The Role of Flexible Packaging in Reducing Food Waste: Organizations, Goals, Case Studies, Insights, and Opportunities for Flexible Packaging

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Executive Summary

Global Scope of Food Waste

- ❑ If food waste were a country, it would rank 3rd in environmental impact behind the USA and China.
- ❑ Global initiatives on food waste are driven by the United Nations Strategic Development Goal 12.3.
- ❑ Countries that use more prepared foods have less per capita food waste.

USA Scope of Food Waste

- ❑ EPA 2023 Food Waste Scale emphasizes the critical role of preventing food waste with solutions, such as packaging.
- ❑ 48% of food waste is from consumers.
- ❑ For consumers, most food waste is in produce, dairy, and dry goods.

Case Studies on Flexible Packaging That Prevents Food Waste

- ❑ 14 Case Studies (8 science-based and 6 design-based) quantify how flexible packaging prevents food waste.

Direction

1. Engage in a systems approach to sustainability.
2. Promote functions of flexible packaging in food waste prevention.
3. Engage in opportunities via organizations to ensure that flexible packaging is part of the solution.
4. Use consumers and brands to advocate for flexible packaging to be included in extended producer responsibility (EPR).

Part 1: Global Scope of Food Waste

Flexible food packaging works hard to prevent food waste. Preventing food waste is a primary strategy for mitigating the environmental consequences of our food system. Food production represents over a quarter of all greenhouse gas (GHG) emissions, exerting significant environmental pressures on water, land, energy, and other resources throughout the food supply chain. From farm to fork, the food system is responsible for 26% of all greenhouse gas emissions. In contrast, food packaging—from the extraction of basic materials like oil to the final converting operations accounts for only 2.2% of all greenhouse gas emissions.

Linking the environmental impact of our food system to the packaging used to protect it is paramount so that the impact of each using the same metrics can be assessed. The good news for flexible packaging is that, from a global perspective, this linkage now exists in the United Nations Sustainable Development Goal (UNSDG) Target 12.3.

In Target 12.3, the UN Sustainable Development Goals (SDG), directly relates to food packaging. The 12.3 goal is to halve food waste at the retail and consumer level by 2030. The United Kingdom was the first country to get more than halfway toward meeting this target; that marks only about a 25% reduction even in the nation with the highest reduction, the UK. They have seen success with this program “Love Food, Hate Waste.” Regardless, this linkage, spawned by UNSDGs 12.3, between the environmental impact of our food system and the packaging used to protect has resulted in focused initiatives, consumers, retailers, brands, and government organizations, and this has increased the understanding of the positive impact of that flexible packaging does and can have on more sustainable food packaging and global food systems.

Part 2: U.S. Scope of Food Waste

Food waste has a significant environmental impact, equivalent to the yearly emissions from approximately 50 million gasoline-powered vehicles. This figure is only increasing, as per capita food waste in the United States is increasing at approximately 6% yearly.

Food waste prevention is indispensable in the context of food waste reduction. The United States, where packaging plays a significant role in prevention, exhibits relatively low per capita food waste compared to certain other countries.

The United Nations Environment Program (UNEP) graph displays food waste in kilograms. The United States has a per capita rate of 59 kilograms, but Nigeria has the highest rate at 189 kilograms. Although Nigeria has a substantial urban population, it also has a substantial rural population. In rural areas, individuals consume fewer packaged foods. Higher levels of food waste result when consumers use less packaged food.

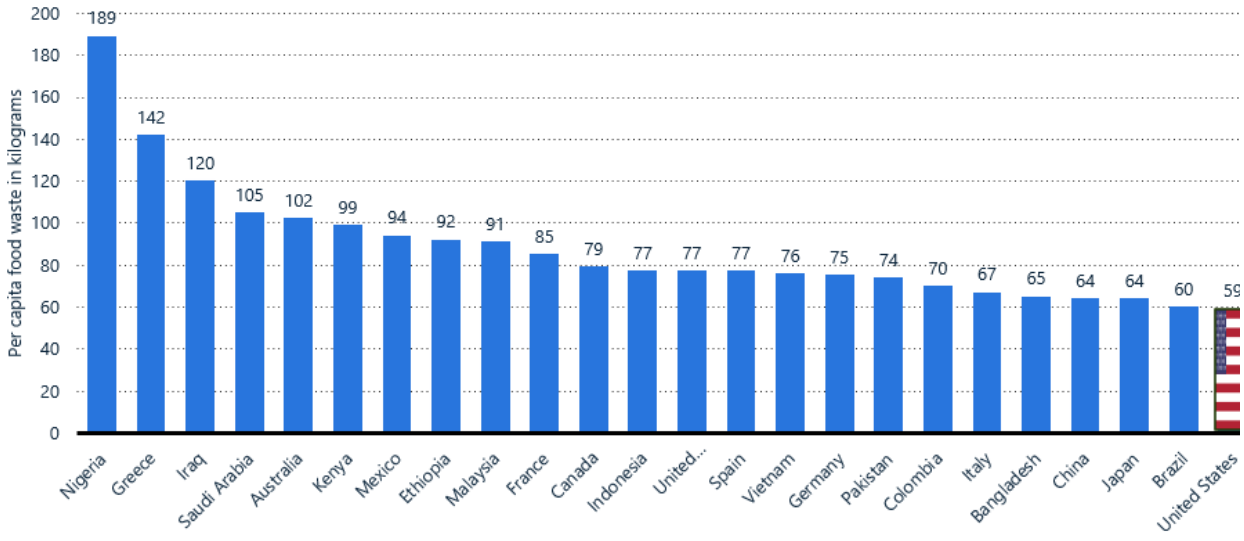


Figure 1. Countries that use more prepared foods have less per capita food waste

Prevention of food waste is the new focus and where flexible packaging can shine. As mentioned, the United Nations food waste reduction target is 50% by 2030, based on a 2015 baseline year. Preventing food waste will have the most environmental and economic benefits. Preventing food waste is also where flexible packaging can shine. Fortunately, there was a significant shift in the EPA's perspective on Food Waste Recovery in 2023, as the Wasted Food Scale replaced the former hierarchy. The previous hierarchy failed to encompass certain critical components; the current hierarchy illustrates a most preferred to the least preferred method of mitigating the environmental consequences of food waste. The current perspective is more appropriate in that it emphasizes the need for food waste prevention. Preventing food waste has the greatest impact on sustainable food systems and is the most effective use of packaging.

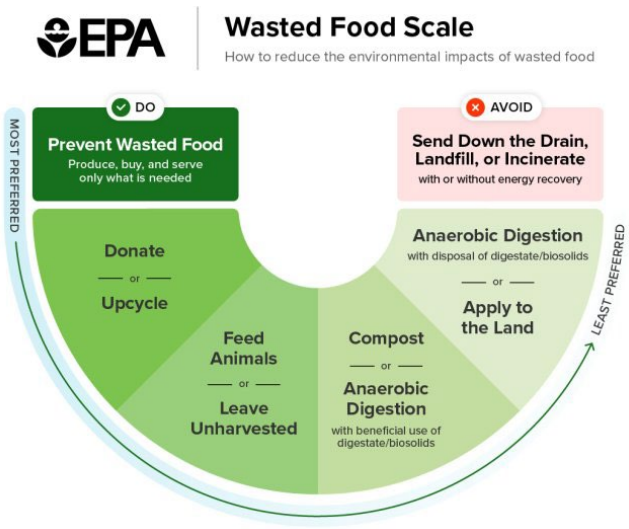
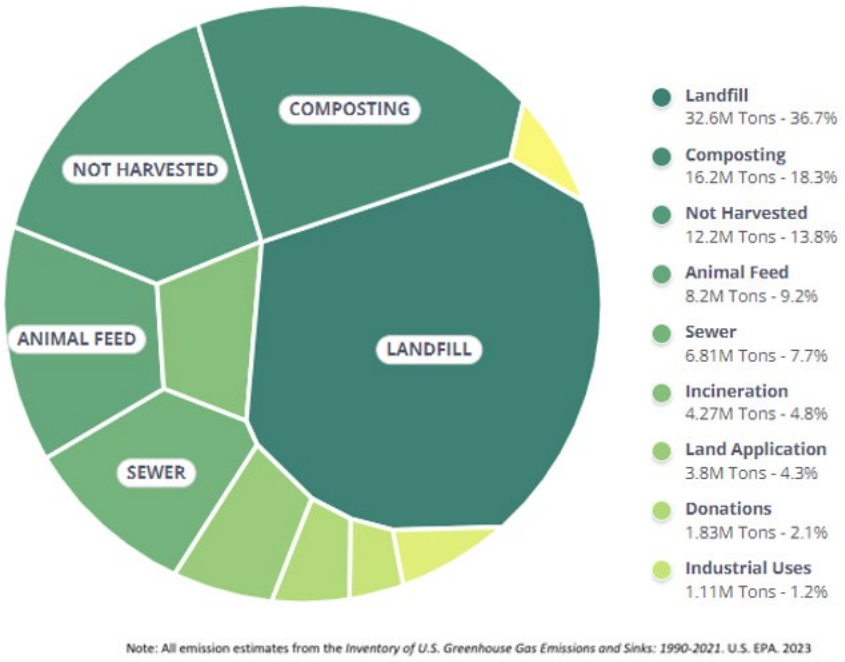


Figure 2. Prevention of food waste is the most preferred

Diversion from retailers to, for instance, food pantries is a component of reduction. This reduces waste, preventing it from being disposed of in a landfill or composting facility. It is not discarded; rather, it is reduced. The solution's failure to address food waste prevention is a limitation, as the waste is not being prevented but rather reallocated. This presents an opportunity to highlight the value of packaging. Technological innovations, such as those that enable food donations, can facilitate food waste reduction. Nevertheless, packaging, particularly flexible packaging, can potentially prevent and reduce food waste. Along the EPA scale, the donation or upcycling of foods with flexible packaging results in a more user-friendly product or a longer shelf life.

Food waste is the primary cause of landfill capacity issues and the primary reason for the scarcity of space in those landfills. As shown in Figure 3, landfilled food waste has a significant environmental impact.



Note: All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021*. U.S. EPA. 2023

Figure 3. Food waste disposal methods

Food waste disposal in landfills is extremely costly. Food waste that is landfilled or composted contributes to 8% of all methane emissions. Landfills contain 24% food waste, the highest percentage of waste in landfills. This underscores the necessity of prevention strategies, including developing innovative packaging. The process of composting involves the utilization of food refuse. The primary objective should be to prevent the accumulation of food waste using food packaging. As a result of the rapid decomposition of organic matter, the concurrent increase in food refuse deposited in landfills has resulted in a corresponding increase in landfill methane emissions. From 1990 to 2020, there was a 295% increase in landfill methane emissions from fast-decaying food waste in landfills. By contrast, durable consumer products, such as refrigerators, do not decompose in landfills, thereby preventing the emission of greenhouse gases such as methane. However, food waste decomposes rapidly in landfills, producing methane rapidly, a harmful greenhouse gas contributing to climate change. Even though this decomposition process is rapid and reduces the quantity of waste in landfills, it is unregulated and promotes climate change. Prevention of food waste inhibits food waste from entering landfills.

New regulations, such as Vermont's 2020 food waste prohibition, are imposing financial penalties on retailers for food waste. This policy promotes the reduction and diversion of refuse. This policy requires a brand to pay for the de-packaging of food refuse at the retail level. The packaging is transported in one direction, while the food is transported in another. Subsequently, the brand decomposes or converts the food into animal feed. The brand is also responsible for appropriately disposing of the packaging, which will require landfill payment if it is not recyclable. Vermont prohibits the disposal of compostable packaging in landfills due to concerns regarding the potential contamination of high-quality compost. California mandates the separation of food remnants, while other states impose restrictions on retailer disposal of food waste in a landfill. In certain instances, regulations may permit composting but are genuinely opposed to food waste. Consequently, retailers must exercise greater oversight over the products they sell or distribute to food shelves and implement explicit food waste prevention measures. The general trend is to decrease food waste by implementing more stringent regulations and providing incentives for prevention.

Food waste can also be prevented by upcycling food in a factory with its byproducts at the outset of production. Whey protein concentrates are one of the first upcycled or commonly upcycled foods. Flexible packaging can be used to package upcycled foods.

Food Waste Organizations

The number of organizations concerned with food waste has increased dramatically, as have the number of specific focus areas. Reducing food waste is a $155-405 billion economic opportunity. The growth in food waste reduction and, specifically, prevention organizations is an opportunity for the flexible packaging industry and the FPA. This is because these organizations are increasing awareness of the need for food waste prevention and garnering funds to prevent food waste. Further FPA alignment with these organizations is advised, as mentioned in the "Direction" section of this report.

Some organizations are global and address the entire value chain, while others are country-specific and focus on only one aspect of the value chain. Organizations were screened and then ranked based on whether and how much of their work is focused on food waste prevention and packaging as a solution to food waste prevention. All food waste organizations are listed in the Appendix.

Global organizations that include packaging as a food waste prevention solution have been identified and ranked, as shown below in Table 1.

Table 1. Global food waste organizations ranked by their involvement in the prevention of food waste using packaging

1. Champions 12.3 2. EUROPEN 3. WRAP 4. ReFED 5. Flexible Packaging Europe (FPE) 6. INCPEN 7. American Institute for Packaging and the Environment - AMERIPEN 8. Flexible Packaging Association 9. BPF & The Plastic Packaging Industry 10. British Plastics Federation - BFA 11. EPA 12. Natural Resource Defense Council (NRDC) 13. U.S. Department of Agriculture (USDA) 14. Project Gigaton 15. Sustainable Packaging Coalition	16. Save Food 17. Plastics Europe 18. SusFoFlex 19. Consumer Goods Forum 20. European Commission on Waste 21. Michigan State University 22. University of Michigan Center for Sustainable Systems 23. Royal Melbourne Institute of Technology (RMIT) 24. The Packaging Federation 25. Wageningen University & Research (WUR) 26. American Chemistry Council (ACC) 27. United Nations Development Program 28. PAC Global 29. Food Packaging Forum 30. ProEurope 31. Clemson FRESH

Organizations within the U.S. that include packaging as a food waste prevention solution have been identified and ranked, as shown below in Table 2.

Table 2. USA food waste organizations ranked by their involvement in the prevention of food waste using packaging

1. ReFED	9. Sustainable Packaging Coalition
2. Champions 12.3	10. U.S. Department of Agriculture (USDA)
3. Food Waste Reduction Alliance	11. EPA
4. Project Gigaton	12. University of Michigan Center for Sustainable Systems
5. WRAP–USA	13. Michigan State University
6. Natural Resources Defense Council (NRDC)	14. PAC Global
7. American Institute for Packaging and the Environment (AMERIPEN)	15. Clemson FRESH
8. Flexible Packaging Association	16. American Chemistry Council (ACC)

The nine (9) organizations that address the entire value chain are ranked in Table 3.

Table 3. Food waste organizations that address the entire value chain ranked by their involvement in the prevention of food waste using packaging

1. ReFED	6. Natural Resources Defense Council (NRDC)
2. American Institute for Packaging and the Environment (AMERIPEN)	7. U.S. Department of Agriculture (USDA)
3. Flexible Packaging Association	8. EPA
4. Food Waste Reduction Alliance	9. University of Michigan Center for Sustainable Systems
5. WRAP-USA	

The six (6) organizations linked to U.S. retailers are ranked in Table 4.

Table 4. Food waste organizations that are linked to U.S. retailers are ranked by their involvement in the prevention of food waste using packaging

1. Champions 12.3	4. Sustainable Packaging Coalition
2. Project Gigaton	5. Flexible Packaging Association
3. ReFED	6. WRAP–USA

Part 3: Case Studies on Flexible Packaging That Prevents Food Waste

ReFED estimates that improved packaging could prevent over one million tons of food waste and six million metric tons of greenhouse gas emissions annually. Case studies are critical to understanding the role of flexible packaging in preventing food waste.

A pragmatic approach to developing and producing case studies was used to avoid the substantial criticism of flexible packaging and plastic-related packaging and to address the data gap on food waste saved by packaging technology and design solutions. Criticism of case studies is common and diverts attention from flexible packaging and food waste prevention benefits. Further, the environment for promoting flexible packaging as a food waste solution has been challenging due to overstated sustainability claims and criticisms of specific packaging formats, particularly plastics. Case studies were designed to avoid this negative criticism.

Moreover, the shelf life extension that can be achieved upon converting to flexible packaging from another format or through the application of technology was not available. This information is product-specific and demands extensive shelf life testing and an understanding of the required shelf life. An in-depth review of numerous case studies did not yield sufficient or convincing information to strongly show an increased shelf life with defined food waste prevention attributed to flexible packaging. Frequently, the case studies did not disclose brand, trade secrets, or sales data, which could more accurately illustrate consumer preferences due to the association with food waste prevention.

Our case studies were designed to provide an image of why they prevent food waste and the impact of this food waste by category. Examples across food categories provide context for the breadth of each solution. This methodology enables a comprehensive evaluation of flexible and other packaging formats, clarifying the role of flexible packaging in technological solutions for food waste reduction. Critically, ReFED standardized data was used to make the process repeatable and U.S.-focused.

Many of these solutions can only be achieved with flexible packaging, so it also helps understand the critical role of a single flexible packaging solution working in multiple categories. Case studies address a wide range of food categories, including meat, bakery, produce, dairy, and prepared meals. This cross-category approach fosters broader stakeholder representation and involvement.

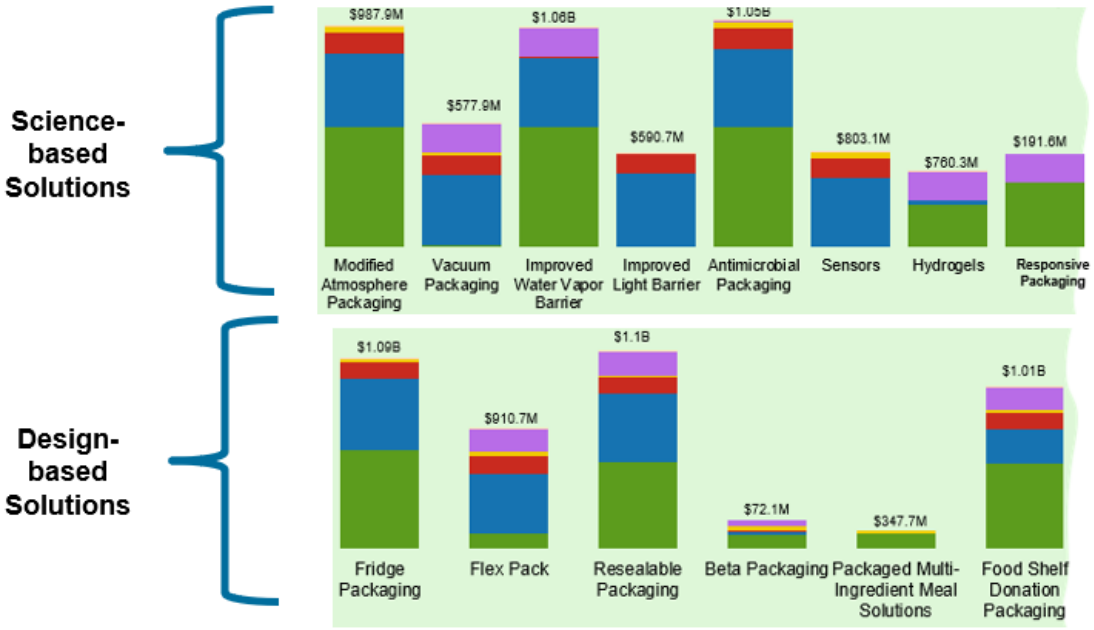


Figure 4. Science- and Design- based case studies

Science-based Flexible Packaging Case Studies That Prevent Food Waste
Eight (8) science-based flexible packaging case studies that demonstrate food waste prevention are highlighted. Five of these solutions are currently used by the flexible packaging industry. The science behind the technology, its relevance to flexible packaging, categories of application, and examples are provided.

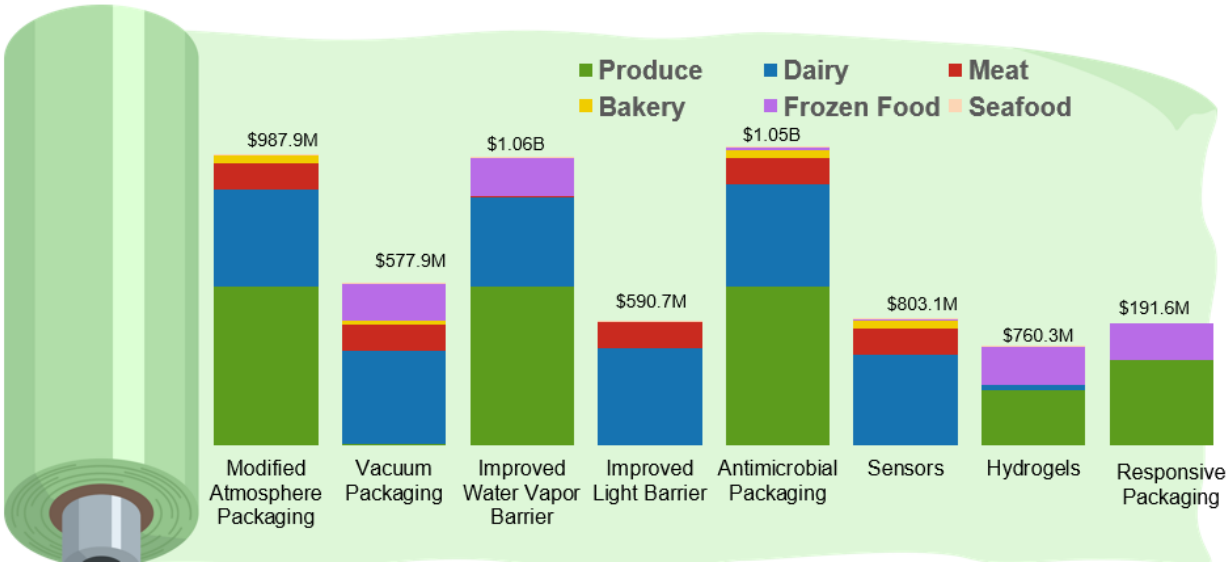


Figure 5. Science-based case studies

Modified Atmosphere Packaging Case Study: $987.9M Annual Impact

Modified atmosphere packaging is a highly relevant case study since it is common practice in flexible packaging to prevent food waste across many categories. The gases that are employed, typically nitrogen and carbon dioxide (and, in the meat industry, carbon monoxide in a restricted quantity), supplant oxygen, thereby reducing microbial growth and oxidation (commonly referred to as rancidity). This inhibits the oxidation or degradation of the product, but it can also prevent microbial growth if the oxygen level remains low. These may be pathogens, but they could also be yeast and fungi, which are more prevalent in the bakery industry.

Flexible barriers are tailored to retain different atmospheres within the package.

Produce: $248.4M annual impact. Micro holes allow steaming in the package, but these micro holes also create a modified atmosphere package, starting with a certain atmosphere and slowly metering different oxygen levels based on the holes' size. Produce is the number one category for this technique and the number one application where modified atmosphere packaging is employed.

Dairy: $152M annual impact.

Meat: $152.9M annual impact. The primary flexible package overwrap has a secondary master flexible package that keeps the meat at around 2% oxygen to retain meat quality and inhibit the growth of *Clostridium botulinum.*

Bakery: $12.2M annual impact.

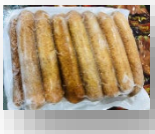
Snack foods: Filled with nitrogen to inhibit lipid oxidation and reduce product crushing.

Vacuum Packaging Case Study: $577.9M Annual Impact

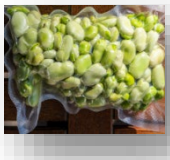
Vacuum packaging is comparable to modified atmosphere packaging; however, it is more specific in that it eliminates oxygen, and the product and container are in direct contact. This is an instance in which flexible packaging is required; it is impossible to achieve this with a rigid PET clamshell or an aluminum can, even with retort processing.

Produce: $1.6M annual impact. Vacuum packaging is not commonly used with produce packaging because removing oxygen creates an environment for anaerobic glycolysis and subsequent rapid produce degradation.

Dairy: $145M annual impact. Injecting CO_2 into the flexible package allows for a vacuum package when the cheese absorbs CO_2.



Meat: $42.3M annual impact. The flexible package conforms to the shape of sausages, inhibiting freezer burn.



Frozen Food: $58.7M annual impact.

Improved Water Vapor Barrier Case Study: $1.06B Annual Impact

Flexible packaging incorporating advanced water vapor barriers is widely used to maintain product moisture levels and extend shelf life. These barriers contribute to microbial control and texture preservation. Superior water vapor barriers are used for flexible barriers for very dry products like cereals, chips, and rice as well as for moist products such as wet pet food and tuna.

Produce: $248.4M annual impact.

Dairy: $141.4M annual impact.

Meat: $2.8M annual impact.

Frozen Food: $58.7M annual impact.

Improved Light Barrier Case Study: $590.7M Annual Impact

Light-induced lipid and amino acid oxidation alters product quality and nutrients. Flexible packaging inhibits light exposure preventing food waste.

Dairy: $152.9M annual impact.

Meat: $39.5M annual impact.

Antimicrobial Packaging Case Study: $1.05B Annual Impact

Antimicrobial packaging has been in use since the 1980s. Commercial applications are moving forward more rapidly. For example, Aptar technology contains channels within the package that release chlorine dioxide which effectively reduces the microbial growth load within the product. The meat and bakery industries employ CoppTech Zinc Oxide and SoFresh ethyl pyruvate technologies to stall microbial growth.

Produce: $248.4M annual impact.

Dairy: $161.4M annual impact.

Meat: $42.3M annual impact.

Bakery: $12.2M annual impact.

Frozen Food: $3.3M annual impact.

Sensors Case Study: $803.1M Annual Impact

Sensors embedded in packaging can detect microbial growth and indicate if a food remains safe to eat. Flexible packaging has a key role to play in this technology since direct food contact is required. The technology can be integrated into the package or label stock.

Produce: $141.4M annual impact.

Meat: $42.3M annual impact.

Bakery: $12.2M annual impact.

Frozen Food: $0.6 M annual impact.

Responsive Packaging Case Study: $191.6M Annual Impact

Responsive packaging, a developing technology, involves sensors that trigger the release of specific compounds, such as antioxidants, preservatives, or moisture absorbers, in response to changing environmental conditions. For example, residual moisture could be absorbed if excessive moisture is sensed, or a CO_2 sensor would detect CO_2 generated from microbial growth, and then preservatives would be released to keep food safe and prevent food waste.

Produce: $134.4M annual impact.

Frozen Food: $57M annual impact.

Hydrogels Case Study: $760.3M Annual Impact

Hydrogels store compounds within the flexible film and can be released if the shelf life reaches a predefined time. They are commonly used when foods have variable shelf lives, such as USAID emergency food rations, military rations, or even the Mars mission, where sensitive nutrients or flavors can be protected until consumption. The intimate contact between the hydrogel and the product enabled by flexible packaging is crucial for effectively delivering the encapsulated compounds. These could be highly sensitive nutrients that can't be released into the product until just before it's eaten to keep them protected. These could also be for flavor release. The real value here is that flexible packaging can have direct product contact, so the compounds are released right into the product from the package. Flexible packaging plays a major role in this arena.

Produce: $86.5MM annual impact.

Bakery: $8.5M annual impact.

Frozen Food: $58.7M annual impact.

Design-based Flexible Packaging Case Studies That Prevent Food Waste

Five design-based flexible packaging case studies that demonstrate food waste prevention are highlighted. The industry uses five (5) of these solutions. The science behind the technology, its relevance to flexible packaging, categories of application, and examples are provided.

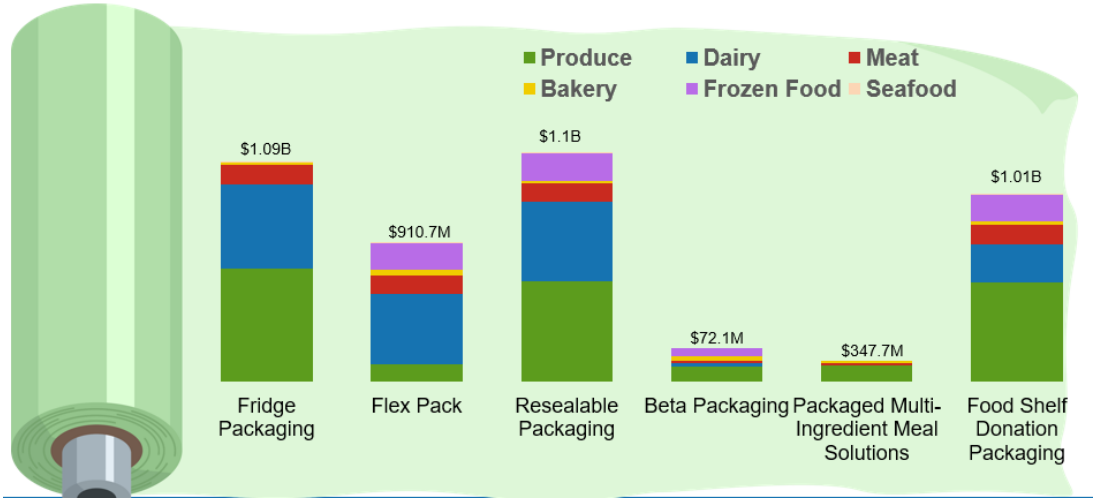


Figure 6. Design-based case studies

Fridge Packaging Case Study: $1.09B Annual Impact

Product placement within the refrigerator significantly affects consumer behavior. Studies have shown that consumers essentially “lose” their food in the refrigerator, resulting in food spoilage.

Produce: $248.4M annual impact.

Dairy: $184.6M annual impact.

Meat: $42.3M annual impact.

Bakery: $5.1M annual impact.

Flexible Packaging Case Study: $910.7M Annual Impact

Packaging that can be reduced so that as the product is consumed, the package decreases in size. Reducing this headspace reduces exposure to oxygen, thus reducing oxidation as well as limiting moisture loss or gain which can keep product quality and inhibit freezer burn. Flexible packaging allows for this elimination of headspace as the product is consumed.

Produce: $37.9M annual impact.

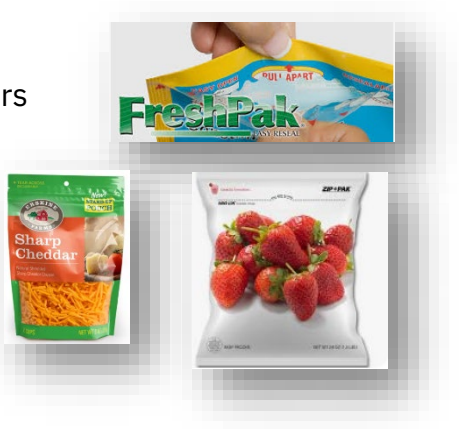
Dairy: $152.9 M annual impact.

Meat: $42.3M annual impact.

Bakery: $12.2M annual impact.

Frozen Food: $58.7M annual impact.

Resealable Packaging Case Study: $1.1B Annual Impact



Resealable packaging is seen in many different forms, including patented zipper options in flexible packaging and flexible lidstock. With resealable designs offering consumers convenience and extending product freshness, there are reduced amounts of contamination, moisture loss, and freezer burn, thereby extending product shelf life.

Produce: $220.2M annual impact.

Dairy: $173.1M annual impact.

Meat: $42.3M annual impact.

Bakery: $5.1M annual impact.

Frozen Food: $58.7M annual impact.

Beta Packaging Case Study: $72.1M Annual Impact

Beta Packaging involves altering or enhancing food products within the packaging itself before consumption. It's a proactive approach that goes beyond simply preserving food quality but actively modifies it. For consumers, beta packaging allows food to be improved or altered before use. An example would be embedding different ingredients into the food-contact side of a flexible package and allowing the consumer to release these ingredients.

Produce: $36.2M annual impact.

Meat: $2.8M annual impact.

Bakery: $5.1M annual impact.

Packaged Multi-Ingredient Meal Case Study: $347.7M Annual Impact

Pre-packaged multi-ingredient meal solutions, exemplified by services like Hello Fresh and Blue Apron, prevent food waste due from portioning.

Produce: $216.32M annual impact.

Dairy: $85.3M annual impact.

Meat: $42.3M annual impact.

Bakery: $7.1M annual impact.

Frozen Food: $58.7M annual impact.

Food Shelf Donation Packaging Case Study: $1.01B Annual Impact

There is a growing interest amongst brands in food shelf donation packaging as a strategy to bypass the retailer and provide food directly to food shelves. The Federal Food Donation Improvement Act in 2023 allows essentially for more donations and less risk, so it is expected to increase, especially in the produce category. Flexible packaging plays a critical part in packaging designs, enabling easy separation from food to facilitate composting of food recalls in Vermont, packaged food must be separated from the packaging so food can be turned into compost or animal feed.

Produce: $216.32M annual impact.

Dairy: $8.5M annual impact.

Meat: $2.8M annual impact.

Bakery: $12.2M annual impact.

Frozen Food: $15.8M annual impact.

Part 4: Direction

A systems-based approach to sustainability is essential for maximizing the impact of flexible packaging in food waste reduction. Food waste prevention is in the vernacular of food packaging decisions, and interest is increasing. Consumers are concerned about costs and how sustainability initiatives are moving forward. These sustainability initiatives increasingly focus on the entire approach from farm to factory to fork. There are many benefits of flexible packaging.

Direction 1. Engage in a Systems Approach to Sustainability
As shown before, flexible packaging waste and food waste can be readily connected since both occur in the same location of the value chain.

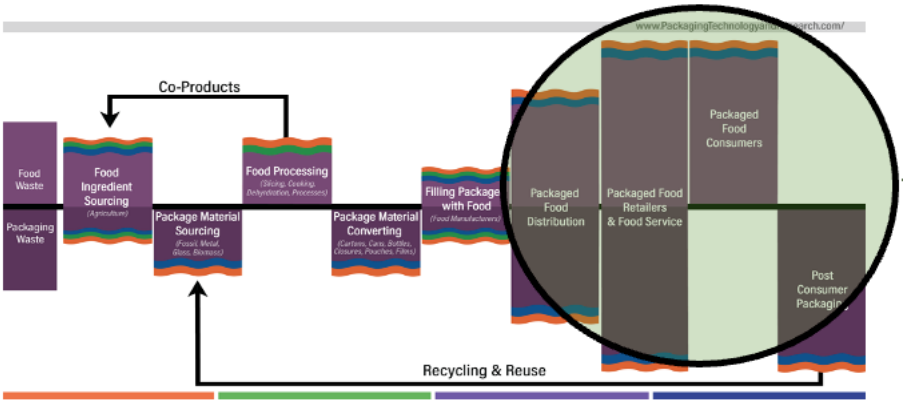


Figure 7. Food waste and flexible packaging waste occurs in the same area of the value chain

Direction 2. Promote functions of flexible packaging in food waste prevention
A key direction is to proactively communicate the role of flexible packaging in food waste prevention by highlighting design and scientific innovations.

- Use science and design solutions to create positive messaging on how efficient flexible packaging is in preventing food waste.
- Fuel research on identified emerging science and design solutions that employ flexible packaging to prevent food waste.
- Food waste occurs globally and fueling global research on flexible packaging will optimize the use of limited research dollars.

Collaborations with industry and academic partners will help the flexible packaging industry ensure the proper data is gathered to prove and quantify how much food waste declines through improved packaging. Further, this alignment with organizations working in flexible packaging globally can ensure that the limited research dollars available can be used most effectively.

Direction 3. Engage in opportunities via U.S. organizations to ensure that flexible packaging is part of the solution

Recognizing the significant economic potential of food waste reduction, strategic investments in research and development, coupled with industry collaboration, can drive positive change. FPA needs to communicate to its members the need to determine food waste prevention in conversions and when materials or packaging formats are changed. The Flexible Packaging Association can expand its engagement further with ReFED and other organizations to promote the benefits of flexible packaging as part of a systems approach to sustainability. These organizations are identified in the Appendix.

- Recognize that reducing food waste is a $155-$405 billion economic opportunity. Investing $14 billion in cost-effective solutions per year over the next ten years could reduce food waste by 45 million tons for each of those years.
- Increase of $73 billion in annual net financial benefit for the U.S. ReFED, "Roadmap to 2030: Reducing U.S. Food Waste by 50% and the ReFED Insights Engine."
- In tandem, explore co-funding on packaging initiatives to prevent food waste or address flexible packaging bans.

Direction 4. Use consumers and brands to advocate for flexible packaging to be included in EPR

Engaging with EPR programs to demonstrate that flexible packaging drives food waste reduction is essential as part of efforts toward a more sustainable food system.

- Flexible packaging may be used less to prevent food waste if flexible packaging is taxed heavily in EPR schemes.
- Bring in knowledge from the 40 countries that use EPR to understand how the U.S. EPR program can best incorporate flexible packaging use.
- Consumers view flexible packaging as minimalistic packaging.
- Brands view flexible packaging as lower cost.
- If flexible packaging replaced rigid packaging for non-beverage products, there would be a waste reduction of 44% and 33% less Global Warming Potential (GWP) (IFEU).

The flexible packaging industry has the opportunity to stand out as a leader in food waste prevention with science-based flexible packaging solutions for food waste prevention.

Appendix

Food Waste Organizations

Recommended Engagement Level: High

Group	Region	Flexible Packaging Insights, Opportunities
American Institute for Packaging and the Environment (AMERIPEN)	North America	Flexible packaging is a huge part of poultry shelf life extension. Now have pre-cooked chicken in all flexible packaging which offers enhanced convenience, with significantly less packaging than rigid packaging. Poultry is one of the largest food waste areas–a good opportunity for further use of flexible packaging in this market.
Flexible Packaging (FPA)	North America	Provides statistics on the use of packaging to prevent food waste.
ReFED	USA	
EUROPEN	Europe	With a Resource Efficient Europe Roadmap target of 50% waste reduction by 2020, there is a lot of potential to position flexible packaging as a food waste reducer, particularly around produce, baked goods, and meat/seafood—which are the big areas of waste in the EU.
Flexible Packaging Europe - FPE	Europe	Flexible packaging makes up a very small portion of the life cycle impact for coffee, frozen spinach, and butter sticks. Most often, consumer behavior has a MUCH larger impact than the packaging. For instance, using milk in coffee—the milk has an impact of 20-25% alone for a cup of coffee, while bagged coffee is about 2-10% of the total impact. Any coffee waste (consumers making too much, dumping grounds, etc.) has a much larger environmental impact than flexible packaging.
INCPEN	Europe	Many of the top items lost at retailers are already packaged in flexible packaging—i.e., bread and deli meats. The products may need better barrier or active/intelligent packaging to extend shelf life. Other products such as many fruits and vegetables are not widely packed in flexible packaging, or not utilizing technologies that could help reduce waste (i.e., bananas).

WRAP	Europe /UK/ Global	Flexible packaging with active/intelligent packaging could help affect the top two (2) food waste areas: bread and potatoes.

Food Waste Organizations

Recommended Engagement Level: High-Medium

Group	Region	Flexible Packaging Insights, Opportunities
BPF & The Plastic Packaging Industry	UK	Flexible packaging is lightweight, prevents food waste, and has a small overall impact on the environment vs. the product contained in most cases.
British Plastics Federation - BFA	UK	
End Food Waste Australia (Formerly Fight Food Waste CRC)	Australia	Limited projects on using packaging for food waste prevention.
Food Waste Reduction Alliance - CBA, FMI, NRA	North America	There could be major opportunities for portion control packaging for the food service sector utilizing flexible packaging in efforts to reduce the amount of food waste. Combined with compostable packaging would result in a method to allow the foodservice sector to compost more food.
EPA	North America	Move to composting to focus on prevention.
Natural Resources Defense Council (NRDC)	North America	Packed produce results in less waste—processors recycle trimmings—a great opportunity for flexible packaging to promote. A similar opportunity for food service, pre-cut/pre-packaged, and portion control.
Department of Agriculture (USDA)	North America	Increased funding for produce and the major categories of food waste have flexible packaging solutions—there is potential to position flexible packaging and extended shelf life as ways to reduce food loss/waste. The lack of consumer understanding of portion size is cited as an issue, leading to the need for more portion control sizes.
Plastics Europe	Europe	Absorbers, emitters, and biosensors are future technologies that will further safeguard quality while reducing food waste. Just using flexible packaging for containment of produce can reduce damage due to consumer handling or dropping produce onto the floor.

Project Gigaton	USA	Prevention.
SusFoFlex	Europe	N/A – more of a group to keep an eye on around new technologies rather than specific flexible packaging implications currently.
UN Food and Agriculture Organization (FAO)	Global	
USAID	Global/UK	The U.S. Government's Global Food Security Strategy is an integrated whole-of-government approach that aims to end global hunger, poverty, and malnutrition through the Feed the Future initiative.

Food Waste Organizations

Recommended Engagement Level: Medium

Group	Region	Flexible Packaging Insights, Opportunities
EU FUSIONS (Food Use for Social Innovation by Optimizing Waste Prevention Strategies)	Europe	Goals similar to the Resource Efficient Europe plan mentioned previously. Portion control packaging and GHG reductions in food/packaging processing are flexible packaging opportunities, though recycling remains the challenge.
FoodDrinkEurope	Europe	Environmental Sustainability Vision Towards 2030. The long-term vision calls for the use of biobased materials for plastics and packaging, as well as a focus on lightweight materials. Shifting demographics to single-family households (35% in Germany live alone) shows the need for portion packaging. Promote the ability to get all food products (such as cheese) out of flexible packaging since some claim that 3-10% of the product remains in the package when the consumer disposes it. The program also recommends resealable features in packaging to reduce food waste.
Inherit	Europe	INHERIT (INter-sectoral Health and Environment Research for InnovaTion) is about stimulating effective policies, practices, and innovations that address key environmental stressors of health and the underlying causes of health inequity.
Ireland EPA - Stop Food Waste	UK	All items on the most widely thrown out list have flexible packaging solutions. Many items, such as produce, are not optimized to use flexible packaging, however, to extend shelf life.

Consumer Goods Forum	Global	Potential format to engage in flexible packaging.
European Commission on Waste	Europe	Shifted to textile waste.
Michigan State University	North America	Much potential; but needs proactive researchers.
University of Michigan Center for Sustainable Systems	North America	Moving forward with packaging concepts. Portion control packaging has a great opportunity to lower food waste. Flexible packaging that does not require refrigeration (aseptic/retort) will also lower GHG output while extending shelf life. The ability of flexible packaging to be placed in the freezer may be promoted as a way to reduce food waste.
Royal Melbourne Institute of Technology - RMIT	Australia	Portion packaging has a major opportunity to impact single-person household waste—45% more food is wasted than in multi-person households. There is an opportunity for flexible packaging near the farm stage of the value chain—reduce damage and increase shelf life. Look to overseas markets like Australia to pre-pack produce. Compostable packaging for produce—helps retailers for composting. There are scavengers, absorbers, and aseptic packaging technology opportunities for flexible packaging.
Sustainable Packaging Coalition	North America	Issues with SDO and How2Recycle® label. It likely will be replaced by EPR. There is limited food waste prevention.
The Packaging Federation	UK	Has a good infographic showing how keeping food in its original packaging has a significantly longer shelf than if not used (about a 10:1 ratio) for cucumbers, salads, breads, and rolls.
Wageningen University & Research (WUR)	Europe/Norway	Limited industry expertise.
The Rockefeller Foundation	Global	
World Resources Institute	Global	
WWF	Global	

Food Waste Organizations

Recommended Engagement Level: Medium-Low

Who/Group	Region	Flexible Packaging Insights, Opportunities
British Retail Consortium	Europe / UK	The drive toward the reduction of food waste has an opportunity for packaging to shine. New technologies to extend shelf life and reclose features need to be tied to food waste. Pre-packed produce in bags saves labor at grocery stores while reducing food waste. Compostable packaging will make composting less labor intensive for retailers as well (put the packaging in with food) and may be necessary for retailers to get landfilled waste below the 1% goal.
Food and Drink Federation	UK	Many FDF members have signed on to the Courtaulds Commitment from WRAP, pledging to reduce food waste. Thus, FDF recognizes the importance of flexible packaging, though does not specifically call it out. A 10% reduction in the carbon impact of packaging, which the FDF calls for could strongly benefit flexible packaging due to its lower impact than many other package formats.
Fusions	EU	
Global Food Cold Chain Council	Global	
International Food Policy Research Institute	Global	
American Chemistry Council (ACC)	North America	Touts the benefits of flexible packaging through resealability, as well as active/intelligent packaging to reduce food waste. Ability to squeeze out/remove all a product before the package is disposed of.
United Nations Development Programme	Global	
PAC Global	North America/ Canada	Shifted to sustainability vs. the role of packaging in the prevention of food waste.
World Bank	Global	Does not link food waste to packaging solutions and instead focuses on food waste and packaging waste.

Food Waste Organizations

Recommended Engagement Level: Low

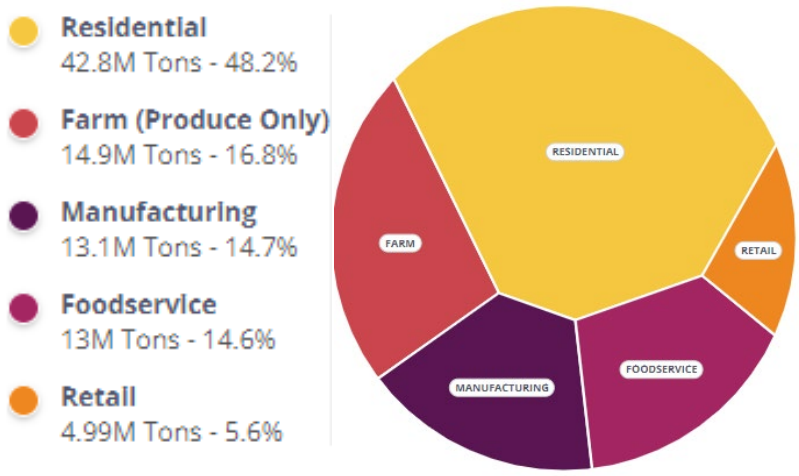
Who/Group	Region	Flexible Packaging Insights, Opportunities
Active & Intelligent Packaging Industry Association - AIPIA	Global	Opportunity to use flexible packaging within a "system" that uses active and intelligent packaging. May include smart labels that are affixed to flexible packaging or could have absorbers/scavengers incorporated into the films themselves.
Australian Food and Grocery Council	Australia	The three overarching areas are competitiveness and growth, nutrition and regulation, and sustainability.
EurActiv	Europe	News on food waste topics.
National Waste Policy Action Plan	Australia	
Organics Recycling Group / Renewable Energy Association	Europe / UK	Compostable plastics, including flexible packaging, can make claims and be a selling point for some products. Need to follow appropriate test protocols. In the UK, there are both HOME compostable and INDUSTRIAL compostable claims, unlike the U.S. where only industrial exists. There could be value in compostable flexible packaging to reduce the labor of separating food waste from packaging prior to composting at retailers.
Pacific Coast Collaborative	North America/ Pacific Northwest	Limited packaging-specific activity.
Food Packaging Forum	Europe	Focus away from plastic.
ProEurope	Europe	Handles EPR frameworks.
Clemson FRESH	USA	Shifted to limited package sustainability scope.
Biodegradable Plastics Institute - BPI	North America	Composting claims/certification can be a benefit for flexible packaging. BPI is one of the main certifiers. The tradeoff is that claims are based on industrial composting, limiting usefulness to consumers.

Food Waste Organizations

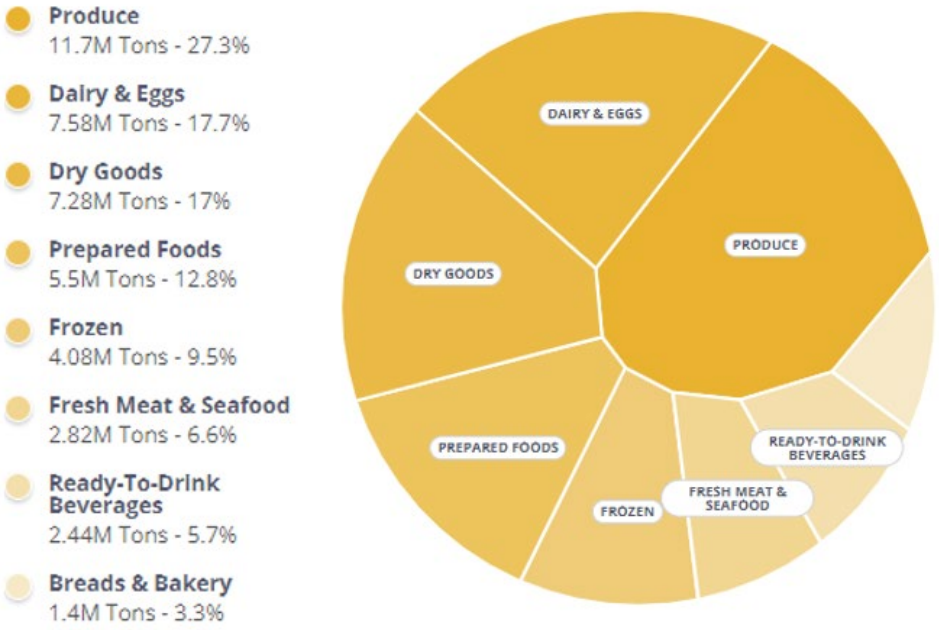
Recommended Engagement Level: Very Low

Who/Group	Region	Flexible Packaging Insights, Opportunities
Foodservice Packaging Institute	North America	Compostable flexible packaging may offer opportunities for foodservice but will require working with composters to allow compostable packaging with food waste.
Composting Council	North America	Based on subgroups from the 'compostable plastics task force,' there is an opportunity to work with a sub-team on the operational affects of compostable flexible packaging. Working with the Composting Council may be able to generate greater acceptance of compostable packaging at composting facilities.

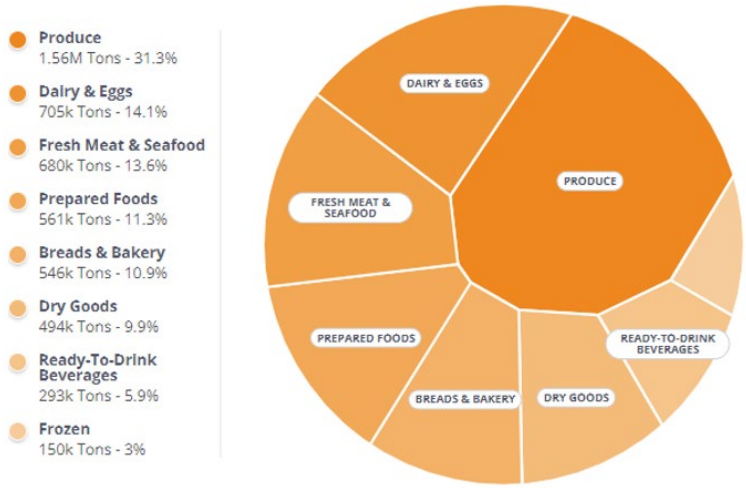
Food Waste in the Value Chain l



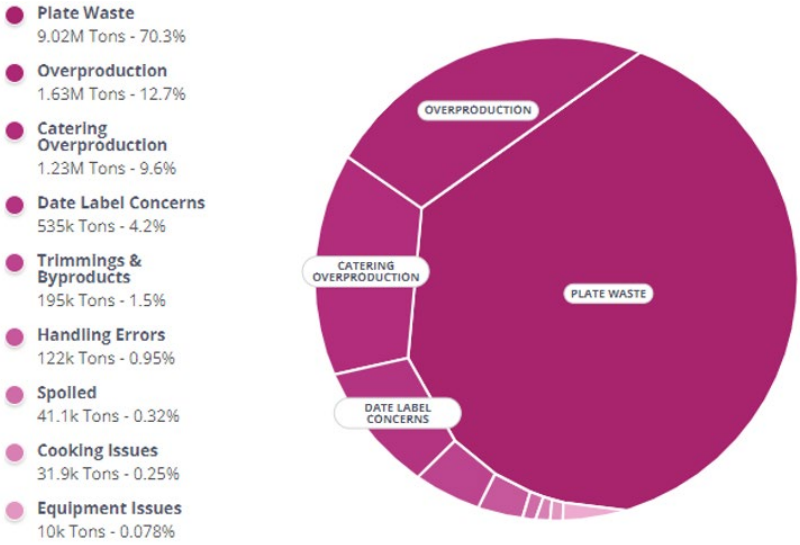
Food Waste in the Value Chain l
For Consumers, Most Food Waste is in Produce, Dairy, and Dry Goods



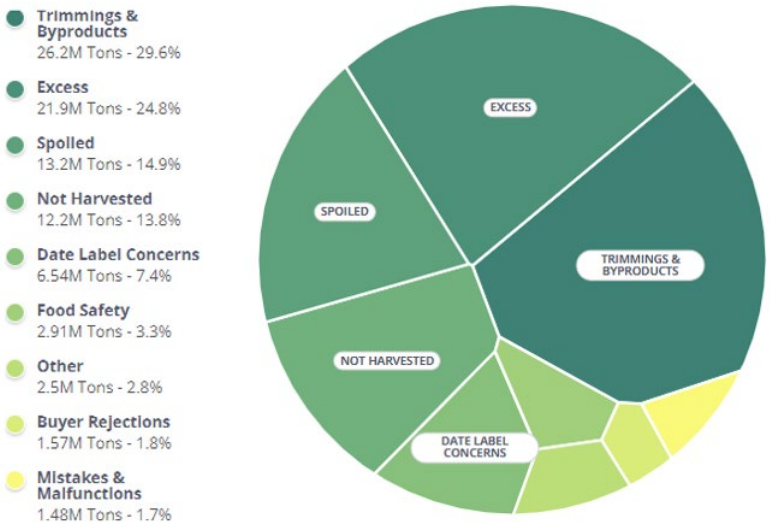
Food Waste in the Value Chain l
For Retailers, Most Food Waste is in Produce, Dairy, Meat, and Seafood



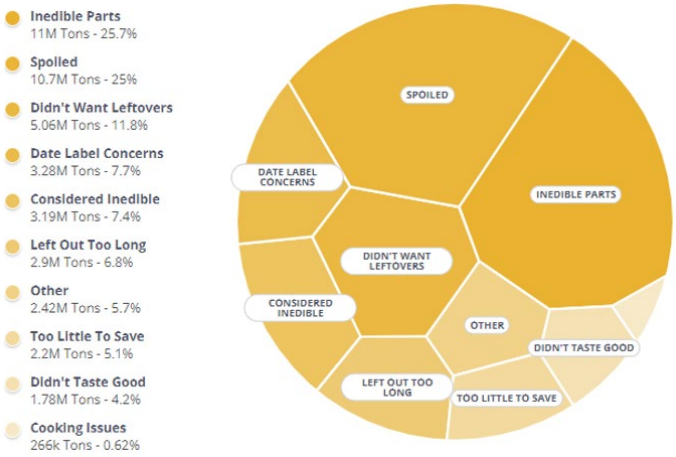
Food Waste in the Value Chain l
For Restaurants, Most Food Waste is Plate Waste and Excess Food



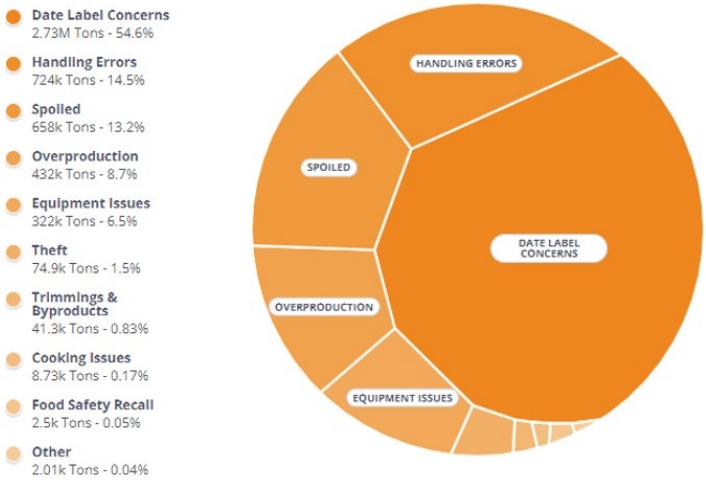
Food Waste in the Value Chain l
26% - 50% of Food Waste Can Be Prevented with better Packaging Including Flexible Packaging



Food Waste in the Value Chain l
For Consumers, 45% of Food Waste Can Be Prevented by Better Packaging Including Flexible Packaging



Food Waste in the Value Chain l
For Retailers, 67.8% of Food Waste Can Be Prevented by Better Packaging Including Flexible Packaging



Food Waste in the Value Chain l
Consumers are seeking direction from brands on how to prevent food waste

Consumer research shows:

- 78% believe food waste should be talked about more.
- 59% think brands should help them be more resourceful with food.
- 58% need more support from food companies to help them save money.
- 52% need more information on how to store items correctly to keep them for longer.

Methodology for Determining Dollar Value Impact of Flexible Packaging Solutions by Category

- Determine % of food waste by dairy, meat, produce, bakery, and frozen food categories and from consumers, supermarkets, and restaurants (ReFED Technical Abstract).
- Define the amount of food waste that can be addressed by spoilage prevention packaging and packaging adjustments (ReFED values of 72,000 + 208,000 tons to total food waste).
    - Identify flexible packaging solutions involving food waste prevention and application to categories.
    - Apply 52% to account for the % of food packaging that is flexible in food packaging.
- Sub-category dollars
    - Market research databases.

PTIS Resources

Todd Bukowski, PTIS Principal, has over 25 years of experience in food and pharmaceutical packaging, in both R&D and operations capacities. At PTIS, Todd leads the sustainability programs including running streamlined lifecycle assessments (LCAs) and sustainability strategies for clients, and was a lead author for the Flexible Packaging Association "A Holistic View of the Role of Flexible Packaging in a Sustainable World" report, among others. He also works on package development process workflow improvements, and technology scouting as well as monitoring and tracking consumer, retail channel, sustainability, legislation, and technology trends as they pertain to packaging. Todd is a program lead for PTIS's Future of Packaging programs and holds an MBA in Supply Chain Management and a Packaging degree from Michigan State University.

Dr. Michael Richmond is a strategic business and technical leader with 30 years of experience across PTIS, Kellogg, Kraft, and Michigan State University, where he was an assistant professor in the School of Packaging. Mike has numerous achievement awards and commendations and is the past head of the Industrial Advisory Committee for the Center for Advanced Food Technology (CAFT) at Rutgers University. Mike was recently inducted into the PMMI Packaging Hall of Fame and The MSU School of Packaging Hall of Fame. In 2013, Mike published "Creating Value Through Packaging: Unlocking a New Business and Management Strategy." Mike lectures at both Michigan State University and Western Michigan University in their packaging and food marketing and MBA programs.

Dr. Claire Sand, Senior PTIS Associate, is a Global Packaging Leader with 30+ years of broad experience in the food science and packaging spectrum. She leads food packaging efforts involving packaging solutions to food waste and more sustainable packaging, as well as providing compelling technology business cases and implementation roadmaps to ease the path of innovative technologies. Dr. Sand is the Owner and Founder of Packaging Technology and Research, LLC, and Gazelle Mobile Packaging Inc. Additionally, she is an Adjunct Professor at the University of Minnesota, Michigan State University and Cal Poly as well as Food Technology's monthly packaging columnist. She is an IFT Fellow, Reister-Davis-Brody awardee, serves on numerous editorial boards, is the author of the Packaging Value Chain, and is co-chair of PAC food waste. Claire has held previous positions in basic research, development market research, and marketing in Germany, Colombia, and Thailand, Total Quality Marketing, Nestlé, General Mills, Kraft Heinz, Safeway, and as a tenured Professor. Sand holds a doctorate degree in Food Science and Nutrition from the University of Minnesota and an MS and a BS in Packaging from Michigan State University.