf life once in a consumer’s home. However, in a 2015 industry survey, 83 percent of respondents reported discarding food on its sell-by date at least occasionally, and 45 percent reported discarding food on this date frequently.²⁴⁸ Another study found that while confusion persists among all age groups, millennials were most likely to discard food based on the date label, while baby boomers were the least likely to do so.²⁴⁹ In fact, in the United Kingdom, a leading research group estimates that up to 20 percent of household food waste is linked to date labeling confusion.²⁵⁰

Without uniform date labeling, it’s impossible to guarantee the dates’ meaning. To remedy this, in December 2016, the USDA Food Safety and Inspection Service released new guidance. This guidance recommends that manufacturers and retailers use “Best if Used By” as the universal terminology to indicate quality.²⁵¹ In January 2017, the two largest food industry associations announced voluntary guidelines to limit date labels to “Best if Used By” to describe product quality and “Use By” for the few highly perishable products or those that may present food safety concerns over time.²⁵²

Both of these steps are great strides in the right direction. Unfortunately, the USDA has purview over only a limited set of products, the industry still has to overcome the challenge of getting its members to adopt the agency’s standards, and in some cases the industry faces conflicting state laws. Similar provisions were proposed at the federal level in the Food Date Labeling Act of 2016, which was introduced in both the House and Senate, but did not see any movement. Federal legislation would be a sure way to overcome the limitations of the current approaches.

Whether it’s single-household purchases or bulk buys, food sold in package sizes larger than needed can lead to food spoilage.²⁵³ Furthermore, store promotions that encourage bulk purchases or purchases of unnecessary products often lead consumers to buy foods outside their typical meal plan, which then leads to waste.

Poor storage habits can also drive waste. When items are hidden behind others in the refrigerator (or, to a lesser extent, in the freezer), waste becomes more likely.²⁵⁴ Most people like to keep their fridges well stocked, and given the sheer size of modern refrigerators, this can lead to wasted food. As food lingers in the fridge, uncertainty over how long foods keep and lack of knowledge about how to use items doom many food items to landfills.

Lack of meal planning and shopping lists, inaccurate serving estimates, and impromptu restaurant meals can lead to spoilage. Furthermore, much like restaurant portions, recipe serving sizes and plates have grown, growing portions along with them, and large portions can lead to uneaten food. In fact, the surface area of the

average dinner plate expanded by 36 percent between 1960 and 2007, meaning you need to serve more food to fill it.²⁵⁵ Simply switching to a smaller plate could cut calories and waste.²⁵⁶ Serving sizes in the Joy of Cooking cookbook have increased 33.2 percent since 1996.²⁵⁷ That is, a recipe that was said to serve 10 now “Serves 7” (or the ingredient amounts are greater for the same number of servings). In some cases, this leads to overeating. In others, it simply leads to extra food in the trash.

Excess prepared food would not produce as much waste if Americans had a better attitude toward leftovers. While many Americans utilize leftovers in the same form or repurpose them into another meal, many more do not. In a 2015 survey, 53 percent of respondents said that they throw away leftovers at least weekly.²⁵⁸ And in households with children, that figure jumped to 70 percent.²⁵⁹

Finally, time constraints and inconvenience can exacerbate the problem. Often, the most convenient option is not the least wasteful option. For instance, ordering in can feel easier than cooking produce on the

In the United Kingdom, it has been demonstrated that people do save money by wasting less food, and that they tend to spend about half that money to “trade up” to more premium grocery products.

brink of spoilage. This dynamic can lead to waste, even with all other best practices.

Food expenditures represent only 10 percent of the average American’s disposable personal income—a smaller proportion than in any other country.²⁶⁰ That’s also half the percentage it was in the 1950s, which means the financial incentive for many of us to be more careful with our food is much smaller.²⁶¹ Nevertheless, in the United Kingdom, it has been demonstrated that people do save money by wasting less food, and that they tend to spend about half that money to “trade up” to more premium grocery products.²⁶²

Household waste is not inevitable, nor has it always been common. Older generations, especially those who experienced or had a parent who experienced World War II or the Great Depression, tend to waste less. As mentioned earlier, the average American wastes 50 percent more food today than he or she did in the 1970s. In a 2015 survey, 84 percent of Americans above 65 years old estimated that they waste less food than the average American and exhibited many of the behaviors associated with waste reduction.²⁶³ An analysis of residential garbage in the United Kingdom showed that this age group generated approximately 25 percent less food waste than similar-size but younger households.²⁶⁴

Consumers in developing countries do not waste nearly as much food as their European or American counterparts. The FAO estimates per capita food waste by European and North American consumers at 210 to 250 pounds per year, while consumers in sub-Saharan Africa and South or Southeast Asia waste a mere 13 to 24 pounds per year per capita.²⁶⁵ Wasting food is, in many cases, a luxury. However, once we account for all the waste and the environmental and social implications, it’s not necessarily one we can afford.

EXAMPLES OF EFFICIENCY AT THE CONSUMER STAGE

Consumers can be a powerful waste reduction force. In the United Kingdom, households reduced avoidable food waste by 21 percent from 2007 to 2012.²⁶⁶ Over that same period, both wasted food and purchases decreased by about 500 grams (1.1 pounds) per person per week, which resulted in total food purchases remaining constant while the population increased 4.5 percent.²⁶⁷ Furthermore, consumers there chose to spend about half the money saved by wasting less food to “trade up” to more premium food and beverage products.²⁶⁸ Example strategies to reduce consumers’ waste include:

- **Tools and information:** Consumers can find waste reduction inspiration all over the Internet through blogs, recipes, reference information, and tips. SavetheFood.com offers tips for planning and shopping, optimal storage, reviving food on the brink, and freezing. Apps and websites on meal planning, storage guides, and shelf life advice show us how to make the most of our food. Education programs like Food: Too Good to Waste provide outreach tools to actively engage and educate consumers.²⁶⁹
- **Flexible purchase sizes:** Allowing customers to customize purchase quantities can reduce waste. In Austin, a grocer called in.gredients sells virtually all of its goods in bulk bins.²⁷⁰ This also reduces packaging waste by encouraging reusable containers. In a 2013 poll, Americans identified smaller quantities as the best way supermarkets could help minimize household wasted food.²⁷¹
- **Food sharing:** Many consumers avoid waste by sharing extra food with family and friends. Online platforms and apps offer new ways to share food with neighbors or those in need. For example, the Ample Harvest website enables backyard gardeners to share their excess produce with local hunger relief agencies.²⁷² The Leftover Swap app helps neighbors share leftovers. The French start-up Partage Ton Frigo (“Share Your Fridge”) helps offices implement common shelves in shared refrigerators to allow people to share extra food at work.²⁷³ In Berlin, the organization FoodSharing set up fridges in the street to facilitate the exchange of excess food.²⁷⁴
- **Backyard gleanings:** Some households avoid wasting food by allowing volunteers to glean their backyard fruit trees. Several organizations facilitate these backyard gleanings and distribute that fruit to food relief organizations. Prominent examples include Food Forward in Los Angeles, the Portland Fruit Tree Project, City Fruit in Seattle, and the Baltimore Orchard Project.^{275,276,277,278}
- **Community events:** Around the globe, food waste awareness events are building momentum. The nonprofit group Feedback organizes events called Feeding the 5000—giant feasts that amply feed 5,000 people with rescued food.²⁷⁹ The group has held dozens of these events in Europe and the United States since 2009. Similar Disco Soup events combine the positive disco spirit with cooking food that otherwise would be thrown away. Hundreds of Disco Soups have taken place in various public spaces in more than 30 countries, including the United States.²⁸⁰

FOOD DONATION AND REDISTRIBUTION

One of the ironies of today's food system is that enormous amounts of food are wasted at the same time that more than 42 million people in the United States lack a secure supply of food to their tables. In fact, only about 3 to 10 percent of unsaleable food from manufacturers, retailers, restaurants, and food service providers combined is donated each year.^{281,282} At the farm level, only a small portion of the largely undocumented losses of fruits and vegetables makes its way to the hunger relief system. We can do much, much better.

Recent growth in donations reflects these opportunities. Donations to the Feeding America network increased by 71 percent from 2011 to 2016, due in part to higher volumes of fresh produce and more donations from the retail sector.²⁸³ Similarly, Food Donation Connection, which focuses on prepared food rescue, has seen a tripling of donations in the past ten years, topping 50 million pounds in 2016.²⁸⁴ Donations of fresh produce to California's Farm to Family increased by 64 percent from 2010 to 2016.²⁸⁵

Donors are protected from food safety liability when donating food to a nonprofit organization. Furthermore, no food donation recipient has ever sued a food donor in the United States.

Barriers remain, however, with transportation topping the list. Indeed, 41 percent of respondents in a survey of manufacturing, retail, and restaurant businesses cite transportation from the donor's location as the main barrier to donating food.²⁸⁶ While donors receive tax benefits for their contributions, nonprofit food recovery organizations typically bear the cost and responsibility of transporting donated food to a central warehouse or to charitable organizations that directly serve needy individuals. Many lack adequate transportation capacity, particularly for perishables like meat, dairy, and prepared foods that need to be chilled during transport.

Transportation needs are especially acute for donations of prepared food from restaurants and institutional food service, which are typically made in smaller quantities from more disparate locations and require quick turnaround. Acknowledging that adequate food rescue infrastructure benefits both donors and local communities, Walmart donated 180 new refrigerated trucks to hunger relief agencies around the country in 2013.²⁸⁷

Potential donors have also cited liability concerns as a key barrier to donating food, although this is changing as existing protections become more widely understood.

The Bill Emerson Food Donation Act, signed into law by President Clinton in 1996, protects donors from food safety liability when donating food to a nonprofit organization. Furthermore, no food donation recipient has ever sued a food donor in the United States.²⁸⁸ Some companies still cite fear of negative publicity if donated food is linked to illness. However, as more large companies institute national food donation programs, these concerns appear to be diminishing.

It should be noted that while food donation provides immediate relief to those without enough to eat, it does not address poverty and the other underlying conditions that drive hunger. In addition, as rates of diabetes, hypertension, and other diet-related diseases rise, some agencies are limiting receipt of foods with little nutritional value.

Examples of Innovative Food Recovery

- Food Donation Connection (FDC) facilitates food rescue nationally and internationally, focusing largely on prepared food donations from national chain restaurants. Since 1992, FDC has rescued more than 500 million pounds of food and currently works through a network of 10,000 charitable organizations. Their donors include Olive Garden, Red Lobster, Outback Steakhouse, Pizza Hut, Chipotle, and Cheesecake Factory, as well as retailers like Whole Foods Market. FDC received more than 50 million pounds of donations in 2016.²⁸⁹
- D.C. Central Kitchen rescues grocery store and farm food that would otherwise be thrown away, while also creating jobs. Its Culinary Job Training program, which has graduated more than 100 classes since 1989, teaches cooking skills to adults facing high barriers to employment, such as a history of incarceration, homelessness, addiction, or trauma. Trainees learn by preparing 5,000 free meals for homeless shelters every day. The organization's revenue-generating Fresh Start Catering employs Culinary Job Training graduates. D.C. Central Kitchen also helped catalyze Campus Kitchens, which now operates on more than 50 high school and college campuses and rescues a combined one million pounds of food annually.²⁹⁰
- Launched in June 2015, Daily Table is a Boston not-for-profit retailer that sells excess, healthy food sourced, mostly in the form of donations, from a network of growers, supermarkets, and manufacturers. Daily Table makes prepared food on-site from some of these donated goods.²⁹¹
- The Food Recovery Network (FRN) was launched in 2011 at the University of Maryland and quickly spread to 200 campuses across the country. Under its model, students recover food from college dining settings and deliver it to nearby food rescue organizations. As of early 2016, the group had recovered 1.6 million pounds of food.²⁹²

- Various electronic platforms have emerged to help connect surplus food with recipients, making it easier for a food business to find a recipient for its donations and facilitate transport of products. These vary from apps like Zero Percent, Copia, and Re-Plate, which connect businesses to food pantries and soup kitchens, to larger-scale efforts like Feeding America’s MealConnect, an online marketplace for surplus foods, connecting donors and food banks across the supply chain. This website helped rescue 208 million meals between 2014 and 2016 and expanded in 2017 to link smaller food donations with local soup kitchens or food pantries.²⁹³
- The Pennsylvania Agricultural Surplus System (PASS), funded by the state, provides resources to cover the cost of harvest, processing, packaging, and transporting excess produce for donation to charitable organizations focused on food security. In the pilot program, the Central Pennsylvania Food Bank acquired more than 100,000 pounds of apples and Pennsylvania growers and pickers recouped \$41,180.²⁹⁴
- The California-based Waste Not OC Coalition is a public-private partnership spearheaded by the Orange County public health department. The coalition facilitates the donation of healthy surplus foods from food service to food pantries, addresses liability concerns, maintains a detailed database of food pantries, and works with Yellow Cab of Orange County to help transport surplus foods. Since July 2014, the coalition has saved more than 360 tons of food from landfills—enough for more than 500,000 meals.²⁹⁵
- Philadelphia’s Drexel Food Lab, a research group composed of culinary arts and food science students, develops low-cost, simple recipes to repurpose surplus food commonly wasted by supermarkets into veggie chips, jams, and smoothie bases. These recipes are used at supermarkets and have the potential to support new local jobs. One study estimated that if turned into a social enterprise that bought the surplus food from an 11-store supermarket chain, added value through processing, and then resold it to the supermarket or another retailer for sale to consumers, these products could generate approximately \$90,000 in monthly revenue across the supply chain.²⁹⁶
- To help cities improve food donation, NRDC is developing a model to estimate the potential volume of food donations in a given city, using Denver, Nashville, and New York as pilots.²⁹⁷ In Denver, NRDC is also projecting the type and size of investments in food recovery and rescue infrastructure (such as transportation, cold storage, and staffing) that would be needed for the city to fully realize its potential for food donation. It is also comparing this potential to Denver’s food insecurity data to assess the degree to which expanded food donation could reduce the “meals gap” among the city’s food-insecure populations.

FOOD WASTE MANAGEMENT

Only 5 percent of food scraps in the waste stream are recycled, usually through composting.²⁹⁸ The rest ends up in landfills and incinerators. In fact, food represents the single largest component, by weight, of municipal solid waste reaching landfills and incinerators in the United States.²⁹⁹ Disposing of food scraps costs \$1.3 billion annually in transport and fees.³⁰⁰ As mentioned earlier, as these scraps decompose, they emit tons of methane, a powerful greenhouse gas.³⁰¹

Food waste is not all avoidable. There will always be some inedible parts, like bones and banana peels, for instance. In these cases, the best strategy is to separate those food scraps and use them for animal feed, composting, or anaerobic digestion.

Food represents the single largest component, by weight, of municipal solid waste reaching landfills and incinerators in the United States.

Animal feed is the preferred option for managing food scraps because it offsets demand for feed grain (often corn and soy), which could free up significant resources and acres of arable land. This option usually solves the disposal problem while cutting costs for livestock producers. Produce packers and food manufacturers have long sent their outtakes and scraps to animal feed. According to the FWRA’s 2016 survey of their grocery store, food processing, and food service members, respondents sent a combined 26 percent of their food waste to animal feed.³⁰² Recently, processing techniques and the use of insects have emerged to transform food waste into other types of animal feed products as well.

Composting is the controlled breakdown of organic waste into useful fertilizer and other soil amendments. Just as recycling returns usable materials to the manufacturing cycle, composting returns nutrients to the nutrient cycle and organic material to the soil. This practice also reduces methane emissions and raises awareness about the quantities of food waste. Compost can displace the use of synthetic fertilizers and the energy use, water use, and air and water pollution associated with manufacturing and applying those fertilizers. Compost also improves soil’s structure, water retention, and nutrient storage capacity.

Anaerobic digestion is a form of organics recycling that can also divert food from landfills. In anaerobic digestion (“anaerobic” meaning “without oxygen”), organic materials such as food waste break down in a controlled process in an enclosed vessel to generate an energy-rich biogas composed primarily of methane and carbon dioxide.³⁰³ This biogas can be used to generate electricity



or heat or to create liquid fuels. After energy extraction, the solid and liquid residue, called digestate, should be processed for use as fertilizer or other soil amendments. See Appendix C for a full set of recommendations on best practices for anaerobic digestion.

Anaerobic digestion is quite common in Europe, especially Germany. In the United States, anaerobic digesters are becoming more prevalent. There are now more than 100 commercial-scale anaerobic digesters in the United States that process food scraps.³⁰⁴ While this technology holds promise, care must be taken to not overbuild capacity, which can impede waste reduction efforts. In Europe, for example, capacity has actually exceeded food waste generation, so some facilities are not operating at maximum efficiency.³⁰⁵ This situation can also create a need to grow food specifically for the digesters in order to meet energy demand.

Local governments are increasingly introducing programs to collect food waste for either commercial composting or anaerobic digestion. The number of U.S. municipalities with food waste collection programs has swelled to close to 300—up 50 percent from 2014 and almost sixfold since 2007.³⁰⁶ Municipal composting access is most widespread on the West Coast. Of the communities with curbside pickup for composting in 2014, 65 percent were

in California, Washington, and Oregon.³⁰⁷ This geographic disparity is changing as a number of major cities in other parts of the country—such as Minneapolis, Austin, San Antonio, and Cambridge, Massachusetts—pilot curbside collection programs.³⁰⁸ Furthermore, New York City now has the largest curbside program, which will serve more than 3.3 million residents by the end of 2017 and extend to the entire city by the end of 2018.^{309,310} This is an impressive expansion when one considers the fact that as of 2014, only 2.74 million households had access to food waste collection across the whole country.

Examples of Improving Food Waste Management

- Several states have passed varying laws against landfilling food, including California, Connecticut, Massachusetts, Rhode Island, and Vermont. Massachusetts’s ban applies to all generators of more than one ton of food waste per week. Connecticut’s ban only applies to commercial generators of two tons per week located within 20 miles of a food recycling facility. Vermont’s policy bars everyone, including consumers, from landfilling food after 2020.³¹¹ California requires commercial organic waste generators to divert that waste from landfills as part of the state’s commitment to divert 50 percent of food waste by 2020 and 75 percent by 2025. In addition, it has committed to recover 20 percent of all edible food waste for human consumption.³¹²
- CalRecycle’s Organics Grant Program is aimed primarily at building compost and anaerobic digestion infrastructure, but in 2016 also introduced grants to promote food donation to rescue partners. Of the \$40 million appropriated to this program for 2017, CalRecycle planned to allocate \$12 million for digestion projects, \$12 million for composting projects, and \$5 million for its new Food Waste Prevention and Rescue project.³¹³
- After implementing citywide food waste collection and composting, Portland, Oregon, began collecting garbage every two weeks instead of weekly.³¹⁴ The amount of trash collected dropped by one-third and service rates were lower than had the program not been started.³¹⁵

FIGURE 10: STATE LAWS MANDATING FOOD SCRAP RECYCLING³¹⁶

	WHO IS COVERED	WASTE PRODUCTION THRESHOLD	DISTANCE EXEMPTIONS
Massachusetts	Large generators (corporations, agencies, cities, etc.)	1 ton/week	None
Vermont	Everyone (individuals, corporations, agencies, cities, etc.)	Graduated threshold of 26 tons/year (2016), 18 tons/year (2017), and all volumes (2020)	20 miles
Connecticut	Commercial generators	Graduated threshold of 104 tons/yr (2014), 52 tons/yr (2018)	20 miles
Rhode Island	Commercial generators (includes multifamily housing with >5 units)	Graduated threshold of 104 tons/yr (2016), 52 tons/yr (2018, for certain facilities only)	15 miles
California	Commercial generators	Graduated threshold of 8 cubic yards/week (2016), 4 cubic yards/week (2017), and 2 cubic yards/week (2020, dependent on state diversion levels).	Only for some rural jurisdictions



- Ohio's Enviroflight feeds six tons of food waste (primarily by-products and leftovers) per day to huge numbers of black soldier fly larvae. In just two weeks, the larvae grow to 10,000 times their birth size. They can then be processed to replace or supplement feed for commercially raised fish. Enviroflight is now working to obtain regulatory approval and establish a large-scale production facility.³¹⁷
- Sustainable Alternative Feed Enterprises (SAFE) converts post-consumer commercial organics into animal feed. The process removes and collects water and oil from food scraps and creates a nutrient-rich mash suitable for nonruminant animal feed. After processing, only 10 percent of the original product remains and goes to compost.³¹⁸
- In 2013, Kroger opened an anaerobic digester at its distribution center in Compton, California, to process 150 tons of inedible food scraps daily from its nearby supermarkets.³¹⁹ The digester uses that waste to generate 13 million kilowatt-hours of energy annually—enough to power 2,000 homes for a year.³²⁰ Additionally, about 40 percent of Kroger's 2,600 stores divert some food waste to livestock feed or compost.³²¹
- Wegmans strives to utilize as much edible but slightly blemished food as possible in its prepared food before designating it for food donation or other fates. After that, however, eighty percent of Wegmans supermarkets divert food waste from landfills in some way. Twenty-one stores send food scraps to animals, 24 send food to anaerobic digesters (in New York), and 29 send food to compost facilities. Some stores combine these strategies.³²²
- Casella Organics, which provides organic waste recycling and disposal services in the Northeast, has informed clients about how much food and other materials have been composted since December 2014. The company started weighing food waste via onboard truck scales at the behest of several of their college clients near Boston who wanted to chart their food waste reduction progress. The colleges use this data when discussing potential changes with their dining services provider.³²³

Taking a Bite Out of Uneaten Food: Progress from 2012 to 2017

Much has happened since NRDC's first *Wasted* report in 2012. While limited data make it difficult to assess whether we are actually wasting less food, America has clearly made progress.

Most notably, in September 2015, the EPA and USDA adopted federal targets to cut waste by 50 percent by 2030.³²⁴ Shortly afterward, the United Nations adopted similar targets as part of its sustainable development goals.³²⁵ Only a couple of months later, the first-ever comprehensive bill to reduce, reuse, and recycle wasted food, the Food Recovery Act, was introduced in Congress. And as part of the omnibus budget package that closed out 2015, food donation tax incentives were permanently extended to businesses of all sizes.

Since 2012, wasting less food has become a regular part of the conversation around a sustainable food future. The topic has received increased attention from businesses, academics, nonprofits, media, and consumers. In November 2015, 15 leading food companies signed on as Food Loss and Waste 2030 Champions, a recognition program by the EPA and USDA for companies committing to determine their current level of food waste, reduce that waste by 50 percent, and document progress on their websites.³²⁶

A 2015 consumer survey found rather high awareness on the issue of wasted food. Of those polled, 42 percent said they had heard or seen something on food waste in the past year.³²⁷ And 45 percent of respondents correctly identified the most recent estimate of U.S. food waste (40 percent).³²⁸ In a 2016 poll of more than 6,700 adults by the Ad Council, 74 percent of respondents reported that the issue of wasted food was important or very important to them.³²⁹

Following are some indicators of food waste reduction in the United States over the past several years.

GOVERNMENT ACTION

- In September 2015, the USDA and EPA announced federal targets to cut food waste by 50 percent by 2030, aligning with the Sustainable Development Goals adopted by the 193 United Nations member states.^{330,331}
- In December 2015, expanded food donation tax benefits were made permanent as part of the omnibus budget package. This new law also eased the method of calculation and increased the cap on deductions, further incentivizing food donation from a wide range of donors.



- From 2015 to 2016, the Food Recovery Act (H.R. 4184 and S. 3108), the Food Date Labeling Act (H.R. 5928 and S. 2947), and the Food Waste Transparency Act (H.R. 4382) were introduced in Congress.^{332,333,334} These bills included significant policy actions that, if passed, could reduce consumer confusion around date labels, support a range of food waste prevention strategies, ramp up food donation infrastructure, increase transparency, and support food scrap recycling.
- From 2011 to 2014, Connecticut, Vermont, Rhode Island, Massachusetts, and California all enacted varying bans on allowing food to enter the waste stream. In 2016, California mandated that 20 percent of currently wasted edible food be recovered for human consumption.³³⁵ These policy shifts have jump-started expansion of food waste recycling infrastructure and, in some cases, boosted food donation and diversion to livestock feed. Since enacting its ban, Vermont experienced a 40 percent increase in food donations from 2015 to 2016, on top of a 25 to 30 percent increase the prior year.³³⁶
- Several states, including Arizona, California, Colorado, Iowa, Kentucky, Missouri, Oregon, Virginia, and the District of Columbia, have added tax incentives for donating food that would otherwise be wasted.³³⁷
- In 2016, the U.S. Conference of Mayors adopted a set of resolutions aligned with the national goal of reducing food waste by 50 percent by 2030.³³⁸
- As of 2016, almost 300 communities across the country offered curbside food waste collection, up 50 percent from 2014 and almost sixfold since 2007.³³⁹ The amount of food waste sent to composting and anaerobic digestion in the United States increased from 3.5 to 5.1 percent of municipal solid waste from 2011 to 2014.³⁴⁰

BIGGER THAN US: WASTING LESS FOOD AROUND THE GLOBE

Compared with our counterparts around the world, the United States is a little late to the table when it comes to tackling wasted food. Globally, noteworthy progress has been made, and there has been far too much activity to fully recount here. Some highlights include:

- **High-level commitments.** In December 2015, the European Commission adopted the Circular Economy Package, which sets targets and time lines for food waste reduction in line with the U.N.'s Sustainable Development Goals.³⁴¹ In 2013, several major European food industry associations committed to halve European Union food waste from distribution, retail, food service, and households by 2020 as part of the Every Crumb Counts Joint Declaration.³⁴²
- **Research and monitoring.** Twenty European countries formed a multimillion-dollar effort called FUSIONS to more consistently monitor food losses. A subsequent project called REFRESH formed to build on that research and put it into action.³⁴³
- **Waste fees.** In South Korea, several local governments now enforce a pay-by-weight system for household organic waste disposal, providing direct economic incentive to throw less food away. Initial results showed a 25 percent reduction in household food waste.³⁴⁴
- **Food donation laws.** In the late 1990s, two regions in Belgium adopted laws requiring supermarkets to offer their unsold products to a food bank before throwing them away.³⁴⁵ In 2016, France prohibited supermarkets from destroying surplus food, instead mandating that they donate it to charities if requested or direct it to animal feed or composting.³⁴⁶ In August 2016, Italy relaxed regulations to enable food donations by retailers and farmers.³⁴⁷
- **Public Campaigns.** Several awareness campaigns have been launched, including the United Nations Environment Programme's "Think.Eat.Save." campaign, France's "National Pact Against Food Waste" campaign, and the United Kingdom's "Love Food Hate Waste." From 2007 to 2012, in fact, the United Kingdom saw avoidable household food waste decrease by 21 percent.³⁴⁸ Numbers have crept up slightly since then, with an increase in food waste of 2.8 percent per person.³⁴⁹
- **Corporate action.** The Courtauld Commitment 2025 is the fourth such collaboration among 53 of the United Kingdom's leading food retailers and brands to further reduce waste, both in their operations and up and down their supply chains. This commitment aims to cut the resources needed to feed the nation by one-fifth over 10 years.³⁵⁰ It follows three similar efforts, each with shorter term goals.

PROGRAM GROWTH AND ACTIVITY

- Progress has been made toward standardizing food date labels—the first step in addressing confusion surrounding them. First, in early 2016, Walmart became the first retailer to standardize date labels for its store-brand items, going from 47 different phrases to one.³⁵¹ In 2016, the USDA recommended that food manufacturers and retailers use "Best if Used By" as the standard date label phrase.³⁵² In January 2017, the two largest food industry associations announced voluntary guidelines to limit date labels to "Best if Used By" to describe product quality and "Use By" for products, of which there are few, that are highly perishable or may present food safety concern over time.³⁵³
- In 2013, the USDA, in conjunction with the EPA, launched the U.S. Food Waste Challenge, a website that highlights the food waste reduction successes of participating organizations. While the agency's initial goal was 1,000 participants by 2020, it now has more than 4,500 businesses, schools, and organizations in the fold.³⁵⁴
- The Rockefeller Foundation established YieldWise, a \$130 million effort to demonstrate how the world can halve food loss by 2030. While the initial focus is on sub-Saharan Africa, the program also supports innovative and catalytic efforts to prevent food waste in the United States and Europe.³⁵⁵
- From 2011 to 2016, donations to the Feeding America network increased by 71 percent, including higher volumes of produce and donations from the retail sector.³⁵⁶
- Launched at the World Economic Forum in Davos in 2016, Champions 12.3 is a coalition of nearly 40 high-level executives and world leaders committed to inspiring ambition, mobilizing action, and accelerating progress to achieve the United Nations Sustainable Development Goal of halving consumer and retail food waste by 2030.³⁵⁷ Champions include CEOs from Unilever, Nestle, Rabobank, and Tesco as well as ministers from Denmark, Mexico, and South Africa and presidents of NRDC, the Rockefeller Foundation, and Oxfam.
- Research on food waste abounds, as does academic interest. There have been dedicated classes on wasted food at Stanford and MIT. Formed in 2014, the International Food Waste and Losses Study Group brings together academics and others researching the topic.³⁵⁸



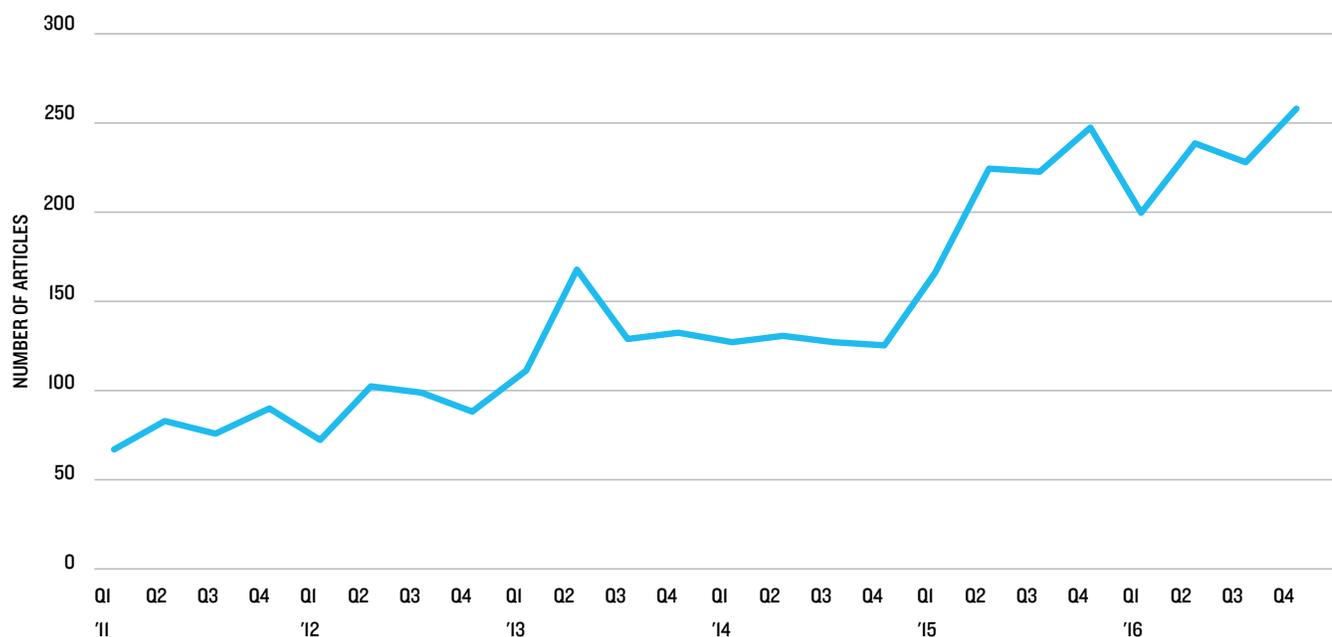
CORPORATE LEADERSHIP

- In 2016, 15 leading companies became U.S. Food Loss and Waste 2030 Champions. Not to be confused with the Champions 12.3 group mentioned above, this separate designation by USDA and EPA recognizes companies that commit to halving their food waste by 2030. They are Ahold USA, Blue Apron, Bon Appetit Management Company, ConAgra, Delhaize America, General Mills, PepsiCo, Weis Markets, Kellogg Company, Campbell Soup Company, Sodexo, Walmart US, Wegmans, Unilever, and YUM! Brands.³⁵⁹
- In 2015, the Consumer Goods Forum committed to halving food waste among its 400 retailer and manufacturer members by 2025.³⁶⁰
- Formed in 2011 by food manufacturers, retailers, and restaurants, the Food Waste Reduction Alliance (FWRA) has continued to establish itself and raise awareness in the industry. Now with nearly 30 participating companies, the FWRA has conducted three biannual studies on food waste generation and disposal as well as food donation. It has also published two best practices tool kits and led its member associations in standardizing date labels, as mentioned above.
- Investors in major food companies are beginning to pay attention to food waste and its impacts on businesses' bottom lines. The Sustainability Accounting Standards Board has identified food waste management as an issue likely to have a material effect on the operating performance of restaurants, food retailers, and distributors. In 2016, Trillium Asset Management, First Affirmative Financial Network, and Green Century Capital Management introduced a shareholder resolution calling on Whole Foods Market to issue a report on company-wide efforts to assess, disclose, reduce, and optimally manage food waste. Twenty-eight percent of Whole Foods Market shareholders voted in support of the resolution.³⁶¹ That same year, Trillium also introduced shareholder resolutions requesting that Costco and Target take similar moves.

TOOLS

- In 2016, the Food Loss & Waste Protocol was published, a global accounting and reporting standard for wasted food.³⁶² This Protocol sets a foundation for measuring and reporting in a way that will make data comparable across the world.
- ReFED (Rethink Food Waste Through Economics and Data) published a report in 2016 that offered the first quantitative cost-benefit analysis of 27 different practices that reduce, recover, or recycle food waste. The report offers a solid foundation for prioritizing action.³⁶³
- The Further with Food website was launched in early 2017 through a public-private partnership to serve as an online hub for the exchange of information about and solutions for reducing food waste.³⁶⁴
- Technological advances for reducing wasted food continue to develop, from fire-sale and food donation apps to new refrigerator concepts that tell consumers what's in their fridge when they're at the supermarket.
- Product design company IDEO hosted an Open IDEO Food Waste Challenge to spur entrepreneurial innovation. More than 450 ideas were submitted, some of which are now being fostered by IDEO's Food Waste Alliance platform.³⁶⁵
- In 2017, NRDC conducted an assessment of the quantities and types of food wasted in three cities: Nashville, Denver, and New York City.³⁶⁶ This assessment, to be released in late 2017, included on-the-ground residential research obtained through kitchen diaries, consumer surveys, and detailed food waste audits. The templates and tools used for this research are available to cities interested in conducting similar assessments. NRDC also estimated the amount of additional food that could potentially be donated to people in need rather than discarded in these three cities. This first-of-its-kind analysis quantified currently untapped opportunities for food donation and the potential reduction in the cities' "meal gap" that could be achieved if best practices for donation were adopted across the grocery, restaurant, and food service sectors.

FIGURE II: NUMBER OF ARTICLES WRITTEN ABOUT FOOD WASTE IN MAJOR NEWS AND BUSINESS OUTLETS BETWEEN 2011 AND 2016³⁶⁷



PUBLIC ENGAGEMENT

- Food waste has seen a steady increase in media coverage, as can be seen in Figure 11. The topic graced the first page of The New York Times business section in 2014, was the focus of a *Last Week Tonight with John Oliver* episode in 2015, and was featured on a *National Geographic* cover in 2016.^{368,369,370} In total, more than 3,300 articles were written in major news and business outlets between 2011 and 2016, reflecting a 205 percent increase of coverage over that period.³⁷¹ Food waste reduction was also included on 17 lists of food trends for 2016 or forecast trends for 2017, including lists featured by *National Geographic*, Today.com, BBC Good Food, *Consumer Reports*, *Forbes*, *Conde Nast Traveler*, the National Restaurant Association annual survey, and Bloomberg.³⁷²
- In 2016, NRDC and the Ad Council launched Save the Food, a national public service campaign encouraging consumers to waste less food. The campaign incorporates TV, radio, print, and digital ads.³⁷³ In its first eight months, more than \$25 million of media space was donated, and survey results demonstrated that those aware of the Save the Food ads were more than twice as likely to say that they sought information about wasting less food, compared to those not aware of the ads.³⁷⁴
- Chefs around the country are embracing the challenge of using oft-wasted ingredients. In one example, more than 30 world leaders were served “landfill salad” and other repurposed items at a United Nations lunch in 2015.³⁷⁵
- The ugly fruit and vegetables movement has taken off, with specialized delivery companies, at least eight U.S. retailers exploring sale of imperfect produce, and a swell of social media activity. (See “Cosmetically Challenged,” page 14, for more)
- Released in 2014, *Just Eat It*, a full-length documentary about wasted food, has won 20 awards, aired on national television, and been translated into a dozen languages.³⁷⁶
- In October 2014, the Zero Food Waste Forum convened food waste leaders for the first conference of its kind. Since then, conferences and events focused on food waste have been held in Philadelphia, Cincinnati, San Diego, and Cambridge, Massachusetts, among other places.
- In 2012, EPA Region 10 and the West Coast Climate Forum jointly developed the Food: Too Good to Waste grassroots campaign and community tool kit, which has been used in more than 14 communities. The resource has seen excellent results, with participating communities reporting 11 to 48 percent reductions in preventable food waste.
- Feeding the 5000, which made its United States debut in Oakland, California, in 2014, has been held in 37 cities around the world, including New York and Washington, D.C. More events are planned for 2017.

Let's Get to Work: Recommendations for a More Efficient Food System

Despite the abundant progress of the past five years, plenty of work remains. We are moving from a period of awareness to one of action. Now is the time to lay the foundation upon which many years of work will build. Comprehensive research and data are still lacking. A concrete implementation plan to achieve the federal targets and bold federal policy are still needed. And businesses must focus on reducing food waste in their own operations and within their sphere of influence with suppliers and consumers. Strategic action on these fronts can propel us toward a more efficient and secure food system.

The ReFED report analyzed a set of 27 specific solutions and found that those solutions could not only cut food waste by 20 percent but generate 15,000 new jobs, double recovered food donations to nonprofits (adding 1.8 billion meals per year), reduce freshwater use by up to 1.5 percent (1.6 trillion gallons annually), and avoid nearly 18 million tons of greenhouse gas emissions per year.³⁷⁹ Ultimately, we need to see shifts in consumer behavior, supply chain operations, market incentives, policy, and public awareness to make these changes possible.

Wasting food wastes everything. We are well poised to make a significant dent in the amount of food wasted, and to do so now. Momentum on the topic is palpable. Let's harness that energy and implement solutions that we know work while also fueling innovation. With increased action and better ways to measure change, we can take on the challenge of wasting less food—and succeed. Here we offer key recommendations for getting there.

FEDERAL GOVERNMENT

In September 2015, the USDA and EPA announced the first-ever national target to reduce food waste across the United States, calling for a 50 percent reduction by 2030. Executive and congressional action will be essential to meeting this goal.

Provide targeted funding for food waste solutions.

Funding is necessary to prove new models, build infrastructure, promote education, and otherwise reduce food waste. The USDA, EPA, and other agencies should use existing grant programs to allocate funds for innovative food waste solutions.³⁸⁰ To enable increased donation of surplus foods, the government should fund improved food rescue capacity through infrastructure (e.g., food storage, transport, and processing facilities) and staffing. There is particular need among food pantries and direct service organizations.

Improve measurement. Current national data on food waste are limited. Filling the gaps will help identify the

most necessary action points and enable us to track progress. This can be done by:

- **Improving current federal data:** Create more robust and actionable baseline data against which progress can be measured. While further research could improve data on all fronts, current federal data on retailers and households are relatively solid. In other areas, however, research is in much need of improvement. For example, there are very little data on farm losses, and current consumer-level estimates inaccurately apply household waste assumptions to restaurant patrons while ignoring waste in restaurant kitchens. The ideal study would take a comprehensive, “farm to fork” approach with the most consistent boundaries and methodologies possible and would explore why loss occurs as well as the type of food lost.
- **Standardizing measurement methodologies and creating aggregation mechanisms:** Build off the Food Loss and Waste Reporting Protocol to establish a standardized methodology to consistently measure food waste. Also, develop a mechanism to aggregate and disseminate that information as it is gathered by individual businesses, institutions, and governments. Over time, this would build a large data pool and allow participants to benchmark themselves against one another. We need one methodology for the private sector and another for local and state governments. For the latter, targeted funding and protocols to support food waste audits could catalyze more participation.
- **Driving measurement and reporting through example and purchasing policies:** Food wasted by government vendors adds cost to government contracts. Federal agencies should mandate food waste reporting in their own food service operations and in major food procurement contracts. This could help reduce food and disposal costs and standardize the practice of reporting throughout the food service industry.

*Wasting food wastes everything.
We are well poised to make a significant
dent in the amount of food wasted,
and to do so now.*

Engage and educate the public. Since the largest portion of food is wasted by consumers in households and restaurants, public engagement is critical. Also, increased consumer awareness spurs policy change and enables businesses to more proactively and creatively



tackle food waste. Furthermore, public engagement can empower individuals to effect change through their spheres of influence as, perhaps, event organizers, health professionals, restaurant workers, or teachers. The federal government could conduct behavior-change campaigns, following the models set by the Save the Food campaign and Food: Too Good to Waste. Also, for long-term behavioral change, we should engage children in school classrooms and cafeterias and through farm-to-school and school gardening programs.

Standardize food date labels. More than 80 percent of consumers at least occasionally discard food prematurely due to date label confusion. Businesses, likewise, wind up discarding perfectly wholesome food. Standardized date labels and subsequent consumer education could quickly reduce the amount of food wasted by both households and businesses. In 2016, the USDA recommended that food manufacturers and retailers use “Best if Used By” as the standard date label phrase.³⁸¹ In January 2017, the two largest food industry associations announced voluntary guidelines to limit date labels to “Best if Used By” to describe product quality and “Use By” for highly perishable products or those that may present food safety concerns over time.³⁸² These are moves in the right direction, but more must be done to truly eliminate the confusion. The FDA and USDA should use their authority to establish the industry guidance as a rule, including a requirement that only consumer-facing dates be visible while sale information for the retailer be coded. Products with quality dates should be allowed to be sold and donated after that date, a circumstance that currently varies by state and municipality. Last, the agencies should conduct or support a consumer education campaign about

date labels. These changes would also be possible through federal legislation rather than agency rulemaking.

Evaluate the impact of federal marketing orders and commercial grading standards on fruit and vegetable waste. While commercial, rather than federal, standards prompt much of the waste of cosmetically imperfect produce, the USDA should evaluate whether its marketing orders and grading standards constrain the sale or donation of wholesome but cosmetically imperfect product. The department also should evaluate the impact of commercial standards on fruit and vegetable losses throughout the supply chain and facilitate changes.

Remove barriers to food donation through the following actions:

- **Update the Bill Emerson Good Samaritan Act** to explicitly provide liability protection for donated food that is mislabeled in ways that are irrelevant to food safety and food that is past its quality date. Liability protection should also cover donors who give food directly to individuals and nonprofit organizations that sell at a discounted price. Furthermore, a federal agency should be designated as the authority over the Good Samaritan Act and should draft guidance clarifying key provisions and terminology.³⁸³
- **Further incentivize food donation** through the addition of tax credits (as an optional alternative to tax deductions) for farmers, tax incentives for transporting donated food, deductions for donations to nontraditional food recovery organizations, and deductions for food with labeling errors that are unrelated to safety.

- **Update the Federal Food Donation Act of 2008** by requiring qualifying federal contracts to offer excess food for donation and report on amounts donated.
- **Finalize the Updated Federal Food Safety Guidelines for Food Recovery** approved in April 2016 by the Conference for Food Protection, and incorporate them into the FDA Food Code.

Encourage local and regional efforts to divert food scraps to organics recycling. Directing food scraps to composting, anaerobic digestion, and other organics recycling options produces a number of environmental and economic benefits. To this end, the EPA should develop model legislation and policies for municipalities, as well as technical assistance and funding (e.g., federal grant and loan programs) for organics recycling infrastructure. We should also improve the market for compost products with a national soils policy or strategy that incentivizes practices such as adding compost to soils.

Create a national goal implementation task force. Designate a small set of diverse stakeholders to advance the national goal to cut food waste by 50 percent by 2030. The task force could provide strategic direction for national efforts, monitor progress, support effective public reporting against the goals and benchmarks, raise visibility of the goals, and recommend improvements.

Incorporate food waste in agricultural and food assistance policies. Many of the above food waste reduction strategies could be directed or incentivized as part of the next Farm Bill. Specifically, funding should be expanded for pilots, innovation, and improved infrastructure. Critical research to better understand issues and develop solutions should be directed. Value-add processing capacity should be expanded. And a specific effort to educate consumers and children alike should be pursued.

STATE AND LOCAL GOVERNMENT

Enact partial or full organics disposal bans, with reduced generation and/or recovery goals.

Prohibiting food from going to landfills or incinerators is proving an effective mechanism to ensure that food scraps are recycled (via composting or anaerobic digestion, for instance). This can be done as a full or partial ban or as a diversion goal. These laws would be most effective in addressing food waste if they also include goals related to reducing generation of food waste, such as Oregon’s stated goal to reduce the generation of wasted food by 15 percent by 2025 and 40 percent by 2050.³⁸⁴ They are also effective when they incorporate recovery of food, as was done in California, where 20 percent of edible food that is currently discarded will be recovered for human consumption by 2025.³⁸⁵ See Figure 10 for state laws of this kind.

Adopt national goals. Whether independently or through the U.S. Conference of Mayors resolutions, states

and cities can commit to the national goal of reducing food waste by 50 percent by 2030. This amplifies the effect of the national goal while signaling to local businesses and residents that the issue is a priority locally.

Establish baseline level of food waste. In order to best prioritize programs and policies, it’s helpful to understand the source of most food waste, how much is edible, and how much could be rerouted to people in need. In late-2017, NRDC will publish a methodology for estimating these baseline levels.

Engage local businesses and community. Businesses, community organizations, and residents are key to reducing food waste. Governments should engage residents through education and public service campaigns, and businesses through recognition programs, technical assistance, and grant programs.

Incentivize produce donations from farms. Each year on farms, many tons of fruits and vegetables go unsold for lack of a market. To encourage this product to be donated, farmers need financial incentives to address the associated costs of harvesting, washing, sorting, storage, packaging, and transportation. Tax credits provide a larger and more effective incentive than deductions, especially among farmers who often don’t have large profits to report. Several states have tax incentives that partially cover product value, as shown in Figure 7. Beyond the current incentives even in those states, we also need expanded funding to cover some of the additional harvest and food handling costs, known as “pick and pack out” costs, incurred by donating farms.

Improve capacity and reduce barriers for food donation. To expand and improve food donation, cities and states should expand infrastructure and staffing capacity for food recovery organizations. They should also examine health and safety regulations surrounding food donation to minimize barriers. Food donation can enable jurisdictions to respond to hunger in their communities while meeting their diversion and other environmental goals and should be woven into waste management plans.

Encourage organics recycling. Develop local and regional composting strategies and infrastructure to support home and community composting, on-site organics recycling at businesses and farms, and expansion of commercial organics recycling. Consider revising regulations for composting infrastructure to streamline the process for obtaining a permit, including the permitting of food scraps to be processed at existing facilities that currently compost only yard trimmings. Amend purchasing policies and requirements to increase local and regional use of compost products (e.g., in new construction). State and local governments can also institute minimum recycling goals, weight-based surcharges on disposal facilities, and economic incentive policies like grants or loans to help expand or establish composting facilities.

A 2017 study found that half of the 1,200 business sites analyzed saw more than a 14-fold financial return on investment in food waste reduction efforts.

BUSINESS

There is good reason for businesses to take aim at the food they are wasting. Though sometimes difficult to measure and therefore to “see,” analyses of businesses that do take action to reduce their food waste demonstrate that it’s worth their while. A 2017 study found that half of the 1,200 business sites analyzed saw more than a 14-fold financial return on investment in food waste reduction efforts. Restaurants tended to have the highest returns, and hotels, food service companies, and food retailers tended to have returns of \$5 to \$10 for every \$1 spent.³⁸⁶

BROAD CHANGES

Conduct regular food waste audits. As the saying goes, what gets measured gets managed. With an eye toward reducing excess food, businesses of all sizes can streamline their operations by auditing their food losses and setting reduction targets. This will establish a baseline against which to evaluate goals and will highlight cost-cutting opportunities. While periodic audits are helpful, daily or weekly measurement ensures that vigilance to reduce waste becomes standard practice. Engaging staff through contests or recognition can create a team effort around food waste reduction.

Set short-term targets. The Consumer Goods Forum set a food waste reduction target of 50 percent by 2025. Fifteen U.S. companies—including Sodexo USA, ConAgra, General Mills, and Ahold USA—have already committed to the national goal of 50 percent reduction by 2030. More companies should join them as part of the U.S. Food Loss and Waste 2030 Champions commitment. Additionally, short-term targets can motivate more specific actions. Companies should set achievable three- and five-year targets, even if they are modest and even if they’re not public. Alternatively, companies could commit to joint short-term targets, like the Courtauld Commitment in the United Kingdom, which enabled the food industry to reduce product and packaging waste by 1.6 million tons from 2009 to 2015.³⁸⁷

Publicly report waste numbers. Just as companies now measure and report their carbon footprint, publicly reporting food waste will help them benchmark and learn from one another while facilitating public dialogue. Implementing the new Food Loss and Waste Protocol could also improve consistency and benchmarking. The FWRA and the British Retail Consortium (BRC) have both published useful joint industry reports, but individual reporting would expand transparency. For instance, Tesco began publicly reporting its food waste by category in 2014 and has continued to do so despite a rise in quantity in 2016.

Focus on reducing meat and dairy waste. Not all wasted food is equal, and meat and dairy have more financial and resource implications than most. If starting with particular categories helps prioritize, choose these two.

Standardize food date labels. Now that the food industry has established guidelines for standardized food date labels, food producers, manufacturers, and retailers should be sure the date labels on their products comply with this guidance.

Adopt best practices and create new ones. The FWRA has put forward two sets of best practice descriptions, including standard operating procedures and methods to overcome barriers to food donations.³⁸⁸ The National Restaurant Association gives guidance on food waste audits, inventory tracking, and other best practices as part of its Conserve program.³⁸⁹ New case studies are emerging regularly as companies try new solutions. Many of these practices save money while also earning goodwill and advancing companies’ greenhouse gas and water footprint goals. In addition, in this time of innovation, there’s opportunity for businesses to try new measures to shift procurement, preparation, service, and merchandising practices. Those that work can help expand the knowledge and practice base of solutions.

Invest in innovative technological solutions. Food and financing companies must foster an atmosphere that supports the piloting, improvement, and large-scale adoption of new food-saving technologies. We already have apps that tell consumers how long products have been in their refrigerator, plan appropriate portions, and create shopping lists. Restaurant kitchens can use waste-tracking software, and some food packages have smart labels with gas- or temperature-sensitive indicators. Solutions are constantly in development to extend product life, reduce shrinkage (losses) during transport, and monitor product freshness. However, this level of innovation needs capital and technical resources to succeed at scale.

SPECIFIC SUPPLY-CHAIN STAGE CHANGES

At Production

Broaden cosmetic standards for fresh fruits and vegetables. Relaxed product specifications related to appearance and product lines featuring cosmetically imperfect produce could potentially reduce on-farm losses while expanding the variety of products on the market.

Expand alternative outlets and secondary markets for lower-grade foods. Some brokers, distributors, and wholesalers already sell lower-grade products. However, further growth and innovation is warranted, from new food products to channels for connecting these foods with underserved populations. A growing cadre of innovative companies is demonstrating the business potential of traditionally undervalued surplus and imperfect fruits and vegetables. Supportive federal policy, technical assistance, and flexible financing can help grow this sector.

Practice farm-level food recovery. Food recovery organizations are eager to receive more fresh produce donations, and gleaning organizations can help harvest unsold crops. Increased funding to help cover farmers' extra harvesting and handling costs and improved capacity to transport donated produce from farms can encourage additional donations. Expanded communication with farmers about the availability of federal tax incentives is also important.

Expand food rescue and recovery infrastructure. A major growth area for the food rescue and recovery community is expanding donations of fresh fruits and vegetables for food-insecure people. Additional resources are needed to fund the associated transportation, storage, processing, distribution, and training costs. Since surplus fresh produce tends to be available in large volumes during narrow time frames during harvest season, expanded capacity to extend the shelf life of donated produce (e.g., through canning or freezing) is essential. Businesses, which benefit from significant tax breaks for donated food, can play a key role in financing such investments. Because they are smaller and tend to have less refrigeration capacity, food pantries face particularly high barriers to handling fresh produce.³⁹⁰

Package produce by the pound. The way fruits and vegetables are sold can also drive produce losses. When produce is packed by numbers of units (e.g., 10 per case), uniform sizes and shapes are favored. Packing by the pound, on the other hand, would require greater flexibility on the part of food service and retail buyers but would likely reduce waste of smaller, larger, or oddly shaped items.

Promote regional or local food distribution. Shorter transport times and distances can reduce losses during distribution. Regionalized markets can also provide a home for produce varieties with shorter shelf lives. Personal relationships, which are often developed as part of local or regional food networks, can help nonstandard product find a market. For instance, a farmer with hail-damaged tomatoes could call a restaurateur to ask if he would still buy them—something that does not occur in more industrial relationships.

Reduce Bycatch and Utilize Lesser Known Species. Highly targeted gear and real-time information sharing that updates fishery limits can help address losses due to bycatch. However, these procedures can be expensive and complex. Another part of the solution is establishing markets for lesser known species that at times make up that bycatch, such as dogfish, monkfish, and skates.

At Processing and Manufacturing

Focus on reengineering. Redesigning products, reengineering equipment and manufacturing processes, and developing new food utilization technologies could improve efficiency in processing. Manufacturers can also develop a streamlined, sanitary way to separate items that are consistently unused and instead sent for donation.

Develop secondary uses for trimmings, peels, and other by-products. Trimmings and peels should be considered for their nutritional value and their potential to be used for other food products whenever possible, such as in soups and smoothies. Similarly, other edible by-products can be developed into ingredients, such as flours.

Optimize product size. Attractively priced large packages often tempt consumers into overbuying. Manufacturers can help consumers avoid waste by offering smaller or customizable amounts. Allowing for smaller portions, by such means as resealable packaging or individual packaging, can reduce food waste at home. However, the trade-offs of additional packaging, such as increased plastic waste, should also be considered.

At Retail: In-Store

Streamline inventory. Stocking fewer items leads each type of item to sell more quickly, reducing both shrinkage and inventory costs. Analyzing item performance can help identify opportunities to eliminate items as well as improve forecasting and inventory management, significantly cutting costs.

Discount older products. Discounting items near the end of their shelf life generates revenue, eliminates need for donation or disposal, and gives customers a bargain.

Redesign product displays. Platforms and other props can make produce bins appear fuller without utilizing as much product and encourages less handling.

Allow prepared foods to run out close to closing. Use signage to explain to consumers that these practices help curtail waste.

Donate more. Retailers should work with local agencies to address the logistical challenges related to food donations. These donations contribute to the community and provide substantial tax deductions. Retailers who donate only nonperishables and bakery items should consider donating meat, dairy, and produce.

At Retail: Beyond the Store

Examine contract terms and aesthetic grading standards. Allowing for occasional flexibility in delivered volumes could significantly reduce the pressure on growers to overplant. Easing cosmetic standards could translate to fewer fruits and vegetables left in the field or culled. In 2008, a U.K. commission investigated grocery supply chains and developed a detailed framework for supplier contracts that addresses aspects of shared risk across the supply chain.³⁹¹ Purchase agreements that share risk with growers—such as purchasing a percentage of the crop rather than a volume of a certain grade product—could lead to much higher utilization of what’s grown.

Adjust promotions. Specials that encourage overbuying, thus passing waste off to the consumer, should be reconsidered. U.K. grocers have been experimenting with alternative promotion schemes that could serve as models for U.S. retailers. For instance, the biggest grocery chains are moving away from “buy one, get one free” and multi-buy promotions on perishable items with the goal of reducing waste among consumers.³⁹²

Educate consumers. The retail environment is an ideal setting in which to educate consumers on food preparation, storage, expiration dates, and safe food handling. Providing more education to customers also improves their shopping experience and loyalty to the retail brand. U.K. grocers ramped up consumer education efforts through information on produce bags, in-store television displays, and online contests.

Optimize package size. Retailers can also help consumers avoid waste by enabling the purchase of smaller or customizable amounts—whether in the form of unpackaged produce, a staffed deli (or similar) counter, or a bulk aisle.

In Restaurants and Other Food Service Contexts

Adapt menus. Reducing menu choices, using specials to flush inventory, repurposing food, and avoiding or redesigning buffets are all best practices for menu planning.

Provide flexible portions. Restaurants can address waste at the table by offering half orders or other flexible portion options, reducing serving sizes (while potentially offering optional refills), requiring customers to opt in for chips and bread baskets, or allowing customers to choose their side dishes.

Use smaller batches and pans. Cooking to order or preparing smaller batches produces less waste. Scaling back production at the end of the day and using smaller serving containers in salad bars or buffets can also reduce the amount of uneaten food.

Encourage guests to take food home. Restaurants should urge diners to take leftovers with them, with as little packaging as possible, made of reusable or recyclable/compostable materials.

Learn about donation benefits. Food donors are protected from liability and receive enhanced tax deductions. Understanding these benefits can encourage donations, which also tends to boost morale among employees who don’t like throwing good food away.

Audit waste and engage staff. Waste audits have been shown to inspire both staff and management to identify opportunities to alter menu items, food preparation habits, purchasing practices, and cooking quantities. While occasional audits can be helpful, integrating daily auditing into standard kitchen practice means that attention to waste will be a continued part of the operation. Involving staff through contests or recognition programs can also be an effective way to reduce wasted food.

Offer low-waste catering. Most catering operations build in significant buffers to ensure that food won’t run out, leading to high levels of waste. Caterers should reexamine their buffers and narrow them if possible. In addition, they should offer clients a lower-waste option, acknowledging the risk that some items may run out.

Minimize food waste in K–12 schools. A wide range of strategies can reduce food waste in schools. These include cutting whole fruit into smaller pieces, providing salad bars, allowing students to choose side dishes, having longer lunch periods (so students can finish their food), and scheduling lunch after recess to prompt better appetites. Also, schools are increasingly using “share tables” that allow children to share untouched food they don’t intend to eat. We can also teach children to value their food more and waste less through home economics or cooking classes, classroom curriculum, educational materials in cafeterias, farm-to-school programs, school gardens, and composting programs.

CONSUMERS

As the largest collective source of wasted food, consumers can make a big difference in their own kitchens and by educating friends, family, colleagues, and others. Some tips are provided below; more information can be found at www.savethefood.com and in the *Waste-Free Kitchen Handbook*.³⁹³

Shop wisely. Consumers can reduce their food waste potential by planning meals, using shopping lists, and buying customized portions of loose produce and bulk bin items. Consumers should also avoid impulse purchases or marketing tricks that encourage overbuying. Though large-volume purchases and promotions may be cheaper per ounce, it may actually be more expensive in the long run if the full purchase is not eaten. A 2015 study from the University of Arizona concluded that Americans pay close attention to sale prices, but not the money squandered through wasted food.³⁹⁴

Understand date labels. Sell-by, use-by, and best-by dates are manufacturer suggestions for peak freshness or quality and are not indicative of safety. Aside from



infant formula, date labels are not federally regulated. Most foods can be safely consumed after these dates have passed. Consumers should be educated about these labels and how to rely more on their own judgment about food quality.

Buy and serve smaller portions, and save leftovers.

Resources such as online portion calculators can help consumers prepare appropriate amounts of food. Uneaten meals can be saved as leftovers in the refrigerator or freezer. Consumers can also ask for smaller or half portions at restaurants and supermarkets, and take leftovers home from restaurants and eat them later.

Use your freezer.

Food lasts much longer when frozen. Almost anything can be frozen, including milk, cheese, and eggs. Buying frozen produce can help ensure you'll always have vegetables on hand. Frozen foods often have as much nutrition as fresh products. In fact, sometimes they have even more because they are frozen within just hours of being harvested.³⁹⁵

Declutter. It's hard to use food when you can't see it. Keeping shelves tidy, storing food in clear containers, and placing newly purchased food to the rear of the shelf in order to push older items to the front will reduce waste. These rules apply to the refrigerator, freezer, and even the cupboard.

Keep it local. Whether it's growing your own, buying from a farm stand or farmer's market, or joining a community-supported agriculture program, connecting with the creation of your food makes you more likely to value it because you know just how much went into getting it to your fridge.

Share food. Sharing with friends and family not only avoids waste but builds community. This might mean sharing excess entrées, splitting a farm box, or even donating a glut of garden-grown produce.

Support stores and restaurants that avoid waste.

Patronize stores and restaurants that make an effort to reduce their waste by embracing practices like flexible portions and allowing items to run out at the end of the day.

Buy imperfect products. Just like retailers, consumers can reduce farm-level losses by purchasing fruits and vegetables with varying sizes, shapes, or colors. Encourage stores to sell imperfect produce, oddly shaped baked goods, items with damaged packaging, and so on.

Send food scraps to backyard chickens and compost.

For inedible parts and other food scraps, backyard chickens make excellent food recyclers. For those who are not ready for additional animals, recycle your inedible food by composting through a community compost program or using a home compost bin.

Fight wasted food everywhere! Convert friends and family through words and deeds. Get involved with food recovery organizations and community events, and donate garden surpluses. Encourage retailers and restaurants to avoid excessive portion and package sizes and to donate foods they can't sell. And, to curb the problem for future generations, teach kids to value their food and not to waste it.

Appendix A: Studies and Data on Food Waste

Data on how much food is thrown away across the United States is notoriously rough and scant. One of the key conclusions of anyone who spends time investigating the topic is that we need better information if we're to understand what food is going to waste and why, as well as which solutions work best. Better data would also give us a way to more fully document progress.

This paper attempts to provide the best information possible given current limitations. In many cases the numbers for food wasted at a national level and within particular segments of the food supply chain are estimates or extrapolations from narrow data. Because different methods have been used, leading to different results, we have chosen to present the range of estimates where more than one study exists, and often include more detail in the endnotes.

NRDC's 2012 estimate that 40 percent of the U.S. food supply goes uneaten each year was based on extrapolations from data from the National Institutes of Health (NIH).³⁹⁶ A preliminary update of NIH data now result in a 37 percent estimate. However, NRDC still believes that the statement "America wastes up to 40 percent of the food supply" accurately reflects available research. This is because the scope of each study discussed below leaves out portions of the supply chain, as can be seen in Table A1. If estimates from the one study that considers the whole supply chain (ReFED) were applied proportionately to the parts of the supply chain left out by other studies, the resulting estimates would amount to 39 percent (USDA) and 43 percent (NIH) of total U.S. food supply. Given the inexact nature of all these numbers and the lack of specific data to document actual reductions at the national level, we continue to feel that 40 percent is a reasonable estimate of how much food goes uneaten across the U.S. food system.

CURRENT STUDIES

When it comes to the overall amount of food going to waste across the country, at the time this report went to print there were five main studies that quantified food waste. They have different scopes, methods, and results, which we describe in this Appendix in an attempt to illustrate why the total numbers, as well as numbers throughout the report, vary:

- **U.S. Department of Agriculture:** The USDA has the most extensive and detailed analysis of retail and consumer losses, including information by product category. However, this data set uses a "consumer" category that includes losses both in and out of home. That is, it merges food service and household losses, using the same aggregated estimates for

fine restaurants, hospital cafeterias, and household kitchens.³⁹⁷ On the food service side, it includes only post-consumer losses (what customers purchase but don't eat), and not what might go to waste in the kitchen. The USDA study also does not capture losses on farms or in processing or distribution.

- **U.S. Environmental Protection Agency:** The EPA provides information only on food scraps actually entering landfills or incineration or going to commercial composting. This excludes many of the other destinations of food waste, such as kitchen drains or animal feed.³⁹⁸
- **National Institutes of Health (NIH):** This estimate balances calories in the food supply with NIH estimates of calories consumed corresponding to adult weight changes observed in a nationally representative sample of the U.S. population in the National Health and Nutrition Examination Survey (NHANES). The original 2009 publication estimated 40 percent of all the calories in the U.S. food supply were not eaten, using data sets from 2003. A preliminary update of this calculation with 2010 data shows an estimated 37 percent of the U.S. food supply is not eaten. Given the preliminary nature of this updated analysis, we do not believe it is yet appropriate to claim an actual reduction in waste over the 2003–2010 period. However, we have used these revised figures to estimate approximate number of pounds going to waste in Figure A1.³⁹⁹
- **ReFED:** The ReFED study extrapolates waste estimates from a variety of sources to generate an estimate for each stage of the entire supply chain.⁴⁰⁰
- **U.N. Food and Agriculture Organization:** The FAO also extrapolates from a variety of sources. However, it combines North America with Oceania (Australia, New Zealand) and develops totals for those countries together. Therefore, it is difficult to compare their total volume estimate with estimates for just the United States. The FAO's rate estimates, however, are useful to fill in gaps where U.S.-specific research has not been conducted.⁴⁰¹

Table A1, originally developed by Further with Food, summarizes the varying factors for each study. These factors include whether inedible parts, such as bones, rinds, and pits, are counted; which destinations, such as animal feed and composting, are included; and which primary data sets and methods are used. In an effort to illustrate a comparison, the table also includes estimates of total U.S. food waste in pounds. Where the study did not provide information this way, an estimate was calculated.⁴⁰²

FIGURE A1: CURRENT STUDIES OF FOOD WASTE IN THE U.S.

ORGANIZATION	ESTIMATE	INCLUDES INEDIBLE PARTS?	FOOD SYSTEM STAGES INCLUDED	DESTINATIONS INCLUDED	METHOD
U.S. Department of Agriculture (USDA) ⁴⁰³	66.5 million tons (133 billion lbs.) for 2010	No (except for some commodities at retail level, such as the inedible parts of discarded whole fresh apples)	<ul style="list-style-type: none"> • Retail • Restaurant/ food service (consumer waste only) • Household 	<ul style="list-style-type: none"> • Animal feed • Biomaterial/processing • Co/anaerobic digestion • Compost/aerobic • Controlled combustion • Land application • Landfill • Sewer/wastewater treatment Some donations are also included (USDA recognizes that donations should not be included as FLW; however, some may be embedded in the data and cannot be isolated)	Estimate is based on nationally representative surveys of retail inventories or shipments and household purchases and stated consumption. Loss estimates are derived with household information but applied to both “in- and out-of-home purchases,” thus including restaurant and food service waste as well, but only for “front of house” (not in kitchen). ⁴⁰⁴
U.S. Environmental Protection Agency (EPA) ⁴⁰⁵	36.46 million tons (73 billion lbs.) for 2014	Yes	Those served by municipal solid waste service, which includes: <ul style="list-style-type: none"> • Retail • Restaurant • Food service • Household 	<ul style="list-style-type: none"> • Compost/aerobic (commercial) • Controlled combustion • Landfill 	Estimate equals municipal solid food waste generation minus composting. Estimates of food waste generation are based on existing studies of the rate of generation applied to updated U.S. Census estimates of number of businesses and households. Composting estimates are based on publicly available state data. ⁴⁰⁶
National Institutes of Health ⁴⁰⁷	37 percent for 2010 (updated from 40 percent for 2003); approx. 80 million tons (160 billion lbs.) in 2010, using USDA’s food supply and consumption pattern assumptions)	No	<ul style="list-style-type: none"> • Distribution/ handling • Manufacturing • Retail • Restaurant • Food service • Household 	<ul style="list-style-type: none"> • Animal feed • Biomaterial/processing • Co/anaerobic digestion • Compost/aerobic • Controlled combustion • Land application • Landfill • Sewer/wastewater treatment 	Estimate is derived by taking the percentage difference between the amount of calories in the U.S. food supply (derived from FAO Food Balance Sheets) and the amount of calories consumed by end consumers (estimated from the weight of the U.S. population). ⁴⁰⁸
ReFED ⁴⁰⁹	62.5 million tons (125 billion lbs.) for 2015	Yes	<ul style="list-style-type: none"> • Farm • Distribution/ handling • Manufacturing • Retail • Restaurant • Food service • Household 	<ul style="list-style-type: none"> • Animal feed* • Co/anaerobic digestion* • Compost/aerobic* • Controlled combustion • Land application* • Landfill • Sewer (nonresidential)/ wastewater treatment* *Destinations are only partially accounted for.	Methodology applies estimates of commercial and residential FLW (from the best publicly available studies as of 2015) to 2015 U.S. Census data on manufacturing, retail, food service, and households to produce national estimates. On-farm estimates are based on extrapolation from numerous agricultural case studies. ⁴¹⁰
Food and Agriculture Organization (FAO) ⁴¹¹	616-660 lbs/year/capita (191 to 204 billion lbs.) using 2010 population	No	<ul style="list-style-type: none"> • Production • Post-harvest handling and storage • Processing • Distribution • Consumption 	<ul style="list-style-type: none"> • Animal feed • Co/anaerobic digestion • Compost/aerobic • Controlled combustion • Land application • Landfill • Sewer/wastewater treatment *These destinations inferred as the study does not explicitly indicate destinations.	Methodology models mass flow of food at each stage of food supply chain from production to consumption. Conversion factors were applied to determine edible mass. Estimates were aggregated for all of North America and Oceania using variety of literature sources. ⁴¹²

Appendix B: The EPA Food Recovery Hierarchy

All waste is not equal, nor is the way we handle our surplus food. The U.S. Environmental Protection Agency has established the Food Recovery Hierarchy to help guide priorities for managing excess food.⁴¹³ It essentially applies the “reduce, reuse, recycle” approach used in materials recycling, with a bit more robustness and detail. Prioritizing action at the top of the Food Recovery Hierarchy is essential because food waste prevention efforts have much greater environmental benefits than do strategies lower on the Hierarchy.

Prevention: The most effective actions for addressing food waste are source reduction (or prevention) strategies. Preventing food from becoming waste in the first place typically offers the greatest financial benefit by reducing the cost of purchasing, handling, and ultimately disposing of food that isn’t utilized. It also helps avoid the use of water, agricultural chemicals, energy, and other resources used to produce, process, transport, package, and dispose of that food.

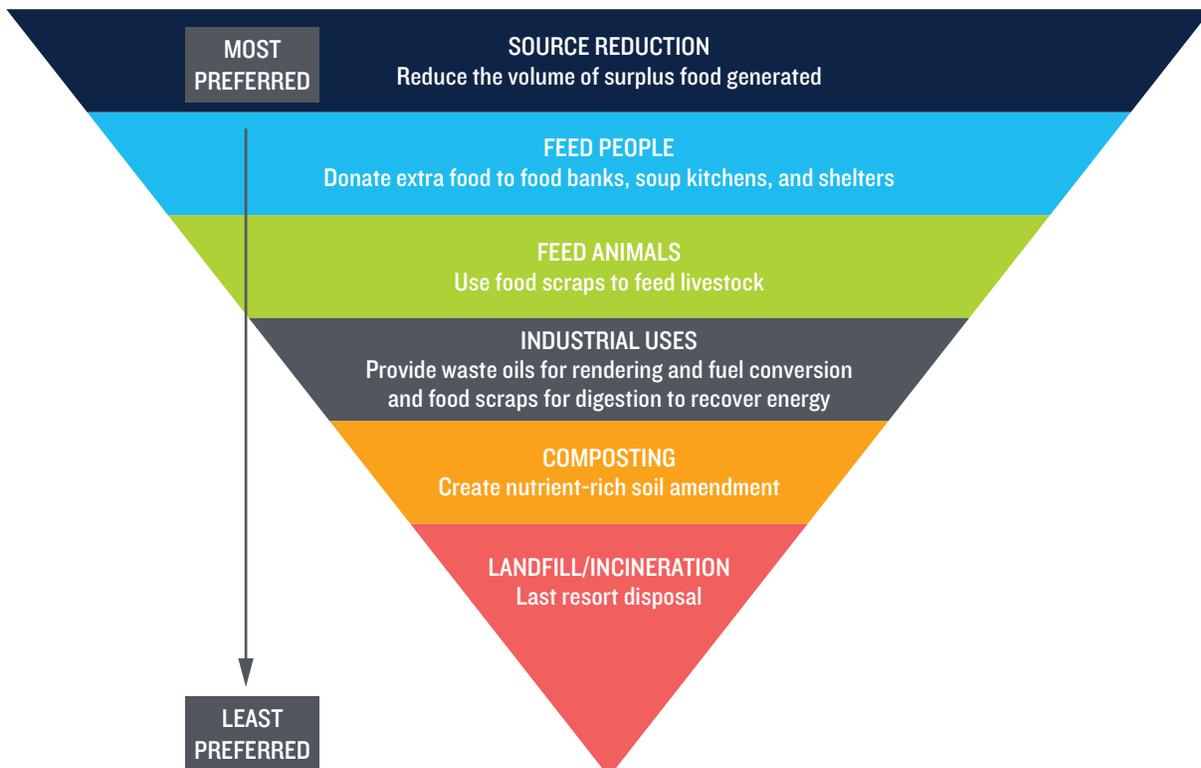
Feeding hungry people: The second-most effective action is donating surplus food to organizations that serve food-insecure populations. Food donation can benefit local communities and generate considerable goodwill, and it is often highly motivating for participating employees.

Feeding animals: When food donation isn’t feasible (such as with post-consumer plate waste and vegetable trimmings), the next-best use for uneaten food is providing it to area farms for animal feed, most commonly for hog operations. This offsets the need to grow other food to feed those animals.

Recycling: The next-best alternatives are recycling strategies such as rendering for animal products, composting, or anaerobic digestion. Composting can be used not only to dispose of food but also to return nutrients to the soil and improve soil’s capacity to retain water. Anaerobic digestion is a recycling technology in which organic waste (such as food or yard waste) decomposes in a closed vessel without oxygen, generating both energy and material that can be composted and returned to the soil. (See Appendix C for a more detailed explanation of anaerobic digestion.) While these strategies don’t offer the cost savings and environmental benefits of food waste prevention or the social and reputational benefits of food donation, they are still useful for deriving value and nutrients from food scraps.

Landfill and incineration: Disposal through landfill and incineration are the least preferred options from environmental and social perspectives because they destroy useful organic matter and nutrients, which could otherwise be repurposed into new products, and result in increased greenhouse gas emissions and pollution.

FIGURE BI: EPA'S FOOD RECOVERY HIERARCHY



Appendix C: Principles for Best Practices in Anaerobic Digestion

Anaerobic digestion (AD) can be an effective approach to extracting energy from food waste before disposing of it.⁴¹⁴ However, it also has potential pitfalls. The following are best practices to ensure the operations are most effective and avoid any additional detriment.

Follow the EPA Food Recovery Hierarchy pyramid (See Appendix B) to prioritize waste reduction and prevention. Before implementing AD, ensure that reduction and prevention initiatives are in place to reduce the amount of organic waste produced. Choose options to divert to animal feed where feasible.

Direct waste materials to their highest and best ecological use. AD may not always be the best technology for processing a particular waste stream, given the potential ecological and economic value of the specific materials. The choice of AD versus composting or other options should take into account whether nutrients will be preserved or lost (for instance, if digestate is landfilled after energy extraction, then nutrients are lost), and how to maximize their utility in feeding soils.

Feed the soil. A significant quantity of material entering a digester remains as liquids and solids at the end of the process, and this digestate should be converted into usable form. Nutrients should be processed through composting or nutrient extraction technologies to enable their incorporation into soil wherever possible. The potential benefits to soil from responsible organic waste management include not only nutrient recycling, but benefits such as increased ability to retain water and nutrients through the addition of fiber/compost. On the other hand, irresponsible management can lead to nutrient burdens or water pollution at or downstream of the digester facility.

Make AD part of a larger system of organics management. Processes and technologies for particular digesters should be selected to correspond to the types of feedstock (inputs) and projected outputs. For example, yard waste does not break down completely in a digester; while some types of dry AD benefit from the addition of landscaping waste as a bulking agent, that type of lignin-rich waste will not fully decompose in the digestion process, and will need to be “finished” after the AD process by composting or another method of curing. Wet AD generally cannot process woody waste (or paper, or compostable serviceware) and is best suited for separated food waste. Consequently, composting will nearly always need to be included as part of a responsible organics system.

Select processes and technologies to correspond to the quantities of feedstock. Prioritizing prevention and reduction means ensuring that proposed AD systems are not scaled too large, which can disincentivize reduction efforts. Ensure that the AD can handle loads of varying sizes (or intermittent use) and that any reduction in input does not necessarily mean needing to seek other feedstocks to meet capacity. Scope projected types and quantities of feedstocks out several years to ensure right-sizing of the operation.

Reduce contamination. Ensure source-separated feedstock whenever feasible so as to maximize use of digestible components and reduce reliance on separation technologies and processes. Lower contamination will also help ensure technologies are operating at higher efficiency.

Don't pollute. Make sure the AD employs the best available controls and procedures to prevent emissions to air and water. Particular concerns include nitrogen to groundwater and methane leakage.

ENDNOTES

- 1 Kevin D. Hall, et al., "The Progressive Increase of Food Waste in America and Its Environmental Impact," National Institute of Diabetes and Digestive and Kidney Disease, *PLoS ONE* (2009) 4(11):e7940. The author confirmed his estimate in communication in 2015. A comparison of this estimate with others is covered in Appendix A of this report.
- 2 Jean C. Buzby, Hodan F. Wells, and Jeffrey Hyman, *The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States*, United States Department of Agriculture (USDA) Economic Research Service Economic Information Bulletin No. EIB-121 (February 2014) www.ers.usda.gov/webdocs/publications/eib121/43680_eib121.pdf. This estimate does include retail and foodservice losses, but does not include food lost on farms. In the ReFED report, it's estimated that 10 million tons of food is lost on farms, which would equate to approximately an additional 60 pounds per capita per year.
- 3 Rethink Food Waste through Economics and Data (ReFED), *A Roadmap to Reduce US Food Waste by 20 Percent*, (2016) www.refed.com. The USDA estimates a total of \$161.6 billion, but includes only retail, food service, and consumer steps in the supply chain. ReFED estimates a cost of \$450 per person. ReFED estimates are used rather than the USDA of \$390 per person because USDA estimates include "out of home" purchases in restaurants, etc.
- 4 Alisha Coleman-Jensen, et al., *Household Food Security in the United States in 2015*, USDA Economic Service. Economic Research Report No. ERR-215 (September 2016). This source states that just over 42 million individuals are food insecure. It would take 27 percent of total losses and waste (in 2010) to provide 2500 kcal/day to that many people, which would equate to a total diet. This figure is meant to illustrate scale and ignores nutritional value and distribution challenges, both of which are significant.
- 5 Jenny Gustavsson, et al., *Global Food Losses and Food Waste*, United Nations Food and Agriculture Organization (UN FAO), (2011) www.fao.org/food-loss-and-food-waste/en/.
- 6 Roni A. Neff, Marie L. Spiker, Patricia L. Truant, "Wasted Food: US Consumers' Reported Awareness, Attitudes, and Behaviors", *PLoS ONE* (June 10, 2015) doi.org/10.1371/journal.pone.0127881. This survey of 1,010 Americans included respondents from a representative range of demographics, income, and educational levels. Those factors did not lead to any major differences in opinion or behavior about wasted food.
- 7 Patrick Canning, et al., *Energy Use in the U.S. Food System*, USDA Economic Research Service, ERR-94. (March 2010) www.ers.usda.gov/publications/err-economic-research-report/err94.aspx.
- 8 Cynthia Nickerson, et al., *Major Uses of Land in the United States*, USDA Economic Research Service, EIB-89 (2007) www.ers.usda.gov/publications/eib-economic-information-bulletin/eib89.aspx. Together, cropland and pasture/rangeland occupy 45 percent of U.S. Land Area.
- 9 Molly A. Maupin, et al., *Estimated use of water in the United States in 2010*, U.S. Geological Survey Circular 1405 (2014) www.pubs.usgs.gov/circ/1405/pdf/circ1405.pdf. Note that this estimate is for water withdrawals, whereas our previous report used estimates for water consumption. The difference is that withdrawals don't account for the fact that some water is returned. For instance, some power plants return about 95 percent of their water withdrawals. However, as withdrawal data is more current than consumption data, we choose to use these newer estimates, which amount to 67 percent.
- 10 ReFED, *A Roadmap to Reduce US Food Waste by 20 Percent*, (2016), www.refed.com. ReFED estimates are 21% agricultural water use, 19 percent cropland, and 18% fertilizer use. These numbers apply ReFED's total estimate of food waste to water, fertilizer, and land calculations in M. Kummu et al., "Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use," *Science of the Total Environment*, 438 (November 2012) P.477-489 doi.org/10.1016/j.scitotenv.2012.08.092. Kummu's numbers are 35 percent agricultural water use, 31 percent cropland use, and 30 percent fertilizer use, but are based on FAO's estimates of total food loss, which we find to be outdated.
- 11 Martin C. Heller and Gregory A. Keoleian, "Greenhouse Gas Emission Estimates of U.S. Dietary Choices and Food Loss," *Journal of Industrial Ecology*, 19:3 (4 September 2014) [doi.10.1111/jiec.12174](https://doi.org/10.1111/jiec.12174). This study finds that the production of food lost at the retail and consumer level in the United States in 2010 contributed an additional 160 MMT CO₂e of GHG emissions. This estimate does not include GHG emissions from disposal, which we conservatively estimate to add another 16 MMT CO₂e by applying 2014 United States Environmental Protection Agency (EPA) estimates of food waste in landfills to the US EPA Waste Reduction Model (WARM). Together, these amount to 176 MMT CO₂e, which equates to 2.6 percent of the total US EPA GHG Inventory of 6873 MMT CO₂e.
- 12 Using the U.S. EPA Greenhouse Gas Equivalencies Calculator, the 176 MMT CO₂e equates to emissions from 37,160,653 passenger vehicles. This equals 15 percent, or 1 in 7, of the 240,155,237 light duty vehicles registered in 2014 according to the Bureau of Transportation Statistics, www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_statistics/html/table_01_11.html (accessed January 2017).
- 13 US EPA, *Advancing Sustainable Materials Management: 2014 Fact Sheet*, (November 2016) www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures. Food represented 21.6 percent of the 136 million tons of landfilled material in 2014, the most recent data available at time of publishing.
- 14 Hugo Valin et al., "The future of food demand: understanding differences in global economic models," *Agricultural Economics* 45 1(2014): 51-67. Estimates of increased food demand for 2050 vary from 59 to 98 percent increase between 2005 and 2050.
- 15 Tom Quested and Liam Murphy, *Household Food and Drink Waste: A Product Focus*, The Waste and Resources Action Programme (WRAP), (May 2014) P. 23 www.wrap.org.uk/sites/files/wrap/Product-focused%20report%20v5_3.pdf. From 2007-2012, both wasted food and purchases reduced by about 500 grams per person per week, which resulted in total food purchases remaining constant while the population increased 4.5 percent.
- 16 Kevin D. Hall, et al., "The Progressive Increase of Food Waste in America and Its Environmental Impact," National Institute of Diabetes and Digestive and Kidney Disease, *PLoS ONE* (2009) 4(11):e7940.
- 17 Craig Hanson and Peter Mitchell, *The Business Case for Reducing Food Loss and Waste*, Champions 12.3, (March 2017) champions123.org/the-business-case-for-reducing-food-loss-and-waste/.
- 18 Food Loss and Waste Protocol, www.flwprotocol.org.
- 19 USDA and US EPA, "USDA, EPA Announce U.S. Food Loss and Waste 2030 Champions," *News Release from Headquarters*, November 17, 2016, www.epa.gov/newsreleases/usda-epa-announce-us-food-loss-and-waste-2030-champions?mc_cid=eee21e9384&mc_eid=38292e3e72.
- 20 European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Closing the loop - An EU action plan for the Circular Economy*, COM/2015/0614 final, Section 5.2. (2015) eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614.
- 21 Public Law No: 114-113 (12/18/2015).
- 22 H.R. Food Recovery Act 4184 and S. 3108 (2015).
- 23 H.R. Food Date Labeling Act 5928 and S. 2947 (2016).
- 24 H.R. Food Waste Accountability Act 4382 (2016).
- 25 Ariz. Rev. Stat. Ann. §§ 42-5074, 43-1025 (2015); Cal. Rev. & Tax. Code §§ 17053.12, 17053.88 (2015); Colo. Rev. Stat. §§ 39-22-301, 39-22-536 (2015); Iowa Code §§ 190B.101-.106 (2015); Ky. Rev. Stat. Ann. § 141.392 (2015); Mo. Rev. Stat. § 135.647 (2015); Or. Rev. Stat. §§ 315.154, 315.156 (2015); D.C. Code § 47-1808.12(2016); VA Code Ann. § 58.1-439.12:12 (2016).
- 26 Emily Broad Leib, et al., *Keeping Food Out of the Landfill: Policy Ideas for States and Localities*, Harvard Food Law and Policy Clinic (October 2016) P.60 www.chlpi.org/flpc-releases-toolkit-to-promote-food-waste-reduction/.
- 27 The Consumer Goods Forum, www.theconsumergoodsforum.com/sustainability-strategic-focus/waste/food-waste-case-studies.
- 28 USDA and US EPA, "USDA, EPA Announce U.S. Food Loss and Waste 2030 Champions," *News Release from Headquarters*, November 17, 2016, www.epa.gov/newsreleases/usda-epa-announce-us-food-loss-and-waste-2030-champions?mc_cid=eee21e9384&mc_eid=38292e3e72.
- 29 Grocery Manufacturers Association, *Grocery Industry Launches New Initiative to Reduce Consumer Confusion on Product Date Labels*, (February 15, 2017) www.gmaonline.org/news-events/newsroom/grocery-industry-launches-new-initiative-to-reduce-consumer-confusion-on-pr/.
- 30 Edelman Intelligence, internal study on behalf of The Rockefeller Foundation, via email communication March 29, 2017. The study found 294 articles on "food waste" in 2011 as compared with 898 articles in 2016.
- 31 Annie R. Specht and Emily B. Buck, "Crowdsourcing change: An analysis of Twitter discourse on food waste and reduction strategies," February 2017 (Paper presented at the 2017 Annual Meeting of the Southern Association of Agricultural Scientists-AG COMM Section. Mobile, AL).
- 32 Ibid.

- 33 Roni A. Neff, Marie L. Spiker, Patricia L. Truant, “Wasted Food: US Consumers’ Reported Awareness, Attitudes, and Behaviors,” *PLoS ONE* (June 10, 2015) doi.org/10.1371/journal.pone.0127881.
- 34 Ibid.
- 35 Ipsos Public Affairs on behalf of the Ad Council (2017), *Food Waste Continuous Tracking Survey*, unpublished raw data from April to December 2016. The study, commissioned by the Ad Council and conducted by Ipsos, Public Affairs, surveyed approximately 6,700 respondents between April and December, 2016.
- 36 Ad Council. 2016. Savethefood.com.
- 37 There is precedence for this approach of setting aside grant funds to target specific problems. In fiscal year 2011, the Natural Resources Conservation Service awarded CIG grants specifically for Greenhouse Gas mitigation and carbon sequestration opportunities. A summary of the awarded projects can be found at: www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/cig/?cid=stelpdrb1042408.
- 38 USDA, US EPA “Join with Private Sector, Charitable Organizations to Set Nation’s First Food Waste Reduction Goals” News Release 2016, www.usda.gov/wps/portal/usda/usdahome?contentid=2015/09/0257.xml.
- 39 ReFED, *A Roadmap to Reduce US Food Waste by 20 Percent*, (2016), www.refed.com. ReFED finds 125 billion pounds across entire supply chain. See Appendix A for more detail.
- 40 Kevin D. Hall, et al., “The Progressive Increase of Food Waste in America and Its Environmental Impact,” National Institute of Diabetes and Digestive and Kidney Disease, *PLoS ONE* (2009) 4(11):e7940. This paper finds that 40 percent of the U.S. food supply goes uneaten, using 2003 data. An updated estimate using the caloric evaluation method conducted by the National Institutes of Health finds 37 percent of the food supply, which when applied to the 2010 food supply, equates to 160 billion pounds. See Appendix A for more detail on USDA and other estimates, and why NRDC continues to find 40 percent to be a good overall estimate.
- 41 ReFED, *A Roadmap to Reduce US Food Waste by 20 Percent*, (2016), www.refed.com. The USDA estimates a total of \$161.6 billion, but includes only retail, food service, and consumer steps in the supply chain.
- 42 Ibid.
- 43 Ibid.
- 44 Jean C. Buzby, Hodan F. Wells, and Jeffrey Hyman, *The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States*, USDA Economic Research Service Economic Information Bulletin No. EIB-121 (February 2014), P.13 www.ers.usda.gov/webdocs/publications/eib121/43680_eib121.pdf.
- 45 Ibid. P.12 Note that the categories of added sugars/sweeteners and added fats and oils were omitted from this chart as they become ingredients in other food products.
- 46 US EPA, “Food Recovery Hierarchy Sustainable Management of Food Waste,” February 19 2017, accessed March 8, 2017 www.epa.gov/sustainable-management-food/food-recovery-hierarchy.
- 47 Food Loss and Waste Protocol, flwprotocol.org/.
- 48 Hugo Valin et al., “The future of food demand: understanding differences in global economic models,” *Agricultural Economics* 45 (2014) 1 P. 51-67. Estimates of increased food demand for 2050 vary from 59 to 98 percent increase between 2005 and 2050.
- 49 M. Kummu et al., “Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use,” *Science of the Total Environment*, 438 (November 2012) P.477-489 doi.org/10.1016/j.scitotenv.2012.08.092. This estimate is meant to provide scale and does not address the many challenges to solving hunger, which go far beyond food production.
- 50 UN FAO, IFAD, WFP, *State of Food Insecurity in the World, in brief*, (2015) www.fao.org/3/a-i4646e.html.
- 51 Tom Quested and Liam Murphy, *Household Food and Drink Waste: A Product Focus*, WRAP, May 2014, P. 23 www.wrap.org.uk/sites/files/wrap/Product-focused%20report%20v5_3.pdf. From 2007-2012, both wasted food and purchases reduced by about 500 grams per person per week, which resulted in total food purchases remaining constant while the population increased 4.5 percent.
- 52 Vaclav Smil, *Feeding the World: A challenge for the Twenty-First Century*, (Cambridge: MIT Press, 2001) P.237. Animal feed represents 1,700 kcal/day of the edible crop harvest of 4,600 kcal/day. After subtracting the 500 kcal/day of meat and dairy products, that leaves 1,200 of the original 4,600.
- 53 These two estimates are generated from ReFED, *A Roadmap to Reduce US Food Waste by 20 Percent*, (2016), www.refed.com and M. Kummu et al., “Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use,” *Science of the Total Environment*, 438 (November 2012) P.477-489 doi.org/10.1016/j.scitotenv.2012.08.092. They are stated in equivalents because while the food is wasted in the US, the global nature of our food system means it is grown – and the water is used—around the world.
- 54 Water Footprint Network, www.waterfootprint.org.
- 55 These two estimates are generated from ReFED, *A Roadmap to Reduce US Food Waste by 20 Percent*, (2016), www.refed.com and M. Kummu et al., “Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use,” *Science of the Total Environment*, 438 (November 2012) P.477-489 doi.org/10.1016/j.scitotenv.2012.08.092. They are stated in equivalents because while the food is wasted in the US, the global nature of our food system means it is produced on land around the world.
- 56 UN FAO, *Food Wastage Footprint: Impacts on Natural Resources*, (2013), www.fao.org/docrep/018/i3347e/i3347e.pdf.
- 57 These two estimates are generated from ReFED, *A Roadmap to Reduce US Food Waste by 20 Percent*, (2016), www.refed.com and M. Kummu et al., “Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use,” *Science of the Total Environment*, 438 (November 2012) P.477-489 doi.org/10.1016/j.scitotenv.2012.08.092. They are stated in equivalents because while the food is wasted in the US, the global nature of our food system means it is produced—and fertilizer used—around the world.
- 58 Martin C. Heller and Gregory A. Keoleian, “Greenhouse Gas Emission Estimates of U.S. Dietary Choices and Food Loss,” *Journal of Industrial Ecology*, 19:3 (4 September 2014) doi.10.1111/jiec.12174. This study finds that the production of food lost at the retail and consumer level in the United States in 2010 contributed an additional 160 MMT CO₂e of GHG emissions. This estimate does not include GHG emissions from disposal, which we conservatively estimate to add another 16 MMT CO₂e by applying 2014 US EPA estimates of food waste in landfills to the US EPA Waste Reduction Model (WARM). Together, these amount to 176 MMT CO₂e, which equates to 2.6% of the total US EPA GHG Inventory of 6873 MMT CO₂e.
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