

Reusable take-out food containers can reduce plastic waste, emissions, costs, study finds

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Reusable containers filled with takeout food from El Harissa Market Cafe in Ann Arbor. For their study, University of Michigan researchers studied the pilot program for returnable takeout containers launched by the nonprofit organization Live Zero Waste in Ann Arbor. The program, Ann Arbor Reduce, Reuse, Return (A2R3), is now in its second pilot phase and was implemented in partnership with the city of Ann Arbor's A2ZERO carbon neutrality plan. Credit: Live Zero Waste

In the effort to reduce plastic waste in the restaurant industry—single-use takeout containers, specifically—University of Michigan researchers compared the lifetime environmental impacts of single-use and reusable food containers.

Their findings support the idea that the number of times a reusable takeout container gets used is a key factor impacting its sustainability performance.

Depending on the single-use container being replaced, the study found that the reusable alternatives—which initially use more energy and generate more climate-altering greenhouse gases—can break even with single-use containers after four to 13 uses.

"Reducing the quantity of single-use plastics in the [restaurant industry](#) by implementing reusable takeout container systems has the potential to reduce greenhouse gas emissions and save on energy, water and cost. Our study found that reusable containers can outperform single-use in all impact categories," said study author Greg Keoleian, director of U-M's Center for Sustainable Systems at the School for Environment and Sustainability.

The study, published online Jan. 5 in the journal *Resources, Conservation and Recycling*, reports that on a global scale, plastic production has accelerated dramatically over the past decades—leading to a sharp increase in [plastic waste](#). In the United States alone, more than 90 times the 1960 amount of plastic municipal solid waste was generated in 2018. Single-use packaging contributes millions of tons of plastic waste to that total each year.

In addition to the number of times that a reusable container is reused and the material type (e.g., polypropylene, the bioplastic PLA, aluminum), the U-M study also found that customer behavior will be a significant

factor in sustainability performance.

"If 5% of customers make trips by vehicle solely to return used containers, the reusable system has higher life-cycle greenhouse gas emissions than the single use," said study co-author Christian Hitt, a dual-degree graduate student and Center for Sustainable Systems research assistant.

"We also looked at the water usage of at-home cleaning of the containers," Hitt said. Excessive washing can tip the balance against the primary energy impacts of reusable containers."

According to the study, education will be key in counteracting these potential downsides by encouraging customer best practices. Informational labels on containers, signage in restaurants, employee dialogue with customers and online information are a few educational tools that the study recommends.

Convenience can also play a part. City-scale systems with common containers across multiple restaurants may prove advantageous, as customers can return containers to different locations, decreasing the likelihood of customer travel for the sole purpose of container return.

Study authors recommend further research on actual customer behavior—including the effectiveness of incentives that encourage best practices, such as discounts to customers wearing bike helmets or meal discounts if returning a container. It is also possible that container deposits could encourage returns, the study reports, citing the example of plastic bottle recycling rates in states with deposit programs compared to those without them (62% vs. 13%).

As a base for their model, the researchers studied the [pilot program](#) for returnable takeout containers launched by the nonprofit organization

Live Zero Waste in Ann Arbor. The program, Ann Arbor Reduce, Reuse, Return (A2R3), is now in its second pilot phase and was implemented in partnership with the city of Ann Arbor's A2ZERO carbon neutrality plan.

The [Live Zero Waste](#) website outlines the process: Upon entering a restaurant, customers can scan a QR code to check out a reusable container. After the container is emptied and cleaned at home, the [customer](#) returns it to the restaurant. The containers, made of FDA-approved polypropylene material, are then sanitized in the restaurants' industrial dishwashers prior to reuse.

Four Ann Arbor restaurants are participating in the system, including Zingerman's Deli. Marketing and communications manager Jennifer Santi, a U-M School for Environment and Sustainability alumna, said chef and managing partner Rodger Bowser worked for years to test, research and develop a reusable container program across Zingerman's businesses.

"We were thrilled when an opportunity presented itself to leverage this idea and bring it to reality with the city of Ann Arbor and a few other restaurants," Santi said. "The program is a next step in our quest to further reduce single-use plastics and our way of challenging the way people interact with restaurants.

"We've received positive feedback from customers, but we would like to grow the program more extensively. When the containers are more visible and available around our city, we expect to see demand grow."

Missy Stults, Ann Arbor's sustainability and innovations director and another SEAS alumna, said the city is "excited to not only pilot but to scale the reusable container program throughout the city. This program represents a meaningful way that we can reduce plastic pollution, lower

[greenhouse gas emissions](#) and all personally be a part of the climate movement."

The research, which was supported by a Morgan Stanley Plastics Waste Reduction Research and Fellowship award, concludes that a reusable container system—as part of a circular economy strategy—offers the chance for significant benefits over time, if customers can be effectively educated to adopt sustainable behaviors.

"CSS is currently working with the nonprofit organization Perpetual to design and evaluate other reusable [container](#) systems in other U.S. cities beginning with Galveston, Texas, which is seeking to reduce plastic marine debris from single-use containers," Keoleian said.

In addition to Hitt and Keoleian, Center for Sustainable Systems research assistant Jacob Douglas was a co-author of the journal article.

More information: Christian Hitt et al, Parametric life cycle assessment modeling of reusable and single-use restaurant food container systems, *Resources, Conservation and Recycling* (2023). [DOI: 10.1016/j.resconrec.2022.106862](#)

Provided by University of Michigan

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