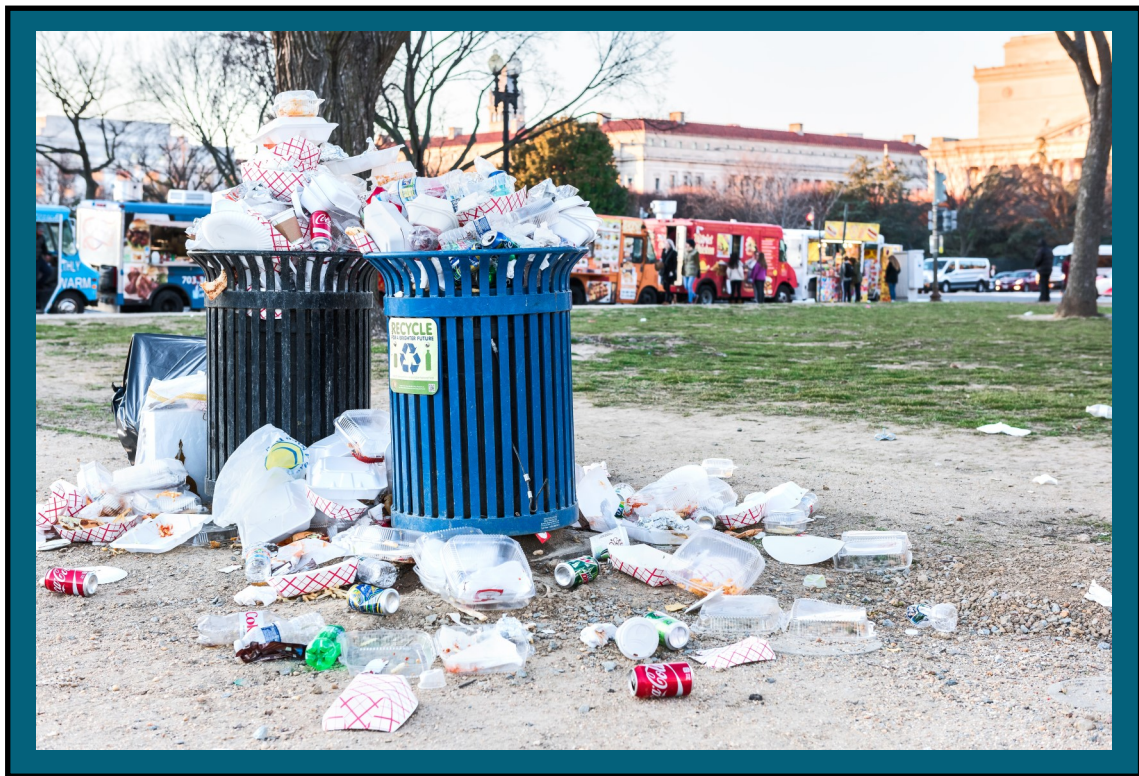


THE DIRTY TRUTH ABOUT DISPOSABLE FOODWARE

The Mismatched Costs and Benefits of
U.S. Foodservice Disposables and What to Do About Them



By Ellie Moss and Rich Grousset for The Overbrook Foundation

February 2020

Table of Contents

Executive Summary	3
A Utility Mismatch	5
Unasked Questions	7
Our Analysis	8
Who’s Picking Up the Check?	10
It All Adds Up	12
Seeking Solutions	17
Tipping the Scale	24
What to Do Now	25
About the Authors	27
Acknowledgements	28
Appendix	29
Endnotes	31

Executive Summary

Costs and Quantities of Foodservice Disposables

Single-use disposables are products used by restaurants and food vendors to serve ready-to-consume food or beverages, and restaurants spent \$19 billion on them in 2016. That same year, we estimate that 561 billion foodservice disposable items were used in the US, becoming a total of 4.9 million tons of waste.

We conservatively estimate that it cost over \$1 billion to manage foodservice disposables in the U.S. in 2016; roughly \$42 million in New York City alone. Improperly managed foodservice disposables further confer a significant economic, social, and environmental cost.



Three-quarters of foodservice disposables were used for take-out, while 21% were used for dining in (where the items were used and disposed of in the same location as they were purchased). We estimate that in 2016, 4% of foodservice disposables were used for delivery, though more recent data suggest that this number has increased sharply since then.

Napkins were the largest contributor to waste by mass at 26% of the total, with cold cups and carrier bags tied for second place at 18% each. Clamshells and other containers rounded out the top five.



Looking at New York City specifically, foodservice disposables made of paper and natural fiber weighed in at about 134,000 tons and represented 10% of the paper and cardboard waste by mass collected in New York City in 2016, while plastic foodservice disposables had an estimated mass of 72,000 tons and represented 8% of the plastic waste collected.

Emerging Solutions

We assessed more than 40 existing products, services or other solutions that are available around the world. Solutions evaluated fell into one of four categories: source reduction, reuse, recycling and composting, and other.

Our modeling shows that aggressively implemented “reduce and reuse” solutions have the potential to eliminate the need for 63% of foodservice disposables. Most of the remaining items should be either compostable or recyclable (based on infrastructure available in New York City), with just 3% needing to be landfilled or otherwise disposed.

There are specific, actionable things that can be done to achieve this. Here are four:



Vote with your Meals: Citizens and restaurant owners can make reusables the new normal and accelerate the transition to the disposable-free restaurant meal future.



Create Enabling Conditions through Policy: Citizens, organizers, restaurant owners and policy-makers can work individually and together to pass enabling policies that support the adoption of reusables. This could be through economic incentives (i.e. a fee on disposables), hygiene laws that appropriately permit reusable containers, or laws such as Berkeley’s ban on use of disposables for in-house dining



Make Using Reusables a No-Brainer: Reusables service companies, meal delivery services, entrepreneurs, and funders and accelerators all have a role to play in making reusable products and services a life upgrade accessible to all.



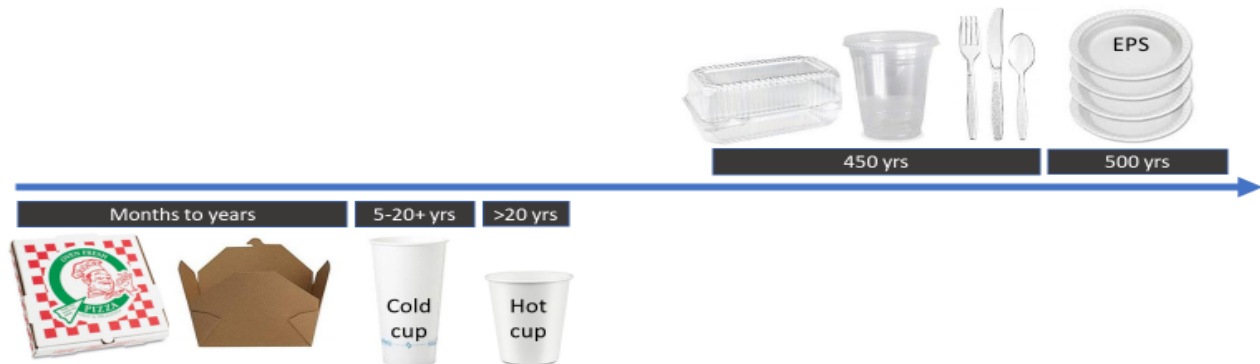
Implement Large-Scale Pilot Projects: Anyone can start, join, or support a large-scale demonstration of the viability of reusables in his or her city and use it as a model to inspire others to do the same.

While foodservice disposables provide a perceived level of convenience, when all of their costs and benefits are accounted for, they do not appear to be worth the tradeoffs that they require. This is not just a question of improving waste management at end of life. The continued use of disposables is likely to impose a greater financial, social, and environmental cost than preventing waste in the first place and encouraging the use of reusables.

A Utility Mismatch

The useful life of most foodservice disposables is measured in minutes, yet their impact lasts years.

By definition, foodservice disposables have a short life. Most will be used for less than half an hour.



*Estimated Times for Foodservice Disposable Items to Decompose in a Landfill*¹

Afterward, the majority of these items will end up in landfills. Items made from plastic, including compostable plastic, can take hundreds of years to decompose in landfills. Paper and fiber-based items will decompose in months, if conditions allow for decomposition, or never, if landfill managers are successful at keeping air and moisture out.

What Are Food Service Disposables?

Foodservice disposables are single-use disposable products used by restaurants and food vendors to serve ready-to-consume food or beverages. They may be used for consumption either on-premise or for take-out or delivery. They include plates, bowls, cups and lids, hinged or lidded boxes / containers, trays, utensils (e.g. cutlery, chopsticks, straws, stirrers), wraps (e.g. for wrapping burritos), napkins, cup sleeves, packaging bags, and carrier bags. Foodservice disposables, by definition, are not food or drink packaging. Bottles, cans, wrappers, boxes, bags, or other containers that are used to transport food or beverages to a retail location are considered packaging, not foodservice disposables.

If these items end up in the environment (streets, parks, rivers, and beaches) pure paper items will biodegrade (meaning they can be broken down by living organisms into elements that are found in nature, such as CO₂ or methane, water, and biomass) in a matter of weeks or months. Plastic and Styrofoam items do not biodegrade in nature, though they do break into smaller and smaller pieces over time. These small fragments of plastic (<5mm) are called microplastics. Paper products coated with plastic, such as cups, take longer to break down, and the plastic becomes microplastics.

There are four primary reasons that foodservice disposables typically become waste:

- **Limited Reusability:** Very little is reusable. Most polypropylene containers, heavy-duty plastic utensils, and bags that are not too dirty from transporting food could potentially be reused, but effectively everything else could not.
- **Challenges with Recycling:** A number of high-volume items, such as coffee cups and lined paper take-out boxes, are not recyclable. Of the products that are recyclable, only a small percentage is captured for recycling (the national plastic recycling rate is 8%). Of the items collected for recycling, not all of it actually gets recycled. Small or food-soiled items like lids or utensils are often excluded from recycling even when they are made from recyclable materials. They are sorted out of the recycling stream by machines because they are too small—they literally fall through the cracks—and then end up in landfills. Food-soiled items, on the other hand, are considered to be contamination. Only a certain percentage of contamination is permitted in the recycling stream, else it can ruin the recyclability of the entire bale, so food-soiled items also get excluded. Finally, there are limited or in some cases no end markets for some recycled materials such as polystyrene (often used for coffee cup lids) and colored polypropylene (often used for the black or white bases of take-out containers.)
- **Challenges with Composting:** Municipal composting is only available in a handful of American cities, so most people have no access to composting. Where composting facilities do exist, certified compostable items can be composted, but they add no value to the compost and can add cost. Composters generally want organic material such as food waste or yard scraps, which makes a rich compost product. Compostable containers, cups and napkins take up space that could be used by higher-value food waste; take up to three times longer to compost than food waste; and increase the risk of contamination because of the potential for toxic substances, such as per- and polyfluoroalkyl substances (PFAS, see box below for detail) or microplastics.
- **Contribution to Litter:** Foodservice disposables such as cups, clamshells, and utensils are consistently in the top ten items found in litter clean-up efforts.



Source: ReThink Disposable

Unmasked Questions

It is common to see a public, office, or even home garbage bin overflowing with disposable plates, coffee cups, and other disposable foodware items.

Yet, while foodservice disposables waste is a particularly visible symptom of our throw-away culture, there have been few studies examining the scope and scale of this problem, and there is very little data to help put it into perspective. This study was undertaken to bridge this informational gap, to serve as a resource to inform decision-making, and to raise awareness of the scale and nature of the impacts from disposable foodware items. This study has two main elements. The first is to quantify and characterize the amount of disposable foodservice items used in the United States in a year. The second is to review potential ways to reduce the amount of disposables being used and estimate the potential impact that these solutions could have.

This study examines these questions:

- What are the costs and benefits of foodservice disposables? Who pays for and who profits from them?
- How big a role does foodservice disposables waste play in the overall waste story in the US, and in New York City in particular? How much of the U.S. and New York City waste streams are comprised of foodservice disposables?
- How much impact could existing solutions have in addressing this challenge, if they were to be widely embraced and scaled?



Our Analysis

Quantifying the Problem

We used a combination of purchased data, desktop research, expert interviews, and data from foodservice distributors to build a quantitative model of foodservice disposable usage in the U.S. for 2016, the most recent year for which the purchased data was available. The model estimates the number of units of foodservice disposable items and the total mass for each type of item and material. Seven recycling and sustainability experts reviewed the model and were ultimately satisfied that the model was reasonable and, if anything, conservative in its estimates. (These experts are noted in the acknowledgements.)

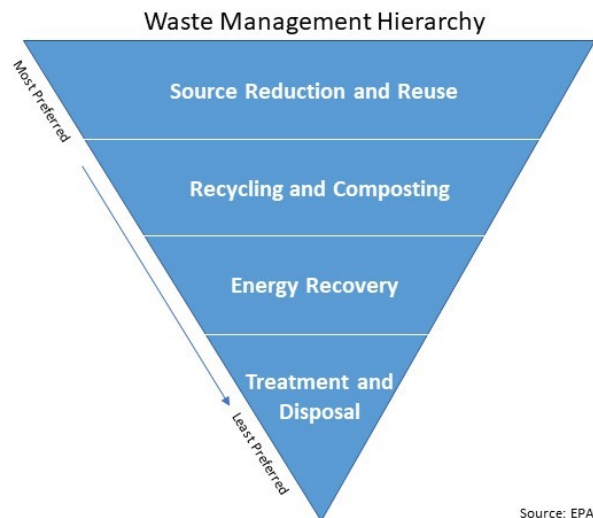
In Scope	Out of Scope
Foodservice disposables, e.g. hot and cold cups and lids, containers, utensils, bags, etc.	Packaged food and beverages e.g. drinks in bottles or cans, food not prepared on site
Restaurants, including quick service restaurants, coffee and snack shops, fast casual restaurants, and full-service restaurants (~70% of the foodservice disposable market by sales)	Retail sales of prepared foods (e.g. at a supermarket), institutional establishments (e.g. schools or hospitals), lodging and hospitality-based foodservice (e.g. hotel restaurants), catering, sports and recreation venues (e.g. stadiums, arenas, event venues), and other markets including airlines, military bases, and food trucks
On premise and off-premise consumption, including take-out and delivery	---

Exploring Potential Solutions

While our quantitative model focused on the US, we looked globally for potential solutions.

We referred to the EPA Waste Management Hierarchy to inform the prioritization of waste reduction strategies. The reverse pyramid, shown below, illustrates the preferred order for reducing waste, with the top levels being most preferred and the lower levels being options of last resort for what is hoped to be a small amount of waste.

For this study, we focused on potential solutions at the top two levels of the waste hierarchy: source reduction and reuse, and recycling or composting. The objective was to identify products, services, or other solutions that could reduce the waste burden of foodservice disposables without increasing environmental, social, or economic harm.



Open Source Model

We are pleased to make available for public use the quantitative model we developed for this project

The model presents data for the U.S. as a whole, and can also be easily customized to look at cities, states, or regions. The model includes a customized presentation of New York City as an example.

It is designed to allow the user to customize these variables:

- **% of U.S. market:** Use this to scale to a particular city based on population, share of restaurants, or your own data.
- **Material mix:** If you have better data on the mix of materials for your city, you can choose to use manual inputs for material mix and the model will pull from those values rather than the baseline we calculated.
- **EPS (Styrofoam) in or out:** Use this toggle to include or exclude EPS from the material mix. If you choose to exclude it, the units and mass that had been EPS are reallocated based on the most likely material substitution for that particular item.
- **On-premise, off-premise, or both:** Use this to toggle between looking only at on-premise use (e.g. dining in a restaurant), off-premise dining (e.g. take-out and delivery), or both.
- **Compostability and recyclability:** This information is specific to New York City but the user can also manually input these values on an item- and material-specific basis.
- **Mass units:** Choose to have your results displayed in metric tons, kilograms, short tons, or pounds.

You can download the model for select cities here: <http://www.mossandmollusk.com/the-dirty-truth>

EPS Foam

Expanded polystyrene foam (EPS), commonly known as Styrofoam, was banned in New York City effective January 1, 2019. The data from 2016 included EPS because it was national data and EPS is broadly used across the US.

To get a clearer picture of what the plastics mix looked like in New York City in 2019, we reallocated the items made with EPS to the most likely substitution material(s). For example, hot cups were previously 78% plastic or wax-lined paper and 22% EPS; once EPS was banned, that 22% was substituted with lined paper cups. For EPS cold cups, the reallocation was proportional to the current levels of usage of existing alternatives, such as lined paper, PET, PP, or PLA; we also considered relative prices. Since EPS was cheap, it seemed more likely that it will be replaced with the next cheapest option. These assumptions were tested with experts who felt they were reasonable.

EPS is a relatively light material, so almost any substitution increases the total mass of foodservice disposables, and substitutions with paper or fiber products tend to enhance this effect. Whether EPS is included or not also affects the breakdown of material between paper and fiber and plastics.

The data presented in the body of this report includes EPS in the mix, unless otherwise noted. The adjusted totals without EPS are presented in the Appendix.

Who's Picking Up the Check?

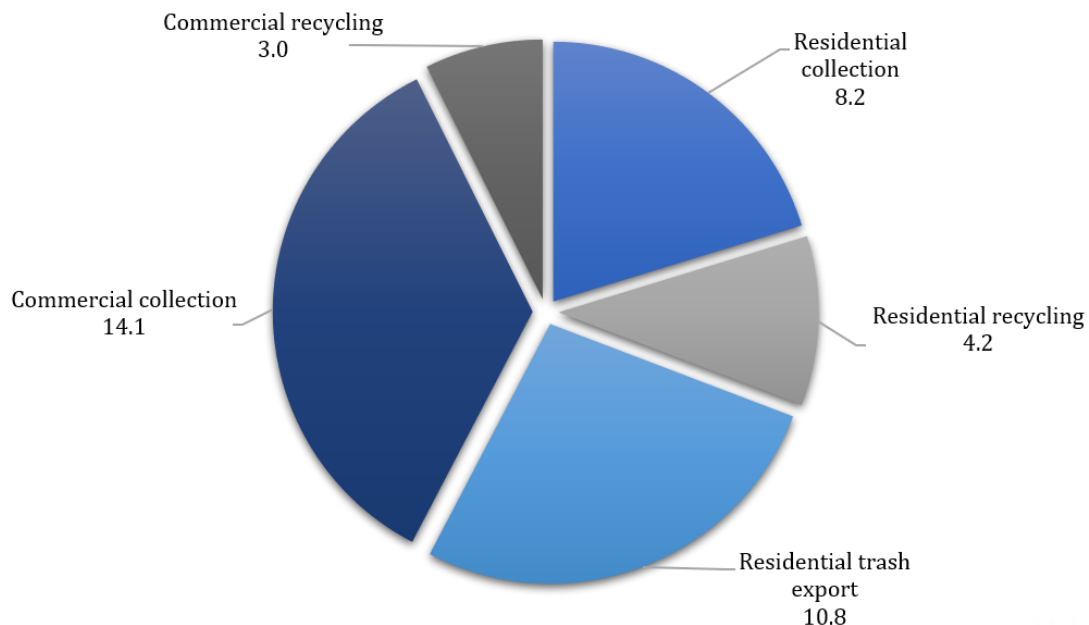
Foodservice disposables are purchased by restaurants, usually from distributors or other suppliers. In 2016, the market for foodservice disposables was \$19 billion in the U.S. and was growing at 3.2% per year,² meaning **restaurants spent \$19 billion that year to purchase foodservice disposables**. Restaurants may transfer this cost, in whole or in part, to customers, or cover it themselves as a cost of doing business.

Once used, most foodservice disposables enter either the commercial (e.g. restaurant or business bins) or municipal (residential and public bins) waste stream.

We used waste management cost data and recycling rates from New York City to estimate the cost of recycling, composting, or disposing of foodservice disposables in the city. We conservatively estimate that **it cost \$42 million to manage foodservice disposables waste in New York City in 2016**. This was ~\$24M of residential waste management (paid for by residents) and ~\$18M of commercial waste management (paid for by businesses).

Using national average costs for collection, recycling, and trash export, we estimate that the **total cost of managing foodservice disposables in the U.S. in 2016 was over \$1 billion**.

Estimated Cost to Manage Foodservice Disposable Waste in NYC (\$M)



However, this is only part of the story. This number only includes the cost of managing foodservice disposables waste that has been properly disposed. Across the U.S. and beyond, foodservice disposables are more likely to become litter than other waste, which confers a significant economic, social, and environmental cost.

- Foodservice disposables show up on streets, beaches, and in storm drains at higher rates than other items.^{3 4 5 6}
- Litter cleanup across the US—of which a significant share is foodservice disposables—is estimated to cost \$11.5B per year. Businesses pay \$9.1B. Governments, schools, and others pay the rest.^{7 8}
- Plastic items that enter waterways or the ocean harm businesses, ecosystems, and people.
 - The productivity, viability, profitability, and safety of fishing and aquaculture are highly vulnerable to marine plastic.⁹
 - Scientific studies have found that environmental damage can negatively affect people’s mental wellbeing. Littered beaches and harm to popular marine species, such as sea turtles, can be associated with issues such as stress, depression, and anxiety.^{10 11}
- Losses to natural capital, meaning the estimated financial value of intact natural resources and systems, are estimated at between \$3,300 and \$33,000 per ton of plastic in the ocean.¹²
- Marine litter has negative impacts on biodiversity, the implications of which are difficult to gauge.¹³

A Quick Guide to Plastic Resins Used for Disposable Foodware

Acronym (Code) Full name	Common foodservice disposables usage
PET (#1) Polyethylene terephthalate	Cold cups, cold cup and take-out container lids, sauce and side cups, clamshells
HDPE (#2) Film High-density polyethylene	Carrier bags
LDPE (#4) Film Low-density polyethylene	Carrier bags
PP (#5) Polypropylene	Cold cups, take-out containers and clamshells, cutlery, straws and stirrers
PS (#6) Polystyrene	Hot cup lids, cutlery, take-out container lids, clamshells
EPS (#6) Expanded Polystyrene Foam	Cold cups, hot cups, plates, bowls, clamshells

Note: Resin #3, polyvinyl chloride, or PVC, is not typically used in foodservice disposables. Resin code #7, which is used for all other resins beyond one through six, is also not typically used for foodservice disposables.

Poly-lactic acid, or PLA, is not technically a plastic resin though it looks and feels like one and is currently used to make cold cups and lids, cutlery, and straws. PLA is industrially compostable and is often marketed as ‘compostable plastic.’

It is worth noting that bioplastic or biobased plastic, made from renewable sources such as corn, may or may not be compostable. The compostability of plastic has no relationship with its feedstock.

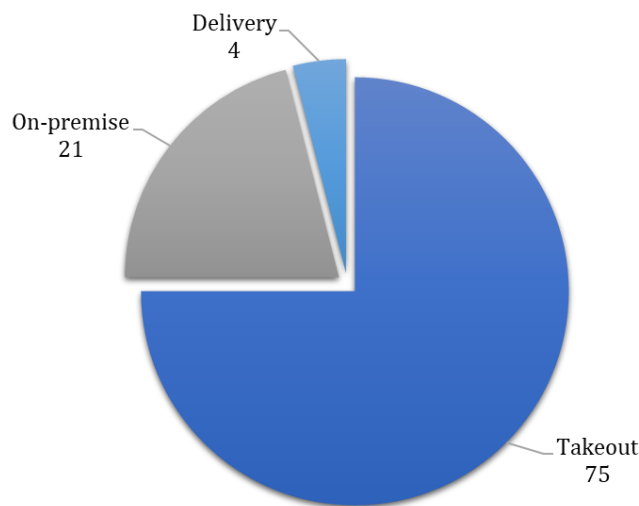
It All Adds Up

In 2016, an estimated **561 billion foodservice disposable items were used in the US**, becoming a total of **4.9 million tons of waste**. (In this study, tons refers to short tons unless otherwise noted.)

Foodservice disposables from U.S. restaurants represented an estimated 1.9% of the overall municipal solid waste stream in 2016.¹⁴

Three-quarters of foodservice disposables were used for take-out, while 21% were used for dining in (where the items were used and disposed of in the same location as they were purchased). We estimate that in 2016, 4% of foodservice disposables were used for delivery, though more recent data suggest that this number has increased sharply in the past three years. According to Citibank research from 2018, restaurant delivery sales currently represent 18% of the total food services market in the U.S. with delivery expected to grow 50% over the next 4 years.¹⁵

Foodservice Disposables Usage in the US in 2016 (%)



Spotlight on New York City

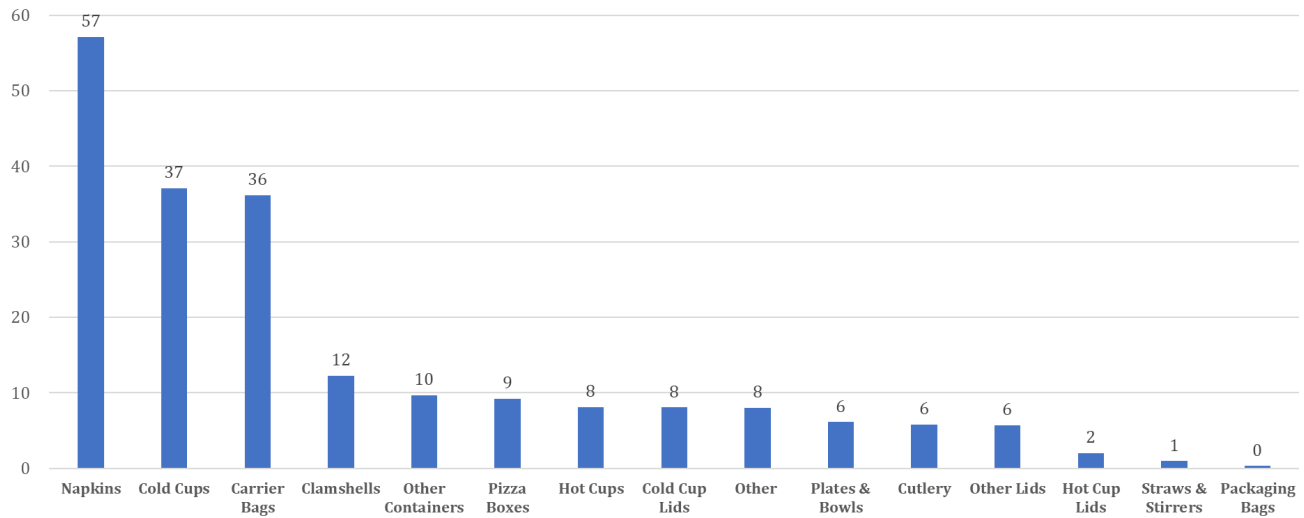
New York City¹⁶ is home to 2.7% of the U.S. population¹⁷ and 4.1% of U.S. restaurants.¹⁸

We estimate that New York City used 23 billion disposable foodservice items in 2016, at a mass of about 207,000 tons. This was the equivalent of 1.5% of all municipal solid waste in the city that year; 10% of the city's paper waste stream; and 8% of the city's plastic waste stream.¹⁹

Top Items

In New York City, napkins were the largest contributor to waste by mass at 26% of the total, with cold cups and carrier bags tied for second place at 18% each.

Foodservice Disposables Used in New York City in 2016
(thousands of short tons)

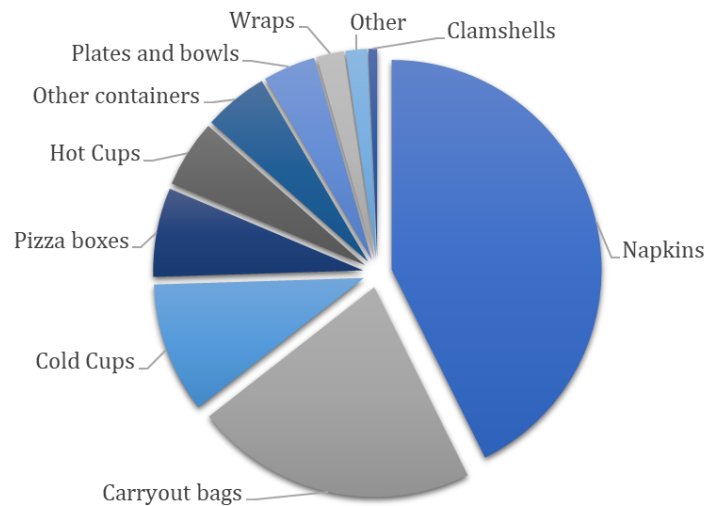


Clamshells and other containers rounded out the top five. While hot cups have become somewhat of a symbol of the foodservice disposables waste problem, they were only 4% of foodservice disposables used by mass.

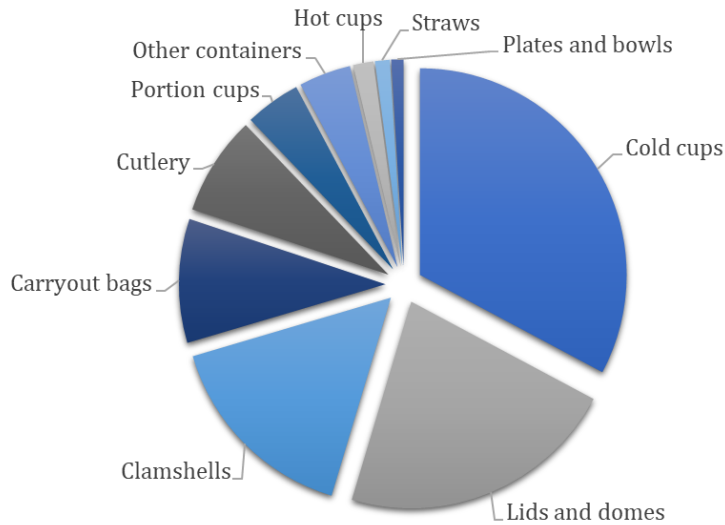
The top items, by mass, that are made from paper and fiber are napkins, carrier bags, cold cups, and pizza boxes.

The primary items made from plastic are cold cups, lids and domes, clamshells, and carrier bags.

Items Made from Paper and Fiber (by mass) – with EPS



Items made from plastic (mass) - With EPS

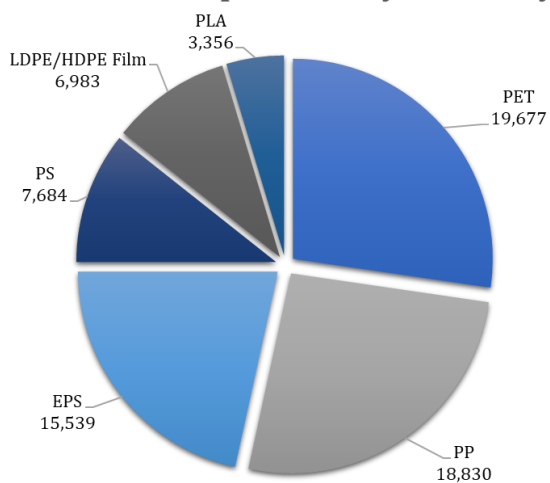


Material Mix

We estimate that plastic foodservice disposables had a mass of 72 thousand tons and **represented 8% of the plastic waste collected** (by mass) in New York City in 2016.²⁰

Anecdotally, according to distributors, demand for PLA has been increasing substantially since 2016. While it is a higher cost material, it has been marketed as a more 'sustainable' choice because it is industrially compostable. Unfortunately, many of the cities where it is being used do not offer composting services, so it ends up being landfill along with other plastics. PLA, however, is a contaminant in the plastic recycling stream and can be problematic for recyclers.

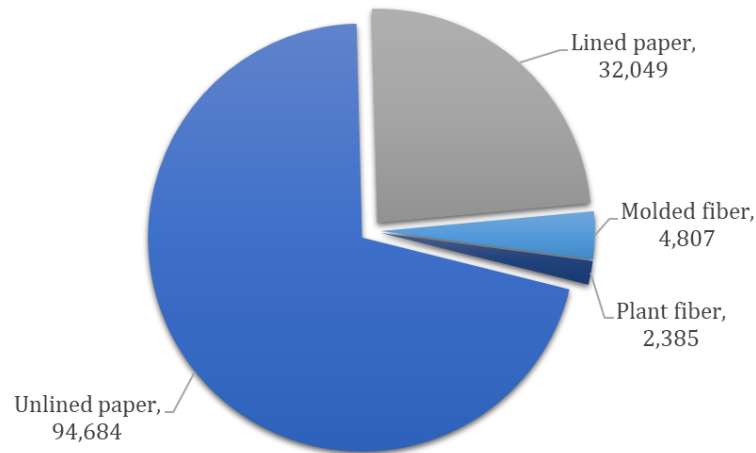
Foodservice Disposables by Plastic Type



Restaurant disposables made of paper and natural fiber weighed in at about 134,000 tons and **represented 10% of the paper and cardboard waste** by mass collected in New York City in 2016.²¹

Unlined paper accounted for 95 thousand tons and 71% of total paper and fiber while lined paper (i.e. paper coated or lined with wax or plastic) was 24% of total paper and fiber used. Over the past two years, molded fiber and plant fiber have become more popular for meals like take-out salads, but they are still a small share of material overall.

Paper and Fiber Foodservice Disposables – with EPS



Final Fate

Our analysis shows that, at most, 59% of foodservice disposables by mass are compostable, at most 52% are recyclable, and at least 18% are neither.

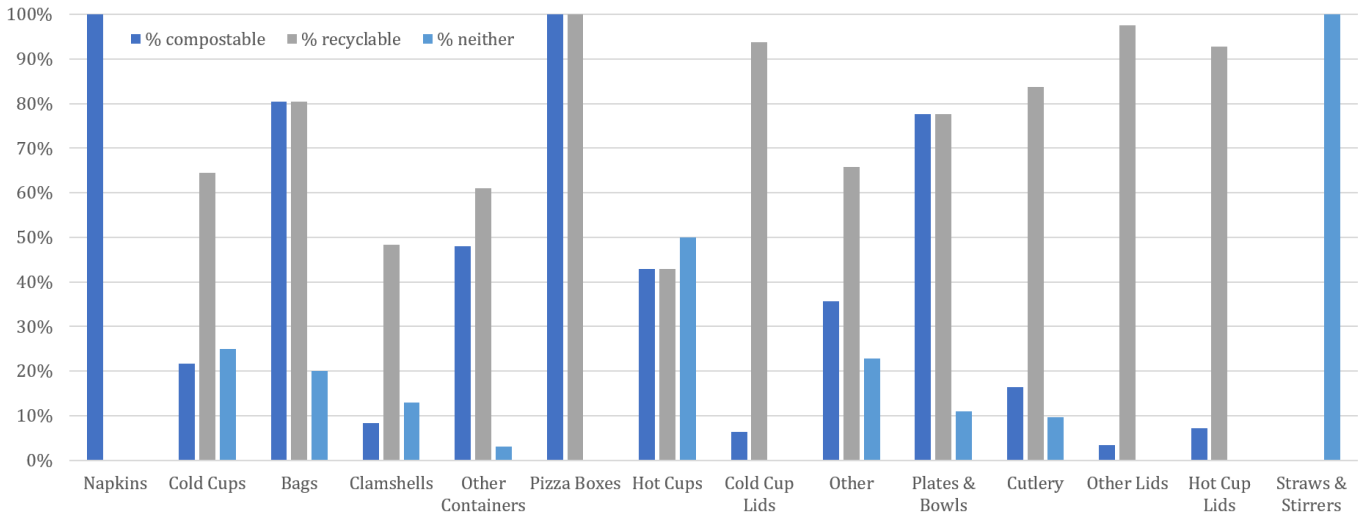
Our data did not include product-specific information about recyclability or compostability so we have assumed that all items made from a recyclable or compostable material are in fact recyclable or compostable, though this is a generous assumption. For example, smaller items such as utensils and cup lids are too small for the sorting machines to handle, so they are sorted out and disposed of in landfills or incinerators with non-recyclable items. Foodservice disposables soiled with food are also sorted out because there are limits to the amount of contamination allowed before the entire bale is deemed worthless. Plus, only certified compostable items should be composted. Therefore, this estimate should be considered a best-case scenario.

Substances of Concern in Paper and Fiber Disposables

There is emerging research showing that per- and polyfluoroalkyl substances (PFAS) are often present in molded fiber and paper containers. PFAS enable paper and fiber to hold up to the moisture and oil in food. PFAS are known to have adverse health effects on humans and to accumulate and persist in human bodies and the environment indefinitely.²² This means that the use of PFAS in foodservice disposables presents a possible danger to human health. Further, items containing PFAS should not be composted, as the chemicals persist in the environment and could contaminate food and water supplies.²³

It is difficult to put a concrete number on the amount of contamination that can be tolerated in the recycling system, though material recovery facility contacts we spoke with said it is around 5% for paper and a bit higher for plastic, and more contaminated bales can usually be mixed with less contaminated bales or with other clean feedstock to reach acceptable levels. However, any concerted effort to increase the recycling of foodservice disposables at a significant scale would need to consider the likelihood that this drives contamination past viable levels.

Potential Fate (Based Only on Material) for Foodservice Disposables in NYC



Note: While clean napkins are technically recyclable, it would be nonsensical to manufacture napkins just to recycle them unused. For the purposes of this study, we assume napkins do get used and are therefore better suited to composting.

General rules of thumb for recyclability and compostability:

- Paper/fiber items are both compostable and recyclable.
- PET, PP and PS plastics, along with aluminum, are recyclable, not compostable.
- Plastic films are recyclable by a small number of facilities and typically need to be brought to a collection location.
- EPS (Styrofoam) cannot be recycled in curbside recycling other than in a small handful of municipalities.
- PLA is industrially compostable, but not compostable at home. It will not biodegrade in the environment and is not recyclable.
- Smaller items such as lids and utensils are often sorted out and landfilled rather than recycled.
- Residual food is a problem for recycling, but a bonus for composting.

Recycling and composting rates in New York City as of 2017:

- Paper recycling rate: 36%,²⁴ as compared to the U.S. average of 65.9%²⁵
- Plastic recycling rate: 17%,²⁶ more than double the U.S. average of 8%²⁷
- Composting rate for food and other composting: <2%,²⁸ less than the U.S. average of 6.3%²⁹

Note: The numbers provided here are residential only and are consistent with how recycling numbers are usually presented, specifically: these numbers reflect the amount collected for recycling as a percentage of the total amount of municipal waste collected. However, as has been noted above, many items that are collected for recycling are not recycled because they are sorted out as contamination. Contamination rates in US recycling are estimated at around 25%. (Source: [Rubicon Global](#))

Seeking Solutions

We assessed more than 40 existing products, services or other solutions that are available around the world.

Solutions evaluated fell into one of four categories: source reduction, reuse, recycling and composting, and other.

Source reduction:

- Reduce excessive and wasteful use of foodservice disposables
- Switch from disposables to reusables for customers dining in restaurants

Reuse:

- Replace disposables with reusables for take-out and delivery
 - o Encourage Bring Your Own (BYO) reusable cups, containers, utensils, and bags
 - o Encourage restaurants to offer their own reusable containers for a loyalty bonus or discount
 - o Provide reusable hot cups, cold cups, lids, and containers for use, managed by a service company

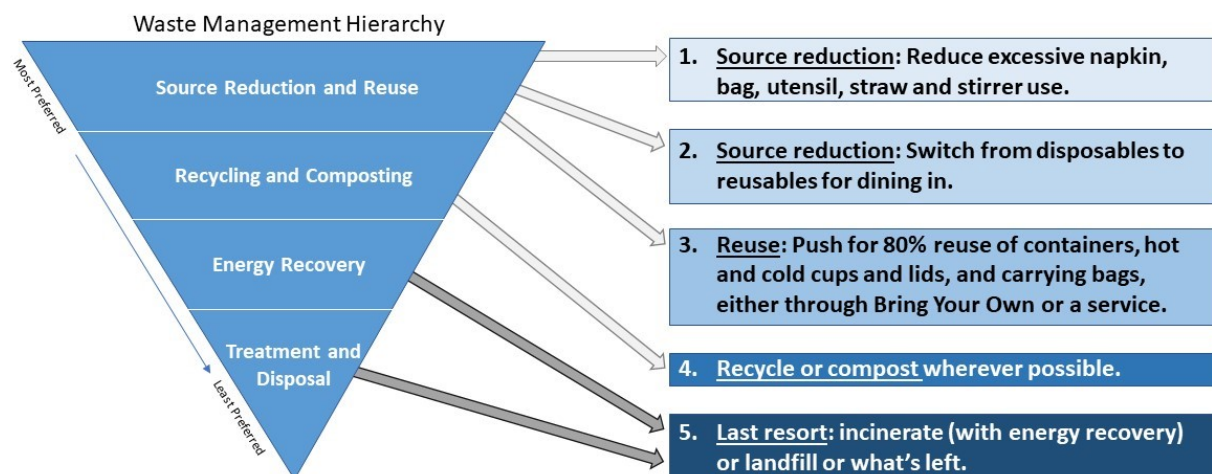
Recycling and Composting:

- Use more recyclable or compostable materials in foodservice disposables
- Encourage and educate people to recycle and compost properly
- Expand the collection of recycling and composting

Other

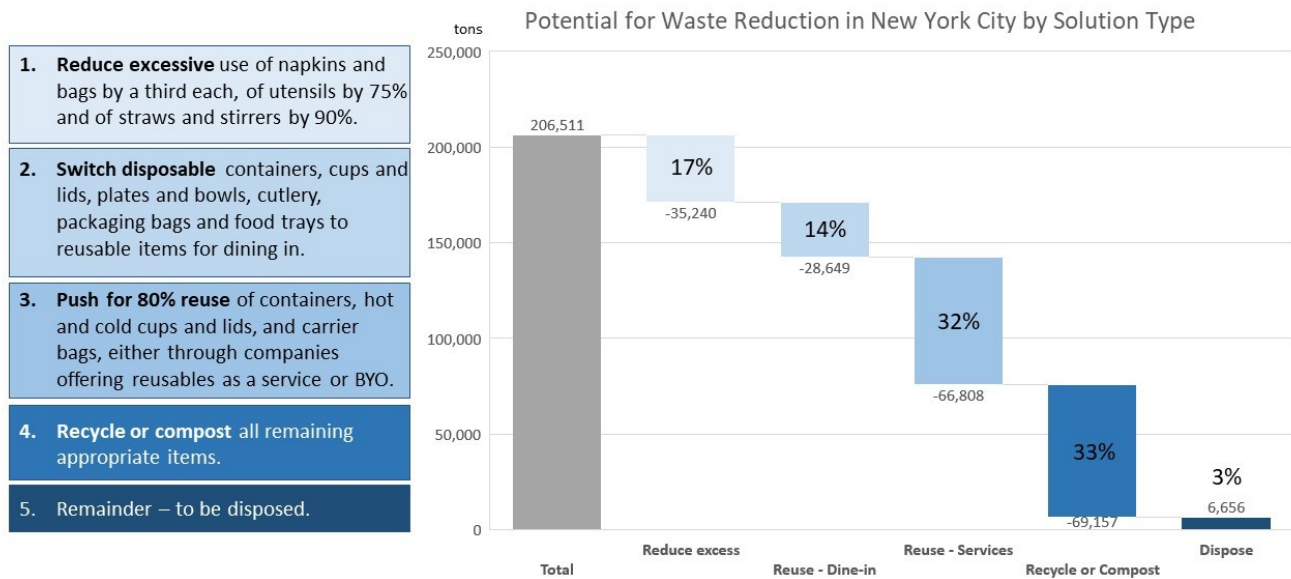
- Use edible foodservice disposables (e.g. edible spoons, straws, even cups)

We then analyzed the source reduction, reuse, and recycling and composting solutions for foodservice disposables usage in New York City to see how much of the problem this set of solutions could address at an ambitious level of adoption. We followed the waste hierarchy's recommended order in applying the solutions. This means that we first try to avoid using a disposable item, then consider switching it to a preferred material. For items that cannot just be eliminated, we seek to switch as many to reusable as possible. Only after that would we look at switching from a non-recyclable or non-compostable container to one that is recyclable or compostable.



Some have proposed that the simplest and most effective solution would be to simply make all foodservice disposables either compostable or recyclable, which would turn foodservice disposables ‘circular.’ This assumes 100% compliance with recycling and composting, which is significantly greater than our current recycling and composting rates. Further, achieving these increased recovery rates would rely on a considerable expansion in collection bins and services, which would come at a cost. Our modeled solution still relies on a significant amount of recycling and composting, but these are modeled as a last resort rather than as our first choice.

We estimate that aggressively implemented “reduce and reuse” solutions can eliminate the need for 63% of foodservice disposables. Most of the remaining items should be either compostable or recyclable, with just 3% needing to be landfilled or otherwise disposed.



Source Reduction

Reduce unnecessary or wasteful items

This scenario is based on the observation that certain items are wasted or simply not needed. Napkins are often provided in inch-thick stacks when one would suffice, resulting in clean napkins being discarded. Take-out and delivery orders are often double- instead of single-bagged; perhaps no bag is even needed. Many restaurants oversupply utensils in an effort to provide excellent service. However, data show that nearly all take-out or delivery meals are consumed at a home (82%) or a workplace (16%) where reusable cutlery is typically available,³⁰ as is the means to wash it. Straws and stirrers represent a very small portion of foodservice disposables used. In keeping with current trends to skip the straw, we are modeling a reduction in straw usage. It should be noted that paper straws are heavier than plastic straws, so switching to paper still has an impact.

Source reduction is modeled using these assumptions:

- Napkin use is reduced by one third
- Bag use is reduced by one third
- Cutlery use is reduced by three-quarters
- Straw and stirrer use is reduced by 90%

What's needed to accelerate progress:

- Awareness campaigns targeting restaurants to change their behavior on offering excessive items
- Delivery platforms should change the default to providing items on request only, or at a minimum, should make it easy for users to opt out of napkins, utensils, straws/stirrers and extra bags. Restaurants also need to comply with customer requests to opt out of utensils.
- Public awareness campaigns encouraging people to skip taking the items they do not need rather than taking them and throwing them away unused.

Switch from Disposables to Reusables For Dining In

Case studies show that reusables typically save restaurants money over time, once the initial investment is paid back. ReThink Disposable,³¹ a nonprofit that has worked one-on-one with 300 restaurants in California since 2018 to make the switch from disposables to reusables, reports that most restaurants save money over time with reusables for dining in. Sodexo, one of the largest foodservice companies in the world, has reported similar results, even accounting for breakage and loss of reusable items.³²

Costs of disposables to restaurants

- Purchase of disposable items, plus shipping and handling costs when applicable
- Disposal of secondary packaging for disposable items
- Waste disposal for used items disposed of on site

Costs of reusables

- One-time investment in the reusables, plus shipping and handling costs when applicable
- Dishwashing
 - Machine (one-time investment and annual maintenance)
 - Space to put machine*
 - Energy, water, detergents and chemicals
 - Additional labor (in some cases)
- Place to store reusable foodware (can often use same space as disposables)

* Some restaurants, such as fast food restaurants, simply do not have space for dishwashers. Creative solutions, such as shared dishwashing capacity, may be required.

We modeled source reduction from switching to reusables for dining in under the assumption that all containers, cups and lids, plates and bowls, cutlery, packaging bags and food trays are replaced with reusable items for customers dining in (consumption on premises).

What's needed to accelerate progress:

- Targeted engagement with mid-size restaurant chains to drive them to make the shift
- Expanded resources for small and medium-size restaurants to access hands-on support to move from disposables to reusables
- Supporting policies such as the ordinance in Berkeley, CA, that imposes a 25 cent fee on disposable cups and ultimately bans the use of disposables for dining in. All disposables used for take-out or delivery must be compostable.

Reusable Solutions

The scope of this report is restaurants, which account for roughly 70% of the foodservice disposables market. The rest is used by retailers (e.g. ready-to-eat grocery items), institutions (schools, corporate cafeterias, hospitals), lodging and hospitality establishments, caterers, sports and recreation venues (e.g. arenas, stadiums), and other markets including airlines, military bases, and food trucks. Many of these are “closed environments,” which means the disposables are used and consumed within the facility, whether it is a stadium or a corporate office. Providing reusables in this context is relatively straightforward because people either return the reusable before leaving the location (for example, a stadium) or it is a location that they return to regularly (for example, a workplace). These locations often use a simple deposit system (i.e., a reusable is provided for a small fee, which is reimbursed when the item is returned) though there are a range of models that can work.

“Open environments,” such as restaurants providing take-out and delivery meals, pose a logistically complex challenge because a reusable cup or container needs to be able to be taken offsite and then recovered, cleaned and made available for use again at the restaurant. Collection sites (where users can return the reusable items once they are done with them) can be participating restaurants, drop boxes in public locations, or reverse vending machines, where you put the container into the machine and it returns the deposit. Currently, it is common for the collection site to be the restaurant, which can be a burden on the consumer if it is not a place they go to frequently. For this model to be more seamless for consumers, a large network of return locations and collection infrastructure is required, which adds cost to the model. Operating in a densely populated area can make the return logistics more convenient for users and also help keep collection costs low; however, there are also ways to structure the collection system to serve smaller towns. The higher the percentage of participating restaurants, the more efficient the system, as well.

Startup companies offering reusables based on a service model are proliferating. Companies may offer hot/cold cups with lids, containers of different shapes and sizes, and/or cutlery, and they handle all washing, collection, and distribution on behalf of the restaurant. There is growing interest from consumers and investors. Cup Club, a company that provides reusable cups for use at cafes and cafeterias and washes them at their own facilities, has received \$460K in early stage funding.³³ Go Box, a reusable container service, receives multiple licensing inquiries every day from all over the world.³⁴

ReThink Disposable's Work with Restaurants in California

ReThink Disposable, a nonprofit that works one-on-one with restaurants to make the switch from disposables to reusables, reports that restaurants were able to achieve more in savings than the cost of making the switch in just the first year, and most restaurants achieved significant savings over time.

In a pilot with Café B33, a University of San Francisco (USF) campus café operated by the on-site foodservice operator Bon Appetit, ReThink Disposable worked with café managers to switch from disposable foodware to all reusables for dining in, without adding labor cost. These changes resulted in annual savings of 2.6 million items, totaling 13.5 tons, and \$157,883. The pilot was so successful that Bon Appetit has decided to make the changes permanent and implement them at all of their USF campus locations.

ReThink Disposable also calculated the avoided greenhouse gas (GHG) emissions as a result of the changes each year at 10.24 metric tons.

Source: [ReThink Disposable](#)

We identified and researched 19 of these companies and observed that reusables service business models fell into three main categories. Additionally, we included Bring Your Own reusables as an option. The bulk of the entrepreneurial activity so far is in cities in the US, Europe, Southeast Asia and Australia (see table on next page).

Entrepreneurial activity expanded notably in NYC during 2019. The restaurant chain, Dig, launched "Canteen by Dig," a reusable to-go container program now available at two of its locations. A+E Networks is currently using the Go Box app as part of an EPA-funded pilot launched in December 2019 to study reusable to-go container programs in workplace cafeterias. Brooklyn-based DeliverZero launched in November 2019 to offer customers the option to receive delivery orders in reusable containers and as of February 2020 has 15 participating restaurants. Additionally, a coalition of organizations called ReusableNYC (www.reusablenyc.org) formed in late 2019 to support the reuse movement in the New York City area through policy initiatives.

We modeled adoption of reusable models using these assumptions:

- Broad adoption of reusable containers and hot and cold cups, achieving an 80% reduction in disposable cups (including lids and sleeves) and containers. Assuming this use of reusables is partly due to the increase in services (as described above) and partly due to individuals using more reusables on their own.
- Reduce carrier bags by 80% through use of reusable bags.

What's needed to accelerate progress:

- **Designers and manufacturers:** Improve design and reduce manufacturing impact of reusable items.
- **Meal delivery companies:** Integrate reusables into delivery services such as Seamless or Uber Eats in the U.S. and Deliveroo in Europe and Australia. For example, Returnr, a service providing reusable containers, is now available through Deliveroo at supported locations in Australia (though users are required to return the containers back to the restaurants themselves).
- **Service companies and cities:** Implement a large-scale demonstration project, for example at the scale of a whole city, so people can experience the model as a new normal rather than an exception.
- **Funders and investors:** Provide additional funding for companies offering reusable services to support expansion and service enhancements, such as improved user interface, logistics, etc.
- **Logistics and industrial washing companies:** Establish partnerships with reusables-as-a-service companies to provide supporting services, such as logistics or industrial washing and hygiene.
- **Local governments:** Create the conditions for success with supporting policies, such as:
 - Restaurant hygiene policy that allows for safe use of reusable containers in restaurants, whether they are part of a service or brought in by the customer.
 - A small fee paid by consumers on use of disposables to improve the economic case for individual consumers to choose reusables.

Model	How it works	Benefits	Challenges	Examples
Subscription – user pays (items washed by service)	<ul style="list-style-type: none"> Users pay a monthly or annual fee to use the service Restaurants also pay, either on a monthly or a per item fee basis 	<ul style="list-style-type: none"> Once subscribed, it becomes a habit (users do not need to make a decision each time) High return rate for reusable items Subscriber model is a stronger business model because of the recurring revenue 	<ul style="list-style-type: none"> Cost to consumer may limit accessibility or appeal Less accessible for tourists / visitors 	<ul style="list-style-type: none"> GO Box, Portland OR and San Francisco, CA Durham GreenToGo, Durham NC The Cup eXchange, Australia
Backed by a deposit or credit card (items washed by service)	<ul style="list-style-type: none"> Users either pay a deposit, refunded when the item is return, or provide a credit card, which is only charged if the item is not returned on time. Restaurants pay a per-item fee, which has been covered by the municipality in some cases. 	<ul style="list-style-type: none"> Can be free to user if containers are returned on time Easy for anyone to participate; doesn't require any commitment 	<ul style="list-style-type: none"> Up-front deposit may limit accessibility Lower return rate (some people choose to keep the reusables) can be costly to business if deposit amount not set high enough 	<ul style="list-style-type: none"> My Fresh Bowl, New York City ReCIRCLE, Switzerland Tiffin, Belgium revoly, Bali, Hong Kong, Singapore Cup Club, UK EcoBox, Luxembourg Freiburg Cup, Freiburg, Germany Hannoccino, Hannover, Germany Recup, Germany Vessel Works, Boulder CO and Berkeley CA Returnr, Australia Ancolie, New York City, NY
Bring Your Own reusables (items washed by the user at home; the container can be purchased from the restaurant or purchased independently)	<ul style="list-style-type: none"> Users bring the reusable cup or container (either specific to the restaurant or their own) to be used for take-out 	<ul style="list-style-type: none"> No additional logistics (container moves with customer) Increased personal choice in cup or container style, size Personal ownership correlates with gentler use of items, motivation not to lose them Some restaurants offer a discount 	<ul style="list-style-type: none"> Requires people to bring their own items, and to carry them from place to place as needed Prohibited by law in some places due to hygiene concerns Without proper procedures for how restaurants fill a container brought from home, hygiene can be a concern For personal containers, item may not be compatible with restaurant equipment (e.g. coffee mug too tall to fit under spout) 	<ul style="list-style-type: none"> Just Salad, multiple USA states and Dubai Huskee Cup, Global There are many manufacturers of reusable cups and containers

Are Reusables Always Better Than Disposables?

Reusable items are designed to be more durable so that they can be used repeatedly, and the environmental footprint of their manufacture is almost always higher than that of a disposable item on a one-to-one basis. However, by reusing the item multiple times, the 'impact per use' comes down over time.

The impact of manufacturing the item is determined by the types and amount of material, source and amount of energy, and type of manufacturing process. For reusable items, the impacts of use and reuse during the item's useful life also need to be considered, such as the Greenhouse Gas (GHG) emissions from the washing process.

A Life Cycle Assessment (LCA) is a data-driven study that can be used to compare two items on a range of environmental impacts over their lifetimes and through the end of their useful lives.³⁵ The LCAs that have been done comparing different types of reusable and disposable cups have come to conflicting conclusions, which is often due to the set of assumptions each study is making about how these items are being made, used, and disposed. The results can also be influenced by the quality of the data available for certain impacts. For example, the databases quantifying the impact of plastic in the environment have historically understated the impacts, though work is underway now to remedy this.

A key number in the comparison of reusables and disposables is the number of times that a reusable item must be reused in order to "break even" with the disposable item on a per-use basis. One LCA concluded that a reusable polypropylene cup must be used at least 10 times to have lower lifetime carbon emissions than a disposable cup of the same material.³⁶ While there are clear problems associated with plastic waste in the environment, many reusable items are made from plastics, such as polypropylene, because it is lightweight, strong and affordable. The belief is that these reusable items are less likely to be littered because they are more durable and have more value.

What is clear is that certain steps can be taken to minimize the environmental impact of reusables:

- Design and manufacture reusable items to minimize their environmental impact from the start. Choose low-impact, durable materials, minimize the weight of the item, and design for recyclability at end of life. Use low-carbon, efficient manufacturing processes.
- Use the reusable item as many times as possible. When it is at the end of its life, recycle or repurpose it if possible, then dispose of it responsibly.
- Use low- or no-carbon energy sources for washing (for example, choose electricity sourced from renewable sources) and wash items as efficiently as possible (this typically means large batch sizes in water and energy efficient machines).

Tipping the Scale

Foodservice disposables do not appear to be worth the tradeoffs that they require. High costs and low utility of foodservice disposables make them an obvious target to be replaced by something better.

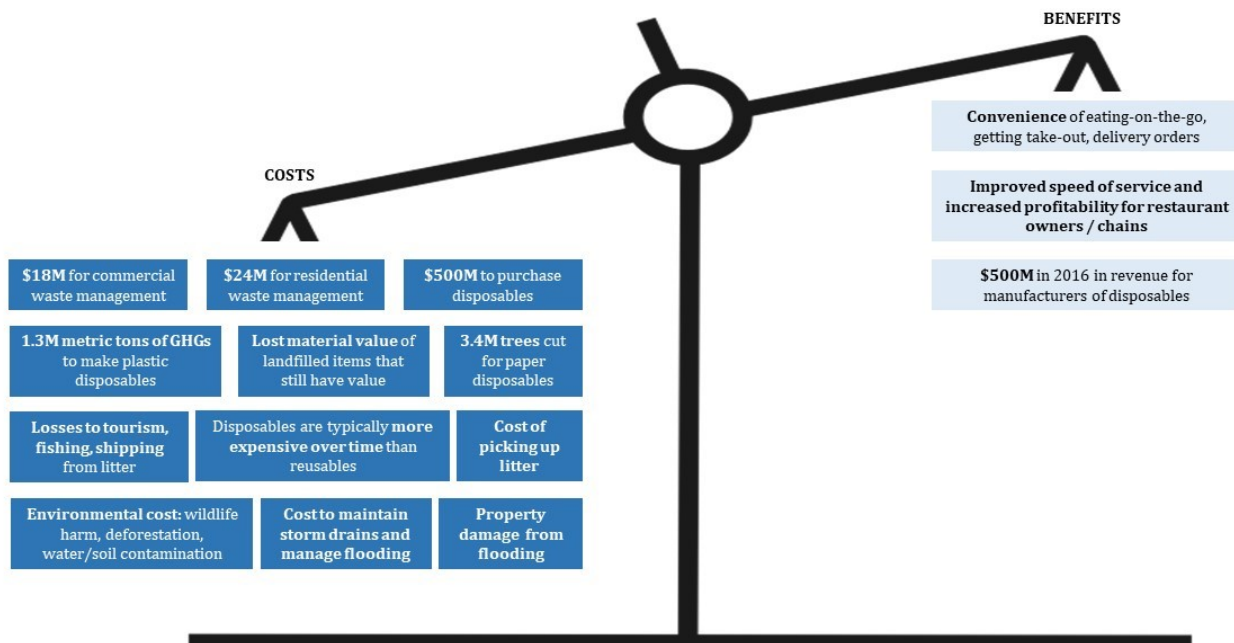
There is no silver bullet. No single strategy can resolve a significant enough portion of foodservice disposables waste. We will need multiple strategies to truly address this problem.

This is not just a question of improving waste management at end of life. The continued use of disposables, which requires investment in new materials and efforts to increase recycling and composting rates, is likely to present a greater cost than reducing waste and encouraging the use of reusables.

This is a systemic challenge that will require systemic solutions. Increased use of reusables for dine-in, take-out and delivery will require the creation of an ecosystem of supporting products (e.g. low impact reusable containers) and services (e.g. shared dishwashing hubs, collection points).

We need to move from uncertainty to action. One challenge to taking action is the degree of uncertainty about what this future ecosystem might look like. We need to create a common vision, communicate it well, and engage innovators and funders to achieve it.

In New York City, do the Benefits of Foodservice Disposables Outweigh the Costs?



What to Do Now

To move toward a world where only 3% of foodservice disposables end up in landfills and none reach the environment, much work needs to be done. There are roles for organizers, entrepreneurs, funders, accelerators, policy-makers, restaurant owners, reusables services, delivery services, and citizens.



Vote with your Meals – Everyone

Goal: Make reusables the new normal and reward businesses that accelerate the transition to the disposable-free restaurant meal future.

Citizens:

- Whenever possible, use reusable services when you eat out, get take-out, or order for delivery. Bring your own reusables if reusable services are not available.
- Tell the owners or managers of the restaurants you frequent that you do not want disposables and prefer reusables, especially for dining in. Encourage them to try a reusables service if there is one in your city.
- Use Yelp’s Eco-Friendly rating³⁷ on restaurants to take waste into account when choosing where to eat.
- For take-out and delivery, tell the restaurant that you do not want disposable cutlery or double-bagging and only ask for as many napkins as you need.

Restaurant owners:

- Make the switch from disposables to reusables for dine-in service.
- For delivery and take-out, work with reusable services in your area. If you cannot, let customers know they are welcome to bring in their own reusables (where permitted). At minimum, ask people what items they need rather than offering them by default.

Create Enabling Conditions through Policy – Action for Citizens, Organizers, Policymakers, Restaurant Owners

Goal: Pass enabling policies that support the adoption of reusables. This could be through economic incentives (i.e. a fee on disposables), hygiene laws that appropriately permit reusable containers, or laws such as Berkeley’s ban on use of disposables for in-house dining.

Citizens: Share your views with your elected officials and make it known that you support sensible legislation to address the public burden of foodservice disposables.

Organizers: Using the model, customize the quantitative data to your city or state and use it to inform citizens and policymakers about the hidden costs of foodservice disposables that are borne by communities, and of the better options that exist.

Restaurant owners: If you have experience switching to reusables or working with a container-as-a-service program, share your insights and perspective with policy-makers. If you do not, let your local restaurant group and/or policymakers know that you support sensible policies reducing the public burden of foodservice disposables and encouraging creation of the infrastructure necessary to scale adoption of reusables.

Policy-makers: Use the quantitative model to understand the likely burden of foodservice disposables on your community. Talk with your department of sanitation, department of water, and other agencies that may be dealing with the implications of this waste. Reach out to policymakers in cities that have already taken action on this issue to understand their perspective and results.

Make Using Reusables a No-Brainer – Action for Reusables Service Companies, Meal Delivery Services, Entrepreneurs, Funders and Accelerators

Goal: Make reusable products and services a life upgrade for all.

Reusables Service Companies: Keep improving and expanding your services to offer them in more restaurants and cities. Demonstrate that using reusables is a better experience all around, and not just for environmentalists.

Meal Delivery Services: Integrate with reusables services and restaurants to make reusables easy to get and return when ordering delivery.

Entrepreneurs: Do you have an idea for how to make reusables services even better? Want to design a new reusable cup or container that is better than what is already out there? Go for it! We need as much innovation and fresh thinking as possible.

Funders and Accelerators: Support start-ups working to replace foodservice disposables with better options.

Implement Large-Scale Pilot Projects – Action for Cities, Policy-makers, Reusables Service Companies, Funders, Nonprofits, Restaurant Owners

Goal: Bring a comprehensive experience of reusable usage to life in one city to demonstrate to policy-makers, investors, restaurant owners, and citizens what it would be like to have reusables as a normal part of everyday life.

All: Start, join, or support a large-scale demonstration of the viability of reusables in your city and use it as a model to inspire others to do the same.

About the Authors

Ellie Moss has extensive experience developing environmental and social impact strategies for investors, corporations and nonprofit organizations. Ellie was the lead author for the “Sea of Opportunity” report which detailed impact investment opportunities to address the issue of marine plastic pollution across the value chain. Other recent projects include the Morgan Stanley Plastic Waste Resolution, co-authoring a Blue Paper on plastic and other pollution to the ocean for the High Level Panel for a Sustainable Ocean Economy, a global mapping of standards, labels and claims for plastic packaging for Consumers International, and the U.S. Farmers and Ranchers Alliance’s 2019 convening on unleashing U.S. agriculture’s ability to address climate change. Ellie began her work as a strategy consultant with The Boston Consulting Group in 2005, and later spent six years with Blu Skye Sustainability Consulting working with companies like Walmart, Microsoft, Nestle Purina, and Energizer. Ellie has a dual degree in Economics and Public Policy from Brown University and an MBA from The Wharton School at the University of Pennsylvania.

Rich Grousset is a social entrepreneur and consultant dedicated to reducing the waste created by single-use disposable products in the foodservice industry. In 2011, he co-founded the University of Michigan’s first reusable to-go container program, Go Blue Box. In 2013, Rich co-founded a start-up company, BizeeBox, to expand adoption of reusable to-go products by restaurants and workplace cafeterias. (Neither of these programs is included in this report because the Go Blue Box is out of scope and BizeeBox is no longer in business.) He is currently managing an EPA-funded, reusable, to-go container pilot project at a New York City workplace cafeteria and is studying the costs and benefits for restaurants to switch from disposable to reusable products as a consultant for Upstream Solutions. Rich has an MBA from the University of Michigan’s Ross School of Business, an MS in Environmental Policy from the University of Michigan’s School for Environment and Sustainability, and a BS in Communication from Cornell University.

The Overbrook Foundation is a progressive family foundation that supports organizations advancing human rights and conserving the natural environment. The Foundation was established in New York in 1948 by Helen and Frank Altschul and currently advances its mission through two programs: Environment and Human Rights. The Overbrook Foundation’s Human Rights program supports organizations promoting and defending human rights in the United States and Latin America. In the U.S. it supports organizations challenging the undue influence of moneyed interests at all levels in the political system, organizations working across reproductive justice and LGBT rights issues, and organizations challenging mass incarceration and criminalization. In Central America and Mexico, Overbrook supports frontline human rights defenders. Through its Environment Program, the Foundation supports projects focusing on biodiversity conservation in Latin America, and sustainable production and consumption in the United States. More recent grantmaking centers around movement building, the intersection of youth and climate crisis, and behavioral change. The program also supports select organizations working on solutions to the single use plastic problem and is a member of the Plastics Solution Fund.

Acknowledgements

The authors would like to thank everyone who contributed to the creation of this report. In particular, we would like to acknowledge Daniel Katz, Katie Gwathmey, Megan Nickel, Stephen Foster, and Mary Grecco from the Overbrook Foundation for their partnership on this project.

We would also like to thank the following people who took time to speak with us, share data with us, and help us test the assumptions for the Excel model. The conclusions in the report are the authors' and this acknowledgement does not constitute attribution to the people listed here.

Martin Bourque, Ecology Center*

Kate Daly, Center for the Circular Economy at Closed Loop Partners

Nicky Davies, Plastic Solutions Fund

Jan Dell, The Last Beach Cleanup*

Nell Fry, Judy Panayos, and Kate Shearer, Sodexo*

Jocelyn Gaudi Quarrell, GO Box

Ron Gonen, Closed Loop Partners

Julia Koskella, Systemiq*

Samantha MacBride, New York City Department of Sanitation*

Jack Macy, SF Environment in City and County of San Francisco

Christina Mitchell Grace and Laura Rosenshine, Foodprint Group

Michael Oshman, Green Restaurant Association

Jane Patton, Center for Environmental and International Law

Matt Prindiville, Julie Lamy, and Miriam Gordon, UPSTREAM

Erin Simon, World Wildlife Fund

Alan Someck, Keystone Hospitality Solutions

Samantha Sommer, ReThink Disposable*

Nick Van Eyck, Kevin O'Sullivan, and Kate Kitchener, New York City Department of Sanitation

Jayati Vora, editor

Laura Weiss, formerly GO Box

Justin Wood, New York Lawyers for the Public Interest

*Report / Model Reviewers

Appendix

Results Adjusted to Exclude EPS

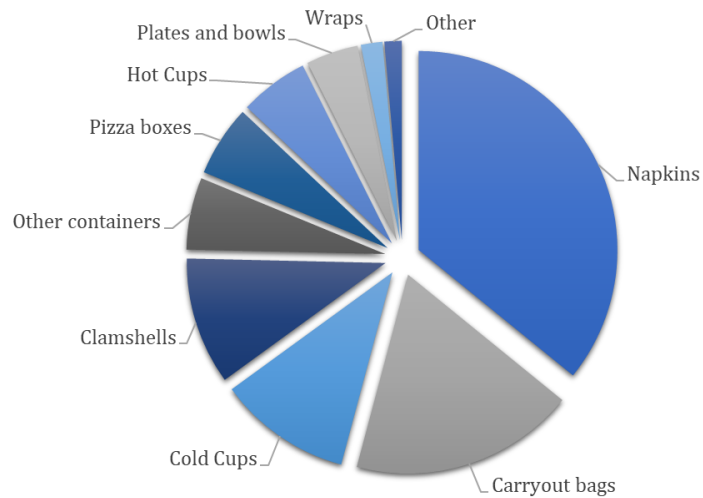
Mass Implications of Shifts in Material Mix:

When we reallocate the EPS items to other materials to better approximate the mix in 2019, cold cups increase to 41,000 tons, while clamshells go from 12,000 to 22,000 tons, and other containers go from 10,000 to 14,000 tons. Hot cups increase to 9,000 tons and plates and bowls increase to 7,000 tons.

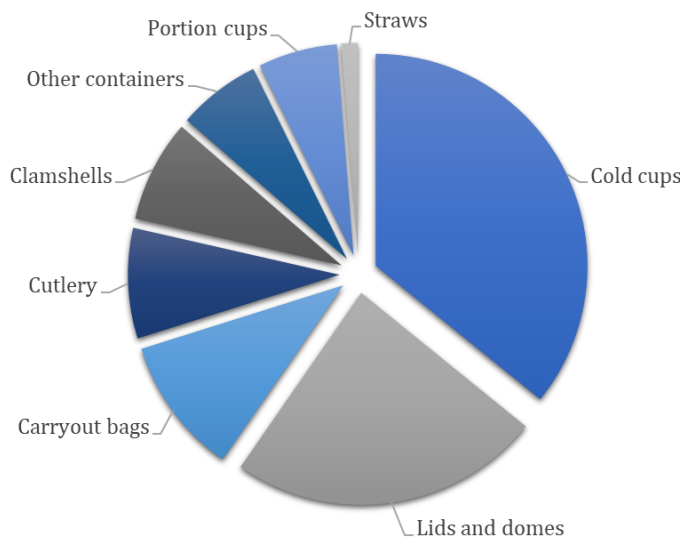
Mix of Paper and Fiber Items Without EPS

When EPS is banned, total tonnage of paper and fiber foodservice disposables is higher because paper and fiber are substitutes for EPS clamshells, containers, and hot and cold cups, along with other plastics where appropriate. Without EPS, clamshells go from last to fourth place and other containers move ahead of pizza boxes.

Items Made from Paper and Fiber (by mass) – No EPS



Items made from plastic (mass) - No EPS



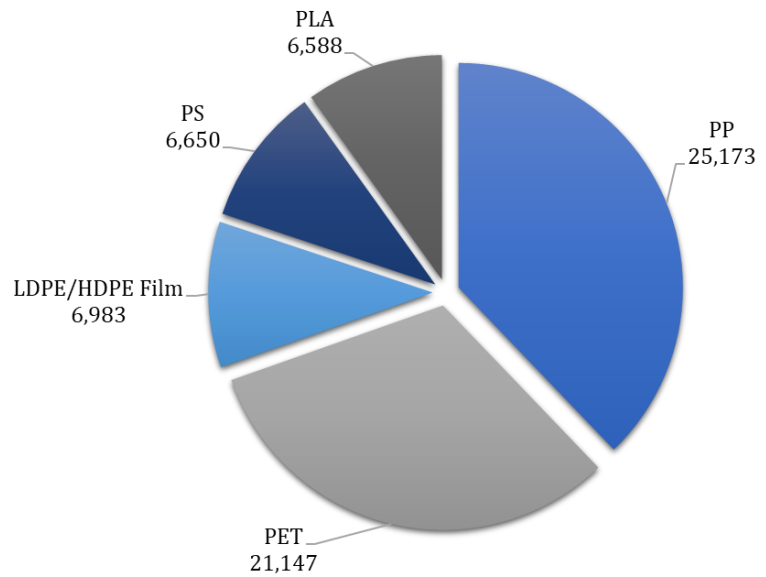
Mix of Plastic Items Without EPS

When EPS is not being used, some of the mass of clamshells switches to other plastics but some of it shifts to paper and fiber, reducing the mass of clamshells made from plastic.

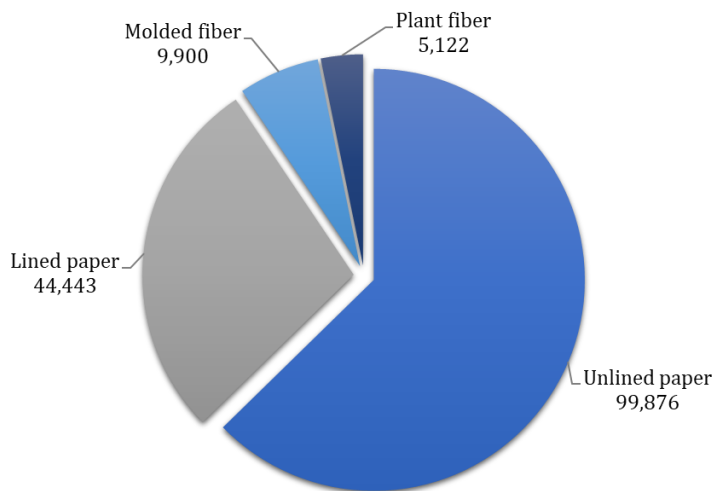
Foodservice Disposables by Plastic Type

Mix of Materials Without EPS

Plastics: When EPS is removed from the mix, use of PET, PP and PLA all increase in tonnage.



Paper and Fiber Foodservice Disposables - No EPS



Paper and Fiber: When EPS is not in the mix, all four paper and fiber materials see increases in tonnage as items formerly made from EPS are substituted with paper and fiber items.

Endnotes

¹ <https://www.bostonglobe.com/magazine/2014/04/02/why-paper-cups-just-aren-greener/W3TIBJ9dff8INlumPQvHSl/story.html>

<https://www.recyclesmart.org/filebrowser/download/3359356>

U.S. Park Service, Mote Marine Lab, ScienceLearn.org

https://www.researchgate.net/publication/288600543_The_decomposition_of_paper_products_in_landfills

<https://www.telegraph.co.uk/news/2018/01/10/stark-truth-long-plastic-footprint-will-last-planet/>

² Freedonia “Foodservice Single-Use Products in the US,” December 2017.

³ Ocean Conservancy’s International Coastal Clean-up 2017

⁴ California Coastal Cleanup Day 2010 Coastal Cleanup Data Summary

⁵ Santa Clara Valley Urban Runoff Pollution Prevention Program - Storm Drain Trash Monitoring and Characterization Project: Technical Report

⁶ Clean Water Action’s “Taking out the Trash” Bay Area Litter study (2011) http://www.cleanwateraction.org/files/publications/ca/Curr_CA_12%2012%2011final.pdf Note that the study did not differentiate packaging from foodservice disposables.

⁷ Keep America Beautiful’s (KAB) 2009 National Visible Litter Survey and Litter Cost Study

⁸ The Single Use Foodware and Litter Reduction Ordinance, Berkeley CA, January 2019

⁹ Beaumont, Nicola. “Global ecological, social and economic impacts of marine plastic,” *Marine Pollution Bulletin*, 2019.

¹⁰ Wyles et al., 2016; Ashbullby et al., 2013; Papathanasopoulou et al., 2016

¹¹ Beaumont, Nicola. “Global ecological, social and economic impacts of marine plastic,” *Marine Pollution Bulletin*, 2019.

¹² Beaumont, Nicola. “Global ecological, social and economic impacts of marine plastic,” *Marine Pollution Bulletin*, 2019.

¹³ Beaumont, Nicola. “Global ecological, social and economic impacts of marine plastic,” *Marine Pollution Bulletin*, 2019.

¹⁴ Calculation using report data and data from EPA: <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials>

¹⁵ <https://www.citibank.com/commercialbank/insights/assets/docs/2018/feeding-the-future.pdf>

¹⁶ Note: All data presented here for New York City is also available for the U.S. as a whole and the quantitative model can be used to easily scale the results to any U.S. city.

¹⁷ United States Census Bureau

¹⁸ Statista (NPD Group) and New York City Department of Health

¹⁹ PlaNYC 2011 Update, page 136 (DSNY and NYC Mayor's Office)

²⁰ 2017 DSNY Waste Characterization Study, EPA

²¹ 2017 DSNY Waste Characterization Study, EPA

²² <https://www.epa.gov/pfas/basic-information-pfas>

²³ <https://www.ceh.org/news-events/press-coverage/content/cancer-linked-chemicals-chipotle-sweetgreen-packaging-theres-know-experts-say/>

²⁴ Calculation referencing <https://dsny.cityofnewyork.us/wp-content/uploads/2018/04/2017-Waste-Characterization-Study.pdf>; <http://transformdontrashnyc.org/resources/a-wasted-opportunity/> ; and 2013 EPA data.

²⁵ <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials>

²⁶ Calculation referencing <https://dsny.cityofnewyork.us/wp-content/uploads/2018/04/2017-Waste-Characterization-Study.pdf>; <http://transformdontrashnyc.org/resources/a-wasted-opportunity/> ; and 2013 EPA data.

²⁷ <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials>

²⁸ <https://www.amny.com/news/compost-nyc-1-20345821/>

²⁹ <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials>

³⁰ <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-changing-market-for-food-delivery>

³¹ <http://www.rethinkdisposable.org/>

³² Reported in interviews for this report.

³³ <https://cupclub.com/news/cupclub-closes-dollar460k+-pre-seed-round-to-tackle-the-global-plastics-epidemic>

³⁴ Interview with Go Box owner

³⁵ LCA's are expensive to do and are typically commissioned by companies or governments as part of product or policy development.

³⁶ Garrido N, Alvarez del Castillo MD (2007): Environmental Evaluation of Single-Use and Reusable Cups. Int J LCA 12 (4) 252–256

³⁷ For more information, please see <https://blog.yelp.com/2019/04/yelp-launches-green-practices-initiative>