

FAQs: Frozen Foods, Sustainability, and Food Waste Reduction



General Sustainability

1) What can life cycle analyses imply about the environmental impact of frozen foods as it relates to reducing food waste?

The most recent and relevant [life cycle analysis](#) study, conducted by Nomad Foods, analyzed environmental impacts as a function of global warming potential and carbon footprint. The [study](#) found that frozen foods' longer shelf life led to subsequent reduction in food waste which ultimately provides significant net carbon benefits when considering retail, consumer, and end-of-life cycle stages.

2) How does composting compare with freezing in reducing GHG emissions?

Yes, composting plays an important role in preventing methane emissions from food waste, but it is relatively uncommon in the United States, [accounting for less than 5%](#) of all food waste. Most food waste still ends up in landfills, where it generates significant amounts of methane, a potent greenhouse gas. According to the 2023 Nomad [life cycle analysis \(LCA\)](#), frozen foods have a notably lower carbon footprint because their extended shelf life helps prevent food spoilage and waste before it ever reaches landfills. By reducing the amount of food discarded, frozen foods cut down on the greenhouse gas emissions associated with both food production and disposal. Increasing the use of frozen foods not only keeps more food out of landfills but also directly reduces overall emissions, making it a practical strategy for sustainability advocates and the general public alike.

3) How can supply chain partners help elevate frozen foods as a waste reduction strategy?

Supply chain partners can help in several ways:

- Retailers can help educate the consumer about the ways frozen foods reduce food waste. Great information is available at <https://frozenadvantage.org/resources/>.
- Processors and cold chain logistics (retailers, distributors, warehousing, transport) can join to explore temperature discipline along frozen food storage and distribution to maximize quality while also optimizing energy use. With more data, the distribution channel may be able to further expand the benefits of frozen foods while preventing food waste. See [AFFI-GCCA's Baseline Temperature Monitoring Protocol](#).

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Packaging

1) Where does packaging carbon footprint fit within the conversation related to sustainability benefits of consuming frozen foods?

Soft plastic packaging can be a concern, but frozen foods often reduce total environmental impact by minimizing food spoilage and waste. Certainly, the type and size of packaging are relevant factors when assessing environmental outcomes; however, it's important to recognize that other considerations may offset these limitations. For example, downstream purchasing behavior, such as buying fresh foods in bulk with short shelf lives, can have a greater environmental impact, as these items are more likely to be wasted if not fully consumed before they spoil or are perceived as inedible. The longer shelf life of frozen foods provides unique environmental benefits by significantly reducing food waste and offsetting current limitations in packaging recyclability.

Further, it's important to recognize the benefits of frozen food packaging. Not only is the package vital for maintaining quality and preventing freezer burn, it's also often the cooking vessel for frozen foods – adding to the ease of preparation for busy families.

2) What improvements are needed in frozen food packaging to make it more sustainable?

Packaging must withstand cold-chain stress; recyclable, compostable, and PFAS-free options are emerging but have performance trade-offs. To further advance sustainability in frozen food packaging, significant improvements are needed in both material selection and manufacturing capabilities. Frozen foods require packaging that can resist cracking, puncture, and maintain strong seals throughout their extended shelf life and exposure to fluctuating low temperatures. Frozen food packaging also often serves as the cooking vessel, thus it must withstand extreme heat temperatures.

These are performance demands that differ from other food categories. The industry, including AFFI members, are actively monitoring developments in packaging science and is poised to adopt new technologies that support recyclability, compostability, and circularity. As innovative materials and forming techniques continue to evolve, they hold promise for balancing environmental benefits with the high performance necessary to ensure food quality and safety throughout the cold chain.

3) Why do some frozen packages instruct microwaving in plastic?

Frozen foods that are heated in plastic containers or packaging utilize 'microwave-safe' materials that are assessed for overall safety and nutrient retention. U.S. Food and Drug Administration regulations require manufacturers to test materials labeled 'microwave safe' to ensure strict safety limits.

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4) What are the best non-plastic food storage options for freezing?

The key attributes one should consider when seeking options for freezer storage containers are air-tight seals and durability. If using glass containers, ensure they are rated for freezer storage conditions. Although silicone is broadly considered in the family of plastics due to its synthetic nature, it is a 'green' alternative. Silicone bags and containers are non-toxic, highly heat-resistant, reusable, and durable.

5) Is the frozen food industry working to improve date labeling?

AFFI member companies are committed to providing accurate, science-backed information on product labels, ensuring consumers can make informed choices about the food they eat. Key issues currently being addressed include harmonizing labeling rules, supporting consistent terminology for quality and safety date labeling, and collaborating with regulatory bodies to align date labeling standards. Currently AFFI and the frozen food industry advocates for "Use by" terminology to be used for food safety, while "Best by" terminology can be used to indicate optimal quality. These efforts are aimed at making date labeling on frozen foods clearer and more reliable, ultimately helping consumers better understand product freshness and safety.

Freezing Process

1) Why is freezer air so dry?

Unlike warm air, which can retain a large amount of water vapor (i.e. humidity), cold air in the freezer cannot hold much water vapor. Any water vapor present quickly condenses and freezes onto surfaces inside the freezer, resulting in frost buildup. This process effectively removes water vapor from the air. Frost-free freezers go a step further by actively removing moisture, which makes the air inside even drier and helps prevent frost accumulation on food and freezer walls.

2) Why is 0°F better than 25°F for frozen food storage?

Both temperatures are below the freezing point of pure water, yet, keeping frozen food at 0°F is much better than at 25°F because it ensures that food stays completely frozen, which helps preserve both its safety and quality and maintains its shelf life. Depending on the type of food, at 25°F, some parts of the food, especially those with added ingredients like sugar or salt, may not be fully frozen, allowing ice crystals to melt and refreeze, which can damage texture and taste. Melted unfrozen portions of the food can also serve as environments for microorganisms to grow, making 0°F the recommended standard for safe, long-term home and commercial food storage.

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3) Why do popsicles get sticky?

Popsicles are a good way to illustrate how freezing points work. Because popsicles contain sugar, their overall freezing point is lowered. While the parts made up mostly of water will stay solid, the areas with more sugar melt more quickly, which results in the sugar moving to the surface over time and becoming sticky.

4) How does ice formation on foods affect texture?

Ice formation on foods can affect texture in unusual ways, depending on the type of food and how it is prepared or consumed. When ice crystals form in frozen foods that are meant to be cooked before eating, like vegetables, meats, or frozen meals, tiny amounts of surface ice rarely have noticeable quality issues after cooking. This is because heating melts the ice and restores much of the food's original texture, so the brief exposure to ice does not have a lasting impact. However, for foods like ice cream that are eaten while still frozen, even a small amount of ice formation can noticeably degrade texture. When ice cream develops ice crystals, it often becomes gummy or grainy instead of its smooth feel that consumers expect. This happens because moisture migrates out of the creamy matrix, forming larger ice crystals and leaving behind a less stable structure. Unlike cooked foods, there is no reheating step to reintegrate the melted ice, so the textural changes remain apparent when you eat it. More information on the science of freezing is here: [Farm to Freezer – Exploring the science and benefits of frozen foods.](#)

5) Are proteins vulnerable to freezer burn?

Yes, proteins are particularly susceptible to quality losses from [freezer burn](#). This is because proteins in foods, such as meat, poultry, and fish, contain small but essential amounts of moisture. When these foods are exposed to dry freezer air due to inadequate packaging or damage to the protective barrier, moisture is drawn out from the protein structure. Even a slight loss of this moisture can quickly impact the texture, flavor, or overall quality of the product. Freezer burn may cause the surface of protein-rich foods to become dry, tough, and discolored, leading to a noticeable decline in eating quality. For freezing at home, it's important to minimize the exposure of the meat to air by wrapping proteins thoroughly and using a container that shields the protein from air flow and moisture loss (such as designated freezer bags, glass or plastic containers).

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6) What is freezer burn? What is frost?

Freezer burn happens when dry, cold air pulls moisture from food, often due to poor packaging. This leads to dry, tough, and discolored areas, affecting texture and taste. These spots can attract moisture from the air, resulting in frost build up. Frost forms when moisture in the freezer air freezes onto food surfaces, usually after temperature fluctuates, which occurs in normal freezer operation and when the freezer door is opened/closed. Repeated fluctuations in temperature over time can increase frost and worsen freezer burn.

Overall, it is important to remember:

- Freezer burn: Moisture loss from food, causing quality issues but still safe to eat.
- Frost: Moisture accumulation from the air, also safe to eat but can affect food appearance and texture.

More information on the science of freezing and preventing freezer burn is here: [Farm to Freezer – Exploring the science and benefits of frozen foods.](#)

7) Are freezing technologies feasible for smaller growers and food service operations?

Small growers can explore opportunities such as cooperative farming and processing arrangements, or form partnerships with larger frozen food processors to redirect surplus produce.

8) Are there guidelines for freezing surplus foods, especially for food rescue organizations?

Blanching is recommended for many vegetables (peas, corn, broccoli, etc.) before freezing, while fruit generally does not require blanching. The National Center for Home Food Preservation at the University of Georgia has a robust [resource library](#) for non-industrial freezing of food.

9) Which foods do not freeze well, especially for food banks?

[Modern freezing technology](#), such as individual quick freezing (IQF), rapidly freezes foods using very low temperature and consistent air flow to ensure small ice crystal size to maintain cell structure and overall quality of food products. This technology works for nearly all foods and preserves texture, color, and nutrition. For freezing in a traditional freezer at home or in a food service setting, preparing food products so that they can be frozen faster is essential, such as dicing produce, freezing on trays, or freezing in small portion sizes. Foods with extremely high levels of water (95%+) such as lettuce, whole tomatoes, mushrooms, or whole eggs (in shell) do not freeze well.

The National Center for Home Food Preservation at the University of Georgia has a robust [resource library](#) for non-industrial freezing of food and offers some recommendations on which foods freeze best in these settings.

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Nutrition/Using Frozen Foods

1) Has AFFI worked with school nutrition programs to increase frozen fruit and vegetable consumption?

AFFI and its members actively support school nutrition programs by working at the national policy level and engaging with school nutrition professionals through the School Nutrition Association. These efforts focus on ensuring that school nutrition regulations recognize the benefits of frozen produce and include them in programs through measures such as crediting standards and eligibility on the USDA Foods Available list for schools. Many AFFI members supply frozen fruits and vegetables to school nutrition programs via traditional distribution channels and the USDA commodity purchasing program for schools. In addition, AFFI and its members support research on produce consumption in the school nutrition settings. For example, a [recent study](#) examined how a smoothie bar intervention impacted fruit consumption and food waste among rural middle school students in Maine.

2) What recipes are available that use frozen fruits and vegetables?

We recommend using frozen fruits and vegetables just as you would fresh produce and encourage you to substitute frozen options in your favorite recipes. For example, frozen chopped onions can easily replace fresh in any dish that calls for onions. Frozen vegetables are excellent additions to stir-fries, soups, casseroles, and sheet pan meals, while frozen fruit is perfect for topping breakfast foods like yogurt, pancakes, or oatmeal, and work well in baked goods, smoothies, or simply enjoyed as a snack, just like fresh fruit or as a natural sorbet! Remember, for food safety, frozen vegetables should always be cooked before eating, but frozen fruit can be thawed at room temperature or microwaved for 30 seconds and eaten raw.

Additionally, here are some recipe options that use frozen produce.

Vegetable recipes:

- [Skillet Pasta](#) – uses frozen vegetables
- [Quesadilla](#) – uses frozen spinach
- [Vegetable Succotash](#) – uses frozen lima beans and corn, can also be adapted to use frozen peppers, onions, and zucchini
- [Chicken & Vegetable Soup](#) – Uses frozen mixed vegetables, can also be adapted to use frozen onions
- [Ratatouille](#) – Can adapt to use frozen onion and bell peppers
- [Gingerly Quinoa and Green Beans](#) – Can use frozen green beans
- [Chicken Fajitas](#) – uses frozen pepper and onion mix
- [Spanish Style Pork Sauté](#) – Uses frozen zucchini, squash, red peppers, and onion
- [Southern Style Rice](#) – Uses frozen onion, bell peppers, and okra
- [Ham and Veggie Frittata](#) – Uses frozen bell peppers, onion, spinach, and broccoli
- [Cauliflower & Chickpea Stew](#) – Uses frozen cauliflower and spinach

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- [Arroz Tapado](#) – Uses frozen mixed vegetables
- And [here](#) is a fun recent article on frozen broccoli with many cooking suggestions that can be applied to most frozen vegetables.

Fruit recipes:

- [Overnight Oats](#) – uses frozen raspberries
- [Papaya Banana Smoothie](#) – uses frozen papaya, can adapt to use frozen banana
- [Peach Green Smoothie](#) – uses frozen peaches
- [Mixed Berry Smoothie](#) – uses frozen mixed berries
- [Mango Lime Popsicles](#) – uses frozen mango

3) How long can leftovers last in a home freezer?

If your home freezer maintains 0°F, as most household units do, it provides long-term storage conditions similar to commercial freezers making it safe to keep leftovers for several months. However, food safety of home frozen leftovers relies on proper preparation and handling before freezing to avoid contamination. Leftovers need to be cooked thoroughly and quickly [cooled properly](#) to below 41°F before freezing, as harmful bacteria can grow if food is undercooked, or improperly cooled. The quality of frozen leftovers depends on how the food is frozen. Rapid freezing, reducing food size for faster chilling, and allowing good airflow around containers are key to minimizing texture and flavor changes over time. The National Center for Home Food Preservation at the University of Georgia has a robust [resource library](#) for non-industrial freezing of food.