

Packaging Practices for Prepared Food Donations

As part of our efforts to expand food donation, the Nashville Food Waste Initiative (NFWI), a project of the Natural Resources Defense Council, has researched and worked to address many barriers to food donation in the community. Prior [NFWI research](#) identified the packaging used to donate prepared foods as a concern for both food donors and the non-profit “last mile organizations” (LMOs) that distribute food directly to people in need.

To better understand current packaging practices, needs, and opportunities for prepared food donation, NFWI interviewed approximately 20 LMOs (such as churches and shelters that provide free meals) and food businesses (such as restaurants, hotels, universities, stadiums, and other institutions) in Nashville. Study participants were selected by emailing requests to a cross-section of LMOs differing in size, services provided, and clientele, and businesses that expressed interest in or are currently donating prepared food.

Recognizing that the cost of packaging is a concern for both nonprofits and donors, we also evaluated the relative cost of different packaging options, including both single-use and reusable containers.

In this brief, we summarize the packaging practices of LMOs and food business donors in Nashville. We also highlight advantages and drawbacks of various types of containers for prepared food, share our cost analysis for different packaging choices and identify strategies to overcome packaging challenges.

Summary of Key Insights

- **Infrequent donors and small LMOs** currently rely heavily on **disposable packaging** (including aluminum foil pans, small polypropylene “deli” containers, and polypropylene bags) due to the low upfront per-unit cost and the minimal labor required.
- **Some regular food donors and large LMOs** in Nashville have successfully deployed **reusable packaging**, including metal hotel pans and rigid polycarbonate containers, which is used by the donor and then returned by the LMO or food rescuer.
- **The cost of packaging is a barrier for both prospective food donors and receiving organizations.** Particularly for food businesses that are new to food donation, the provision of free packaging can be a helpful encouragement.
- **Limited storage space for packaging is a key challenge for both LMOs and donors.** Compact, stackable packaging is ideal.
- Receiving food in **smaller-sized packaging** helps small LMOs better handle and serve food. However, some but not all donors report that dividing donations into smaller containers takes additional labor.
- We compared the packaging cost of donating 50 pounds of food per week using various packaging options over a ten-year period (the estimated lifespan of the most durable option evaluated). We found that reusable **stainless steel hotel pans, even though they have the highest upfront purchase cost, are the cheapest of all options** when cost is evaluated over a ten year period. The cost of using stainless steel pans to donate 50 pounds of food once per week would be \$8 to \$10 annually. Using rigid, reusable polycarbonate containers would cost \$13–\$16. By contrast, disposable containers have low upfront costs, but over time are significantly more expensive: using non-sealable bags to donate the same quantity of food would cost \$36–\$44 per year, aluminum foil pans \$166–\$187, polypropylene “deli” containers \$370–\$528, and sealable bags (e.g. “Ziplocs”) over \$650 per year. This suggests that, where the logistics can be worked out to exchange reusable containers between a donor and LMO, the purchase of reusable containers can lead to significant cost savings over time while reducing resources used.

Types of Packaging

Disposable¹ Containers: Most donors and LMOs in our research currently use disposable containers for donating food given their low upfront cost and ease of use.

- *Aluminum foil pans* are currently the most common vehicle for entrees, sides, and other prepared solid foods.
- *Polypropylene "deli" containers* are commonly used for soups and other liquid-like foods. Donors typically divide large quantities of food into 16 oz or 32 oz containers.
- *Polypropylene sealable bags* are used to transport soups and liquid items, as well as odds-and-ends ingredients. Donors and LMOs both expressed a strong preference for brand-name bags, which seal tightly and are durable.
- *Non-sealable twist-tie bags* are used for soups, dry goods, and sides.
- *"Clamshell" plastic containers* are used by some businesses for items like sandwiches and salads that were already packaged that way for retail sale. Exact sizes vary.

Reusable Containers: While disposable containers predominate, reusable containers are used in a limited number of well-established partnerships between larger LMOs and larger donors, with containers returned to the donor's location by the LMO when subsequent donations are picked up.

- *Polycarbonate storage containers* (e.g., Cambro or Carlisle brands) are used for entrees, sides, and bulk dry ingredients, especially cold foods that do not need to be reheated.
- *Stainless steel hotel pans* are used less frequently than other types of packaging. These durable steel pans are used for entrees, sides, and some fluid items like soup. Typically, these pans are owned by the donor.

Pictures of common types of packaging are shown in Table 1. The pros, cons, and typical applications for various packaging types are shown in Table 2.

<i>Disposable containers</i>					<i>Reusable containers</i>	
<i>Aluminum foil pan</i>	<i>Polypropylene "deli" container</i>	<i>Polypropylene sealable bag</i>	<i>Non-sealable twist-tie bag</i>	<i>"Clamshell" plastic container</i>	<i>Polycarbonate storage containers</i>	<i>Stainless steel hotel pans</i>
						

General Packaging Considerations

Provision of packaging: We found that approaches to covering the cost of packaging between donor and LMO currently vary widely. Factors include the type of packaging in which the food was originally presented, the donor's comfort level with allowing reusable packaging to be taken off-property, and the financial resources available to the donor and LMO.

Some large LMOs provide packaging for large, frequent donors (e.g. hotels), which the donors keep on-site until ready for use. Other LMOs bring containers for each instance of pickup. When LMOs receive food from catered events (or grocery stores' delis) the food is typically transported in the packaging in which it is sold or served (such as to-go clamshells), in which case additional packaging is not needed.

¹ Some of these containers (such as aluminum pans, polypropylene "deli" containers, and sealable bags) can be washed and reused several times, but they are not designed for long-term durability and reuse.

Packaging as an incentive: Both LMOs and donors report that the cost of purchasing packaging can be a significant but not prohibitive expense. **Prospective donors in Nashville have said that being provided with packaging would make them more likely to start or continue a donation partnership.** Particularly for food businesses that are new to food donation, the provision of packaging can be a helpful encouragement.

Cost: Low upfront costs incentivize the use of single use, typically plastic, containers. The potential long-term savings associated with reusable containers (as discussed later in the brief) are often not acted upon, in part due to tight operating budgets for LMOs, donors' disinclination to have higher value reusable containers that they own leave their facilities, and the perceived challenges of moving the packaging back and forth between donors and LMOs.

Storage space: Donors and LMOs typically seek to minimize the space used to store packaging and strongly prefer less bulky packaging and/or rigid packaging that is stackable. **Most commonly, donors reported having space for no more than 2 cases of pans and lids (approx. 8 ft³).** When reusable packaging is provided to donors and LMOs, it is important to provide quantities that align with donation amounts so that excess space is not required to store packaging that is not being used.

Food presentation: Metal hotel pans and aluminum foil pans typically offer the most attractive presentation of entrees when the food reaches end users at homeless shelters and other settings. Some items can become visually unappealing when served if packaged in plastic bags.

Size issues: Less donor labor is required to package donations in large containers, but these large containers can be difficult to handle for LMOs that serve food in small quantities or lack the space to thaw

Table 2: Pros, Cons, and Best Uses for Different Types of Packaging

Type	Pros	Cons	Best Uses
Disposable containers	<ul style="list-style-type: none"> No return necessary Low upfront cost 	<ul style="list-style-type: none"> Typically, single use Ecologically less preferable than reusables Recurring expense Potential for spills 	<ul style="list-style-type: none"> Infrequent donors LMOs without capacity to promptly return reusable containers LMOs and donors with limited storage space When financial constraints prohibit upfront investment in reusable containers
<i>Aluminum foil steam pans</i>	<ul style="list-style-type: none"> Reheatable in same package Easily portable Attractive food presentation Typically recyclable Compact storage 	<ul style="list-style-type: none"> Non-secure seal Not sturdy in transit Ecologically less preferable than reusables Recurring expense Risk of finger cuts from sharp edges 	<ul style="list-style-type: none"> Solid entrees or sides
<i>Polypropylene "deli" containers</i>	<ul style="list-style-type: none"> Stackable Tight seal Sometimes reusable Typically recyclable Appropriate for small quantities 	<ul style="list-style-type: none"> Labor to clean if reusing Non-durable Ecologically less preferable than reusables 	<ul style="list-style-type: none"> Soups and liquids
<i>Polypropylene sealable bags</i>	<ul style="list-style-type: none"> Stack well if frozen flat Flexible to fit into tight spaces Available in multiple sizes Appropriate for small quantities 	<ul style="list-style-type: none"> Unwieldy and non-stackable if liquids are not frozen flat More expensive than twist-off bags Difficult to remove food from bag Can rip or tear Ecologically less preferable than reusables 	<ul style="list-style-type: none"> Soups and liquids "Odds and ends" Foods that will hold up well in transport
<i>Polypropylene twist-tie bags</i>	<ul style="list-style-type: none"> Compact storage Flexible to fit in tight spaces 	<ul style="list-style-type: none"> Potential to rip or tear Unwieldy for re-serving food Can detract visual appeal of food Ecologically less preferable than reusables 	<ul style="list-style-type: none"> Organizations with limited storage Foods that will hold up well in transport
<i>Individual serving (e.g. clamshells)</i>	<ul style="list-style-type: none"> Stackable 	<ul style="list-style-type: none"> Do not stack well Do not seal well Typically non-recyclable Ecologically less preferable than reusables 	<ul style="list-style-type: none"> Solid entrees
Reusable containers	<ul style="list-style-type: none"> Durable Less packaging waste Stackable Lower long-term cost Easy to move on a wheeled rack Ecologically preferable to disposable containers (even if disposables are recycled) 	<ul style="list-style-type: none"> Labor required to store, manage, and return High upfront cost Bulkier storage compared to aluminum foil pans Need to recirculate for service 	<ul style="list-style-type: none"> Solid or liquid entrees and sides Donors that donate on a regular basis and at a significant scale Facilities with storage space for unused packaging LMOs with capacity to return to donor promptly
<i>Stainless steel hotel pans</i>	<ul style="list-style-type: none"> Easier to clean than polycarbonate pans Food can be reheated in container 	<ul style="list-style-type: none"> Heavy 	<ul style="list-style-type: none"> Facilities with storage

large bags of frozen liquids. Donors and LMOs reported that bags are generally unsuitable for preserving the visual appeal of items that can be crushed or broken, though small bags (two gallons or less) may be suitable for malleable items such as cut vegetables or pasta.

Environmental impact: A comprehensive assessment of the environmental implications of packaging approaches is beyond the scope of our research. However, factors include the natural resources used to create the packaging; whether packaging is later reused, recycled, or landfilled/incinerated; the proportion of material recovered from those items that are recycled; and the resources used to wash and transport reusable items. Most donors and large LMOs that were interviewed recycle aluminum foil pans after use. Those that do not cited limited staff time and potential costs as the principal limitations. While plastic bags can also be recycled at certain drop-off locations in Nashville, no interviewees reported doing so. Note that for nearly all materials generally, reuse is environmentally preferable to recycling; recycling is in turn better than landfilling/incinerating. Obtaining items with recycled content is also a way to reduce environmental impacts.

Considerations for Reusable Packaging

Pros and cons: Donors that use reusable packaging reported that the principal burdens associated with reusables are the upfront cost and the logistics for ongoing exchanges of the packaging between donors and LMOs. Nevertheless, organizations using this approach reported being pleased with the long-term cost savings, as well as the potential reduced environmental impact compared with using disposable packaging.

Cost: The upfront costs to purchase reusable packaging can be a barrier. That said, these options are a substantially better value over time, as detailed below.

Logistics: Approaches for handling reusable packaging vary. Commonly, the donor puts food into the container, then the LMO transports it to its facility and either serves the food immediately or transfers the food to an LMO-owned container until it is served. The reusable container is then washed by the LMO and returned to the donor, typically during a subsequent food pickup. Donors typically re-wash the containers upon receipt for food safety reasons.

Labor: Donors currently using reusable packaging reported minimal additional labor requirements, if any. Some, however, did report that using reusable packaging required them to keep track of the packaging and ensure its timely return. Others reported that, since the LMOs return the packaging after they use it, no additional labor requirements were created. Donors not currently using reusable packaging, however, often perceived an additional labor burden and were apprehensive about this idea as a result. LMOs did not indicate that using reusable packaging resulted in any increased labor requirements.

Transportation: Typically, LMOs return packaging when they pick up additional food from the donor, suggesting that reusable packaging does not lead to additional transportation needs.

Cost Comparison for Disposable and Reusable Containers:

Once the issue was raised, both donors and LMOs reported recognizing the potential for long-term cost savings from switching from disposable to reusable packaging. Below, we compared the trade-off between the higher upfront cost of reusable packaging with the relatively low upfront cost of disposables. We explored the annual cost of donating 50 pounds of food per week using different types of packaging over a 10-year time span. A 10-year timeline was used to reflect the lifespan of metal hotel pans, the most durable of the options explored. Results are shown below.

This analysis suggests that **stainless steel pans (with lids) are the cheapest of all options** over the long term. Using stainless steel hotel pans to donate 50 pounds of food once per week would cost between \$8 and \$10 annually. Reusable polycarbonate storage containers would cost \$13–\$16 per year (depending on the specific containers). By contrast, single-use disposable containers have low upfront costs, but are significantly more expensive on an annual basis:

- Non-sealable bags \$36–\$44 per year
- Aluminum foil steam pans \$166–\$187 per year
- Polypropylene “deli” containers \$370–\$528 per year
- Sealable bags \$661 per year

While the contrast is stark, our analysis does not account for any additional costs of transportation, labeling, and cleaning, or the fact that donors may use an array of packaging types depending on volume and types of foods donated. Nevertheless, these figures highlight the significant economic benefit of using reusable containers where the upfront investment and logistics are feasible for both donors and LMOs.

Our analysis is summarized below and the Appendix provides a full explanation of our calculations.

Table 3: Packaging Cost Per Year to Donate 50 Pounds of Food Each Week					
Packaging	Example size and dimensions ²	Food carrying capacity (fl oz)	Example unit cost (each) ³	Packaging cost per oz	Cost per year
Reusable containers					
<i>Stainless steel steam pans (plus lids)</i>	Full size: 20 ¾" x 12 ¾" x 4"	480	\$20.35	\$0.04	\$8.14
	Half-size: 12 ¾" x 10 ⅜" x 4"	224	\$12.26	\$0.05	\$9.81
<i>Polycarbonate storage containers (plus lids)</i>	Full-size: 20 ¾" x 12 ¾" x 4"	480	\$16.69	\$0.03	\$13.35
	Half-size: 12 ¾" x 10 ⅜" x 4"	224	\$9.98	\$0.04	\$15.97
Disposable containers					
<i>Polypropylene non-sealable bags</i>	Large: 15" x 17"	150	\$0.06	\$0.000380	\$35.57
	Small: 12" x 14"	90	\$0.05	\$0.000500	\$44.46
<i>Aluminum foil steam pans (plus lids)</i>	Full size: 20 ¾" x 12 ¾" x 4"	480	\$0.90	\$0.001875	\$187.20
	Half-size: 12 ¾" x 10 ⅜" x 4"	224	\$0.40	\$0.001786	\$166.40
<i>Polypropylene "deli" containers (plus lids)</i>	Large: 5 ½" (height) x 4 ½" (diameter)	32	\$0.13	\$0.004198	\$370.22
	Small: 3" (height) x 4 ⅝" (diameter)	16	\$0.10	\$0.005987	\$528.00
<i>Polypropylene sealable bags</i>	2 gallon: 13" x 15"	32	\$0.24	\$0.007500	\$661.44
	1 gallon: 10 ⅑" x 10 ¾"	16	\$0.12	\$0.007500	\$661.44

Best Practices

- Choose packaging that preserves the visual appeal of food throughout transport and service.
- Package food in smaller containers for small LMOs (when feasible).
- Place plastic bags in a vessel with rigid sides while filling them to avoid spills.
- Consider using reusable packaging for long-term cost savings and ecological benefits.
- Where reusable packaging is not feasible, aluminum pans and polypropylene containers are the most effective containers for solid and liquid/soft foods, respectively.
- Lay sealable bags for liquid items flat in freezer to provide uniform containers for stacking and transport.
- Reuse disposable containers to the extent feasible.
- Recycle packaging that can no longer be used.

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² Dimensions of pans vary widely. These specifications reflect standard Gastronorm Sizing.

³ Unit costs for disposable containers reflect information provided by the Nashville Rescue Mission and Food Donation Connection. Prices for reusable containers reflect the lowest prices that NFWI could identify through a web search conducted in July 2018.

Appendix: Cost Calculation Methodology

Packaging cost per year calculations are based on an assumed donation level of 50 lbs per week (2600 lbs/year). Food weight is converted to volume using US EPA factors of **3.8 lbs/gallon**.⁴

To find cost per year, 2600 lbs (weight of food donated per year) is converted to gallons to find the volume of food donated per year. $2600 / 3.8 \approx$ **684 gallons/year**.

Next, the gallon figure per year is converted from gallons to fluid ounces so that the amount of packaging needed to carry it could be easily quantified. 1 gallon = 128 fl oz, so the volume of food donated per year is approximately **87,579 fl oz**.

Next, this figure is divided by 52 to determine the fluid ounces of food donated per week. For a 50-pound donation, this would be approximately **1,684 fl oz/week**.

Lastly, we assumed that each weekly donation is completed using only one type of container and that each container is fully filled. In practice, donors are likely to use a variety of packaging types and containers may not always be filled fully, so actual costs will vary somewhat. It was also assumed that new disposable containers are purchased each week. Polycarbonate containers are assumed to last for five years and stainless steel containers for 10 years.⁵

The resulting formula for cost per year for reusable packaging is:

$((\text{ROUNDUP}^6 (\text{Volume per week} / \text{container volume})) * \text{price}) / \text{lifespan in years} = \text{cost per year}$

The formula for cost per year for disposable packaging is:

$(\text{ROUNDUP} (\text{Volume per week} / \text{container volume})) * \text{price} * 52 = \text{cost per year}$

Example:

A chef decides to donate surplus food using 32 oz polypropylene deli containers. Donating 50 pounds per week is equivalent to 1684.212 fl oz per week. Each container holds 32 oz, so she will need $1684 / 32 = 52.625$ containers; this means that she will **actually** need 53 containers (rounded up). Each container costs approximately \$0.134333, so she will have to spend $53 * \$0.134333 = \7.12 per week, or $\$7.12 * 52 = \370 per year.

⁴ US Environmental Protection Agency Office of Resource Conservation and Recovery, 2016. "Volume-to-Weight Conversion Factors." https://www.epa.gov/sites/production/files/2016-04/documents/volume_to_weight_conversion_factors_memo_04192016_508fnl.pdf

⁵ Chris Whitney of One Generation Away and Seema Prasad of Miel Restaurant.

⁶ ROUNDUP used because the number of containers used must be an integer; if the average donor gives food once per week, then they would need enough containers to carry the weekly amount of food. (E.g., if they donated 900 fl oz of food weekly using 480 fl oz pans, they would need two pans so that the food could be carried in one trip, rather than twice in the same pan.)