



Designing Packaging to Prevent & Divert Food Waste

GUIDE



**PACKAGING
DESIGN**

GreenBlue is an environmental nonprofit dedicated to the sustainable use of materials in society. We bring together a diversity of stakeholders to encourage innovation and best practices to promote the creation of a more sustainable materials economy.

The Sustainable Packaging Coalition (SPC) is a membership-based collaborative that believes in the power of industry to make packaging more sustainable. We are the leading voice on sustainable packaging and we are passionate about the creation of packaging that is good for people + the environment. Our mission is to bring packaging sustainability stakeholders together to catalyze actionable improvements to packaging systems and lend an authoritative voice on issues related to packaging sustainability. The Sustainable Packaging Coalition is a trademark project of GreenBlue Org.

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ABOUT THIS GUIDE



ONE OF THE MOST

alarming indicators of our society's waste is that as much as 35% of all food in the United States isn't eaten and is thrown away. This is wholesome, edible food that could have gone to food insecure families. Globally, about 30% of food is wasted.

Food waste is an incredibly important problem to tackle, and not just because of the enormous inefficiency and injustice of wasted food. Food waste is also an environmental catastrophe. The land, water, fossil fuels, fertilizer, and other resources used to produce our food generate greenhouse gasses, which are unnecessary if the food goes uneaten. When food ends up in landfills, it generates methane, a greenhouse gas that is more than 25 times more potent than carbon dioxide. Though methane capture technologies exist, a majority of landfills do not capture their methane.

The food we waste is responsible for roughly 8 percent of global emissions. Yet addressing this problem can also be a powerful lever in reducing emissions. Food waste reduction has been identified as a top solution to climate change by Project Drawdown.

Today, packaging and food waste are often thought of as binary choices for brands and retailers—either food is packaged to extend shelf life and prevent food waste, or it is sold loose, which is thought to lead to food waste. Most manufacturers rely on assumptions about how their packaging might be preventing food waste. Although the primary job of food packaging is to deliver undamaged, unspoiled food to consumers, few companies have set public goals acknowledging the relationship between food waste and packaging.

The purpose of this guide is to help companies reduce food waste happening downstream in their supply chain, at the consumer and retailer levels, by prioritizing food waste prevention and deploying the right packaging designs, formats, and technologies. In doing so, it primarily considers packaged food sold in grocery environments, rather than freshly prepared food or food service settings. This document offers guidance for how to:

- Commit to Solving the Food Waste Problem
- Incorporate Food Waste Prevention and Diversion into Packaging Design
- Educate Consumers

Much research has already been done on the topic of food waste - where it occurs, why it happens, and what can be done about it. It is outside the scope of this guide to provide a comprehensive review of the complex social and economic drivers behind food waste or the myriad of solutions that can be drawn upon. Rather, this guide aims to explore the specific role that packaging can play in both causing and preventing food waste, and provide actionable solutions for using packaging as a tool to reduce and prevent food waste in retail and in consumers' homes.



For those who want to dive deeper, the Resources section of this guide highlights some of the most relevant research for the packaging industry.

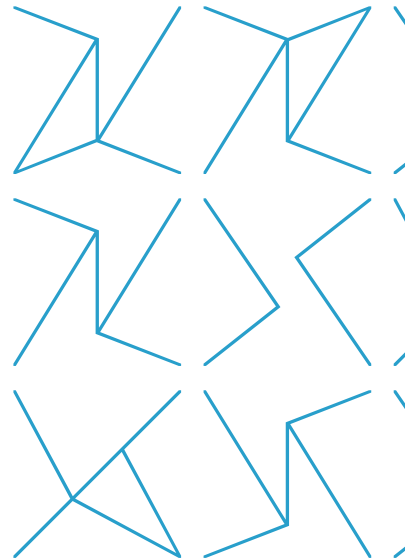
PACKAGING'S POTENTIAL TO TACKLE FOOD WASTE

FOR COMPANIES WITH carbon emissions reduction goals, actively addressing food waste in their supply chain can be a way to meet these goals. Packaging can be a way to both make progress and cause unintended setbacks in our collective efforts to reduce food waste and the resulting greenhouse gas (GHG) emissions. On average, only 3-3.5% of the climate impact of packaged food comes from the packaging itself. This proportion can be significantly higher for certain kinds of foods and formats, but ultimately, packaging “pays off” if the protective features help to reduce food waste by at least ~4%.

To begin, there are many questions companies can consider: Why does food get wasted? Does the problem lie with consumers and individual behavior, or further up the supply chain with producers, distributors, and retailers? Is packaging the solution to food waste?

ReFED's Insights Engine identifies solutions to move the food system to solve our national food waste problem, including strategies such as portion sizes, meal kits, consumer education campaigns, standardized date labeling, waste tracking and analytics, composting, and markdown alerts.

Packaging-related solutions are among the top 12 solutions to reducing the GHG emissions associated with food waste. ReFED's analysis shows that changes to packaging, including packaging design and the use of **ACTIVE AND INTELLIGENT PACKAGING**, can help divert 1.1 million tons of food waste and save 314 billion gallons of water. The solutions were also ranked on their ability to reduce GHG emissions by avoiding the resources that go into producing, processing, and transporting food, as well as the methane emissions from food disposed of in landfills. **Making**




changes to packaging can reduce 6 million metric tons of CO₂e annually - the equivalent of taking 1.3 million cars off the road for a year. Direct packaging solutions can also have a combined net financial benefit of \$4.13 billion dollars. Related solutions such as meal kits, standardized date labeling, and consumer education campaigns are some of the most financially beneficial solutions explored.

It's important to note that packaging's role in helping to prevent food waste should not be used to greenwash or hide the other real, negative environmental impacts packaging can have, such as when it escapes the waste management system and becomes ocean plastic pollution. Although packaging can help extend shelf life for perishable items like produce, food packaging is also commonly used to enable on-the-go disposability and convenience. Some of the most frequently-littered packaging types are food wrappers for chips and snacks, as well as soda bottles. These packaging formats are not primarily designed to reduce food waste or insecurity, and their use should not be defended with arguments about food waste prevention.

Ultimately, food waste and packaging are part of a complex system of food production, distribution, and consumption. This includes where the food is grown, how it is collected and distributed, and how it is marketed in stores. Food waste also depends on shifting consumer behaviors and attitudes towards eating at home and on the go, as well as tastes, trends, and perceptions of the environmental and economic cost of food waste. Creating a more sustainable food system will require

analysis of resource inputs and greenhouse gas emissions from farm to fork.

Packaging can neither solve all the food waste problems in this system, nor can it be blamed for all of the food waste across the system. Instead, improvements to packaging can help to reduce consumer food waste and should be implemented with other system-wide changes such as adopting standardized date labeling, consumer education campaigns, and other food waste prevention initiatives.

An aerial photograph showing a white car driving on a dark road that winds through a dense, green forest. The image is framed by a thick green border on the left and bottom.

**MAKING CHANGES TO
PACKAGING CAN REDUCE
6 MILLION METRIC TONS
OF CO₂E ANNUALLY—THE
EQUIVALENT OF TAKING
1.3 million cars
OFF THE ROAD FOR A YEAR.**

1. Commit to Solving Food Waste

THE OPPORTUNITY TO address waste food is vast, and spans food categories and geographies. Today, a handful of leading food manufacturers, brands, and packaging companies have set goals to tackle the food waste across parts of their supply chain. Yet as part of the last leg of the supply chain, food waste in consumers' homes remains a largely untackled problem.

Perhaps this is because when a company's product is wasted in a consumer's home, the associated impacts fall under the company's "Scope 3" emissions. These are emissions that occur across the value chain of a company. A consumer's interaction with a product, such as how it is stored and whether it is used up or thrown away uneaten, are examples of a company's indirect, Scope 3 emissions. Scope 3 emissions are often the majority of a company's total environmental footprint, and emissions associated with consumer behavior have historically been considered very difficult to measure and address. .

AS AN EXAMPLE, A BRAND PRODUCING CONDIMENTS MAY CONSIDER THE FOLLOWING GOALS AND INITIATIVES TO ADDRESS FOOD WASTE:

	INITIAL STAGES	ADVANCED STAGES
GOALS	Reduce food waste during food production processes at factory	Reduce % of condiment going to waste because it is difficult for consumers to extract from container
INITIATIVES	Campaign to encourage consumers to use the condiment to give new life to leftovers	Take responsibility for how their packaging contributes to food waste by incorporating better design



Given the joint problems of the growing climate emergency and the staggering amount of food being landfilled, much of it from consumers' homes, **it is time for companies to reduce their carbon footprint by tackling food-waste-related Scope 3 emissions head on.** Though it can be difficult to address, companies should no longer set aside the food waste happening downstream in their supply chains, beyond the control of their manufacturing and distribution processes. Companies need to acknowledge the significant role that food waste plays in their product and packaging life cycles and commit to innovating towards solutions.

Committing to solving the food waste problem presents distinct opportunities for companies. First, there is currently a noticeable gap in leadership of companies using packaging as a tool to reduce household food waste. Although some consumer packaged goods (CPG) brands have launched food waste awareness campaigns, few have developed holistic initiatives that help address the problem from multiple angles. For example, a condiment brand may launch a campaign to encourage consumers to use the condiment to give new life to leftovers. The brand may even have goals to reduce food waste loss during its food production processes. Yet it is much less common for a brand to acknowledge that perhaps as much as 15% of condiments routinely go to waste because they are difficult for consumers to extract from the container. Few brands openly claim responsibility for how their packaging performs, or fails to perform, in consumers' homes and contributes to food waste.

Second, a number of studies indicate consumers are eager for packaging-related solutions, such as **RESEALABILITY** and more **PORTION** options. While consumers are not typically familiar with the nuances of how



packaging may be preventing food waste, they are able to name specific features they'd like to see such as freezer-ready meat and poultry packaging. By appealing to consumers' desire for packaging that can prevent wasted food, retailers and CPG brands have an opportunity to access new customers while increasing their brand value.



Although consumers that waste less food may buy less, ultimately, consumers will support brands that help them reduce food waste. This is because by offering features that consumers are asking for, such as **RESEALABILITY** functionality on shredded cheese, brands are adding value



*It is time for companies to
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Scope 3
related emissions head on.*

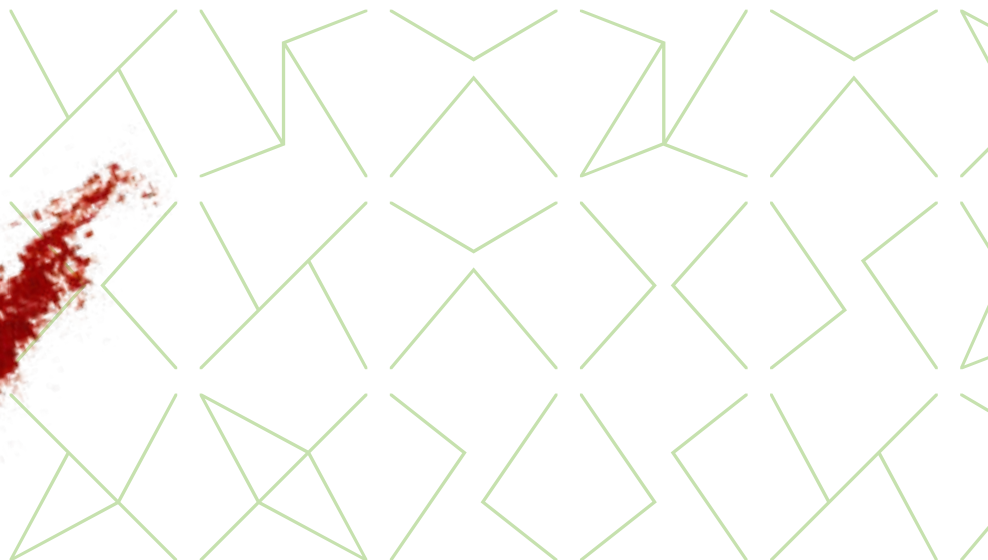
for their customers. These brands may have an advantage in retaining customers that their competitors without an eye towards food waste prevention do not. For more consumer attitudes and behavior studies about packaging and food waste, see the [RESOURCES](#) section of this document.

Third, actively addressing food waste across the entire supply chain, especially in the untapped arena of consumer food waste, can be a strategy for achieving corporate climate reduction goals. If a package or product redesign helps to prevent or reduce food waste, the avoided emissions can be measured and reported as part of a company's carbon accounting. ReFED's [Impact Calculator](#) is one tool that can help companies measure the avoided CO₂ equivalent associated with their food waste prevention efforts. As companies look for more ways to meet their commitments, the potential reductions associated with consumer food waste should not be overlooked. For more on accurately measuring the impacts of and reductions to downstream emissions (also known as Scope 3 emissions), consult the GHG Protocol's [Guidance for Use of Sold Products and End-of-Life Treatment of Sold Products](#), as well as the [FLW Protocol's Guidance](#).

Recent efforts to quantify the entire food system's carbon footprint indicate that its impacts have previously been vastly underestimated. [One analysis](#) found that in 2018, the global food system was responsible for one third of all global emissions that year, not one tenth as previously estimated. Rather than focusing on the impacts solely from producing food, the new analysis accounts for those emissions that are food-related but were

previously allocated elsewhere, such as food waste disposal, refrigeration, packaging, and transportation.

Clearly, the full interplay between packaging waste, food waste, and global emissions is not yet fully understood. Food waste may happen in tandem with packaging waste, both of which contribute to climate change. At the same time, reducing global emissions hinges on reducing food waste, and packaging can and should play a role in achieving this. We predict that the integration between climate change and food waste will become more well-recognized going forward. Companies that unite these problems in their sustainability strategy are well poised to be leaders in their industry.



UNDERSTANDING THE PERFORMANCE OF PACKAGING IN RETAIL AND CONSUMER SETTINGS

TO TRULY TACKLE DOWNSTREAM FOOD WASTE, companies need to understand how effective their packaging is at preventing spoilage and encouraging consumption in retail and residential settings. A number of studies have analyzed in-home food waste, looking at which food categories are most often wasted and the underlying reasons for the waste. Several of these studies are referenced in the **RESOURCES** section of this document, and offer a starting point for companies that want to better understand the source of the problem. The research can pinpoint hotspots for food waste across categories, such as produce and dairy, as well as some of the most common packaging “failures”, such as a lack of a closure or seal. Depending on whether the hotspots in waste production occur in retail or consumer environments, targeted improvements specific to those contexts can be implemented.

Companies can use the existing research to ground themselves in the most common examples of packaging-related food waste, but the greatest learnings will come from looking directly at their own products’ performance. Asking honest questions about when and how your packaging fails can be done by:

- Surveying consumers
- Surveying retailers
- Listening carefully to customer feedback
- Visiting grocery and retailer settings to assess on-shelf performance, markdowns, and back-of-house waste
- Conducting observational consumer research



These efforts will provide primary data about how well your packaging is performing at its “job” of protecting food contents, making them easy to access, communicating how to optimally use the product, and serving as a storage container in the fridge or freezer.

Armed with a better understanding of the specific sources and causes of food waste in their downstream supply chain, companies can begin to address this waste with packaging designs and innovations that proactively prevent food waste. These strategies are discussed in the **Incorporate Food Waste Prevention into R&D and Packaging Design** section of this document.

SETTING INTERNAL AND PUBLIC GOALS

A COMMITMENT TO THE FOOD WASTE PROBLEM BEGINS with goals that address, measure, and reduce food waste across the supply chain. Often this begins with private, internal goals that are only shared with employees and help set the initial direction for the company. Once a company has more confidence and establishes baselines and data, it may make these goals public. These goals are published on websites and in corporate reports, and are often paired with industry-wide, collective goals such as the [New Plastics Economy Global Commitment](#).

Though goals to tackle food waste across the supply chain are still new, more and more CPGs and food brands are starting to set goals around food waste, typically beginning with food waste in their upstream supply chain. For example, [Kellogg's set a goal](#) to reduce its total organic waste and total waste per pound of food across its facilities.

Companies can go a step further by setting specific packaging and consumer-focused goals for food waste reduction. They may set a goal to measure typical food waste in consumers' homes for a flagship product, improve product evacuation by 10% across a product line, add storage tips and instructions for a line of frozen goods, or to switch to standardized date labeling on 100% of its packaging. These goals refer to some of the best practices and suggestions outlined in the rest of this document.

There are no one-size-fits-all internal goals that companies should set for food waste. Rather, companies will need to analyze how their products perform and ask thoughtful questions to determine where there are packaging failures that can be addressed with better design and innovation. One tool, ReFED's Insights Engine, outlines [common causes of residential food waste](#), such as spoilage or date label concerns, by product category. With a better understanding of the causes of food waste in homes and the best practices for packaging design, companies can set meaningful goals that are specific to their food category, product line, packaging format, and consumer needs.





Public goals that demonstrate a public-facing commitment to the issue are also critical for signaling the need for change across the entire supply chain. One example of a platform for setting collective goals around food waste is [Champions 12.3](#), a group of global leaders from government, business, research, and farming communities committed to cutting global food waste by 50% at the retail and consumer level, and reducing food losses along production and supply chains by 2030. Champions 12.3 launched the 10x20x30 initiative, and over 200 food manufacturers, suppliers, and retailers have committed to reducing food loss and reporting on their progress. Though many of these commitments have focused on upstream or production food loss, there is also an opportunity to use these platforms to demonstrate a commitment to downstream food waste.

There are no one-size-fits-all internal goals that companies should set for food waste.

BALANCING FOOD WASTE REDUCTION AND PACKAGING RECOVERABILITY GOALS

AS COMPANIES PURSUE new packaging formats, materials, and technology that can help reduce food waste, it is important to also consider how to balance recovery goals for packaging. In many instances, recoverability and food waste prevention may be at odds - for instance, adding a flexible film to produce may help extend shelf life though the film may not be readily recyclable. An on-pack sensor may help consumers know when a product has spoiled, but may cause the packaging to be non-recyclable or non-compostable. This tradeoff should not be ignored, but rather examined from a lifecycle perspective to understand what changes would lower the impact of the overall product-package system.

Historically, these tradeoffs have been quite common. Innovative formats and

technologies were used to protect the product and extend shelf life, but these measures typically rendered the packaging unrecyclable and therefore bound for landfills. Truly innovative packaging solutions will not ignore other stages of the lifecycle, such as recoverability.

In short, redesigning packaging can not only prevent GHG emissions through reduced food waste, it also offers an opportunity to reduce GHG emissions by increasing recovery of packaging at the end-of-life. Designing packaging with goals to divert both food waste and packaging waste from landfills is not mutually exclusive.

Manufacturers and brands need to consider the entire life cycle of the package and make improvements that do not cause unintended consequences. Switching from a landfill-



bound package to one that is recyclable or compostable may require tradeoffs in the form of a higher cost, lower shelf life, and/or heavier package. All of these considerations must be weighed with life cycle analysis or packaging assessment tools.

While innovation continues to bring down cost and extend shelf life for newer materials and formats, companies can continue to make their packaging more sustainable by introducing bio-based or recycled content. Recycled content is a valid and important step towards a more sustainable package if designing for recovery is not possible for that product, for example, because of barrier level needs to prevent food waste. It should be considered as part of a holistic sustainable packaging strategy, since sourcing recycled content or bio-based feedstocks for a package often has a bigger impact on the environmental footprint of a package than making it recoverable at end-of-life. More information is available in the [SPC's Recycled Content Guide](#), and the [Recycled Material Standard](#) offers a way to source certified recycled content for your packaging.

Rather, it is increasingly possible to make progress on the recoverability front while also achieving the primary food waste reduction goal. For example:



Polyethylene films and bags that protect produce can be designed with the Store Drop Off recycling stream in mind, and be clearly labeled for consumers using the How2Recycle label



Sensors, packets, closures, and resealable packaging should be tested for compatibility with today's recycling infrastructure, making sure their barcodes or tags do not add to contamination to recycling processors



Produce packaging, such as salad bags, can be a good fit for compostability, because the contents can also be composted



Trays, punnets, and other packaging types can be made from renewable or recycled content and be designed to be readily recyclable



2. Incorporate Food Waste Prevention and Diversion into Packaging Design

THE OPPORTUNITY TO ADDRESS THE FOOD WASTE challenge with packaging is truly astounding. As previously mentioned, ReFED has estimated that **changes to packaging design can help divert 1.1 million tons of food waste annually while reducing emissions by 6 million metric tons CO₂e.** This represents a remarkable chance for the packaging industry to address climate change downstream in their supply chain.

The goal for food companies, as [summarized](#) by ReFED, is to optimize food packaging size and design to ensure complete consumption by consumers and avoid residual container waste. Below are specific design strategies that have been identified by leading nonprofits and industry research as key to reducing household and retail-level food waste. This guide was written to follow the [EPA's Food Recovery Hierarchy](#), which ranks source reduction of food waste as the most preferred strategy for food waste prevention, and closes with discussion of the less preferred strategy of food waste diversion from landfill through composting. Within this structure, strategies are ordered to first prioritize address the causes of food waste, and then to more clearly communicate spoilage to consumers, and then finally responsibly dispose of wasted food through composting.

PACKAGING DESIGN OPPORTUNITIES TO REDUCE FOOD WASTE



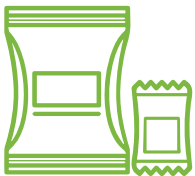
**RESEALABLE
PACKAGING**



VISIBILITY



**ACCESS TO
CONTENTS
(PRODUCT
EVACUATION)**



**VARIETY IN
PORTION &
PACK SIZES**



**COMPOSTABLE
PACKAGING**



**ACTIVE &
INTELLIGENT
PACKAGING**

Resealability



THE OPPORTUNITY

Packaging that is not resealable is still quite common today. For products that are not consumed in their entirety quickly, like cheese or yogurt, an open, unsealed package may contribute to mold growth and cause the entire contents to spoil. Even foods that are less perishable, such as coffee, nuts, or grains, may be perceived as rancid or unfresh by the consumer if they are stored in an open, unsealed package for an extended period of time. While in some cases this can be best addressed with consumer education about proper storage, in other instances resealable packaging may also be appropriate.

Changes to packaging design can help divert 1.1 million tons of food waste annually while reducing emissions by 6 million metric tons CO₂.



BUSINESS CASE

In several studies, consumers report problems with packaging that is not adequate to keep food fresh and edible, such as packaging that is not resealable or is difficult to empty. Surveys show that consumers want more resealable and reclosable packages, particularly for certain product categories like meat, snack, and bakery.

There are many product categories that may benefit from resealable zippers, lids, or other closures to help maintain product freshness. The decision to add these features should be balanced with an understanding of a food's failure mode and an understanding of how consumers store and consume the product. Together, this data would indicate that resealability could help to reduce food waste.

DESIGN TRADE-OFFS TO CONSIDER



It's important to note that resealable features such as zippers, lids, films, or ties are often not recyclable or can render a packaging not recyclable. This is in part because these features often use a different material from the rest of the package, creating a multi-material package that is more difficult to reprocess. Sensors, packets, closures, and resealable packaging should be tested for compatibility with today's recycling infrastructure, making sure their barcodes or tags do not add to contamination to recycling processors. The [Association of Plastic Recyclers \(APR\)](#) provides guidance on designing for recyclability by resin and packaging component. Companies can learn more about the recyclability of their packaging by joining [How2Recycle](#) and referencing the [Guide to Recyclability](#) and [Guide to Future Recyclability](#).

Resealable features may also require the packaging to use a different material, or more material overall. In some instances, it is possible that the environmental benefits from less food waste may be lower than the environmental impacts from increased material usage. To better understand the impacts and benefits associated with resealability, companies should use life cycle analysis tools to estimate the environmental impact of their packaging, as well as food waste calculators like ReFED's [Impact Calculator](#) to estimate the food waste prevention benefits of their new design.

Increasingly, these tradeoffs, while a reality for many packaging designs today, can be overcome with better design. There is an opportunity to develop innovative new resealable packaging that does not increase the overall carbon footprint of the packaging or limit its recyclability.





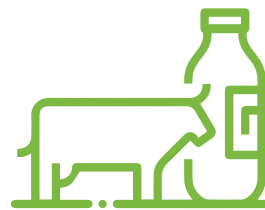
How do you determine if your packaging might benefit from resealable design features? Consider the following characteristics of your package's product. Your packaging might benefit from a resealable design if:

The contents are unlikely to be finished in one sitting, such as large portions of cheese

The contents are highly perishable and contain multiple servings in one pack, such as several drumsticks of raw chicken

- The contents are likely to change texture and become stale as a result of how consumers typically store the product, such as crackers
- The products in an unsealed container can grow mold or easily spoil, such as dairy or prepared produce
- Resealability can increase consumer loyalty, reach new customers, or strengthen brand value
- The product is intended to be consumed on the go and may spill or leak during transport if not properly sealed

If these situations apply to your packaging contents, you should strongly consider adding resealable features to your packaging design to reduce the likelihood of the contents spoiling or being thrown out due to consumer perception and personal preference.



Easily perceived as no longer fresh



Multi-serving & unlikely to be finished in one sitting



Highly perishable (quickly becoming moldy or stale)



CASE STUDY: RESEALABILITY

Consumer demand has increased the desire for both convenience and sustainability in pet food packaging. In response, brands have started to offer resealable packaging as a way to help consumers preserve product quality and ensure freshness after a bag has been opened. These features are in turn communicated to consumers as a distinct selling point. For example, Blackwood's dry dog food product is sold in a bag with a resealable zipper pouch, with the title "Resealable Bag to Preserve Freshness."

Heinz developed the Heinz Banz Fridge Pack, a resealable format that caters to customers that want to consume beans in smaller or larger portions than the standard size can. Each 1 kg pack is the equivalent of ~2.5 standard size cans, an average of 5 servings. The ambient shelf-life is 15 months, on par with the can format. Once opened, the container can be resealed and stored in the fridge, where it keeps fresh for up to 5 days.

Portion and Pack Sizes



THE OPPORTUNITY

A wider variety of pack sizes for all kinds of foods helps to address new trends in household size, purchasing habits, and awareness of appropriate portions. Smaller portions and pack sizes can [help reduce food waste from](#):

- Opened food that spoils because only some of the contents are eaten or cooked at once
- Consumers cooking too much food due to the default quantity in the package
- Consumers having no other option except to buy larger portions than they need because smaller portions aren't available

Smaller portions and pack sizes also help brands offer consumers options that meet

their healthy eating goals. Particularly with snack foods, larger packaged portions lead to overeating because people pay little attention to the size of their portions. Many brands have increased their packaging [size five-fold](#) since 2002, which has led to parallel increases in portion sizes, calorie intake, and the prevalence of obesity.

Looking ahead, the [2020–2025 Dietary Guidelines for Americans](#) advise individuals to “pay attention to portion sizes”, particularly for foods that are not “nutrient dense”. Researchers also [call on the food industry](#) to sell foods in more reasonable portion sizes. Smaller portion sizes and [nutrition fact labels](#) that better communicate serving sizes can help encourage healthier eating habits while also reducing unnecessary food waste.



BUSINESS CASE

Changes to portion and pack sizes are an opportunity not just in processed foods, but across food categories, including baked goods. One example of portion sizes beginning to shift to meet consumer demand is with smaller loaves of bread. [The Wall Street Journal](#) reported that bread companies and grocery-store bakeries are responding to new demands from shoppers by selling smaller loaves. Consumers reported not being able to finish an entire loaf before it turns stale, wanting to buy half loaves more frequently due to freshness, or preferring smaller portions if they live alone. The desire to prevent food waste was also cited as a reason. Similarly, the [American Baker's Association found](#) that more than half of all Gen Z and millennial consumers said they would buy more baked goods, including bread, if they came in smaller portions.

ReFED's Insights Engine estimates that portion sizing as strategy in food service would have a net financial benefit of \$9 billion annually, and is ranked as the top solution for emissions reduction and water savings. While there is less data on how portion sizes for packaged food would translate to financial and environmental benefit, it is evident that more variety in portion and pack sizes is needed to meet the changing reality of today's household sizes and purchasing behaviors. In the US, the number of people per household has [decreased in recent decades](#), yet [packaging sizes](#) have not necessarily kept up with this macro trend.

DESIGN TRADE-OFFS TO CONSIDER

While the right portion or pack size can reduce food waste, it may also create unique challenges. Transitioning to individual portions or smaller pack sizes should be done after consumer research indicates a desire for smaller portion sizes, as in the case of bread. As they experiment with new sizing, companies may see increased byproduct, the need for additional packaging material, increases in barrier requirements, and additional costs.

However, the need for more packaging should not be an immediate deterrent, because food waste has a bigger impact than packaging. For example, if slightly more material is used to pack items in single servings and this helps consumers use up all of the contents, then this change will likely have a net environmental benefit.

Companies should also note that making a package significantly smaller could render it not recyclable. For example, packages that are [smaller than 2"x2"](#) are more difficult to sort correctly at a recycling facility. This is covered in more detail in the [APR Design Guide](#) and the [How2Recycle Guide to Recyclability and Future Recyclability](#).





CASE STUDY: PORTION AND PACK SIZES

Portion packs can have a lower impact even if portioning requires using more material. For example, [portioning Camembert cheese](#) into wedges, as opposed to selling a whole wheel, results in fewer carbon emissions. This is because although portioning the product into six sections requires an additional 3.3 grams of composite paper, the carbon emissions reduction in food waste is approximately 4-5 times higher than the additional packaging.

To reduce the problem of overcooking due to pack sizes, companies can design packaging that has segmented portions. For example, in [Perdue's Perfect Portions packaging](#), chicken breasts are placed in five individually-wrapped pouches. This is ideal for consumers who are looking for the value of purchasing a multipack, but want to prepare smaller servings. These kinds of multipacks encourage consumers to cook just the amount that they need and safely save the rest for later, while still realizing the savings that often come with buying food in bulk quantities.

In Japan, where changing demographics have resulted in smaller households, Coca-Cola took steps to ["shrink the drink"](#), creating two new packaging sizes - 350 mL and 700 mL - for its drink. With smaller households the norm, this means a smaller group of people are likely to share small-to-mid-sized beverages. A smaller package size prevents the beverage from being thrown away after going flat because it wasn't consumed in time.

Active & Intelligent Packaging



THE OPPORTUNITY

Active and Intelligent packaging are two strategies of using packaging technology to reduce food waste. “Active” packaging works to further extend shelf life of a product, while “intelligent” packaging works to communicate product quality.

As a category, active packaging slows spoilage through technologies such as ethylene absorption, modified atmospheres, moisture absorption, etc., or adaptive materials that inform as to the quality/safety of the contents. These are often used to reduce the perishability of meat and produce. Some of these technologies have been around for a number of years, while others are newer or have not been applied to a wider range of products, such as dairy or salad greens.

Active packaging may contain agents that promote shelf-life extension by absorbing or emitting certain volatiles, controlling moisture levels, or reducing microbial activity. Antimicrobials used in food packaging include bacteriocins, enzymes, essential oils, selected polymers, metal ions, and inherently antimicrobial polymers. Also falling under this category, coatings are various edible formulations that help maintain the appearance and taste of food, mainly produce, while also being tasteless and odorless. They are an opportunity to address food waste issues without genetic modification of food, increased packaging materials, or significant changes to the supply chain.

Intelligent packaging, sometimes called smart packaging, may include various sensor technologies. These solutions can help track the quality of perishable food products and may include digital connectivity to help grow their adoption by consumers. Sensors can be particularly helpful for highly sensitive food like meat, poultry, and dairy, and they can be embedded into existing packaging design.



BUSINESS CASE

Active and intelligent packaging technologies have the potential to create \$1.74 billion in net financial benefit while reducing food waste by 452,000 tons annually. In addition, smart packaging offers new business opportunities based on digitization, giving companies the ability to track the product, sense an attribute of the packaged food or its immediate environment like pH or temperature, and communicate this information to the manufacturer or consumer.

While many of these technologies are ready to scale, the category as a whole requires further support from large brands and investors. ReFED has estimated that these technologies will require an annual investment of \$257 million from manufacturers. This investment can come in the form of pilot partnerships with solutions providers, as well case studies that demonstrate the value proposition of these technologies across different product categories.



DESIGN TRADE-OFFS TO CONSIDER

Active and intelligent packaging solutions need to be tested to make sure they do not inhibit the successful recovery of packaging at its end of life. In general, active packaging has the potential to improve the recyclability of packaging by replacing chlorinated plastics such as PVC and PVDC with more easily recyclable, active polyolefins and polyesters. Intelligent packaging may in some instances create recycling challenges, since add-ons such as metallized sensors, RFID tags, or stickers can be problematic for material reprocessors.

Active and intelligent packaging

technologies hold a lot of promise but are best paired with other research and development (R&D) and packaging redesign strategies such as resealability and portion sizes. They are not silver bullets, since technologies like ethylene absorption or coatings are unlikely to eliminate food waste once the package is open or if there are underlying problems, such as pack sizes that are too large. It is also important to engage and **EDUCATE CONSUMERS** about the packaging technologies used (see the section Educate Consumers), since in many instances consumers will need to understand how to use the packaging as intended.



CASE STUDY: ACTIVE & INTELLIGENT PACKAGING

While some aspects of active and intelligent packaging have been implemented for certain categories of food like meat, many are not yet the norm in the American food market. Manufacturers and brands may want to partner with research organizations and solutions providers to pilot and adopt active and intelligent packaging. Young companies have helped larger food brands deploy sensors, coatings, stickers, and other active and intelligent packaging solutions that reduce spoilage costs across their supply chain while also improving the customer experience.

For example, the SPC's [Food Waste Repackaged Challenge](#) identified four solutions that extend shelf life of produce and meat products using coatings, labels, sachets, and antimicrobial properties:

- [Ryp Labs](#) is a food and crop protection company developing and commercializing biomimicry solutions to combat global food waste, sustainably and safely. Their food-safe sticker, StixFresh, is marketed as extending the shelf life of fresh produce by up to two weeks, by simply peeling and applying the sticker to the produce. Their sachets and sheets formats, Shelf Defense, can be placed in clamshells and other container formats to protect smaller fruits such as berries and grapes from premature rotting.



- [Innoscentia](#) is developing labels for dynamic shelf life of food in order to unlock the full potential shelf life and thereby reduce waste produced because of the current expiration dates. Their analogue label is marketed as being cheap to produce, proven to enable a price premium and highly appreciated by end consumers in early testing.
- [Green Pod Labs](#) is working in developing markets to bring active packaging that activates a defense mechanism within the fruit and vegetable to slow down the ripening rate and prevent any microbial growth during transport and storage.
- [SAVRpak](#) reduces food waste through the removal of condensation from inside food containers; achieved by leveraging the dew point temperature. SAVRpak believes their product extends the shelf life of leafy greens and berries by 50% with a drop-in sachet.

New forms of modified atmosphere packaging that can reduce food waste by promoting food safety are also beginning to reach more widespread adoption. As an example, [Clean Crop Technologies](#) uses a proprietary blend of gasses to create ionized gasses which can remove contaminants (e.g., listeria, e-coli, salmonella). These molecules revert quickly without leaving residue or byproducts.

Many more startups and innovations aim to tackle the problem of food waste using active and intelligent packaging concepts, and have begun to partner with large food brands, retailers, and distributors to scale their solutions. ReFED offers a [directory of solutions providers](#) to help companies identify partners with technologies that can extend shelf life and reduce food waste, while in some cases also reducing the material requirements of packaging.

Access to Contents



THE OPPORTUNITY

Being able to easily access contents, also known as product evacuation, is one of the most important features of packaging. After all, if a product is difficult to access, the packaging has not done its job of delivering the contents. For certain food categories like condiments, features such as squeeze tubes and nozzles have become ubiquitous design tools to help dispense products.

Yet it is still quite common for food to remain in a package that a consumer has determined they are finished with. For example, leftover contents might be as high as [15% for product categories like condiments](#), simply because consumers can't easily access the remaining contents. Although the [data on this problem](#) is still limited, anecdotally, it's clear that the inability to get all the product out of a packaging is a real problem for consumers, such as for [ketchup](#), [honey](#), peanut butter, yogurt, and [beauty products](#).



BUSINESS CASE

Small remnants of uneaten product add up to real amounts of food waste and unnecessary emissions. Consider one example of a ground beef packaged in a [chub](#) tube versus an easier-to-access tray. One [study](#) of the life cycle impacts of both packages found that, although the tube is a lightweight format and had a lower carbon footprint, when a loss of 10 grams of meat were added to the life cycle calculations, the tube had a significantly higher carbon footprint than the easier-to-access tray.

Over millions of stock-keeping units (SKUs)

and consumers, the amount of food going uneaten because it was difficult to extract from packaging, though unknown, is likely significant. Because of the limited data, companies may benefit from consumer testing and waste audits to better understand the scope of the problem across packaging and food categories.



Being able to easily empty a container also has important benefits for the recycling stream. Today, food contamination on packaging can turn a readily-recyclable package, like a plastic jar, into one that is too dirty to be recycled properly. For example, the jar may be pulled out of the recycling stream at a material reprocessing facility and instead sent to landfills. This kind of contamination increases costs along the entire recycling system, and may result in municipalities refusing to accept certain packaging types. While the specific levels of food contamination across different packaging formats is not well-researched, broadly speaking food contamination hurts the recyclability of packaging and increases costs. Companies that want to ensure their packaging is recycled at its end-of-life should **consider better access to package contents as a strategy that both reduces food waste and improves recoverability of packaging.**



Consider better access to package contents as a strategy that both reduces food waste and improves recoverability of packaging.

DESIGN TRADE-OFFS TO CONSIDER

Companies should consider designing ways to improve a consumer's ease of accessing the contents when:

Consumer feedback and/or testing indicates high levels of food residue in the package after consumers are done using it

As with resealability, it's important to note that adding new features such as dispensers or pumps can impact the recyclability of packaging. Programs like [How2Recycle](#) and the [APR Design Guide](#) can help companies understand the impacts of their design choices.



A food product is highly viscous (e.g. condiments, peanut butter, yogurt)



Consumers tend to dispense more product than they intended or needed



Consumer feedback and/or testing indicates high levels of food residue in the package after consumers are done using it

CASE STUDY: ACCESS TO CONTENTS

Improving access to product contents may involve partnering with coating technology providers such as [LiquiGlide](#), whose technologies can help improve product evacuation. LiquiGlide's coating is now being used on [toothpaste tubes](#) in Europe to eliminate the friction between the inside of the package and the product. This allows the toothpaste to flow freely from the container, and has enabled the transition to a more readily-recyclable format and material.

This is an example of waste reduction of consumables more broadly, but may have implications for food waste. For example, this type of technology could be applied to many other types of viscous products, such as mayonnaise and honey, to help consumers get all of the contents out of their containers, adding value and reducing unnecessary waste. It's important to remember that any coatings used should be tested for its impact on recyclability as well as for any material health concerns.



LiquiGlide®



Visibility



THE OPPORTUNITY

The increased visibility afforded by transparent packaging has important implications for packaging and food waste. First, when consumers can see into a package, they may be more likely to purchase the item that best meets their needs, be reminded to use up all the contents, and notice when food has started to lose its freshness, such as salad greens that are beginning to have too much moisture or wilt. Visibility can help combat the “out of sight, out of mind” phenomenon that can lead to food being forgotten and wasted. Likewise, UV light is also a spoilage mechanism for some food products, and reducing visibility would be a strategy to help protect those products.



BUSINESS CASE

Consumers generally want to be able to see as much of the product they're buying as possible, although the importance of visibility varies based on product category. For example, visibility is particularly important for meat cuts because it enables consumers to see exactly what cut they are buying and whether it meets their needs. Since meat is a high-carbon food product, using visibility to help consumers purchase the right product can conserve the embodied resources of meat.

Adding visibility features for other product categories, such as condiments, may help to prevent food waste by allowing consumers to see exactly how much product is left in the package, rather than guessing the remains by the weight or feel of the packaging. A mustard container that is transparent can help a consumer realize there's a remaining tablespoon that can be added to their salad dressing, for example, rather than feeling a lightweight container and assuming it is empty.



DESIGN TRADE-OFFS TO CONSIDER



VISIBILITY CAN REDUCE FOOD WASTE IF:



- Consumers use color, shape, or texture to determine freshness
- There is a high amount of residual product when consumers believe the container to be empty (e.g., condiments)
- It may encourage consumers to “use up” all the product
- It enables consumers to ensure they are purchasing the correct product

VISIBILITY CAN CAUSE FOOD WASTE IF:



- Exposure to light spoils the product
- It encourages consumers to not finish the product (e.g., due to visible natural separation)

At the same time, it's important to note that visibility may cause food waste for certain product categories. Potato packaging is one such example. Exposure to light causes potatoes to turn green, and consumers may throw these potatoes away due to toxicity concerns. Today, most potatoes are sold either loose and are bagged by consumers into clear plastic bags, or are sold in clear plastic or mesh bags. A more effective package for light-sensitive products like potatoes, not yet common in supermarkets, could be a dark, opaque, paper bag.

As with other types of packaging changes, adding visibility features can limit the recyclability of packaging. For example, clear films may be less readily-recyclable than opaque rigid

formats, and adding see-through windows to paper packaging can also render the material less valuable during reprocessing. This is a tradeoff that may be necessary and important if the visibility can help prevent food waste and avoid GHG emissions, but it shouldn't be added to all packaging without consideration. As the example of potato packaging shows, there are contexts where visibility is not necessary for the consumer experience, and where it can even damage product contents.

Visibility, and in some cases its opposite, opaque or dark packaging, is often an overlooked yet important consideration for packaging to better reduce and prevent food waste.



CASE STUDY: VISIBILITY

As noted, visibility in the right contexts is key for preventing food waste. [Hormel's Applegate](#) brand notes the importance of transparency for meat packaging, with consumers wanting to be able to see the actual meat they're buying and feel confident that it's high quality. This even extends to how the product is arranged inside the packaging - the contents can be "shingled out", as opposed to "coin stacked", to maximize visibility. This has the added benefit of helping consumers see exactly how much product is left once they have opened a package.

Visibility may also be important for pet snacks, when consumers are examining the product to determine if the size is appropriate for their dog or if the texture is something that their pet is likely to enjoy. [Manufacturers such as epac flexibles](#) aim to keep both food prevention and recyclability in mind when designing packaging solutions that maintain a window into product contents to help consumers make informed product choices.

Compostable Packaging

THE OPPORTUNITY

The goal of packaging should be to reduce the known causes of food waste in retail and homes whenever possible. Food waste is not inevitable or unavoidable, but as companies and consumers take time to get better at preventing waste, some amount of food waste will continue to occur fairly consistently. For example, until important retail-level solutions such as [imperfect and surplus produce channels](#) and [enhanced demand planning](#) are widespread, retailers will continue to have some amount of spoilage and food waste. In the case of consumers, until education campaigns reach a large swath of the population, food waste in homes will also continue.

As explained in the [EPA's Food Recovery Hierarchy](#), composting food waste is less environmentally preferable than eliminating food waste or feeding people or animals, in part because the composting process produces carbon dioxide. However, the alternative for food that has already spoiled or cannot be donated is a landfill, where the food waste would produce methane. Thus, composting is preferred to reduce the overall greenhouse gas emissions, as methane is a more potent greenhouse gas than carbon dioxide. Therefore, brands and retailers should consider how easily a package's contents spoil, and how the packaging currently used may be inhibiting the successful composting or anaerobic digestion of food waste.

BUSINESS CASE

Compostable packaging can help ensure that packaging is not a barrier to composting food waste. Today, composting facilities often need to invest in depackaging equipment that can remove food from bags, jars, trays, and other packaging. A facility without this kind of equipment may not be able to accept the food waste, and the material will instead be sent to a landfill, particularly if there are no other composting facilities nearby. By contrast, compostable packaging can help deliver food waste to a composting facility, without requiring expensive depackaging equipment. In this way, designing for compostability is the final step companies can take to limit the environmental damage caused by food waste.



Compostable packaging can also mitigate contamination at composting facilities. As an example, produce stickers, which are not compostable, are a common contaminant in composting facilities. A retailer that needs to compost spoiled produce will not be able to remove all the produce stickers, and consumers often don't remove them from the skins or peels they are putting in their compost bin. Because of this, it makes sense to develop and use produce stickers that are compostable, enabling more food waste to be composted correctly.



DESIGN TRADE-OFFS TO CONSIDER

Compostability is not a blanket solution for all packaging types. Rather, companies should pursue compostable packaging when products have a high level of food residue and food waste, such as in food service and produce applications. Companies should also be aware that some composting facilities do not accept compostable packaging, particularly if it looks similar to traditional plastic and is not labeled properly with a third-party certification mark. To be successfully adopted, compostable packaging needs to be paired with clear and prominent on-packaging labeling, consumer education, and support for composting infrastructure.

For more important considerations surrounding compostable packaging, see the [SPC's Guide to Compostable Packaging](#).

When making the switch to compostable packaging, companies should also explore ways to support and invest in composting infrastructure so that more consumers have the ability to send the package to be composed at a composting facility. The lack of widespread access to composting infrastructure and possible solutions are explored in the SPC's "[Ensuring the Success of Compostable Packaging](#)" document.

Is your Product a good fit for compostable packaging?

The criteria on the right can help packaging is likely to help divert food scraps from landfill.





CASE STUDY

Early research shows that compostable packaging can also be paired with other food waste prevention technologies, and as such can be effective in preventing food waste, not just diverting it at end-of-life. For example, an EU project called [YPACK](#) demonstrated that compostable packaging with a formulation of active ingredients had antibacterial effects that could increase the shelf life of fresh products like meat, produce, and fresh pasta. This shows that compostable materials have the potential to not only divert food waste, but, with further research and development, be paired with other packaging innovations to more actively prevent food waste.

Ultimately, the design strategies outlined above should be deployed as part of a cohesive effort to reduce packaging-related food waste.



Common Packaging Formats and Food Categories that can Benefit from Better Design



Can it extend shelf life with **active & intelligent packaging** features?

Is **visibility** preventing or contributing to food waste?

Is this the right portion/pack size?



Can a better design improve **product evacuation**?

Should it be **resealable**?



Should it be **resealable**?

Should it be **compostable** due to current high levels of food waste?

Can it prevent mold growth with **active & intelligent packaging** features?



3. Educate Consumers

IN DEVELOPED ECONOMIES SUCH AS THE US, THE largest contributor to food waste - 37% - is the residential sector. Companies can commit to addressing the food waste in their customers' homes and design better packaging, but if consumers aren't engaged in food waste reduction, the improved designs will translate to limited food waste savings. What are the opportunities to educate and engage consumers in these efforts?

Messaging needs to focus on actionable steps that consumers can take in their homes, like storing produce in a specific way, or freezing certain products to extend shelf life. Consumer packaged goods companies and brands are well-connected with their consumers, and should use their platforms to promote specific in-home behaviors that reduce food waste.

Second, it's important to start with the basics. Many consumers are unaware of the role that packaging plays in preserving food and preventing waste. In one [survey](#), 65% did not agree that packaging helps to avoid food waste, and only about one third noticed the shelf life extending function of packaging. As the study summarized, "... the functionality of the packaging usually ceases with the consumer. Consumers are only marginally aware of the advantages of food product packaging in the household, and do not perceive the direct connection between packaging, freshness, shelf life, and spoilage as food waste."

In order to combat this, messaging on packaging can explain the food waste prevention benefits associated with the packaging design and/or material choices. For example, a package may explain that it now offers a seal to improve freshness, or that it includes a packet to absorb excess moisture. Or, it might mention how the package's film includes a layer of antimicrobial material that better protects the product. While consumers may not yet be aware of the interplay between packaging and food waste, the UK-based nonprofit WRAP conducted surveys that found consumers do value packaging innovations that improve convenience and make products last longer. Honest, simple messaging about the role that the packaging's features play in preserving food are not yet widespread, and would help to advance consumers' understanding of packaging's role in food waste prevention and protection.

Effectively engaging consumers on food waste is about more than just running educational campaigns that remind consumers to "waste less" or "use it up". These types of campaigns are often too generalized to be of particular use to consumers,



and may even leave them feeling guilty for not knowing exactly how to reduce food waste. In fact, such campaigns have in some instances been called out as examples of “cause marketing”, rather than true efforts to reduce food waste.

There is more that can be done, beyond messaging a package’s existing features and sharing best practices through educational campaigns. Two of the most powerful ways that brands can prevent consumer food waste is through standardized date labeling and on-pack storage and usage information. These are incredibly important tools that companies should be using to ensure consumers maximize product lifespan, and are discussed in more detail below.

STANDARDIZED DATE LABELING

ReFED’s [Insights Engine](#) has identified standardized date labeling as a top food waste solution, with the opportunity to save 582,000 tons of food waste annually and offer a net financial benefit of \$2.41 billion dollars. It involves standardizing the wording of food label dates to two phrases, one to indicate quality and another for dates which indicate safety risk, in order to reduce consumer misinterpretation. This would also eliminate visible “sell by” dates.

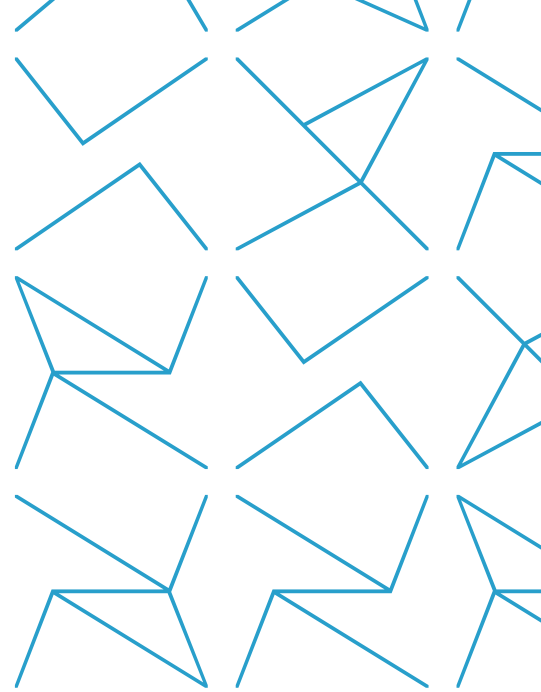
Current date labeling practices on food packaging are inconsistent and cause confusion because there are a number of phrases being used across different products - “sell-by”, “best-by”, “use-by”, and “best before” dates. This confusion is estimated to account for about 7% of all consumer waste. In the UK, it is estimated that confusion over date labels causes as much as 20% of safe, edible consumer food to be wasted.

To address this challenge, ReFED has developed a [Date Labeling Standardization Tool](#) to help manufacturers determine which label to use for different products. Aligning with the Food Marketing Institute (FMI) and Consumer Brands Association (formerly Grocery Manufacturers Association), it recommends that consumer products packaging uses two standard phrases, “best if used by” and “use by”. The term “best if used by” describes product quality, where the product may not taste or perform as expected but is safe to use or consume. The term “use by” should be applied to the few products that are highly perishable and/or have a food safety concern over time; these products should be consumed by the date listed on the package.



The Tool's goal is to help limit the number of products that are assigned a discard label and reduce the unnecessary waste of products that are still safe to consume. It offers a decision tree that can help companies determine which label they should use for a given product, as well as additional messaging that can help clarify the meaning of the label.

Brands and retailers can use tools like these to update their packaging to these new standards, since reducing the consumer confusion associated with date labeling represents an extremely cost-effective and impactful way to prevent food waste.

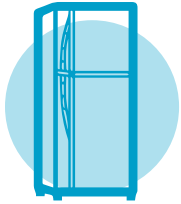


ON-PACK CONSUMER EDUCATION

On-pack communication is a powerful tool for reducing household-level food waste and can include messaging about why the product is packaged a certain way to extend shelf life, resealable functionality and any other important design features, storage tips, and preparation and leftover cooking ideas.

Today, there is an opportunity for more packaging to have prominent storage and usage instructions, since studies have shown consumers look on-pack for this kind of information. To have an even greater impact on reducing food waste downstream, packaging manufacturers and brands can actively participate in providing consumers with information and tips to extend shelf life and use up the products they buy.

THE UK-BASED NONPROFIT WRAP RECOMMENDS THAT BRANDS USE A NUMBER OF ON-PACK COMMUNICATION STRATEGIES TO EDUCATE CONSUMERS ABOUT FOOD USE AND STORAGE, INCLUDING:



STORAGE AND REFRIGERATION INSTRUCTIONS, for example, where and how to store delicate produce such as bagged salad or berries, how long a product is fresh after opening, or which items should not be refrigerated, such as bread.



USE IT UP AND “REVIVAL” TIPS, such as ideas for using cookie or cereal crumbs on ice cream or yogurt, as well as tips for re-crisping crackers or chips.



SUGGESTIONS FOR FREEZING, such as whether a product typically consumed fresh (e.g. bread) can be stored in the freezer for future consumption.



MEAL PLANNING / PORTIONING SUGGESTIONS, such as tips for how to portion and divide larger packs into a meal for two or four people, particularly applicable for bulk packaging of meat and fish.



EXPLANATION OF DATE LABELS by providing a simple definition of what a “best buy” or “use by” date label means.



THE “STORY OF FOOD”, including reminders of what is required to grow or harvest a food product, e.g. “Feed, water and love go in – surely this yogurt is too good to bin?”. WRAP focus panels have found that consumers respond well to this type of “motivational” messaging.



COOKING AND LEFTOVER TIPS, such as preparation tips that use up the entire produce item rather than discarding ends and peels, or ideas for how to pair the food item with common leftovers such as rice or chicken.



“ONCE OPENED” ADVICE that communicates how long a product typically lasts once it has been opened.



To maximize its food waste reduction potential, on-pack messaging needs to be prominent. This can include front-of-pack labeling and graphics to communicate storage instructions, as shown in this mock-up of a bread bag from [WRAP's bakery-specific guidance](#).

Educating consumers using data labeling and on-pack messaging is not just a nice-to-have, it is essential in the fight against food waste. Consumers use the information they find on packaging to determine how to cook the food, how to store it, and when to throw it out. Packaging has an incredible opportunity to influence all three of these behaviors to reduce unnecessary food waste.

4. 8 Questions to Consider

BELOW IS A PACKAGING DESIGNER'S CHECKLIST TO PACKAGING THAT PREVENTS FOOD WASTE.



DOES your package include multiple servings, and is prone to going stale or appearing less fresh?

If so, explore resealability designs and closures.



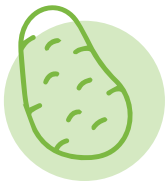
ARE your package's contents difficult to fully extract from the package because of their sticky, gooey, or oily nature? Do consumers struggle to get all of the contents out of the package?

If so, explore designs and new technologies that make it easier to access contents.



DO consumers use visual attributes such as color, shape, or texture to determine product freshness when purchasing the item? Do consumers struggle to know when the container is empty?

If so, explore features that improve visibility into the product contents.



DOES exposure to light damage your package's contents? Do consumers tend to not finish the contents if there is visible natural separation?

If so, use opaque or dark packaging to limit visibility and transparency.



ARE your package's contents often sold in family packs or bulk portions? Do you offer only one size of product? Do consumers struggle to finish the entire contents before the "use by" date?

If so, consider new pack sizes and portion sizes that better accommodate smaller households and desire for variety.



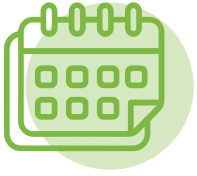
DOES the food in your package often get thrown away in grocery stores because of perishability? Do composting facilities require depackaging equipment to be able to process the perished food?

If so, consider the role that compostable packaging may play in helping to divert food waste from landfills without contaminating a composting facility.



DO your package's contents often wilt, become stale, spoil, or get damaged from excess moisture? Is the existing packaging resulting in product failures such as mold growth?

If so, explore existing active and intelligent packaging technologies, as well as innovative new solutions emerging on the market.



DOES your package show multiple dates, such as “best by”, “use by”, and/or “best before”?

If so, use [ReFED’s Date Labeling Standardization Tool](#) to eliminate consumer confusion around date labeling.

CONCLUSION

On-pack communication is a powerful tool for reducing household-level food waste and can include messaging about why the product is packaged a certain way to extend shelf life, resealable functionality and any other important design features, storage tips, and preparation and leftover cooking ideas.

Today, there is an opportunity for more packaging to have prominent storage and usage instructions, since studies have shown consumers look on-pack for this kind of information. To have an even greater impact on reducing food waste downstream, packaging manufacturers and brands can actively participate in providing consumers with information and tips to extend shelf life and use up the products they buy.

5. Resources

THE RESOURCES BELOW ARE INTENDED TO HELP companies dive deeper into the wealth of existing research on food waste, including data on where it occurs by sector and product category, as well as guides exploring specific solutions such as improved product labeling.



Climate change-food waste link

[The Drawdown Review](#)

Data on food waste by sector and category

[ReFED Insights Engine](#)

[Quantification of food waste per product group along the food supply chain in the European Union: a mass flow analysis](#)

[Reducing Food Loss and Waste: Setting a Global Action Agenda](#), WRI

LCA research on packaging as a solution

[Food packaging sustainability: A guide for packaging manufacturers, food processors, retailers, political institutions & NGOs](#), Denkstatt

[Less Food Loss and Waste, Less Packaging Waste](#), National Zero Waste Council

[Evidence review: Plastic packaging and fresh produce](#), WRAP

Data on consumer attitudes and behaviors

[Avoiding food becoming waste in households – The role of packaging in consumers' practices across different food categories](#), Helén Williams et al., Journal of Cleaner Production

[Contextualising food waste prevention - Decisive moments within everyday practices](#), Hebrok et al., Journal of Cleaner Production

[Consumer Perceptions of the Role of Packaging in Reducing Food Waste](#), Fight Food Waste Cooperative Research Center

[Helping Consumers Reduce Food Waste - Retail Survey 2015](#), WRAP

[Why does food get wasted?](#), Quad

[Wasted Food: U.S. Consumers' Reported Awareness, Attitudes, and Behaviors](#)

[Global best practice for designing interventions to reduce household food waste](#), Fight Food Waste Cooperative Research Center

Introduction to packaging-related solutions

[ReFED Insights Engine - Solutions Database](#)

[Opportunities for packaging and processing machinery and technologies to tackle food waste](#), Fight Food Waste Cooperative Research Center

[Sustainable Packaging Guidelines](#), Australian Institute of Packaging

[A review of packaging-related studies in the context of household food waste: Drivers, solutions and avenues for future research](#), Ruby Bo Yiu Chan, Packaging Technology and Science

[Packaging and shelf life of perishables](#), Dr. Eva Almenar, MSU

Improved labeling guides

[Food date labelling](#), WRAP

[Labelling Guidance](#), WRAP

[Label better, less waste: Yoghurt](#), WRAP

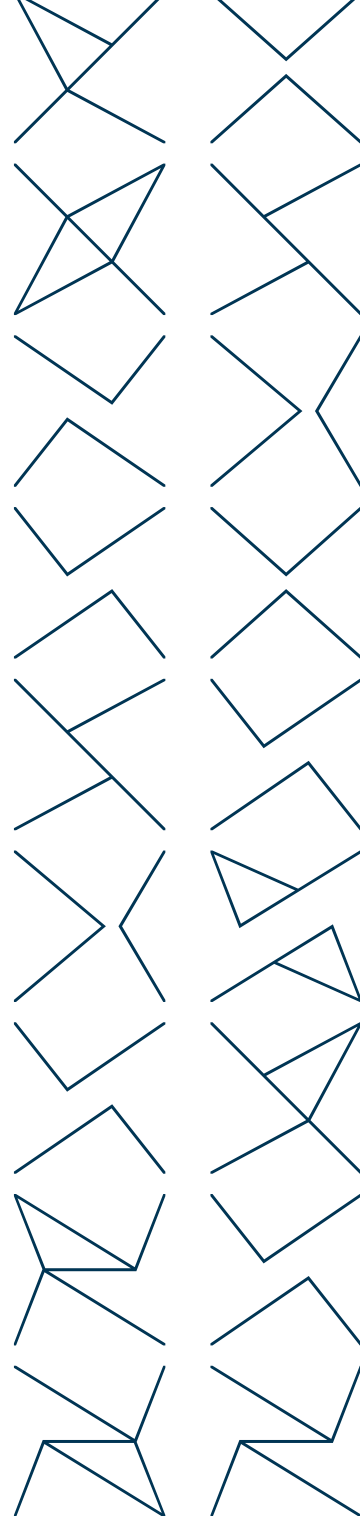
[Label better, less waste: Fresh chicken](#), WRAP

[Label better, less waste: Milk](#), WRAP

[Label better, less waste: Cheese](#), WRAP

[Label better, less waste: Fresh pork, beef and lamb](#), WRAP

[Label better, less waste: Bread and bakery goods](#), WRAP



6. Endnotes

[ReFED Food Waste Monitor by Destination](#)

[Importance of Methane](#)

[Your Trash Is Emitting Methane In The Landfill. Here's Why It Matters For The Climate](#)

[Project Drawdown Reduced Food Waste](#)

[The Drawdown Review: Climate Solutions for a New Decade](#)

[ReFED Solutions Database](#)

[ReFED Solutions Database Package Design](#)

[ReFED Solutions Database Meal Kits](#)

[ReFED Solutions Database Standardized Date Labels](#)

[ReFED Solutions Database Education Campaigns](#)

[Better Alternatives Now B.A.N. List 2.0](#)

[Briefing: What are Scope 3 emissions?](#)

[Corporate Value Chain \(Scope 3\) Standard](#)

[Zero Waste via Non-stick Surfaces](#)

[Meat and poultry packaging is evolving](#)

[ReFED Impact Calculator](#)

[GHG Protocol Category 11:](#)

[Use of Sold Products](#)

[GHG Protocol Category 12: End-of-Life Treatment of Sold Products](#)

[Connecting Food Loss and Waste to Greenhouse Gas Emissions: Guidance for Companies](#)

[Greenhouse gas emissions from food systems: building the evidence base](#)

[Ellen MacArthur Foundation The Global Commitment 2022](#)

[Kellogg's Food Waste Reduction](#)

[ReFED Food Waste Monitor Residential Sector](#)

[Champions 12.3](#)

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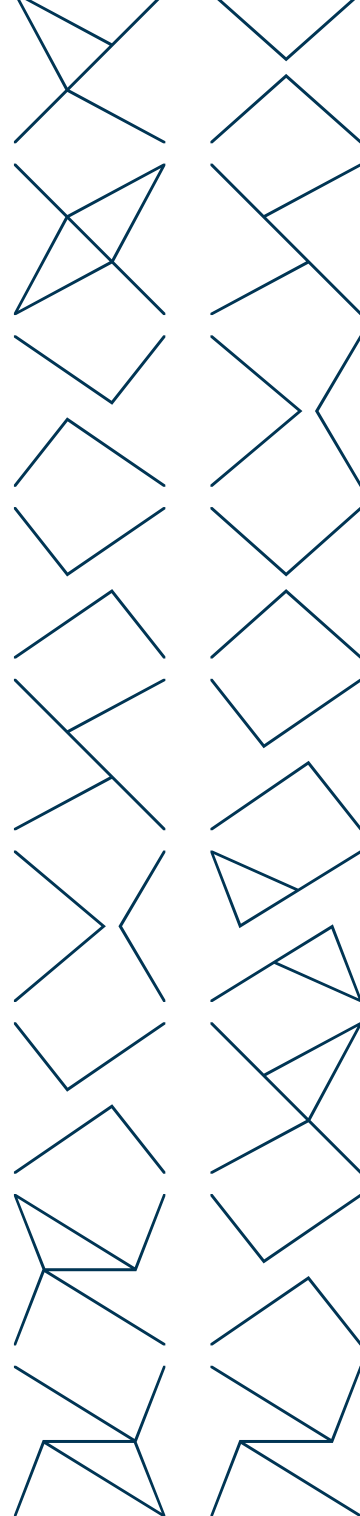
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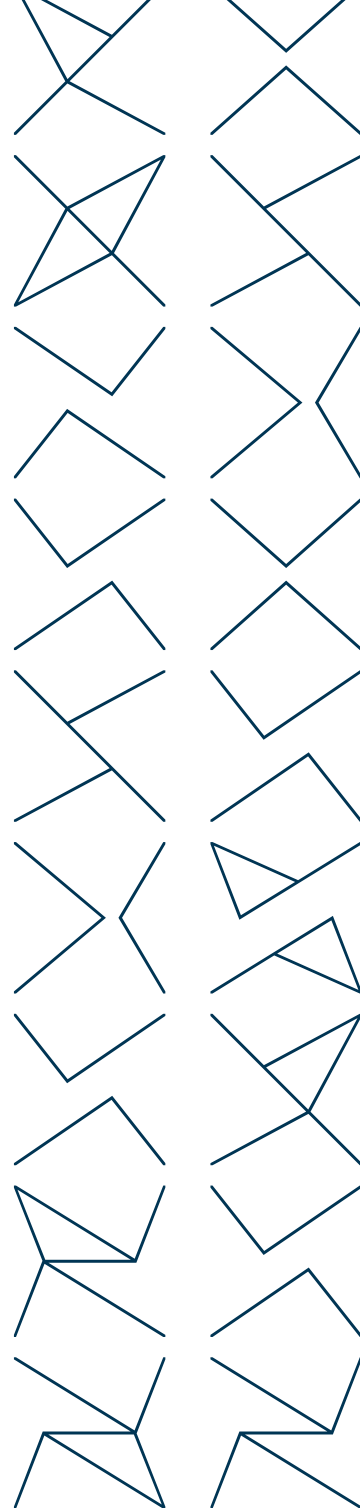
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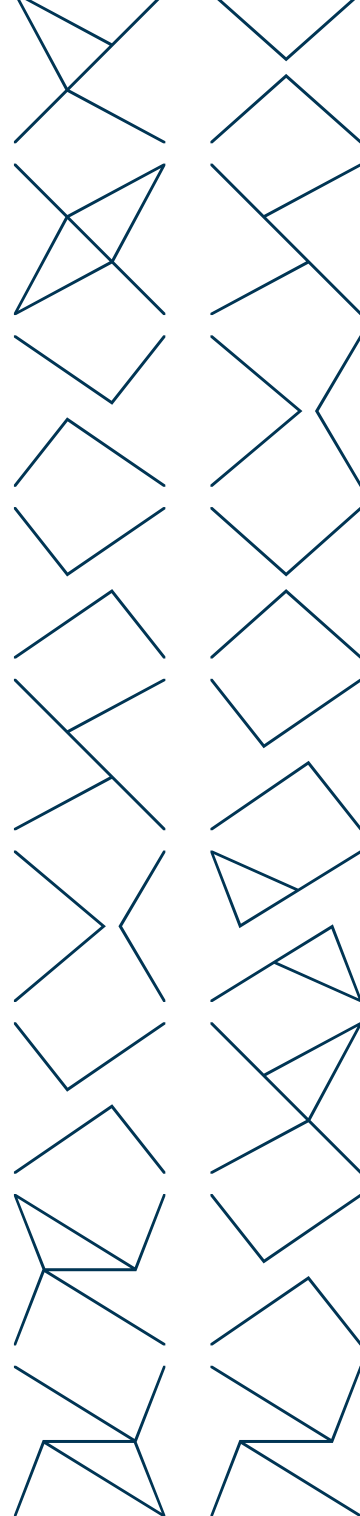
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