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REDUCING FOOD WASTE

by Changing the Way Consumers Interact with Food

Arabella Advisors

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The New Venture Fund, with support from The Rockefeller Foundation, commissioned Arabella Advisors to identify transformational opportunities to accelerate food waste reduction in the United States. Support for this report is part of the foundation's $130 million commitment to demonstrate how food loss and waste can be halved through its YieldWise initiative.

The New Venture Fund, a 501(c)(3) established in 2006, conducts public interest projects and provides professional insight and support to institutions and individuals seeking to foster change through strategic philanthropy. The New Venture Fund offers domestic and international grant-making support, executes donor-developed projects, and provides full fiscal sponsorship, including grants and contracts management for innovative initiatives.

EXECUTIVE SUMMARY

With 62.5 million tons of food wasted in the United States each year, there is much work to be done to bring about substantial changes in the food industry that will create a more efficient food system and help preserve the environment.[1] This guide describes promising opportunities to reduce food waste in three areas—packaging, food retail, and home kitchens—and discusses a number of solutions that could be piloted, validated, and scaled to significantly reduce food waste in America.

Several social and economic trends make the coming decade a favorable time to invest in advancing innovative solutions: consumers are purchasing, storing, preparing, and disposing of food in new ways; technological advancements are modernizing the retail supply chain and new distribution models; and the food industry has advanced its data analytics to drive its decision making. Together, these trends offer a window of opportunity to elevate our country's food waste problem and address it from cultural, attitudinal, and operational perspectives.

This solutions guide is intended for food industry leaders and disruptors, advocates for food waste reduction, designers, and funders who seek direction on ideas they can consider for implementation. We developed this guide with input from experts from across the food system, as well as innovative thinkers from other sectors. Through over 40 interviews and a series of cross-sector convenings with 30 industry insiders, we identified solutions that have the potential to greatly reduce food waste and that can be feasibly implemented over the next five to 10 years.

While the solutions presented hold promise for achieving meaningful reductions in food waste, there are a number of barriers to overcome. First are the cultural attitudes and behavioral practices of American consumers, who are driven by preferences for convenience and low cost. Second are the challenges companies within the food industry face in introducing and accepting changes, both operationally and culturally, in the absence of strong indications from consumers that they want food waste reduction to be a corporate priority. Additionally, not all solutions in this guide will be widely accepted or feasible in all geographies or settings, and some would result in higher prices for food products and services, which would present challenges for consumers—and corporations—with limited resources. All solutions proposed here should therefore be evaluated for the burden they could place on impacted parties, not solely for the benefit they would provide.

Bringing Packaging Solutions to Scale

Packaging improvements can reduce food waste by delaying spoilage, right-sizing food quantities, and communicating information about food to consumers that can empower them to waste less food. Food and packaging manufacturers, food retailers, and transportation companies have an opportunity to expand existing packaging solutions to more food categories and to develop new packaging innovations to prolong the life of food.

Promising packaging solutions have the potential to 1) further develop and expand existing **packaging technologies and material innovations** that better protect food and extend shelf life, 2) adopt **processing technologies and innovations** that complement packaging innovation and/or lessen the need for extensive packaging, and 3) institute **package sizing** that aligns more closely with consumer need. As examples, two solutions to expand existing packaging technologies are modified-atmosphere packaging (MAP) and increasing the application of vacuum-seal technology across product categories to extend shelf life.

The main barriers to innovation and change in packaging technology and application are packaging companies' concerns of liability related to product freshness, the cost of changing infrastructure and production systems, and concerns regarding consumers' perceptions of freshness and their willingness to accept new products and standards. Because packaging plays a role throughout the entire supply chain—all the way to the consumer's home—food and packaging manufacturers, scientists, logistics

experts, food retailers, and alternative retail model pioneers should collaborate to identify the best solutions for application and the right methods for introducing solutions into the marketplace.

Rethinking Retail Practices

Today, most traditional brick-and-mortar retailers have implemented improvements to reduce food waste in their stores. Much of this progress has been with recovery, meaning that food retailers have put processes in place to ensure food is donated to food banks or other outlets before it spoils and is discarded. But there is also greater opportunity for retailers to design and adopt new ways of procuring, handling, and selling food across the continuum of their operations.

Retailers can 1) institute **procurement practices and purchasing systems** that enable delivery of the exact amount of food customers need, 2) establish **transportation practices** that increase product longevity, 3) rethink **store infrastructure design** to take food waste into consideration, 4) adopt **storage, stocking, and handling practices** that optimize the timing of a product's delivery and sale and minimize product degradation, 5) implement activities that change **customer perceptions** about food and waste, 6) enact new **merchandising programs** that align customer interests and store practices, and 7) **create the industry standards and policy environment necessary** to increase food waste prevention and recovery. There are several specific solutions within each of these categories that could be used to lower food waste in the retail setting, ranging from the development of in-store farming systems to merchandising programs that introduce dynamic pricing for perishable foods.

The major barriers to innovation and subsequent change in food retail are a lack of knowledge about which prevention efforts would have the greatest impact, the cost of infrastructure changes, and the fear that customers won't accept new shopping experiences or change their habits to support retailers' goals of less waste. A number of priorities compete for retail leaders' time, so food waste reduction will only be prioritized if executive leaders within the industry commit to food waste minimization as a top concern for their corporations.

Revamping the Home Kitchen Experience

With just over 50 percent of the food that ends up in landfills originating with consumers, the home kitchen is a prime location to address food waste. Unlike the packaging industry and the food retail world, the design and function of the consumer home kitchen have remained largely stagnant over the last 50 years. Changes within the home kitchen have the power to influence consumer behavior, but greater innovation is needed to prompt consumers to make decisions that minimize food waste.

To reduce consumers' in-home waste, food industry stakeholders need to 1) **help consumers better manage the food they purchase** and 2) **equip consumers' physical space** to minimize waste. With the proliferation of digital tools and consumers' adoption of technology in their day-to-day lives, digital solutions stand the greatest chance of influencing and changing consumers' food and waste monitoring habits. Two types of new tools and platforms are needed: informative tools that provide information on products and ideal storage practices, and interactive tools that help consumers remember what products they have purchased and when they will expire. The latter group of tools could potentially include social features that enable waste-tracking competitions among peer groups or geographic communities to encourage waste reduction. In addition, there are many promising ideas for advancing the "internet of things" and incorporating food waste messaging into new food distribution models such as meal delivery services.

Enhancing the physical components of the kitchen, researching how appliances influence consumer choices, and updating appliances—including food storage and waste collection systems—to encourage behavior change could all help to minimize in-home food waste. Community-level solutions, such as the opportunity to develop design guidelines that architects, construction companies, and government agencies could refer to in their creation of physical building standards, will also contribute.

The major barriers to innovation in the home kitchen are the number of sources from which consumers buy food—making tracking purchases and freshness a complex endeavor—and the diversity of kitchen footprints and formats that exist across the country. Due to the variety of solutions that could influence the home kitchen, stakeholders from a wide range of industries will need to engage to support the development of innovations in this space.

Conclusion

We hope the solutions presented in this guide serve as a springboard for action and collaboration within and beyond the food industry to drive the field forward. We recognize that not all of the solutions can be adopted widely, and some may not be feasible for all consumers and corporations due to associated costs or other factors not readily apparent. We also know that the complexities of the food system could make it so that a positive change in one part of the supply chain could have unintended—and perhaps even detrimental—consequences within another section of the system. Therefore, the greatest progress will be made if food industry leaders and disruptors, food waste advocates, researchers, designers, and funders come together to jointly evaluate and improve food system operations to reduce food waste from farm to fork.

INTRODUCTION

Efforts to address food waste in the United States have reached a tipping point: a growing number of advocacy groups, government agencies, food industry leaders, and consumers have acknowledged the environmental and economic benefits of reducing the estimated 62.5 million tons of food that is wasted in the United States every year.[2] Three high-potential opportunities explored in this document—bringing innovative packaging solutions to scale, reshaping retail practices, and redesigning the consumer kitchen experience—can, collectively, help these stakeholders significantly reduce food waste in America.

We chose these three areas because within each one there are timely and realistic opportunities to achieve meaningful food waste reduction. For example, there are solutions within the packaging industry that packaging companies and retailers can implement now and that don't require outsized investments and infrastructure changes. Rapid changes in the retail industry are creating openings for corporate champions to deploy and scale solutions to reduce food waste. And, changes in how consumers purchase, store, prepare, and dispose of food in their home kitchens can help to reshape individual and community behavior. Across all these approaches, there's an opportunity to replicate solutions that exist in one part of the supply chain within other parts of the food system.

Additionally, there are a few social and economic trends that make the coming decade an opportune time to invest in piloting innovative solutions in packaging, retail, and home kitchens, while scaling those that already show promise.

This document is a guide to the solutions within each of these three opportunity areas that industry stakeholders should consider piloting, validating, and scaling to create a paradigm shift in how Americans think about and interact with food. This solutions guide is intended for food industry leaders and disruptors, advocates for food waste reduction, designers, and funders who seek direction on how to significantly reduce food waste. In this guide, we include ideas for implementation—some that are easier to achieve in the near-term and others that must be executed over a longer time horizon—and pinpoint barriers that proponents of the ideas need to overcome. We also identify the parties who need to be involved to ensure success. Each of the sections in this guide can be read independently of the others, but we encourage readers to read all sections because the solutions across each opportunity area are closely intertwined. If they are addressed in concert with one another, they have the greatest potential for reducing food waste.

Why Address These Areas Now?

The EPA and USDA have set an ambitious goal to reduce food waste by 50 percent by 2030, and many supporters of the goal have efforts underway to reach it. Additionally, there are a few social and economic trends that make the coming decade an opportune time to invest in piloting innovative solutions in packaging, retail, and home kitchens, while scaling those that already show promise. First, consumers—who now have greater access to technology in their daily lives and who also have little free time—are purchasing, storing, preparing, and disposing of food in new ways. Second, technological advancements are modernizing the retail supply chain and new distribution models, such as online ordering and meal delivery services, are shaking up traditional methods for selling food. The food industry has also advanced its ability to collect and use data to drive its decision making. This is particularly true for food retailers, who play a central role in determining what food manufacturers produce, how they present it, and, therefore, what food is available to consumers. Lastly, Americans are demanding more from the companies they buy from, both in terms of corporate values and the quality of the products and services they provide. Taken together, these trends present a large window of opportunity to elevate our country's food waste problem and address it from cultural, attitudinal, and operational perspectives.

Barriers to Implementing Food Waste Solutions

While the solutions we present in this document hold promise for achieving meaningful reductions in food waste, there are a number of barriers to overcome. First and foremost are the entrenched cultural attitudes and behavioral practices of American consumers. Consumers are driven primarily by their preference for convenience and low cost. Many are not aware of the economic and environmental problems that food waste presents, and more importantly, many do not recognize how they are primary contributors to the problem and stand to save money by being less wasteful. Because small changes in consumer actions collectively can make a large-scale difference, it is vital to engage and educate consumers about the problem of and solutions to food waste. In fact, this is the best way for food waste reduction efforts to succeed.

In addition to deep-rooted consumer attitudes and behaviors, it is hard for companies within the food industry to introduce and accept changes, both operationally and culturally. The highly competitive markets for packaging companies, food retailers, and appliance manufacturers create situations in which these groups are understandably reluctant to adapt their practices, products, and services unless it is clear that consumers' demand justifies the high costs of establishing and implementing the change.

Another barrier to change within the food system is the fact that not all solutions that we propose across the three opportunity areas will be widely accepted or feasible in all geographies or settings. Some are best suited for urban environments where industry-disrupting services are more likely to be piloted, embraced, and expanded, while other solutions are better suited for suburban areas where grocery stores and consumer kitchens tend to be larger. It is also probable that some solutions would result in higher prices for food products and services, which would present challenges for consumers—and corporations—with limited resources. Therefore, the solutions proposed here should be evaluated for the burden they could place on impacted parties, not solely for the benefit they would provide.

The solutions we propose will only succeed with acceptance from consumers and the support of influential companies. Therefore, it will be important for those who engage in food waste efforts to invest in piloting and scaling the solutions we propose while also helping consumers accept the solutions that have been proven to reduce waste. To encourage widespread implementation of successful solutions, it will be necessary both to recruit corporate executives to lead by example in their respective industries and to capitalize on employees' enthusiasm for the cause.

Each solution proposed in this document is marked by one of the following icons to indicate what stage of development it is in. As indicated, some solutions need further innovation to reach a stage to be impactful, while others need validation to substantiate their usefulness or are ready for broader adoption or wider application across the food system.

 In need of further development

 In need of validation

 Ready to be scaled

Methodology

We developed this guide with input from experts from across the food system, as well as innovative thinkers from other sectors. To identify opportunities for food waste reduction, we interviewed 40 experts from the retail, packaging, consumer behavior, food waste advocacy, and sustainability sectors to understand where they see opportunities to significantly reduce food waste across the food supply and consumption continuum. (See Appendix D for a list of individuals we interviewed.) Using this expert input, we identified solutions that have the potential for great impact and that could feasibly be implemented over the coming decade. Through a series of cross-sector convenings, we gathered input from an additional 30 industry insiders on the necessary steps to begin implementing the ideas presented here.

BRINGING PACKAGING SOLUTIONS TO SCALE

Food and packaging manufacturers, food retailers, scientists, food transportations experts, and funders have the opportunity to capitalize on existing innovative packaging solutions to significantly reduce the 66 percent of food that retailers and homes send to landfills annually.[3] According to ReFED's *Roadmap to Reduce US Food Waste by 20 Percent*, packaging adjustments would result in an economic value of $3,443 per ton, and spoilage prevention packaging would have an economic value of $2,326 per ton.[4]

Packaging improvements can reduce food waste by delaying spoilage, right-sizing food quantities, and communicating information about food to consumers such as optimal consumption timeline and safety concerns. Prolonging shelf life preserves freshness and better protects food, giving retailers and consumers more time to sell and consume it before it spoils. Changing package sizing can deliver the exact amount that consumers need, reducing leftover product. Innovations in package design and technology can also communicate information about shelf life, viability, and proper storage techniques in a way that is clear, accurate, and user-friendly so that consumers will adjust their behavior to waste less food.

Innovative packaging solutions already exist; they need to be scaled to effect real change.

Innovative packaging solutions already exist; they need to be scaled to effect real change. One such innovation is the recent work the Grocery Manufacturers Association and Food Marketing Institute have done to streamline date labeling on food, but there are other endeavors that those interested in minimizing food waste can advance as well. Well-developed, investable packaging technology, such as modified-atmosphere packaging (MAP) and high-pressure processing, can extend shelf life and preserve food freshness. But these technologies have yet to be expanded into high-value, perishable product groups, including meat, cheese, produce, and baked goods. There are several opportunities to take a solution that exists in one point of the supply chain and adapt it to fit the needs of another. For instance, shippers could modify the environmental manipulation technology used in MAP and deploy it in shipping containers and trailers to preserve food mid-route. There are also early-stage technologies that need to be further developed and piloted before scaling. These include biodegradable alternatives to plastic, food safety sensors, and smart tags for food.

Liability, cost, and concern over consumer perception have limited the broad adoption of existing packaging innovations. Manufacturers and retailers are hesitant to adopt early-stage technologies, such as food safety sensors, because they may be liable if the technology fails and indicates that spoiled food is safe to eat. Additionally, packaging developments run the risk of driving up costs and leave questions about who would bear that cost: producers, manufacturers, retailers, or consumers. Manufacturers ought to take advantage of low-cost packaging solutions that can reduce waste where possible, especially to avoid adding cost to products that could make them unaffordable, particularly for low-income consumers. Corporations are also wary of consumer perceptions when altering packaging because of consumers' demonstrated hesitance to accept new technologies and models for packaging, such as vacuum-sealed meat. Consumers value freshness, and, as a food retail executive explains, "when consumers see a cut of meat encased in packaging, they assume that product is less fresh or was not cut in the store."

Additionally, there are safety and environmental implications for packaging changes that deserve considerable attention. Scientists and packaging manufacturers must work to ensure that new packaging does not contain toxic chemicals, which can leach into food and cause serious health effects. Additionally, innovation in the field could result in packaging solutions that conflict with the goals of some food system advocates to achieve shorter supply chains and package-free food systems. Packaging innovators should be aware of these goals and take steps to ensure that their creations do not further entrench harmful practices, such as very long-distance shipment methods and the production of more material waste.

Solutions to Consider for Implementation

There are a number of well-developed innovations in the packaging field that producers, manufacturers, and retailers can adopt, as well as early-stage innovations that manufacturers and scientists can further develop. We are highlighting three intervention areas within the packaging industry that have especially strong potential for food waste reduction:

1. Further develop and expand existing **packaging technology and material innovation** that better protects food, extends its shelf life, and communicates product information.

2. Adopt **processing technology and innovation** that preserve food in a way that complements packaging innovation and/or lessens the need for extensive packaging.

3. Institute **package sizing** that more effectively delivers the exact amount of food that consumers need and reflects the changing demographics and trends in US household sizes.

For a comprehensive list of the solutions described below, please refer to Appendix A.

SOLUTION 1: Further develop and expand **packaging technology and material innovation** that better protects food, extends its shelf life, and communicates product information

The field of packaging technology and material innovation offers strong potential for food waste reduction because of its existing body of solutions. There are already significant advancements in active packaging, which involves elements that enhance the environment within the package. Responsive packaging, an earlier-stage technology, responds to stimuli in the package environment by providing an indication of quality or influencing the environment accordingly. Examples of responsive packaging include packaging with sensors that indicate freshness and packaging that emits naturally occurring gases that counteract those that foods release.

Packaging manufacturers can further develop early-stage technologies that preserve freshness, extend shelf life, and provide information to consumers, and they can adapt existing technologies to serve multiple parts of the supply chain. Producers, manufacturers, and food retailers can:

Develop consumer-facing sensor technology to indicate food safety. While sensors are widespread in the food manufacturing industry, they are not available to consumers. However, these tools can be adapted to allow consumers to tell whether a food is safe using their smartphone. Si-Ware Systems, for example, is developing an app that uses near-infrared sensors to analyze food for safety in real time. The Grocery Manufacturers Association and the Food Marketing Institute recently adopted standard wording on packaging to signify safety ("use by") and quality ("best if used by"), and companies like Si-Ware Systems can build on this industry momentum to create more accurate ways to signify the longevity of perishable products. They will need to eliminate the chance of false positives to avoid liability for manufacturers and foodborne illness for consumers. Once engineers improve this technology, there is an opportunity to combine it with active processing technology that can release gases to preserve the food based on a sensor's reading.

Explore consumer acceptance of alternate versions of products with longer shelf lives. Shelf-stable products, which differ from their refrigerated counterparts in processing temperatures and packaging material, offer a dramatically longer window for consumers to eat a product before it spoils. However, American consumers prefer products like milk to be refrigerated. This is in contrast to European consumers, who accept shelf-stable milk and benefit from its six-month shelf life. Researchers should test consumer perceptions of shelf-stable products and explore the success of educating consumers on the small processing changes that differentiate products like shelf-stable and refrigerated milk.

Expand active packaging to shipping containers in order to preserve the freshness of unpackaged products during transport. Shipping companies can preserve unpackaged produce, such as apples, by using active packaging technology to manipulate the environment in shipping containers with naturally occurring gases that are harmless to consumers but that preserve produce. This would be particularly effective when shipping produce to a manufacturer who will then package the product or when shipping a product that will remain unpackaged in the store.

Capitalize on innovations in biodegradable and alternative, sustainable packaging solutions that offset the increase in material needed for other new packaging technologies. There has been a recent wave of innovation in alternative packaging development that offers increased biodegradability and recyclability. These innovations have less environmental impact and allow packaging manufacturers to offset the increase in other kinds of packaging materials. For example, scientists at the USDA are working to develop a film made from milk protein that is biodegradable and offers oxygen-blocking properties that delay spoilage. And, the Wyss Institute for Biologically Inspired Engineering at Harvard University is developing a plastic substitute out of shellfish protein. Work is underway to improve the economics and reliability of these materials. Researchers should also address the consequences of using allergens in packaging.

Expand the use of MAP technology to additional perishable product groups. MAP—an effective, low-cost technology—is permeable packaging filled with a blend of environmental gases customized to meet the respiration needs of a food product. Certain food manufacturers are already using MAP. Italian foods company Buitoni, which produces pastas, uses a MAP film that removes oxygen from pasta packages and prevents air from dissolving into the pasta. There is an opportunity to expand MAP to highly perishable foods, such as meat, produce, cheese, and bakery items. Consumer concerns about products being altered—with gases or otherwise—present one barrier to MAP's further implementation, but products like Buitoni pastas, which look similar to other refrigerated products, help normalize MAP packaging for consumers.

Increase the use of vacuum-sealed products, such as meat and seafood, to prolong shelf life. Vacuum sealing is much more effective than traditional packaging at delaying spoilage for highly perishable products like meat, seafood, and bakery items, which are often sold at store counters wrapped in paper or in containers that are not airtight. But because consumers perceive vacuum-sealed food as not being fresh, retailers and manufacturers are deterred from using it. For example, consumers prefer cuts of meat to be red even though the redness indicates oxidization. Vacuum-sealed meat, however, retains a purple color because it hasn't been exposed to oxygen. Consumers in the United Kingdom have learned to accept vacuum-sealed meat despite its color, indicating that consumer attitudes can be reshaped under the right conditions. While US consumers have been slower to choose purple-colored vacuum-sealed meat over red-colored meat at the deli counter due to perceptions of freshness, consumers have shown they are willing to accept vacuum-sealed meat from meal kit purveyors and online grocers, who offer it as the only packaging option. These increasingly prevalent alternative retail models offer an opportunity to reshape consumer perceptions. A food waste expert shared that after receiving vacuum-sealed meat from a meal kit delivery service, she felt more comfortable buying vacuum-sealed products in other settings, where she noticed they cost the same as traditional options.

Integrate smart tags and QR codes that contain information on product shelf life and storage tips into packaging that can be read by apps and appliances. Packaging can convey information about viability and optimal storage so consumers can remind themselves of what is still left in their refrigerator and cabinets. "We don't have the mental capacity to track what we have eaten and what is in the refrigerator," explained one product designer. One packaging executive suggested that food manufacturers could print preparation tips and recipes for leftover food on packaging in the same way that cookie recipes are commonly found on chocolate chip bags. Radio frequency identification

(RFID) tags—electronic chips that send signals with information—are one way to attach information to food, but they have not been widely expanded because of their added cost. As alternative retail models experiment with RFID tags as a replacement for checkout lines, food retail companies could partner with food manufacturers to include helpful food storage tips with the digital receipt that is sent to consumers. Another timely opportunity for retailers and food manufacturing companies is to work together to include food safety and storage information in QR codes, which are increasingly prevalent in many industries and allow consumers to scan the package with their smartphone to receive the stored information.

SOLUTION 2: Adopt **processing technology and innovation** that preserve food in a way that complements packaging innovation and/or lessens the need for extensive packaging

In addition to altering the material that encases food products, processing developers have discovered ways to process foods that lessen reliance on preservatives and keep food fresh without requiring extra plastic casing. Food scientists and manufacturers can:

Use predictive analytics and vision technology in processing plants to increase efficiency. Predictive analytics and vision technology installed in processing machines allow processing plants to be more efficient and identify where waste is occurring. While this technology exists, food manufacturing executives tell us there is a great opportunity to further develop and expand this technology.

Expand use of new technologies that allow food to be processed with fewer preservatives and/or less need for refrigeration. New processing innovations prolong shelf life while aligning with the growing consumer preference for fewer preservatives in food. While alternative processing methods do not work for all product groups, researchers have demonstrated the success of high-pressure processing—the use of extreme temperature and pressure to chemically change microbes and enzymes in a way that delays spoilage—in preserving highly perishable foods, such as avocados and seafood. While this innovation aligns with consumers' preservative-free preference, "it is counter to the consumer trend toward fresh products," one packaging manufacturer noted.

Encourage food manufacturers to adjust cosmetic standards for produce to reduce the amount of produce they reject. Food manufacturing companies often have a long list of specifications that they require each food item that suppliers deliver to them to meet. This is to ensure that the fresh produce (or the ingredients in their products) are high-quality, aesthetically pleasing, and of the required size. However, as one food manufacturing executive pointed out, having so many specifications leads to "either trimming or not accepting a certain size, thereby wasting food." Consumer product companies that have reduced the number of specifications per product have experienced decreased food waste and greater efficiency in their production systems. Companies have also identified alternative products to create with slightly off-specification produce, such as making baby carrots from misshapen carrots. This solution is an example of how food waste reduction can align with business incentives.

SOLUTION 3: Institute **package sizing** that more effectively delivers the exact amount of food that consumers need and reflects the changing demographics and trends in US household sizes

Shoppers frequently buy and open products that contain more than they need, so they often end up wasting food they don't finish. By right-sizing packaging, manufacturers can offer consumers the exact amount of food they need for a specific purpose, thereby reducing discarded excess food. To address this need, packaging manufacturers, food producers, and retailers can:

Further develop recyclable and compostable packaging solutions to offset the use of more packaging that accompanies buying portioned products. While customized serving sizes offer consumers the potential to waste less food, they often send more packaging to landfills. To offset this unfortunate consequence, packaging developers ought to build on the substantial momentum in the field of recyclable and compostable plastics. PepsiCo has developed sustainable solutions in recent years, including the first 100 percent plant-based, renewably sourced bottle, which mirrors PET plastic bottles without using petroleum-based materials.

Implement smaller portion sizes in food retail and quick-service foodservice to meet consumer needs across all perishable product groups. As the size of US households decreases and Americans increasingly cook for one, there is a growing need for one-serving packaging. Individual-serving sizes have already been expanded to less perishable products such as chips, but consumers could also use individually packaged high-value perishable items, such as meat and seafood. "Portioning out food is a great way to nudge consumers to buy the right amount so they waste less," said one expert on consumer packaged goods. A sustainability expert pointed to packaging company Sealed Air's individually packaged chicken breasts as an example of how manufacturers can successfully deliver the just-right amount to consumers.

Expand the use of resealable packaging. This is a simple solution that is relatively inexpensive to implement and that can make a big difference in prolonging the shelf life of food in a consumer's pantry or refrigerator. Enabling consumers to reseal the packaging after they've eaten one serving will help them protect food from spoiling without adding excess packaging. Additionally, resealable packaging avoids consumer concerns about more advanced technologies such as inserting gases or adding preservatives. One packaging design expert pointed out that "[resealable packaging] as an innovation makes consumers' lives easier, which is a key element to behavior change." However, a consumer packaged food executive noted that sustainability initiatives can stand in the way of resealable solutions because the plastic needed may make the container unrecyclable. Researchers ought to explore how to overcome this hurdle to this low-cost food waste solution.

Expand use of compostable packaging and composting programs in large institutions, such as stadiums and universities. As more large institutions adopt long-term sustainability goals, a growing number of stadiums, universities, and government facilities have set goals to eliminate food waste. A leader in this effort is the University of Florida's Ben Hill Griffin Stadium, which seeks to be the first zero-waste stadium in its athletic conference. The stadium diverts an average of 70 percent of its waste from landfills per game through its recycling and compost programs. While these programs require costly and large-scale waste management changes and patron engagement campaigns, they have long-term cost benefits associated with waste reduction and can generate positive publicity for the institution.

Engaging Stakeholders to Implement the Solutions

Food and packaging manufacturers, food retailers, scientists, and shipping experts all play a critical role in overcoming challenges with implementing new packaging technologies. Because packaging spans the entire supply chain, these solutions will reach their full effect when leaders at each stage—from production to food recovery—adopt and promote them.

Encouraging Food Industry Leaders to Promote Change

An essential way to achieve measurable change in the packaging industry is to have industry leaders promote and adopt new and proven solutions. In 2016, PepsiCo pledged to direct zero food waste to landfills across its direct operations and to design 100 percent of its packaging to be recoverable or recyclable by 2025. Nestlé has also been pioneering changes to its packaging and processing systems that reduce food waste. Engaging large companies such as these would achieve outsized impact for the level of effort, given the large market share of the top large food processing companies and their influence on the rest of the industry. "It's much easier to change the behavior of a few hundred companies than 300 million consumers," said one sustainability advocate.

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While food retailers often do not make direct packaging decisions, their input is vital in determining the kinds of food produced, and they serve as a channel for consumer demand. Retail leaders in food waste reduction—such as Kroger and Walmart—are potential partners for packaging manufacturers in this effort. Additionally, as mentioned, online grocers and meal kit delivery companies like Blue Apron and FreshDirect have demonstrated how consumers can accept typically unpopular packaging models, such as vacuum sealing.

Industry groups have already positioned themselves as allies in using packaging for food waste reduction. The Consumer Goods Forum, the American Institute for Packaging and the Environment, the Food Waste Reduction Alliance, and the Sustainable Packaging Coalition are already devoting substantial resources to promoting food waste reduction among their members. These groups, whose members include food manufacturers, packaging manufacturers, researchers, food retailers, and restaurant representatives, serve as platforms that can promote solutions and encourage collaboration among industry leaders. Some industry groups for specific products, such as the Produce Marketing Association, have also demonstrated their commitment to this cause.

Stakeholders Who Can Foster Momentum

Despite the many leaders in the field, there is still work that needs to be done to engage additional partners in this effort. There is a role for entities at each point in the supply chain: production, manufacturing, transportation, food retail, consumption, and food recovery. Packaging companies design packaging products to meet retailers' needs. Retailers will need to demand new changes to packaging to drive investments by packaging companies, and they will need to be convinced that consumers will accept these changes. Scientists, researchers, app developers, and big data companies are integral to further developing and proving the effectiveness of packaging technologies and solutions. Manufacturers can take the lead in adopting packaging interventions that reverberate throughout the supply chain. Alternative retail model pioneers have the potential to change the way consumers see food and what packaging they accept. They can bypass the dozens of different touch points and packaging needs throughout the supply chain by offering products directly to consumers. This has the potential to reduce packaging waste while offering food in the right portions and at the time consumers need it. Consumers can encourage these changes by showing companies that they are willing to accept packaging and processing solutions that reduce food waste.

In this disparate field, education about packaging solutions is vital to encouraging widespread adoption. There is an opportunity for packaging researchers, scientists, and manufacturers to collaborate in creating a matrix that highlights the kinds of technology, temperature, and processing solutions that optimize storage of each type of food. This would provide food producers, manufacturers, and foodservice professionals with a comprehensive reference point for optimizing food packaging.

There is a role for entities at each point in the supply chain: production, manufacturing, transportation, food retail, consumption, and food recovery.

There is also potential for promoters of packaging solutions to partner with advocates and experts in adjacent fields. Developers of biodegradable and alternative packaging solutions could partner with sustainability and conservation advocates. Food system advocates who call for fewer preservatives in food might partner with scientists developing preservative-free processing technology. Promoters of food label transparency could combine efforts with packaging manufacturers looking to add food viability and transportation tips to QR codes. Nutrition advocacy groups may be interested in partnering on an effort to reduce packaging sizes. Food waste stakeholders across all intervention areas ought to watch out for opportunities to collaborate with adjacent fields.

RETHINKING RETAIL PRACTICES

Brick-and-mortar food retailers can implement significant, effective food waste reduction strategies across their operations. According to ReFED, food retailers generate 13 percent of the food wasted, adding up to approximately 7.97 million tons of food a year.[5] Although this is a relatively low percentage, the highly competitive and consolidated nature of the market and its influence over consumer behavior gives this sector a significant opportunity to make meaningful reductions by 2030 and to reduce waste in other parts of the supply chain.

Most food retailers have enacted programs and processes that enable them to recover food to donate or repurpose instead of sending it to landfills. For example, in 2015 retailers provided 1.4 billion pounds of food to Feeding America, the country's largest network of food banks.[6] While this is no doubt a valuable contribution to society, it points to the economic value that retailers stand to gain by preventing food from needing to be donated in the first place. Retailers have struggled to prevent food waste due to a handful of barriers, including not knowing what prevention efforts could have the greatest impact, the cost of infrastructure changes, and the fear that customers won't accept changes to their shopping experience and practices. From an economic perspective, though, food waste prevention efforts are equally important to recovery efforts because the further downstream that food is wasted on the continuum from the farm to the consumer's plate, the costlier it becomes.

Additionally, as customers demand greater accountability from the companies they support, their brand loyalty will increasingly depend on a company's ability to take responsibility for its environmental footprint.

Additionally, as customers demand greater accountability from the companies they support, their brand loyalty will increasingly depend on a company's ability to take responsibility for its environmental footprint. Retailers need to be ready to respond to the growing pressure from customers to be part of the solution to our environmental problems, not a contributor or bystander. From a cultural perspective, food retailers shape consumer behavior, influencing people's decisions about when they shop, what they buy, and how much they buy. This influential position offers retailers a meaningful opportunity to set new norms for how our society thinks about food, leading to actions by retailers and their customers—the greatest generators of food waste in the country—that can curtail waste and create an efficient and equitable food system.

Solutions to Consider for Implementation

The following pages outline specific solutions that food retail companies can pursue—along the continuum of food production to consumption—to significantly reduce food waste in their operations. We've included ideas for retailers that have begun initial efforts to reduce food waste, as well as for those who are positioned to expand on well-established initiatives to further reduce waste and to champion change in the sector. We've also pinpointed some of the barriers that need to be overcome and identified the parties who need to be involved to achieve success. The seven solutions we identified are:

1. Institute **procurement practices and purchasing systems** that enable delivery of the exact amount of food customers need.

2. Establish **transportation practices** that increase product longevity.

3. Rethink **store infrastructure design** to take food waste into consideration.

4. Adopt **storage, stocking, and handling practices** that optimize the timing of delivery and sale, and minimize product degradation.

5. Implement activities that help shape **customer perceptions** about food and waste.

6. Enact new **merchandising programs** that align customer interests and store practices.

7. **Create the industry standards and policy environment necessary** to increase food waste prevention and recovery.

Each of the seven solutions requires different approaches to achieve less food waste. Some steps can be taken within the next one to two years, while others will take longer to achieve. For a comprehensive list of the solutions described here, please refer to Appendix B.

SOLUTION 1: Institute **procurement practices and purchasing systems** that enable delivery of the exact amount of food customers need

Retailers can make changes to prevent food waste from becoming a problem at the front end of the food retail system. Most retailers forecast purchasing needs through demand planning processes that are centralized at the corporate office rather than at individual stores. However, they have an opportunity to more accurately predict how much food each store will need and exactly how much customers will buy. Retailers can:

Develop and implement new technologies that enable in-store farming. Technological advancements are enabling retailers to rethink the traditional continuum of farming, harvesting, transporting, and selling. One frontier that retailers could further explore is in-store farming, which eliminates the need to transport products from farms. Today, companies such as Berlin, Germany-based Infarm are piloting this work with highly perishable items like lettuce. Infarm sells modular growing systems that retailers can purchase to grow products like greens, radishes, and herbs inside the store. In the United States, Target is already experimenting with modular farming systems. Other retailers could initiate similar testing programs to evaluate the opportunity presented by indoor farming technology.

Further develop forecasting technology to allow for highly local customization. Today, forecasting is done at the national or regional level, but retailers could improve their systems to give store managers the flexibility they need to manage inventory in tandem with local customer shopping patterns. For example, if a store manager knows that a local university football game takes place every Saturday, he or she can work with the procurement team to ensure the store has an appropriate amount of chips and salsa on hand during the few days leading up to game day. "The main reason stores use demand planning tools is to keep shelves full and customers happy, but there could be a way for these tools to be used to manage food waste as well," says a logistics specialist.

Establish an industry-wide forecasting and data sharing program. Forecasting systems look across stores within one company, but there would be value in anonymously sharing aggregate sales data across systems and companies to identify macro-level trends in customer buying patterns. While retailers would require a system that allays their concerns about proprietary information, they could work with an industry association, such as the Food Marketing Institute, to share data. "Under the banner of sustainability, there is opportunity for various retailers to collaborate to take a closer look at what the drivers and opportunities are in food waste reduction," confirms a retailer's sustainability director. Aggregated data, once analyzed, would show trends regarding the volume of goods customers purchase and the frequency with which they buy them. This information could help individual retailers make more informed procurement decisions and help parties further up the supply chain, such as manufacturers and processors, understand their customers better, making the industry more efficient overall and reducing waste.

Implement training programs that provide buyers with specialized knowledge and resources about waste reduction strategies for various types of products. Industry-wide, buyers must contend with many demands within their organizations. Generally speaking, they are not given enough time, knowledge, resources, or personal incentive to select the highest-quality products that will last from acquisition to customer purchase. According to a former food retail CEO, retailers "have gotten very lean in their buying departments, and this limits the understanding and specialization of store headquarters about the products they are purchasing." If given the right incentives and resources, buyers could determine the products and scheduling practices that would best support waste minimization.

SOLUTION 2: Establish **transportation practices** that increase product longevity

Once food is procured, it must travel to the retailer warehouses and stores while still viable and consumable. These are two steps retailers should pursue to reduce waste within the supply chain transportation system:

Conduct a thorough assessment of the shipment practices that cause the greatest product degradation. Retailers should work with suppliers of perishable products to determine the points in the transportation process that cause the most damage to products or present the greatest opportunity for greater preservation. They should evaluate transportation methods that use machine handling and human handling to determine the degree to which standard practices in the industry can be improved.

Invest in business models that provide faster transportation and delivery. Today, laws and policies restrict driving time for truckers to ensure their safety and that of other drivers on the road. While these laws must be upheld, they slow down the movement of perishable food from origin to destination. Retailers should prioritize investment in team driving models (two drivers per truck) to ensure product is delivered to warehouses and retail stores as quickly as possible.

SOLUTION 3: Rethink **store infrastructure design** to take food waste into consideration

While some solutions present opportunities to enact change within the existing infrastructure and systems along the food supply chain and retail setting, retailers can also reconfigure the physical layout of their stores to promote food waste prevention. Infrastructure interventions are a large-scale, long-term investment, so they will be most easily integrated into new store construction and renovation projects. Ideas to implement include:

Invest in developing lighting technologies that extend shelf life. To date, retailers have used lighting in stores to give customers a visually comfortable atmosphere that entices them to buy products within specialty departments like produce, seafood, and bakery. The industry as a whole has done little, however, to employ lighting as a tool to extend product shelf life. Says a store designer, "stores are currently using lighting to make product look nice, but there is a greater opportunity to see if we can use lighting to keep products fresh." New lighting technologies may have potential for controlling temperature in food displays and cases, and retailers may want to explore how best to invest in technology development in this area.

Develop and install containers, shelving, fixtures, and displays that minimize handling and merchandise products effectively in lower volumes. Retailers should design stores to discourage people from handling the products and encourage displays that only stock what customers need. Display designers should develop product displays that only appear to be piled high but instead contain less product. More innovation in shipping container size and compatibility with in-store shelving is needed, as are solutions for product padding and care within boxes and on displays. Since retailers do not control all the packaging systems they handle, retailers will need to work with suppliers and other stakeholders within the supply chain to generate improvement in this area.

Improve refrigeration and temperature control technology and standards to maximize product freshness and shelf life. "Temperature control is critical," underscores a retail executive. Together, retailers need to adopt industry-wide perishable temperature control standards, especially for national and international shipments. Individually, retailers should expand controlled-atmosphere technology to store backrooms and display cases that control the ripeness of produce. Distribution centers already use this technology, but its application in-store would further increase the preservation of perishable product. Retailers must also work with refrigeration manufacturers like Hussmann and Hillphoenix to develop new technologies and product designs that further optimize moisture and temperature for the most highly perishable products. Alongside this solution, retailers could conduct a return on invested capital study to determine the degree to which refrigeration improvements would pay off in the long term.

Develop guidelines that store designers can use to determine optimal store layouts. Store designers develop plans based on guidelines that respond to several needs, including customer interests, worker needs, and physical and technological restrictions. Food waste is not currently a primary consideration in store design. "When you're dealing with food, there is so much that goes into [decision making], from handling, safety, and other concerns. We could be making decisions that negatively impact this issue without even knowing it," explains a store designer. There is therefore an opportunity to make food waste a primary concern at the store design level. One design improvement would be to locate the dairy section close to a store's loading docks to minimize transit time and the potential for longer periods without refrigeration. Another example would be to design more customizable layouts that reduce affixed shelving, casing, and structures, thereby giving stores flexibility to move product based on product volume and seasonal needs. To encourage recovery, stores could be designed to have sufficient space to house refrigeration units for products nearing their "best by" dates to be donated to food banks and/or animal feed or composting programs.

SOLUTION 4: Adopt **storage, stocking, and handling practices** that optimize the timing of delivery and sale, and minimize product degradation

There are multiple processing and placement steps that take place between product acquisition and the moment when products are purchased by customers, and these steps can contribute to waste in stores. The following are solutions for storage, stocking, and handling practices that can minimize waste in stores:

Pursue technological development to test product viability and reduce handling. One retailer that minimizes product handling and maximizes its shelf life is Costco. Rather than distributing food to warehouses, the retailer ships produce straight to the store, thereby prolonging product shelf life. Along the same vein, retailers should pursue technology development to find new ways to transport and inspect product with minimized handling. Target, for instance, is testing spectrometer technology to inspect products without opening the storage containers and handling the product unnecessarily. Other retailers could work to identify other promising solutions that they could employ and introduce industry-wide to reduce the need to touch products to assess freshness.

Require food manufacturers and suppliers to deliver food in shipping containers that are sized to streamline storage and display processes in warehouses and stores. "Retail-ready packaging" allows products to be placed on store shelving and displays in one motion, reducing handling and shelving time. "Retailers should revisit the size of the pack containers they are getting from suppliers to make sure they are getting the amount they need," suggests a former retail leader. Retailers can also request pack sizes that mirror what they will sell in one day or shipment cycle so that excess product is not delivered to the store before it can be sold.

Have vendor representatives rotate product when restocking shelves. Retailers can require that vendors who stock products in their stores comply with the first-in, first-out approach. With numerous demands placed on food retail workers, outsourcing this effort to vendors will ensure that store workers can address other operational needs while maintaining the ability to sell older products before newer products are purchased.

Add more controlled-atmosphere rooms in retailer warehouses. Today, most retailers regulate the ripening of bananas based on stores' needs by using controlled-atmosphere technology. Retailers use this specialized system for bananas because they are a top seller and they quickly become a sunk cost if they are not sold. As technology becomes more advanced and its associated cost lowers, there is opportunity for retailers to use similar methods in the handling and storage of other products, such as apples and berries.

Equip store workers with the food safety compliance knowledge they need to prevent unnecessary disposal of food. Store employees may not always know the correct storage and display needs, such as temperature or shelf life, of a given food. According to a retailer representative, "the channel of communication from headquarters to the store level can be convoluted." For this reason, retailers need to clarify their policies for the handling of products near their "best by" dates and provide greater information about spoilage so that products are not pulled from shelves prematurely due to safety and compliance concerns. One low-cost intervention in this area, for example, is to ensure employees know to keep the vents at the bottom of produce cases clear so air circulates to keep the products cold. Food manufacturers and suppliers could work with the Grocery Manufacturers Association to build on its existing product safety initiatives to develop food safety and preservation guides for retailers. Or, retailers could develop and experiment with technology to track the freshness of perishable products, not unlike Walmart's current efforts to apply innovations in database technology to track fresh products back to their point of origin.

SOLUTION 5: Implement activities that help shape **customer perceptions** about food and waste

As mentioned in our introduction, consumer acceptance of new solutions and practices is critical to truly reduce food waste at a large scale. According to ReFED, consumers generate 51 percent of the 52.4 million tons of food that is sent to US landfills annually, equating to approximately 26.56 million tons of food annually.[7] This means the retail industry's customers are a core driver of the food waste problem. Most customers do not actively think about the impact their preferences have on retailers' choices. Retail experts have said that they believe customers would be willing to accept different shopping conditions if they understood why the stores changed their operations. Here are two steps that retailers can take to influence customer opinion and prompt acceptance of waste-reducing efforts:

Support an industry association study to gather customers' opinions on food and waste. The industry has studied customer preferences, but an industry association such as the Food Marketing Institute or the Grocery Manufacturers Association could work to understand what customers' preferences are after being informed of the true cost of food production. This would give the industry insight into customers' desire for abundance versus having just enough food available, and their acceptance threshold for frozen versus fresh products and other waste reduction practices.

Capitalize on evolving customer attitudes to educate customers about food quality, proper preservation and use, and the true cost of abundance and product availability. In today's ever-changing marketplace, customer preferences are continually evolving. Most customers expect stores to carry pre-packaged food and they have become accustomed to warehouse-like shopping and delivery services. These trends indicate that customers are adaptable to change and eager to accept it when it aligns with their interests and values. Yet as a former retail executive explained, "consumers don't realize that their behavior is causing a problem that leads to more waste." Through marketing, in-store signage, and phone apps, retailers can conduct education campaigns that help customers understand how their preferences and actions can cause waste. As an example, retailers can put signs by speckled apples to indicate that the speckles were caused by a hail storm during the growing season, but that the fruit's taste was not compromised. Retailers could print expiration dates of the food purchased on customers' receipts, while groceries ordered through a retailer's online service could be delivered with messaging about how to use and store food in ideal ways. "The shame reaction [that consumers have when they waste food] is strong," one expert tells us, "and people want to have information they can use to counteract it." Further work will need to be done to advance the product tracking capability and software development to enable this messaging, but it is one way the industry can evolve to keep pace with consumers' interests and desire for greater information about their food.

SOLUTION 6: Enact new **merchandising programs** that align customer interests and store practices

More than ever, customers value sustainability and want the companies to which they give their business to focus on it. A 2015 Nielsen study revealed that almost three out of four millennials are willing to pay extra for sustainable offerings, while 72 percent of those ages 15 to 20 are willing to pay more for products and services that come from companies that are committed to positive social and environmental impact. With razor-thin margins in a highly competitive market, retailers must respond quickly and authentically to gain and maintain customer loyalty—particularly the loyalty of younger generations, who are building their shopping habits. Retailers can implement innovative merchandising programs to align their practices with customer values and preferences, including:

Pilot grocery concierge services online and in stores. Today, digital tools make it easy for people to order ahead, whether it be restaurant take-out or pharmacy prescriptions. Retailers can implement inventory management systems that enable them to deliver infrequently purchased items in line with customer demand. Customers could pre-order products like starfruit or kumquats, which are not in as high demand as apples or bananas, freeing a store from having to offer higher volumes of items that are likely to go to waste.

Introduce dynamic pricing models for perishable food. Dynamic pricing is the practice of setting prices based on customers' willingness to pay, as estimated by the retailer. While many retailers are experimenting with dynamic pricing, they should do more to evaluate customer acceptance of the practice and to study their willingness to pay for products that do not meet cosmetic standards and/or are reaching expiration. Some retailers worry that selling less-than-perfect products will erode the quality of their brand, but with the right messaging and price points, retailers can reduce waste and even increase profits. When Intermarché, the third-largest food retailer in France, launched an "ugly fruit" program and an accompanying viral marketing campaign, it was reported that overall store traffic rose 24 percent. In fact, competitors Auchan and Monoprix launched similar initiatives to keep pace.

Expand retail models that allow consumers to buy only the amount they need. Many food system advocates call for a system that includes zero disposable packaging. One way for retailers to move toward this goal is to implement models that allow consumers to measure out the exact amount of food that they need and purchase it in their own reusable container. As one packaging design

expert said, "what if consumers could buy the exact amount of cereal that they need for the month?" Early models exist in grocery stores and alternative food retail outlets, with leaders in Europe such as Original Unverpackt in Germany and LØS Market in Denmark. Stateside, Whole Foods' bulk department allows consumers to purchase their desired quantity of dried beans, pasta, oats, nuts, dried fruit, spices, and dried herbs. While many of these foods have long shelf lives, spices and dried herbs are a helpful offering for food waste reduction because consumers often resort to buying a whole container when a recipe only calls for a small amount. While expanding this model to all of food retail would not be feasible any time soon, especially due to food safety and regulatory concerns, retailers ought to look for ways to introduce variations of this model in stores.

Expand direct-to-customer and meal kit delivery models. Some retailers are experimenting with this now, and there is opportunity to continue this work to discover how open customers are to services that arrive when they want them in the amount that suits them, and how much they are willing to pay for those services. However, as one retail expert noted with regard to this opportunity, "we need to make sure we are not pushing waste [out of the store environment and] into the home."

SOLUTION 7: Create the industry standards and policy environment necessary to increase food waste prevention and recovery

Beyond the specific solutions to waste that can be applied along the continuum of food production to consumption, the right large-scale conditions must exist to ensure that changes within the industry can last over the long term. Specifically, retailers need to have standards to aspire to and to measure their progress against, and federal, state, and local policies must align with retailers' interests in reducing waste. On these fronts, two necessary efforts are:

Develop industry-wide measurement standards for waste tracking and targets for stores of different sizes. Many retailers quantify their energy consumption and point to its reduction as an indication of their commitment to sustainability. While this work is important, retailers must do the same with food waste. The industry needs to jointly develop a uniform system of measurement for tracking in-store waste and define the metrics that stores should meet in relation to their size, just as they have done with energy consumption. A model similar to LEED certification in building construction would help retailers tout their commitment to waste reduction. "The financial cost of energy waste is obvious. It needs to be more clear what the dollar amount is for [companies' food waste]," says a retailer's sustainability representative. Therefore, individual companies should pilot their own food waste audits in the next one to two years to demonstrate the value in waste measurement.

Work with policymakers to improve laws that protect retailers from liability when donating food to food banks. While the Bill Emerson Good Samaritan Food Donation Act of 1996 protects retailers who donate food from criminal and civil liability, this law could be improved to further support retailer donation. Retailers can work with advocates to amend the law to explicitly extend protections to past-dated food and to food donated to individuals (not just nonprofit organizations).

Engaging Stakeholders to Implement the Solutions

Leaders and supporting partners from within the industry are needed to implement these sector-wide, corporate-level, and store-level changes. A vast number of priorities compete for food retailer leaders' time and attention, so food waste reduction will only be prioritized—and the solutions described here will only be implemented—if influencers within the industry commit to address the urgency of the problem and make waste reduction a top value within their companies.

Encouraging Major Players to Spearhead Prevention Efforts

Change within the retail sector will be most likely when the industry's largest players take a stance. When Walmart, the world's largest seller of seafood, announced its plan to only sell seafood certified by the Marine Stewardship Council, the demand for the council's certification increased sevenfold. If companies such as Safeway, Publix, and Target publicly prioritize food waste reduction and show how it benefits their operations, other retailers will follow. "Beyond the first movers, there is the second wave," explains a sustainability expert. Commitments by retail executives to invest in corporate-level and store-level innovation and pilots to prove the business case for potential solutions will build momentum within the industry and promote more broad, sector-wide change.

Fortunately, individual retailers have already taken the lead in food waste recovery efforts and have demonstrated value in addressing the financial, environmental, and cultural problems food waste creates. Kroger and Stop & Shop, for example, have invested in anaerobic digestion systems to turn their food waste into energy, while Whole Foods, Hannaford, and Walmart have piloted imperfect produce programs. Food recovery efforts like these can be matched by waste prevention efforts if leaders within individual retailers act as champions for corporate-level change. Once retailers demonstrate quantifiable benefits for their work, more sector-wide engagement will occur. Because competition within the industry is tight, retailers can create positive pressure among other stores who won't want to be left behind once a new industry standard is established for addressing food waste.

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Additionally, executive leaders of companies that recognize the opportunity to address the challenge should form a joint commitment to implement the industry-wide solutions outlined here. According to one industry expert: "There needs to be an executive-level council that is driving the food waste initiative in the United States that challenges their companies and the country to address food waste." This level of cooperation would signify industry-level change, which in turn could be leveraged to prompt individual retailer attention to the issue.

Stakeholders Who Can Foster Momentum

To support corporations in their leadership of this work, other industry associations and advocates need to be on board. The Grocery Manufacturers Association, the Food Marketing Institute, and state and local grocery associations can support retailers in their implementation and messaging about pilot programs, documenting and publicizing their willingness to try new solutions and their resulting successes. The Food Marketing Institute also has an important role to play in making the case to retailers that waste reduction is something consumers value. The organization could help devise effective consumer engagement campaigns to determine practices that do not confuse or turn consumers away. Associations and advocates can help tap into the competitive spirit that exists among retailers to build positive pressure for members of the food retail industry to change. Lastly, food distributers and wholesalers, many of whom are not involved in industry trade associations, can also serve as important partners in this effort.

REVAMPING THE HOME KITCHEN EXPERIENCE

Consumers' home kitchens are one of the main places were food goes to waste. As mentioned previously, just over 50 percent of the food that ends up in landfills originates with consumers at home.[8] Therefore, changing consumer behavior must be a prominent strategy in our nation's fight against waste.

Unlike in the packaging industry and the food retail sector, where changes have occurred to reduce waste, consumer home kitchen design and at-home methods of food storage and disposal have remained largely static for decades. Recently, though, several innovative solutions have started to emerge to help consumers monitor the food in their homes. One such innovation is Samsung's Family Hub, a refrigerator with built-in cameras that take pictures of the fridge's contents, which consumers can access via their smartphones while grocery shopping. Another new technology is Whirlpool's Zera food recycler, which turns food scraps into compost in 24 hours. Other industry innovators like IKEA have put forth designs of "the kitchen of the future," but such visions do not have food waste reduction as their primary goal. To make food waste reduction a central goal for consumers, greater innovation is needed within the home kitchen environment and its systems to enable consumers to fundamentally change the way they manage and consume food.

Fortunately, several trends are beginning to create windows of opportunity for broad-scale consumer behavior change. A 2016 PLOS ONE study found that just over 58 percent of Americans surveyed agreed that throwing food away is bad for the environment, while 77 percent of Americans surveyed feel guilty when they throw away food. These statistics point to the fact that consumers do not wish to be wasteful. As mentioned earlier, direct-to-home distribution models and technological advancements with smartphones and sensors are creating opportunities for consumers to interact with food products in new ways, both in retail settings and at home.

Unlike in the packaging industry and the food retail sector, where changes have occurred to reduce waste, consumer home kitchen design and at-home methods of food storage and disposal have remained largely static for decades.

Consumers need to be equipped with the tools and information that can help them plan their meals, prevent over-buying, fully consume the food they purchase before it spoils, and maximize recovery and recycling. While interventions in the home kitchen offer the greatest potential for food waste reduction, they are also the hardest to implement, as there are currently few proven solutions, and reshaping consumer behavior and creating a broad-scale cultural shift will take considerable time. The following pages describe efforts to take to overhaul the home kitchen experience to help consumers reduce food waste production within their own kitchens.

Solutions to Consider for Implementation

Through our research and discussion with leading experts in food waste reduction, kitchen trends, and appliance and kitchen design, we identified two main steps to help consumers waste less food at home. They are:

1. **Improve consumers' management of food** they purchase.

2. **Equip consumers' physical space** in the home kitchen to minimize waste.

For both solutions to be effective in encouraging and sustaining broad-scale behavior change, one condition must be met: consumers must have a desire to change. The benefits to consumers are

numerous: saved money, saved time, and a feeling of positivity that comes from contributing to broader societal improvements, such as being perceived as a "good neighbor" or contributing to food security in their communities. Emphasizing one benefit over another may be more effective for certain populations, but it's important to promote and sustain the messaging. As one food waste expert tells us, "in American culture, people don't think they are wasting food, and if they do, [it is socially acceptable]," because waste generation is seen as an unavoidable part of our way of life. Examining how the home kitchen experience influences consumers offers an opportunity to change the perception that waste is unavoidable and prompt consumers to rethink their actions at home. For a list of the solutions described here, please refer to Appendix C.

SOLUTION 1: Improve consumers' management of food they purchase

The most promising way to decrease consumer food waste is to help consumers better manage the food they purchase. To help consumers implement better food management habits and waste monitoring practices, there are five solutions that food industry innovators and food waste advocates should pursue:

Create digital solutions that help consumers keep track of their purchases, learn about their food, and help one another identify ways to minimize waste. Websites like Goodful, which offers video instructions of simple recipes, and apps like Foodfully, which tracks consumers' food purchases and expiration dates and provides recipes for soon-to-expire products, are examples of early solutions in this area. Much more innovation is needed in this area to make solutions that fit seamlessly into the consumer experience and encourage adoption and behavior change.

Two types of new tools and platforms will spur these sorts of innovations: informative and interactive. Informative tools can provide information on products and ideal storage practices and act as platforms where consumers can share recipes for soon-to-expire products. Interactive tools are needed to help consumers remember what products they have purchased and when they will expire. "We know that customers are on their phone when they're shopping, and we know there is a lot of waste at home. There could be a way to use technology to remind people that their food is close to expiring," says a food retail representative. If developed to meet consumer needs, interactive apps could integrate data about the food consumers purchase at different stores, giving consumers a full picture of the food they have, when it will go bad, and offer information regarding what to do with it before it spoils. These tools could track the costs of food so consumers can monitor how much money they are wasting when food spoils, thereby giving consumers a compelling financial case for minimizing their waste. New solutions could also enable waste-tracking competitions—among social communities or geographic communities—to encourage waste reduction.

Innovators we spoke with indicated that there are obvious barriers to this envisioned future. One challenge is that consumers purchase food from varied retail outlets, so the greatest challenge with app development and use is data sharing. It will be a complex endeavor to create software solutions that integrate data from many different retailers' point-of-sale systems and connect that data to appliances or post-waste tracking devices. The ability to tackle this challenge will directly depend on the appetite of consumers and companies to prioritize food waste as a top concern. Innovators and funders who seek change in this realm can align to build a community of entrepreneurs to work together to tackle the ecosystem challenges and barriers to innovation. Research and consumer engagement to develop new tools should begin now, because it may take years to spread adoption among consumers and inculcate widespread behavior change.

Further develop the physical "internet of things" to effectively support consumers in monitoring their food waste. The continued emergence of smart tools such as visual recognition technology and sensors can advance consumer tracking efforts. In the future, consumers' waste bins may be able to recognize the type of waste that is being disposed of, weigh the waste, and send that information to

a database that the consumer and third parties could access to understand their waste patterns and make decisions accordingly. South Korea's government has led in this area, using a waste weighing technology to charge Seoul residents fees based on the amount of food waste they are discarding.

Create a source of "big data" to help food manufacturers, retailers, and industry innovators make macro-level decisions about food production, sales, and consumption. Better tracking capabilities, such as advances in food recognition technology or other methods, would create opportunities to use data to identify trends in food waste, such as what food is wasted most during certain times of year. For example, an industry association or consumer-facing startup might be interested in creating waste profiles of different consumer populations to help food producers, retailers, kitchen product makers, and app developers determine what foods (and in what volumes) to grow, sell, and manage.

Share food waste messages through school systems to educate the country's youth about food spoilage and proper usage. While most of the solutions proposed here are geared toward adults and their actions in home kitchens, a critical way to increase awareness of the issue and engender long-term cultural change is to educate young people. Doing so would help youth learn to value food early in life, making it more likely that young people would be more waste-conscious as adults. K–12 school systems and postsecondary institutions should incorporate information about proper storage and consumption of food, as well as the impacts of food waste, into their health and environmental science curricula. This would provide students with knowledge they can take home to inform their families and later rely on in their adult lives. As an example, schools could inform students about which foods do and do not need to be refrigerated and share information about the shelf life of perishable food. One app developer said, "inspiration is a strong message for people, especially young people interested in food." Schools could also lead by example, introducing food recyclers and composting into their institutional food practices.

Support the continued expansion of new distribution models and the integration of messaging about food waste into these services. Consumers are proven to have "diversification bias," meaning they seek variety when they choose items for future consumption, which leads them to over-estimate their future needs. Additionally, consumers are aspirational when they shop in terms of what they envision their future selves doing and consuming. These conditions lead consumers to overbuy and waste products without intending to. Meal delivery companies, like Blue Apron and HelloFresh, limit the quantity of food consumers receive, which can help consumers avoid excess purchasing without relying on their ability to estimate future needs. These companies can deliver information to consumers about how to minimize waste and encourage them to adopt practices of minimal product use. An appropriate cost-benefit analysis will need to be done to evaluate the larger carbon footprint of these new food distribution models, each of which requires different levels of packaging, cooling, and transportation inputs than traditional food retail models. Additionally, these emerging distribution models may not be widely adopted across the country, and even if they are, it may be years before they fundamentally change the food retail landscape.

SOLUTION 2: Equip consumers' physical space in the home kitchen to minimize waste

In addition to helping consumers monitor their food consumption and waste, there are ways that innovative kitchen designers can rethink the physical components and built environment of the home kitchen. The main solutions are:

Rethink refrigerator design. Appliance companies could redesign refrigerators specifically with the goal of helping consumers extend the life of their food and minimize waste. Today, kitchen appliance companies design within the constraints of traditional industry standards, which do not help consumers manage their food as well as they could. The size and format of refrigerators and cabinetry are

typically such that consumers can't fully see what they have or easily remember when they bought which products. These appliances also do not provide feasible options for post-use disposal, such as composting. Refrigerator depths could be changed, as a more shallow footprint would improve product display and visibility. According to one food waste expert: "People do not like 'white space' when it comes to food. They don't want to see a plate with a little bit [of food] on it, and they don't want to see an empty fridge." Refrigerators could incorporate more drawers with temperature variations intended for specific functions or offer controlled-atmosphere environments like those used in packaging to support the preservation of food. Refrigerators could also be designed with messages or smart technology features to encourage consumers to use food that is nearing its use-by date. Consumer kitchen startup Innit is on the leading edge of this effort, working to integrate commercial-grade sensor technology into wi-fi-connected appliances to make food tracking and consumption simpler for consumers. More work like this can advance the field and increase consumer demand for such appliances.

Advance freeze-drying technology so that it is ready for wider expansion in the consumer market. Freeze drying extends shelf life without the use of any preservatives. While freeze-dried products are available in grocery stores and online, consumers would also benefit from being able to apply this processing technology to their extra food at home. However, home freeze dryers are too expensive for the average consumer. This offers the opportunity to conduct further testing of consumer interest in freeze drying and development of affordable in-home solutions.

Design waste collection systems to incorporate bins for food waste, not just landfill trash and recycling bins. The average American home today has both a trash bin and a recycling bin. However, far fewer households collect kitchen scraps for compost. Consumer product designers and kitchen designers should consider organic waste as they design waste collection areas for kitchen and cabinetry layouts. One appliance designer pointed out that product companies won't sell products unless there is a consumer demand, so it will be important for consumers to seek this type of change in their kitchens.

Commission a study to determine whether there is a correlation between refrigerator size and food waste generation. One expert on consumer kitchen trends told us that the refrigerator has replaced the range as the centerpiece in the modern kitchen. Despite its central function in the home kitchen, it is unknown how appliance size impacts waste generation. Experts wonder whether smaller appliances lead to greater waste, because less can be preserved and/or more frequent grocery trips are required, or whether larger appliances lead to greater waste, because consumers can store more than they can realistically eat. Appliance designers will need this information to guide their product development processes and encourage changes in consumer behavior.

Prove the viability of tools that make food last longer in consumers' refrigerators. There are tools that can delay spoilage for unpackaged food. For instance, specialized paper can absorb gases that accelerate the ripening of produce in a vegetable crisper. This is a low-cost solution that easily equips consumers to preserve their food. More work needs to be done to prove the viability of such innovations, however. As one sustainability advocate pointed out, these products must "reach the bar of convenience and technical efficacy" to succeed in the marketplace. When designing these tools, product developers must also ensure that they do not introduce toxic elements to the home environment.

Explore the creation of alternative layouts and kitchen operations that could help consumers minimize waste. Designers may be interested in reconfiguring the traditional kitchen layout that centers on the refrigerator, oven/stove, and sink to better encourage food waste reduction. One interior designer proposed that "the new kitchen should be flexible" to respond to consumer needs. Human-centered design firms should perform ethnographic research and plan for future kitchen technologies to give appliance companies and built environment designers a new vision for how people will want to store, prepare, consume, and dispose of food in the future. Considering that there are so many different configurations and setups across home kitchens in America, work will need to be done to identify solutions and formats that can be applicable within varying settings and home sizes.

Develop design guidelines for architects, construction companies, and government agencies to refer to when creating building standards. Once trial solutions have been piloted, and a set of best practices emerges for appliance designs and architectural layouts that support waste reduction, design guidelines could be developed that housing construction companies could use to create their own construction standards. Such guidelines could then influence new building development standards and regulations. A partner such as Enterprise Green Communities could offer support in this realm. Enterprise Green Communities is an independent entity that helps developers, investors, builders, and policymakers incorporate sustainable construction practices into affordable housing planning. This organization could help disseminate best practices and spread the word about the ideal setups to promote in-home consumer waste reduction.

Integrate food waste reduction standards into green building certification programs and align kitchen appliance development work with regulatory trends. Industry associations could work with the US Green Building Council, for example, to add food waste reduction standards to LEED certification requirements to match existing standards for energy and water efficiency. Industry associations can also work with government regulators to align product development efforts with new regulations being implemented at the municipal level. As an example, as jurisdictions across the country consider rollouts of organic waste bans, companies could help develop products and systems that will prepare consumers for new laws that will dictate their food disposal practices. That way, consumers will have the tools to respond when new regulations are enacted.

Take greater steps to inform consumers about the functionality of their current appliances and kitchen systems. Technological advancements and new designs will take time to develop, so in the interim, non-technical work should be done to educate consumers about things they can do now to extend the life of their food. Refrigerator companies should provide accessible guidance on how to optimize temperature control and the internal storage configurations of their appliances. Kitchen stores should model ideal practices in their showrooms to inform consumers of best practices to replicate in their own homes, and food waste reduction advocates should work to reiterate messages through educational campaigns, materials, and popular media. As one innovative product designer noted with regard to this opportunity, "there is very little education about separating different kinds of produce, and consumers need to learn to store food more intelligently."

Institute communal composting programs to encourage waste recovery and feed existing composting streams. There is a need for more building-wide and neighborhood-wide coordination to deal with food waste. Multi-unit buildings and neighborhoods can institute communal composting programs to encourage collective action to recover unavoidable food waste for reuse as fertilizer and as a potential energy source.

Engaging Stakeholders to Implement the Solutions

In-home kitchen design and consumer food management are ripe for innovation, and a diverse range of players from several sectors will be needed to help advance new ideas. Product designers and app developers can rethink how consumers purchase, prepare, store, and dispose of food and present new solutions to help them change their behavior. Similarly, innovative builders, architects, and advocates can propose new built environment solutions to minimize waste in the home. At the city level, waste management agencies can help scale solutions in waste management by working to advance composting at the community level.

Organizations from a wide range of industries can support the development of innovations in this space. Appliance design companies and kitchen industry associations like the National Kitchen & Bath Association, the International Housewares Association, and the Association of Home Appliance Manufacturers can encourage, fund, and publicize efforts to innovate in the home kitchen. Home construction organizations that represent developers and builders, like the National Association of Home Builders, can do the same. Popular media outlets can also influence consumers by promoting

new solutions once they are developed and encouraging consumers to integrate them into their homes. Entities such as *Consumer Reports* can offer legitimacy to innovative solutions when warranted, and social media influencers like Spoon University, whose content is geared toward college students, and food-focused television networks and blogs, which appeal to a larger audience, can promote waste reduction education campaigns. Finally, innovators in this space can coordinate with grocery industry associations and food retailers to support educational campaigns at retail stores to support shifts in consumer behavior.

CONCLUSION

This solutions guide has laid out promising opportunities that food industry leaders and disruptors, food waste advocates, researchers, designers, and funders can pursue to reduce waste in food manufacturers' product delivery, food retailers' operations, and consumers' food management and consumption. We recognize that not all of these solutions can be adopted widely, nor may all be widely accepted by consumers and corporations due to associated cost or other factors not readily apparent. The food system is complex; a positive change within one link of the supply chain could have unintended—and perhaps detrimental—consequences within another section of the system. Packaging improvements that support greater food preservation could, for example, create greater materials waste than desired. Conversely, the success of one solution in the supply chain may solve a problem somewhere else in the chain, especially given the interdependency of some of the solutions proposed here. Our belief is that the greatest opportunity lies within the areas where food manufacturers, suppliers, and retailers come together to think about how their operations impact how consumers interact with food.

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While we hope there are solutions each party can consider piloting or implementing fully to advance food waste reduction efforts, we encourage stakeholders from across the food system to come together to jointly make changes so that food waste reduction is a core consideration as food travels from farm to fork.

The solutions in this guide are ready for advocacy groups, government agencies, and food industry leaders to take up themselves, but many could be accelerated by philanthropic support. We see opportunities for funders and investors interested in various components of the food system to support the development, implementation, and evaluation of these solutions. Recognizing that there is more work to be done to cultivate the sustainable, equitable food system we envision, we hope our findings serve as a springboard for action and collaboration within and beyond the food industry to continue to drive the field forward.

Endnotes

1 "A Roadmap to Reduce US Food Waste by 20%: Technical Appendix," last modified March 2016, https://www.refed.com/downloads/ReFED_Technical_Appendix.pdf.
2 Ibid.
3 Ibid.
4 Ibid.
5 Ibid.
6 Diane Letson, "New Business Feeds the Need," Feeding America, July 19, 2016, http://www.feedingamerica.org/hunger-in-america/news-and-updates/hunger-blog/new-business-feeds-the-need.html.
7 "A Roadmap to Reduce US Food Waste by 20%: Technical Appendix."
8 Ibid.

APPENDIX A:
PACKAGING SOLUTIONS FOR FOOD WASTE REDUCTION

IN NEED OF FURTHER DEVELOPMENT

Develop consumer-facing sensor technology to indicate food safety

Use predictive analytics and vision technology in processing plants to increase efficiency

Further develop recyclable and compostable packaging solutions

IN NEED OF VALIDATION

Explore consumer acceptance of alternate versions of products with longer shelf lives

Expand active packaging to shipping containers in order to preserve the freshness of unpackaged products during transport

Capitalize on innovations in biodegradable and alternative, sustainable packaging solutions to improve new packaging technologies

READY TO BE SCALED

Expand the use of MAP technology to additional perishable product groups

Increase the use of vacuum-sealed products to prolong shelf life

Integrate smart tags and QR codes that contain information on product shelf life and storage tips into packaging

Expand use of new technologies that allow food to be processed with fewer preservatives and/or less need for refrigeration

Encourage food manufacturers to adjust cosmetic standards for produce to reduce the amount of produce they reject

Implement smaller portion sizes in food retail and quick-service food service

Expand the use of resealable packaging

Expand use of compostable packaging and composting programs in large institutions like stadiums and universities

APPENDIX B:
RETAIL SOLUTIONS FOR FOOD WASTE REDUCTION

IN NEED OF FURTHER DEVELOPMENT

Develop and implement new technologies that enable in-store farming

Invest in development of lighting technologies that extend shelf life

Develop and install containers, shelving, fixtures, and displays that minimize handling and merchandise products effectively in lower volumes

Improve refrigeration and temperature control technology and standards

Pursue technological development to test product viability and reduce handling

IN NEED OF VALIDATION

Further develop forecasting technology to allow for highly local customization

Establish an industry-wide forecasting and data sharing program

Conduct a thorough assessment of the shipment practices that cause the greatest product degradation

Invest in business models that provide faster transportation and delivery

Develop guidelines that store designers can use to determine optimal store layouts

Require food manufacturers and suppliers to deliver food in shipping containers that are sized to streamline storage and display processes

Support an industry association study to gather customers' opinions on food and waste

Develop industry-wide measurement standards for waste tracking and targets for stores of different sizes

READY TO BE SCALED

Implement training programs that provide buyers with specialized knowledge and resources about waste reduction strategies

Have vendor representatives rotate product when restocking shelves

Add more controlled-atmosphere rooms in retailer warehouses

Equip store workers with the food safety compliance knowledge they need to prevent waste

Educate customers about food quality, proper preservation and use, and the true cost of abundance and product availability

Pilot grocery concierge services online and in stores

Introduce dynamic pricing models for perishable food

Expand retail models that allow consumers to buy only the amount they need

Expand direct-to-customer and meal kit delivery models

Improve laws that protect retailers from liability when donating food to food banks

APPENDIX C:
HOME KITCHEN SOLUTIONS FOR FOOD WASTE REDUCTION

IN NEED OF FURTHER DEVELOPMENT

Create digital solutions to consumers keep track of their purchases, learn about their food, and help one another identify ways to minimize waste

Further develop the physical "internet of things" to effectively support consumers in monitoring waste

Rethink refrigerator design

Advance freeze-drying technology to be ready for wider expansion in the consumer market

Design waste collection systems to incorporate bins for food waste

IN NEED OF VALIDATION

Create a source of "big data" to help food manufacturers, retailers, and industry innovators make decisions about food production, sales, and consumption

Share food waste messages through school systems to educate the country's youth about food waste

Commission a study to determine whether there is a correlation between refrigerator size and food waste

Prove the viability of tools that make food last longer in consumers' refrigerators

Explore the creation of alternative layouts and kitchen operations that could help consumers minimize waste

Develop design guidelines for architects, construction companies, and government agencies to refer to when creating building standards

Integrate food waste reduction standards into green building certification programs and align kitchen appliance development work with regulatory trends

READY TO BE SCALED

Support the continued expansion of new food distribution models and the integration of messaging about food waste into these services

Inform consumers about the functionality of their current appliances and kitchen systems

Institute communal composting programs to encourage waste recovery and feed existing composting streams

APPENDIX D
LIST OF INTERVIEWED STAKEHOLDERS

NAME	ORGANIZATION
Christine Gallagher	Ahold USA
Bob Lilienfeld	American Institute for Packaging and the Environment
Kara Rubin	Beyond Brands
Whitney Beadle	BIOFerm Energy Systems
Adam Wintle	Biogas Energy Partners; Exeter Agri-Energy
Gaurav Raut	Blue Apron
Rachael Vegas	Brandless
Bob Deans	C2Sense
Jan Schnorr	C2Sense
Naomi Starkman	Civil Eats
Rob Kaplan	Closed Loop Fund
Ron Gonen	Closed Loop Fund
Jeremy Brosowsky	Compost Cab
Greg Drescher	Culinary Institute of America
Jonathan Deutsch	Drexel University, Drexel Food Lab
Michael Keleman	Emerson Climate Technologies
Karen Hanner	Feeding America
Kavita Shukla	Fenugreen
Andy Harig	Food Marketing Institute
Brianna McGuire	Foodfully
Sharon Franke	Good Housekeeping
Meghan Stasz	Grocery Manufacturers Association
Jose Alvarez	Harvard Business School
Emily Broad Leib	Harvard Food Law and Policy Clinic
Aidan Mouat	Hazel Technologies
Courtney Bourns	Henry P. Kendall Foundation
Noreen Otto	Hy-Vee
Pat Hensley	Hy-Vee

NAME	ORGANIZATION
Bobby Chang	Incase; Mission Heirloom
Kris Moon	James Beard Foundation
Cecile Carson	Keep America Beautiful
Clare Miflin	Kiss + Cathcart
Andrew Shakman	LeanPath
Sheila Ongie	National Co+op Grocers
Dana Gunders	Natural Resources Defense Council
Walter Peterson	Nestlé USA
Louise Bruce	New York City Department of Sanitation
Ashley Zanolli	Oregon Department of Environmental Quality
Claire Sand	Packaging Technology & Research
Andrew Aulisi	PepsiCo
Anke Boykin	PepsiCo
Glenn Bergman	Philabundance
Kathy Means	Produce Marketing Association
Michael Hewett	Publix Super Markets
Ron Cotterman	Sealed Air Corporation
Christy Cook	formerly Sodexo
Marcus Hannibal Madsen	Soren Rose Studio
Nina Goodrich	Sustainable Packaging Coalition
Amber Koehler	Target Corporation
Lara Hendlin	Target Corporation
Robby Cruz	Target Corporation
Elise Golan	United States Department of Agriculture, Office of the Chief Economist
Helen Gurfel	Urban Land Institute, Greenprint Center for Building Performance
Eileen Hyde	Walmart Foundation
Kelley Rich	Whirlpool Corporation, WLabs
Scott Sichmeller	Whirlpool Corporation, WLabs
Kylie Sale	Whole Foods Market
Michel Nischan	Wholesome Wave
Kai Robertson	World Resources Institute
Pete Pearson	World Wildlife Fund