To Sort or Not to Sort:

The Relative Greenhouse Gas Benefits of Front-of-House Recylcing and Composting in a Quick-Service Restaurant

Prepared by Global Green USA
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Landfilling recoverable wastes, such as packaging and food, costs the foodservice industry millions of dollars each year and releases potent greenhouse gases. With the support and participation of a variety of corporate partners, Global Green's Coalition for Resource Recovery (CoRR) develops systems by which these wastes can be consistently and economically recovered, bringing valuable material back onto the market and creating a net greenhouse gas benefit. These partners have the opportunity to advance their sustainability and waste diversion performance, better serving customers seeking to lead a greener lifestyle, and who are ready and willing to assist in restaurant waste diversion efforts.

As part of the CoRR project, Global Green conducted a waste characterization with Pret A Manger, an international chain of quick-service fresh food and coffee shops with a companywide goal of 75% waste diversion from each store and participation of 80% of their stores. Pret A Manger deployed front-of-house four-stream bins at five locations which collected paper; metal, plastic, and glass; trash; and, for the first time, front-of-house food waste. Based on the results of this study, Global Green undertook an analysis comparing several waste recovery scenarios to determine the relative greenhouse gas outcomes for systems that emphasize recycling versus systems that emphasize composting. The outcome of this analysis showed that packaging recycling, particularly for paper items at locations where significant paper is generated, leads to improved emissions outcomes relative to composting, even given low capture rates.

Background

It has been stated by some groups that the way to maximize waste diversion and capture rates in a front-of-house foodservice environment using single-use packaging is to purchase compostable packaging (paper or plastic) and compost it along with the food waste all in one bin. By eliminating the need for customers to sort their waste, it is hypothesized that greater diversion of waste from landfills can be achieved through recovering packaging as well as a larger proportion of the food waste as compared with a 3- or 4-stream recycling scenario (capturing paper separately, and, if applicable, trash/ non-recoverable items). This is assumed to lead to a greater greenhouse gas emissions benefit compared to systems where customers are asked to sort.

However, to date very little has been published that thoroughly explores these greenhouse gas and waste diversion scenarios, comparing a system in which all paper or plastic disposable packaging is composted, with presumably higher capture rates for all items, versus one where the packaging items are recycled with presumably lower capture rates for all items. Assuming that any foodservice establishment will have food wastes, the crux of the question being addressed by this analysis is this: ***are higher capture rates for food and packaging worth, from an emissions perspective, the omission of any or all recycling streams?***

Global Green undertook an initial evaluation of this question to inform the direction of waste diversion efforts, both those of Global Green's Coalition for Resource Recovery (CoRR) and other groups who seek to divert waste from the landfill in quick-service venues. It should be noted that the purpose of this exercise is to provide an understanding of relative magnitudes of greenhouse gasses from different systems for further consideration, and is by no means a comprehensive analysis of environmental impacts.

Waste Recovery System Analysis

As a starting point, Global Green evaluated hte 4-stream front-of-house recycling, composting, and trash system implemented at international quick-service restaurant and CoRR member Pret A Manger. Pret A Manger generates front-of -house waste taht is comprised fot he following materials, intended to be disposed of in the waste streams shown below:

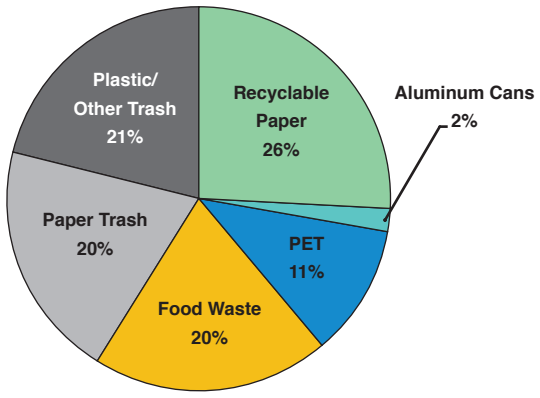
Figure 1: Types of Material Waste

Paper Packaging	Metals/ Plastics	Food/ Compost	Trash
Salad Containers	Aluminum Cans	Food Scraps	Baguette Paper Bag
Sandwich Containers	PET Bottles		Chop Sticks
Soup Cup	PET Fruit Cup & Lid		Coffee Cup Lid
Soup Lid	PET Yogurt Cup & Lid		Cutlery and Straws
Coffee Cup	PET Cold Cup & Lid		Chip Bag
Coffee Cup Sleeve			Hot Wrap Paper
Paper Take Out Bag			Napkins[1]
			Pastry Bag
			Plastic Bags
			Sushi Container
			Stirrers

Based on the data from a waste characterization conducted by Global Green, the realtive volumes of these wastes captured in hte front-of-the-house are as follows:

Figure 2: Relative Volulumes of Material Waste

Material	Average Volume Per Store (lbs. / day)
Recyclable Paper	13.494
PET	1.207
Aluminum Cans	5.723
Food Waste	10.102
Paper Trash	10.527
Other/ Plastic Trash	10.966



1 While specified as trash for the current four bin system being tested by Pret, napkins are compostable. Given this recom mendation to specify napkins as compostable in the future, the fate of napkins was considered to be compost for Scnario 1: The Ideal Current System.

Based on this waste characterization data, Global Green calculated the net greenhouse gas emissions of the current system, and subsequently used these observed waste stream weights and the associated emissions impacts as the basis for analyzing several scenarios:

1. The Current System with a 100% Capture Rate: The same amounts and types of packing materials (paper, plastic, trash items, etc.) that were observed were recycled or landfilled, and food waste composted, with capture rates at an ideal 100%.

2. Composting of All Food, Plastic and Paper, with 100% Capture Rate: The observed amounts of packaging materials (paper, plastic, trash items, etc.) were designed for compost bility where applicable and composted with the food waste. Capture rates were an ideal 100%;

3. The Observed Current System: The same amounts and types of packaging materials (paper, plastic, trash items, etc.) that were observed were recycled or landfilled, and food waste composted, with capture rates at the rates observed during the waste characterization.

GHG Emissions Calculation Methodology: Boundary Conditions and Emissions Factors

Net greenhouse gas emissions for each end of life scenario were calculated using the boundary conditions and emissions factors used in US EPA's Waste Reduction Model (WARM).

The following are the greenhouse gas emissions impacts from disposing of these wastes by recycling, composting, or landfilling assuming default distances for transit used by the model. All numbers are derived from the WARM model except for the compost emissions factor for mixed paper. In EPA WARM's model all forms of compost feedstock modeled, including PLA and various forms of food and yard waste, are estimated to have the same emissions factor when composted. Data is not available to fully separate the relative impact of these streams.

Figure 3: Net GHG Emissions for Material Types by Material Management Option (lbs. of CO2e/ lb. of Material)

Material	Recycling	Composting	Landfill
Paper (Mixed Paper - General)	-3.88	-0.22	-0.04
Plastic (PLA)	NA	-0.22	-1.76
Plastic (PET)	-1.22	NA	-0.07
Food Scraps	NA	-0.22	0.79
Paper Trash (Mixed Paper - General)	N/A	-0.22	-0.04
Other Trash (Mied Plastic)	NA	-0.22	0.07
Other Trash (PLA)	NA	-0.22	-1.76

2 Full EPA WARM model documentation can be found at: http://www.epa.gov/climatechange/waste/SWMGHGreport.html

Given this, mixed paper was assumed to have a similar composting emissions factor as food waste, yard waste, and PLA.

Scenario Modeling Assumptions

The following assumptions were used for all three scenarios analyzed.

- ***The amount of metal was assumed to remain constant, and to be recycled in all scenarios.***

  As such, metal is not included in the analysis.

- ***The relative use of paper and plastic packaging were considered static.***

  This analysis is not intended to influence choices of packaging material purchase (e.g., paper versus plastic), but rather the method by which that material type is disposed given a specific composition of packaging materials. Packaging changes explored in this analysis include the switch from one type of plastic (PET) to another (PLA) to allow for the use of a different disposal method and the switch of non-recyclable paper, such as pastry bags, to compostable forms of paper packaging. For a comprehensive discussion of criteria to be considered when selecting packaging from a sustainability perspective, please see the Sustainable Packaging Coalition's Definition of Sustainable Packaging.[3]

- ***The change from a non-compostable plastic to a compostable plastic is feasible.***

  This decision is in fact subject to a variety of factors, including economic and performance factors. For the purposes of simplicity, this analysis includes only the greenhouse gas emissions implications of the disposal of each material.

- ***Items that were discarded outside the store were not included in this analysis.***

  While the availability of local waste recovery infrastructure should inform packaging purchasing decisions, the purpose of this particular exercise is limited to informing the design of in-store infrastructure for recovering existing packaging types.

- ***Paper food packaging can be recycled in common paper mills without significant operational impacts.***

  While at present the recycling of post-consumer paper foodservice packaging is negligible, CoRR has a goal of post-consumer paper foodservice packaging being recycled at high

[3] This definition may be found at: http://www.sustainablepackaging.org/content/?type=5&id=definition-of-sustainable-packaging

levels, and into high quality materials. This evaluation was conducted to see the relative benefits of recycling versus composting packaging in a front of house quick service restaurant environment given this goal is achieved and no additional operational or environmental impacts are placed on mills as a result of recycling this material. Given this, emissions for post-consumer paper food-service packaging were assumed to be equivalent of that of the recycling of mixed waste paper.

- ***Thermoform PET can be recycled back into PET resin and has the same greenhouse gas impacts as recycling bottle grade PET.***

  Significant effort is underway to advance recycling of thermoform PET; however, given that recycling of thermoform PET is still in nascent stages, average life cycle inventory data is unavailable.

- ***75% of paper trash is napkins or paper towels and can be composted.***

  Napkins and paper towels were not weighed separately from the category 'other paper trash' in the Pret A Manger waste assessment on which this greenhouse gas emissions modeling is based. However, based on qualitative visual observations of the material, an assumption of 75% by weight of the paper trash sorted being either napkins or paper towels.

  Paper towels and napkins often have short fibers that make them unsuitable for recycling, but they are often able to be composted. According to ASTM International Standard D6868, if paper items meet certain criteria for biodegradability, and have additives such as those that increase wet strength at less than 1% of weight or that are biodegradable, the item is considered acceptable for industrial composting.

Modeled Scenario Results

Scenario 1: Current System at 100% Capture Rates

To determine the maximum amount of greenhouse gas savings from the front-of-house environment, assuming optimal consumer behavior, these assumptions (additional to those above) were made:

- *The paper, plastic, and trash items are made from compostable materials and captured for composting, and therefore the trash stream has been removed entirely.*
- *For the sake of simplicity, the weight of the plastic stream remains constant despite the switch from PET to PLA (in reality, this may **reduce** the weight of the stream, which would in this case be of detriment to the net emissions results).*
- *Paper napkins, previously included as trash, are specified for composting and composted.*
- *Capture rates are set at an ideal 100%.*

Figure 4: Scenario 1 Net Emissions

Material	Average Volume per Store (lbs./ day)	Recovery Method	GHG Factor: Recovery (lbs. C02e per lb. recovered)	GHG From Recovery (lbs. CO2e)
Recyclable Paper	13.49	Recycling	-3.88	-52.36
PET	5.72	Recycling	-1.22	-6.98
Food Waste	10.10	Composting	-0.22	-2.22
Paper Trash	10.53	Composting	-0.22	-2.32
Plastic/ Other Trash	10.97	Landfill	-0.07	-0.77
Net Emissions				**-63.11**

This scenario yields a very high greenhouse gas benefit, in large part due to the emissions mitigations resulting from the recycling of paper.

Scenario 2: Compost All Packaging and Food

To understand the differences in hte relative greenhouse gas emissions for Scenario 1, where packaging is recycled, to one where all packaging was designed for composting and composted, the following scneario was modeled with these assumptions:

- *The paper, plastic,and trash items are made form compostable materials and captured for composting,a nd therefore hte trash stream has been removed entirely.*

- *For the sake of simplicity, the weight of the plastic stream remains constant despite the switch from PET to PLA (in reality, this may **reduce** the weight of the stream, which would in this case be of detriment to the net emissions results).*

Figure 5: Scenario 2 Net Emissions

Material	Average Volume per Store (lbs./ day)	Recovery Method	GHG Factor: Recovery (lbs. CO2e per lb. recovered)	GHG From Recovery (lbs. CO2e)
Recyclable Paper	13.49	Composting	-0.22	-2.97
PET	5.72	Composting	-0.22	-1.26
Food Waste	10.10	Composting	-0.22	-2.22
Paper Trash	10.53	Composting	-0.22	-2.32
Plastic/ Other Trash	10.97	Composting	-0.22	-2.41
Net Emissions				**-11.18**

Based on comparing the two scenarios above, it is clear that the scenario that involves recycling is preferred if 100% capture of packaging materials and food waste can be achieved.

However, the 100% capture rate is clearly unrealistic. To account for this, the following scenario is based on capture rates and material compostion idetified through the waste sorts of Pret A Manger stores conducted by Global Green with the goal of seeing if the observed capture rates were sufficient to warrant a customer sorting system including recycling.

Scenario 3: Observed Scenario: Pret A Manger's Four-Stream System

The observed scenario reduces greenhouse gas emissions to a 20% greater extent than the scenario where all packaging is designed to be composted and 100% capture is achieved from all packaging and food waste discarded front of house.

Figure 6: Scenario 3 Net Emissions

Material	Average Volume per Store (lbs./ day)	Capture Rate	Recovery Method	GHG from Recovery	GHG from Landfill	Net Effect (lbs. CO2e)
Recyclable Paper	13.49	33.82%	Recycling	-17.70	-0.36	-18.06
PET	5.72	39.40%	Recycling	-2.75	0.24	-2.51
Food Waste	10.10	10.97%	Composting	-0.24	7.11	6.86
Paper Trash	10.53	0.00%	None/ Landfill	0.00	-0.42	-0.42
Plastic/ Other Trash	10.97	0.00%	None/ Landfill	0.00	0.77	0.77
Net Emissions						**-13.36**

Discussion and Conclusions

Based on this analysis, capture rates observed, and the composition of the waste discarded, it is shown that the inclusion of recycling in a front-of-house resource recovery system has a greater opportunity to mitigate greenhouse gas emissions accounted for in the end-of-life portion of the material's life cycle, compared to a full switch to compostable packaging and capturing all the food waste. Additionally, recycling paper packaging would continue to be optimal in this environment as long as a capture rate for paper of 33% is maintained while capture rates for other materials remain constant. Further piloting and testing is needed to better understand the types of environments beyond the quick service restaurant, and to determine whether a capture rate of 33% or greater is feasible in the long term.

While every effort should be made to maximize diversion of all waste streams, successful programs that improve the capture of paper will have a strong impact on a restaurants carbon footprint relative to efforts to capture other materials in restaurants that generate a significant amount of paper. Given this, establishments with use of paper packaging at similar or higher levels to those analyzed here should consider paper packaging recycling as the preferred landfill diversion in areas where post-consumer paper foodservice packaging recycling is an option.

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Started in 1994, Global Green has worked to create sustainable urban environments and combat global wamring through a unique cross-cutting approach that merges innovative research, technical assistance, cutting-edge community based projects and targeted education and outreach.