Exploring Reusable Takeout Packaging as an Alternative to Disposable Plastics in Maine's Restaurant Industry

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EXPLORING REUSABLE TAKEOUT PACKAGING AS AN ALTERNATIVE TO DISPOSABLE PLASTICS IN MAINE'S RESTAURANT INDUSTRY

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A THESIS
Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science (in Ecology and Environmental Sciences)

The Graduate School
The University of Maine
December 2022

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EXPLORING REUSABLE TAKEOUT PACKAGING AS AN ALTERNATIVE TO DISPOSABLE PLASTICS IN MAINE’S RESTAURANT INDUSTRY.

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Thesis Advisor: Dr. Cynthia Isenhour

An Abstract of the Thesis Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science (In Ecology and Environmental Sciences) December 2022

Since the emergence of plastic over 100 years ago, businesses have increasingly relied on them to protect products. While convenient, the proliferation of plastic packaging is a major contributor to pollutants in the soil, oceans, and bodies of humans and animals alike. Goals in states like Maine seek to reduce the amount of waste and alleviate these issues. However, the deeply embedded popularity of disposable packaging and lack of reliable waste processing capabilities has caused Maine to fall short of its goals. While solutions need to focus on reducing the amount of packaging entering the economy, most businesses rely on substitutes for plastic rather than waste reduction. On its face, biodegradable substitutes for plastic appear to be a good solution. However, lifecycle assessments of these materials indicate that their environmental impact is similar to traditional plastics. Further, studies suggest that biodegradable packaging can leave behind contaminants after they decompose. Thus, strategies like reuse, that focus on reducing the amount of waste, are preferable to material substitution. Compared to other sectors, the restaurant industry is just beginning to explore reuse as a solution to waste issues. In particular, the recent explosion in the popularity of takeout and delivery food makes the
restaurant industry an impactful area of study. In this thesis, I explore reusable takeout packaging in the restaurant industry and the factors that influence the adoption of these systems.

Chapter One presents a review of literature focused on reusable packaging in the restaurant industry. Reuse systems were examined through the lens of four major identifiable themes: environmental impact, economic success, social behavior, and operational logistics. As will be seen, success of reusable programs largely depends on how these four factors interplay with each other within a given business environment.

Chapter Two investigate the factors that make single-use packaging so durable in our society and what social aspects prevent a switch towards reusable packaging. While reusable packaging can provide many benefits, there are numerous social barriers that cause single-use packaging to continue its dominance. This chapter explores these barriers and presents the findings of stakeholder engaged research that was conducted as part of this project.

Chapter Three presents the findings of a waste audit conducted in the town of Bar Harbor, ME. This short chapter helps contextualize the findings from the previous chapters and provides a baseline for understanding the barriers and opportunities for reusable packaging systems in Maine’s coastal communities.

Chapter Four pulls the learnings from the previous three chapters into a cohesive business plan. While every detail of this chapter is meant to be actionable, the plan itself is intended only as a framework for a business that provides reusable packaging logistics in Maine. This chapter goes through the entire process of starting a business and identifies viable locations, potential risks, marketing strategy, and explores the financial considerations involved in starting such an organization. Finally, Chapter 5 takes note of the key findings from this paper and suggests areas where future research can improve on this work.
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CHAPTER 1: A REVIEW OF EXISTING LITERATURE ON REUSABLE PACKAGING

Introduction

Since China implemented its National Sword policy to reduce the amount of waste imported from other countries, the US has been struggling to handle the materials it can no longer ship overseas (Wang, 2015). Municipal waste systems that are unaccustomed to this glut of material have led to improper handling, causing landfills to become the default option for many recoverable materials (Jiang & Lin, 2014). Worse still, the breakdown of waste management systems in the US is a large factor in these plastics and pollutants ending up in our oceans, agricultural lands, and even in the bodies of people and animals (Ng et al., 2018) creating both ecological and human health issues. In the natural environment, several studies agree that the most abundant source of identifiable litter originates from food packaging sources (Mitchell et al., 2021; Okuku et al., 2020; Sajorne et al., 2021). As the food and beverage industries are responsible for offering these materials to consumers, there is a great opportunity to mitigate plastic pollution through the food and beverage industry. As such, this project focuses on the restaurant takeout industry because it is a rapidly growing sector of the food industry (Agarwal et al., 2020; Zimmermann & Bliklen, 2020).

While recent advancements in plastics development have created materials that can break down faster or be processed through biodigestion and composting facilities, these products rarely work as advertised. A study conducted by the Oregon Department of Environmental Quality (Vendries et al., 2018) found that while these engineered plastics can break down, the conditions under which they decompose are often only achieved in specialized facilities. Vendries et al. (2018) found that compostable packaging needs to be composted in
facilities with specialized equipment which few municipal waste processors have access to.

With few facilities able to process these materials and confusion about the difference between them and traditional materials, packaging marketed as compostable is often treated like their petroleum-based counterparts, negating any potential benefits. In addition, when biodegradable plastics are treated at the correct facility, there is evidence that the finished products can contain harmful chemicals (Thakali & MacRae, 2021). Unchecked, these contaminants can build up in agricultural soils and be transferred to the foods produced from them. Further complicating these dynamics is that consumers must separate biodegradable and compostable materials from normal waste (Jiang & Lin, 2014) adding a layer of inconvenience that may prevent customers from disposing of them properly. In addition, Vendries et al. (2018) found that most products labeled as biodegradable or compostable often have worse lifetime environmental impacts than their traditional plastic counterparts when compared via lifecycle assessment (LCA). Even if biodegradable and compostable materials behaved as advertised, we must ask ourselves how sustainable can these materials be if they don’t fundamentally reduce the amount of waste being generated?

The problem of waste generation is even more pronounced as we start to understand the effects that the COVID-19 pandemic had on our waste systems. Zimmerman & Bliklen (2020) reported that some municipalities saw waste production increase as much as 60% over the course of a single month when lockdown mandates began. In particular, the use of disposables grew during the pandemic as concerns over the safety of reusable products (Jiang & Lin, 2014) caused both consumers and producers to favor single-use options. Although the pandemic was a catalyst for this large influx of material into municipal waste streams, waste generation was likely headed towards a 60% increase anyway based on historical trends (Šuškevičė &
Kruopienè, 2021). For example, in Maine, where the government has identified waste reduction goals, the state has consistently seen growth in its per-capita waste production (State Goals, 2015). A large component of this trend is attributable to the growing popularity of online retailing and food delivery services leading up to 2019, before COVID-19 even reached the United States (Agarwal et al., 2020; Zimmermann & Bliklen, 2020). In the US, disposable packaging makes up roughly 36% of municipal waste streams (Coelho et al., 2020), of which nearly 78% is composed of products used in food and food service industries (Environmental Protection Agency (EPA), 2015). Reducing even just a portion of this waste source could have significant environmental benefits (Coelho et al., 2020). While most strategies have focused on replacing the plastic packaging in favor of more “green” options, those alternatives do not fundamentally reduce the amount of material sent to the landfill. Strategies that aim to reduce the amount of material produced and subsequently landfilled need to be developed in order to reduce the total environmental impact of packaging materials.

According to the US EPA’s hierarchy for waste management, which has been adopted by states like Maine, the order of preferred waste management strategies is Reduce, Reuse, Recycle, Compost, Waste-to-Energy, and Landfill (State Goals, 2015). Focusing on the second most preferred strategy on the list, reusable packaging strategies aim to reduce the amount of packaging that’s thrown out by extending the useful life of packaging materials. Further, making reusable packaging with recyclable materials can greatly improve the environmental impacts of reuse systems (Zimmermann & Bliklen, 2020). Considering that single-use packaging accounts for as much as 30% of a company’s CO₂ emissions, designing reusable packaging for end-of-life recycling could have significant impacts on CO₂ emissions from businesses (Zimmerman & Bliklen, 2020).
For restaurants, reusable packaging systems include a host of models that aim to make use of more durable materials to serve multiple consumer orders (Coelho et al., 2020). These systems can range from products such as metal water bottles that a consumer washes and fills on their own, to packaging that is recovered and returned to the company’s stock by a third-party service. While each reuse system is different, their effectiveness is dependent on a high degree of participation from consumers. Zimmerman & Bliklen (2020) calculated that, in order for reusable systems to gain economic and environmental advantages over their single-use counterparts, consumers at event venues needed to return the packaging at a rate of 90%. While each system will likely be different, return rates are clearly key to success. Thus, reuse systems need to encourage consumers to return their packaging, which may be seen as an inconvenience compared to the current make-take-waste model of consumerism (Mahmoudi & Parvizionran, 2020).

To learn more about these issues, this chapter looks at the different reuse systems and packaging materials used in the restaurant industry. This literature review looks to answer questions regarding the social, economic, and environmental viability of switching to reusable packaging and what logistics must be addressed. To do this, we performed a review of literature regarding reusable packaging in the restaurant takeout industry. Findings from studies that conducted LCA’s were considered particularly helpful as they are integral to understanding lifetime environmental impacts. It is well known that the production costs of durable packaging are higher per individual unit than their lightweight disposable counterparts. The advantage of reusable packaging is the ability to spread those costs over a longer lifetime and numerous uses (Mahmoudi & Parvizionran, 2020; Zimmermann & Bliklen, 2020), with some materials able to withstand over 1,000 use cycles. The inherent differences in the mode of use between
disposable and reusable packaging requires them to be compared on per use impacts, rather than the sum of lifetime impacts, in order to account for the amount of utility each package provides (Mahmoudi & Parviziomran, 2020). This analysis will focus on four major areas: social considerations, economic impacts, environmental impacts, and logistical considerations. The section on social considerations will break down the cultural impacts of switching to reusable packaging including the major factors that encourage or prevent consumer participation. The section on economic impacts will look at the economics of switching to reusable systems from the view of consumers, municipalities, and businesses. The section on environmental impacts will outline the major impacts switching to reusable packaging will have on CO₂ equivalent emissions, water use, and environmental degradation. Finally, the section on logistical considerations will outline the major supply chain and reverse supply chain logistical hurdles of implementing reuse solutions.

**Methods and Results**

Articles were acquired using the search tool *OneSearch* through the University of Maine. *OneSearch* has access to 342 scholarly databases representing billions of published works. Search terms included “reusable container”, “food”, and “LCA”, and were limited to peer reviewed articles published between 7/6/2011 and 7/6/2021. The initial search returned 134 articles and 2 conference transcripts. After eliminating the conference transcripts, duplicate papers, and missing articles (i.e., articles that had been removed from publication), there were 100 articles left. The abstracts of the remaining articles were then scanned for relevance to our research, eliminating articles that mentioned, but did not directly address, the search terms as they related to this study. In total, 15 articles were determined to directly address the search criteria and were selected for full review. Among these articles was research represented from the 3 different
perspectives of the reuse issue: supply chain (5), retail (7), and festivals (3).

Discussion

Social considerations:

When considering social aspects of reuse models, it is important to note what factors lead individuals to participate in the system. As noted by Jiang & Lin (2020), there is often a discrepancy between the number of people who would like to participate in reuse systems and the number of people who actually participate in those systems. While some of this discrepancy can be attributed to a lack of accessible reuse models (Muranko et al., 2021), there are often other factors involved. For one, specialized packages that contain logos or unique design features can be perceived as souvenirs by the consumers (Šuškevičė & Kruopienė, 2021) and taken home rather than returned to circulation. In this case, companies must choose between a package's marketing appeal and operational utility. A related concept is the idea of emotional durability, a term coined to describe the practical durability of an object from the perspective of the individual. In essence, emotional durability recognizes that personal views of a products' physical durability or worth has a large influence on that material’s useful lifespan (Woods & Bakshi, 2014). Issues surrounding emotional durability are likely to be a major complicating factor in reuse systems, as modern conceptions of durability and convenience often cause materials to be thrown out before the end of their useful life (Rigamonti et al., 2019). Muranko et al (2021) found that reusable products that are owned exclusively by individuals, described as exclusive reuse, are thrown out earlier in their lifespan than reusable products whose ownership is transferred between the business and the end-user during successive uses, a model described as sequential reuse. Muranko et al (2021) described the cause of this effect to be a lack of knowledge and familiarity with the products' physical durability by the individuals who
participate in exclusive reuse and a corresponding decrease in value of that packaging to the individual.

In order for reusable packaging systems to be effective at reducing environmental impacts, it is necessary for consumers to be active participants in the process (Muranko et al., 2021). This represents a major divergence from the current model of make-take-dispose, which requires very little effort or thought on the part of the consumer. As such, the increased complexity and effort required to participate in reuse systems can present enough logistical challenges to discourage consumers from participating (Šuškevičė & Kruopienė, 2021). In order to combat this effect, providers of reusable packaging can use incentives to increase participation (Šuškevičė & Kruopienė, 2021). Researchers have found that clear marketing and effective communication can help make these systems less confusing (Muranko et al., 2021). Other studies suggest that clear communication around the indirect costs of tossing packaging may help increase consumers’ willingness to participate (Vörösköi et al., 2020). Woods and Bakshi (2014) also note that reusable packaging systems are not likely to succeed unless they maintain the user’s current quality of life. This, perhaps more than any other reason, may be the key to the success of reusable packaging systems. If reusable packaging systems do not maintain or improve the consumers quality of experience, then it may be unlikely that they are adopted by the general public.

While quality of experience may have a large impact on participation rates, the need to redesign packaging to fit with reuse systems presents a unique opportunity to improve customer experiences. Zampori & Dotelli (2014) noted that chicken packaging trays made from aluminum could be designed to decrease cooking times, increase kitchen safety due to decreased contamination issues, and could be reused. The quicker cook times and decreased amount of
packaging and utensils used to cook the chicken proved to be both economically and environmentally advantageous over other packaging (Zampori & Dotelli, 2014). Packages may also be designed to better protect the foods, leading to a decrease in food waste due to damage or spoilage (Ingrao et al., 2021) and allowing consumers to spend less time and money acquiring fresh food. Indeed, even subtle design features of packaging can lead to decreases in waste. Camps-Posino et al. (2021) found that larger food packages are often associated with greater amounts of food waste while Ingrao et al. (2021) found that containers filled to 70% of their capacity were more visually pleasing to customers and led to less food waste. These findings suggest that restaurants can work with the design of their packaging to influence customers perceptions of value while reducing food waste and the cost associated with that waste.

**Economic considerations:**

In considering the financial and economic implications of reuse models, we first look more broadly at the implications to municipalities before narrowing our scope to restaurants and, finally, end with the impacts on individual consumers. In the US, 33% of all waste is made up of single use packaging and, in the EU, 38% of all plastics are made into packaging materials (Ingarao et al., 2017). In the US, plastic accounts for about 39 million tons of waste per year, a large portion of which are byproducts of the restaurant industry (EPA, 2015). Globally, 380 million tons of plastic packaging are created annually of which 24% are used to package food and between 5 and 13 million tons of which will end up in the oceans (Šuškevičė & Kruopienė, 2021). In terms of global operations, the US restaurant industry accounts for nearly 35% of all disposable food service ware (Woods & Bakshi, 2014). According to Sharma & Jain (2020) all of this leads to the US spending 6.5% of its GDP, equating to $1.4 trillion per year, collecting and treating waste. While the effects of China’s National Sword policy were felt nationally, the
effects in Maine were particularly drastic. Before 2017, waste managers in Maine could sell mixed recycling for an average price around $10-$30 per ton, but this soon turned into a cost of $100 per ton (Clark & Beneski, 2021) after China stopped accepting waste imports. It is estimated that Maine municipalities now spend between $16 and $17.5 million per year handling packaging waste (Clark & Beneski, 2021). Even transitioning a modest 20% of single use plastics to reusable packaging could represent large savings for municipalities and the US.

Reuse strategies do, however, represent an inherent change to municipal waste systems. While it is most effective to establish a reuse program with a localized center that provides system logistics (Ingrao et al, 2021), municipalities may not have the capacity to incorporate such systems into their infrastructure. Additionally, as municipal waste management depends on consumer participation, municipalities would be burdened with educating the public about reuse systems. Without such an education program, Muranko et al. (2021) notes that reusable packaging is often more difficult for municipal waste managers to process and require specialized equipment to recover. Thus, if reusable packages end up in the waste system, they can add large financial costs to municipal budgets in Maine. For example, the bottle redemption program costs taxpayers roughly $2.4 million annually due to improper participation (Clark and Beneski, 2021). While most of this cost is associated with fraudulent activity, it does highlight the importance of a consumer base that is willing to participate.

For reusable packaging to be most beneficial, it has been estimated that packaging return rates should exceed 90% (Zimmerman & Bliklen, 2020). In order to achieve this level of participation, reuse models must properly incentivize and communicate with their customers (Muranko et al, 2021). While discounts for participating do work to incentivize customers, it’s been found that charging customers on a deposit or subscription service basis tends to incentivize
greater return rates (Muranko et al., 2021). In particular, deposit systems, which place a refundable charge per container used, tend to be the most effective (Šuškevičė & Kruopienė, 2021). However, no reusable system is particularly popular when offered as an optional alternative to single use packaging. In a study of reusable cups at music festivals, Šuškevičė & Kruopienė (2021) found that concert goers would prioritize the convenience and low-cost of single use cups over reusable cups when the two systems were presented together. For consumers, it appears there is an inherent conflict between doing what they feel is right and doing what is convenient. When this conflict also presents financial implications (i.e., losing a single-use cup costs nothing while losing a reusable cup means losing their deposit) then the incentive is to choose the option that is perceived as cheaper and more convenient. This presents a particular dilemma for businesses as choosing to transition their packaging slowly could result in a financial failure of the reuse system due to low participation rates.

For businesses transitioning to reuse models, the increased complexity of logistics and corresponding increase in manual labor needs could represent significant cost increases (Accorsi et al., 2014). While these costs can be offset by decreased expenses in the long term, studies in Europe suggest that there may be a cost increase if systems are not properly adhered to (Accorsi et al., 2014). As restaurant takeout and delivery services are set to grow to $102 billion, minimizing these costs will be important to the long-term success of reuse models (Gallego-Schmid et al., 2019). Possible solutions to defray the increased labor costs include manufacturing intelligent packaging designs (Ingrao et al., 2021; Zampori & Dotelli, 2014) to minimize material and product losses, passing the cost onto consumers through subscriptions or deposits (Muranko et al., 2021), and centralizing collection and redistribution activities. As noted by Muranko et al. (2021), placing collection and redistribution receptacles in central locations creates a system that
is easier to use by the consumer and relies on employees to make packaging end-of-life decisions which helps increase product lifespans. Both of these factors lead into the single most important factor of reuse success; high return and reuse rates on a per package basis (Zimmerman & Bliklen, 2020).

**Environmental factors**

Environmental analysis of reusable packaging versus disposable packaging can be tricky due to the differences in materials and how the products are used. While cradle-to-grave assessments of products provide a good metric to judge lifetime impacts, they do not inherently account for the differences in utility between products. Thus, when comparing reusable and single-use packaging, it is necessary to evaluate the environmental impact on a per use basis rather than on an item lifetime basis (Accorsi et al., 2014; Camps-Posino et al., 2021; Ingarao et al., 2017; Ingrao et al., 2021; Šuškevičė & Kruopienė, 2021; Woods & Bakshi, 2014; Zampori & Dotelli, 2014). Many studies indicate that polypropylene containers are the best choice for widespread integration into reusable systems (Accorsi et al., 2014; Harnoto, 2013). This is mainly due to the balance this material strikes between durability and ease of manufacturing. In addition, aluminum and other metals can provide specific advantages during their use cycle because they allow for specialized design features that enhance cleaning, shelf-life, and heating qualities (Zampori & Dotelli, 2014). While glass containers can provide advantages after just a few uses, their high production impacts, increased weight, and fragility make them poor candidates for reusable packaging when compared to common plastic and metal alternatives (Ingarao et al., 2017). Additionally, when considering products that contain more than one material, plastic replacements for glass tend to be harder to recover and recycle during the end-
of-life processes (Muranko et al., 2021) but are, nonetheless, treated like glass by consumers due to their similarity.

A key factor in the comparison between disposable and reusable packaging is that reusable containers tend to require more material to produce (Camps-Posino et al., 2021) and therefore impact the environment more on a per unit produced basis. The increased durability from using more material, however, helps the impact of that reusable product to be spread amongst a much longer useful lifetime (Ingrao et al., 2021; Muranko et al., 2021; Woods & Bakshi, 2014; Zampori & Dotelli, 2014). For example, an analysis of 360 single-use compostable clamshells created 85.5 kg CO2e while one reusable clamshell used 360 times created just 1.27 kg CO2e (Harnoto, 2013). According to Harnoto (2013) reusable clamshells’ environmental impact is favorable compared to the equivalent number of single-use clamshells after the 14th use, in every metric other than water use. Using more durable materials, such as stainless steel, necessitates that the package be used more times for its per-use environmental impacts to be beneficial (Camps-Posino et al., 2021).

Throughout the literature, the number of uses a package can withstand is key to the impact reduction potential of reusable systems. Additionally, unlike disposable packaging, reusable packaging has several phases in its lifetime in which the environmental impact can be improved upon. For instance, disposables can really only reduce emissions and water use during the production and end-of-life phases of their lifecycle. In contrast, reusables can realize efficiencies throughout its entire life cycle by improving washing practices, shortening redistribution channels, or making material improvements, to name a few (Zampori & Dotelli, 2014). Confirmation of this is found through experiments that used different wash cycles during a reusable packages’ life, which greatly affected the water and energy consumption measured
with life cycle analyses (Gallego-Schmid et al., 2018; Potting & van der Harst, 2015). Considering that the washing of reusable packaging accounts for the largest portion its contributions to CO₂ emissions, the ability to implement more efficient wash strategies can greatly improve the advantages of reusable packaging (Camps-Posino et al., 2021). Further, designing reusable systems to be geographically close can greatly reduce emissions from transportation use. While disposable packaging represents set delivery routes that flow continuously in one direction, usually over long distances (Ingrao et al., 2021; Ingarao et al., 2017), reusable packaging systems that minimize collection and redistribution travel distances can reduce transportation emissions by up to 80% (Muranko et al., 2021).

**Logistical considerations**

Each model of reuse consists of a specific makeup of three factors: 1) consumer behavior, 2) reusable product, and 3) reuse enabling infrastructure (Muranko et al., 2021). Reusable products come with two main modes of intended use (Muranko et al., 2021); exclusive reuse and sequential reuse. Exclusive reuse items require each individual consumer to own and care for the package (Muranko et al., 2021) with the provider of goods and services interacting only to refill it. Sequential reuse products require commercial providers to establish the infrastructure that handles the collection, cleaning, and redistribution of the packaging to future customers (Muranko et al., 2021). Muranko et al (2021) describe three types of infrastructure; infrastructure-less which is reserved for exclusive modes of reuse; infrastructure for returns only which typically utilize a third-party vendor to handle washing and redistribution; and infrastructure for returning, washing and redistribution. For the restaurant industry, there are four main systems that emerge from the combination of infrastructure and modes of reuse (Appendix A): deposit systems (Šuškevičė & Kruopienė, 2021); purchase systems; lending systems; and
subscription systems (Muranko et al., 2021). Deposit systems entail collecting a deposit for the packaging which is returned to the customer when the packaging is given back (Šuškevičė & Kruopienė, 2021). Subscription systems charge users on a period basis, allowing them to check out a set number of packages at a given time (Muranko et al., 2021). Purchase systems are most commonly used in conjunction with exclusively reused packages and rewards users by discounting their purchase (Muranko et al., 2021). Lending systems can work opposite to or in conjunction with rewards systems by charging users for using disposable packaging or charging them for failing to return reusable items (Muranko et al., 2021).

Success in reuse systems is dependent on their ability to care for the packaging, extending its time in the economy and increasing their useful life (Muranko et al., 2021). Therefore, in evaluating the success of reuse systems, we must look at how the qualities of each system (Appendix B) promotes packaging longevity. In the literature, it is clear that businesses that provide the infrastructure to reuse packaging tend to benefit from increased packaging use cycles (Muranko et al., 2021) due to the expertise of staff trained to identify damaged units and repair or replace them as necessary. Logistically, keeping enough packaging on hand in sequential reuse systems can pose challenges for industries where there are intermittent and intense surges in traffic (Potting & van der Harst, 2015), such as large music venues. Exclusive reuse systems, in contrast, typically benefit from needing no backstock and simple logistics which are easier for consumers to understand (Accorsi et al., 2014; Vöröskói et al., 2020). Important in all systems of reuse is clear communication as well as proper supply and labor management (Accorsi et al., 2014; Muranko et al., 2021; Šuškevičė & Kruopienė, 2021), which can be hard for smaller businesses. Additionally, the reverse product logistics that require the packaging be transported from a collection site to a wash site and then distributed to businesses
increases the risk of packaging breakage during transit and handling (Ingmaro et al., 2017). For businesses, these issues can present a significant barrier to establishing successful reusable packaging systems.

At the heart of this issue is the concept of convenience, it is simply more convenient for consumers and businesses to think of packaging as a part of their purchase which is intended to be thrown away once it has served its initial purpose (Muranko et al., 2021). In order for reuse systems to be successful, a change needs to occur in our collective conceptualization of what packaging is. One step towards this is to recognize that disposable packaging represents an inherent loss to society (Šuškevičė & Kruopienė, 2021). By throwing packaging away after one use, society is planning for the obsolescence of that material and all of the money, labor, and utility that it embodies (Potting & van der Harst, 2015). By incorporating packaging into the cost and process of a product, we obscure the costs of the packaging (Vöröskői et al., 2020) by conceiving it as a part of the product to be wasted. Separating the costs of packaging from the products they contain, reusable systems change this conception, causing the packaging to be perceived as a product in and of itself (Muranko et al., 2021). Creating reusable packaging systems that are managed separately from the consumable product can make it more clear that the packaging is separate from the product and allows for a consolidation of program communications and logistics (Muranko et al., 2021).

**Conclusions**

In theory, reusable packaging can provide many advantages compared to disposables. While environmental impacts need to be scrutinized on a per use basis, the impact of packaging can be reduced by including reuse systems into current restaurant models (Harnoto, 2013; Muranko et al., 2021; Vöröskői et al., 2020). While these effects are clear if the reuse systems
are utilized properly, poor participation rates presents the potential for reusables to create worse environmental impacts than their disposable counterparts (Potting & van der Harst, 2015; Šuškevičė & Kruopienė, 2021) due to their high production impacts. However, reusables have more opportunities to reduce their environmental impacts by improving use-cycle processes such as washing techniques (Gallego-Schmid et al., 2018; Potting & van der Harst, 2015) and shortening reverse logistic transportation routes (Ingarao et al., 2017; Ingrao et al., 2021). For businesses, increased logistical complexities do represent technical challenges for businesses in creating models that work financially (Accorsi et al., 2014). While some of these costs can be passed on to consumers, this can create equity issues for low-income customers and negatively impact participation rates (Muranko et al., 2021; Šuškevičė & Kruopienė, 2021). In order for reusable packaging to be more widely accepted, it may be necessary for consumers to conceptualize all packaging as separate from the product in order to realize the inherent loss disposable packaging represents (Šuškevičė & Kruopienė, 2021).

While this study reviewed available literature, reusable packaging systems are relatively new to the restaurant industry and they have not yet been the subject of much original research. For this reason, future research is needed to increase confidence in these results. Reusable packaging systems are relatively novel operations, especially in the restaurant industry. Future studies should focus on creating original research on reusable packaging in restaurants before robust conclusions can be made regarding the viability of reuse systems as a whole.
CHAPTER 2: AN EXAMINATION OF BARRIERS AS DURABLE AS PLASTIC

Introduction

Coastal Maine, with its rocky shores, tall pines, and long summer days — draws visitors from around the world each summer. The gem of the Maine mid-coast is Acadia National Park which features more than 150 miles of hiking trails, sand beaches, and geological wonders on a glacially-shaped island. With over 4 million visitors in 2021, the park brings a significant boom in population during the summer months.

Coastal towns like Bar Harbor anchor Maine’s tourist economy and are emblematic of the waste issues that face many Maine municipalities. Restaurants in Bar Harbor offer take-out food, providing an essential service for the tourist industry and contributing to the local economy. However, there is a price to be paid for these services and it takes the form of countless disposable coffee cups, to-go boxes, sandwich wrappers, straws and plastic utensils which often end up overflowing public rubbish bins. This creates a deeply ironic conundrum as tourists are drawn to the natural beauty of Maine’s coast, yet their presence is often a precursor to the increased presence of food packaging litter at natural attractions. On a small island without local disposal facilities, the costs to collect, haul and then pay to dispose of or manage discarded materials is significant. With a small year-round population of only 5,000— these costs take up a significant portion of the city’s budget and divert spending away from other important public priorities.

This paper draws on transdisciplinary, stakeholder engaged research with communities throughout Maine, a place known affectionately to many around the world as “vacationland,” to explore both the costs of plastic pollution and opportunities for the adoption of reusable food take-out container systems. Our work with Maine restaurant owners throughout the state
suggests that while many of them are acutely aware of and concerned about the environmental impacts of the waste their businesses generate, they find themselves challenged to adopt alternatives. Several recent disruptions have shaken global supply chains for both food and packaging, as well as systems for handling recyclables and waste. In Maine, the COVID-19 pandemic and the closing of plastics recycling export channels have combined with growing concern about ocean plastics to help shape new materials management policies, including Extended Producer Responsibility (EPR) legislation, plastic bag and expanded polystyrene (Styrofoam) bans—as well as a change in the food code to allow for the use of reusable packaging (Maine DHHS & Maine CDC, 2021). These shifts are reshaping society’s relationship with plastics and are impacting Maine’s restaurants, already struggling from pandemic shutdowns, disrupted tourist traffic, supply chain issues, and worker shortages (Eichacker, 2021; Writer, 2022).

To investigate these issues, a yearlong research project was conducted in conjunction with representatives of Maine municipalities, waste management organizations, environmental groups, and the hospitality industry. Stakeholders were engaged through workshops, surveys, a waste audit and interviews to assess the opportunities for plastic reduction and barriers preventing the adoption of reusable take-out container systems. Throughout the study, participants generally expressed interest in reusable packaging systems and felt positive towards their effectiveness for reducing waste, pollution and overall environmental impact. Additionally, most participants were acutely aware of problems associated with plastic waste and pollution. However, stakeholders also revealed that there are significant barriers preventing restaurants from adopting reusable take out packaging. This research makes it clear that without addressing or removing these barriers, the adoption of reusable packaging is likely to be slow and patchy.
This chapter explores these issues and follows on Pollans (2017) query about “how, existing systems can migrate towards more effective and efficient material management practices, and what are the barriers to doing so” (Pollans, 2017 p.2307).

**Literature Review**

Plastics present a unique kind of temporal and material problem: they are simultaneously durable and disposable. This means that the "afterlives" of plastics are considerably longer than their shockingly brief use-phases (Liboiron, 2016 p.103). Because of this, plastic detritus all too often ends up on our beaches, in our soils, and even in our bodies. Recent efforts to reduce plastic consumption and waste have been gaining momentum through campaigns, pledges, and policy across geographies and scales (e.g., Surfriders “rise against plastics” campaign, the EU’s directive on single use plastics, and the international Alliance to End Plastic Waste). Recognizing that “nothing is waste in general but only in particular” (Reno, 2015, p.559), our work centers on a particularly abundant and problematic kind of waste – disposable restaurant-ware – and nascent efforts to reduce disposable food packaging through reuse programs.

As noted in the first chapter, our focus on the restaurant industry is motived by an observed annual growth of 7-8% in take-out and delivery sales leading up the COVID-19 pandemic (Agarwal, 2020; Zimmerman, 2020; Edison Trends, 2021) - a rate roughly double that of the restaurant industry as a whole (Ahuja et al., 2021 p.2). Additionally, the onset of the COVID-19 pandemic coincided with a substantial acceleration of delivery and take-out models, with sales doubling in the United States (Ahuja et al., 2021). As increased consumption in the United States is associated with increased waste (Powell & Chertow, 2018, p.2) the dramatic growth in take-out and delivery marked a corresponding uptick in waste production (Zimmerman, 2020). This major disruption combined with the ongoing Chinese waste import
ban (Berry et al., 2020) to create a situation in which Maine has been unable to attain its waste reduction goals (Clark and Beneski, 2021).

In recent years, concerns over the environmental and economic impacts of this waste have led to changes in Maine’s approach to waste management. Although Maine has passed the Nation’s first extended producer responsibility (EPR) legislation for packaging, as well as bans on single use plastic bags and Styrofoam (Mezzofiore, 2019; Sellers, 2021), these laws represent barriers to waste generation without proposing solutions for the economic actors they affect. Such legislation can act as a catalyst for businesses to transition to plastic alternatives, but as noted in Chapter 1, these new materials often present their own environmental issues (Vendries et al., 2018). Regardless of the material used, single-use take-out packaging forces participants into what Lily Pollans describes as a “disposal mode” of governing waste, "characterized by governmental rationalities of economic efficiencies" (Pollans, 2017, p.2302), where materials are managed at the end-of-life. This “weak” mode of governance not only fails to address issues of consumption and waste, it also cements existing practices, as “the more mature a system [...] the more difficult it is to change” (Pollans, 2017, p.2307). That is to say, weak modes of waste governance preclude more sustainable alternatives and reproduce existing waste management systems (Pollans, 2017; Mourad, 2016).

Decisions about materials management in Maine and beyond are often guided by what is known as the "waste hierarchy" - a tool designed to help decision makers determine the preferable management strategy for objects based on environmental outcomes (see, for example Mourad 2016; Maine DEP; US EPA, 2016; Wagner 2016). Systems for managing materials have, to date, largely remained focused on objects' end-of-life, despite the discursive attention to strategies like source reduction and reuse in the waste hierarchy (Mourad 2016). Our work
focuses on systems of reuse, which keep items in circulation without destruction. In contrast to the single-use plastic disposables that often end up on sidewalks and beaches, reuse is about “object durability, so that repeated use can take place” (Vaughan et al., 2007 p.128). Research suggests that many forms of reuse can offer significant environmental benefits through reduced plastics production and resultant plastic waste (Sandin & Peters, 2018; WRAP 2021; Nasr et al., 2018). Yet despite the potential environmental and economic savings associated with reuse, our work with business owners, policymakers, and materials managers, suggests that there are real barriers to putting reusable systems in place. It is critical to understand these barriers if we hope to support scalable reuse programs that are effective and equitable.

In the context of waste, the barriers to sustainably managing materials are often assumed to be educational. That is, interventions meant to disrupt the "disposal paradigm" (Pollans, 2017) frequently take the form of educational campaigns. The underlying assumption is that if people only knew better, rational actors would transform our systems, making them more effective at preventing, reusing, and recycling materials and saving money in the process. Indeed, the literature on waste is dominated by a variety of behavioral approaches that attempt to raise awareness, change attitudes, and implement individualized solutions to what is, effectively, a systemic issue (Caggiano 2021; Schanes et al., 2018; Isenhour & Reno, 2019). These approaches predominantly "rely on voluntary behavior change, rather than changing contextual factors which may determine households’ behavioral decisions" (Abrahamse et al., 2005 p.274). But many of the barriers to more sustainable behaviors are quite durable. The convenience, normalcy and widespread use of disposable packaging systems often cause individuals to view changing these systems as a threat to their quality of life (Woods & Bakshi, 2014). With such deep seeded sentiment associated with disposable packaging systems, it becomes clear that “the more mature
a system, … the more difficult it is to change” (Pollans, 2017; p. 2307). Proponents of reusable packaging systems, therefore, must consider the social and interpersonal relations that are maintained by the current waste system.

While single-use plastics are extremely durable materials, they were intentionally designed absent of any emotional durability (Woods & Bakshi, 2014) which dramatically reduces their perceived value and decreases their useful life (Rigamonti et al., 2019). But studies on reuse behaviors suggest that the benefits can extend far beyond the environment as consumers come to assign emotional and social value to materials like plastic, previously understood as disposable. Vaughan, for example, found that those participating in curb-side dairy services saw their reusable milk bottles as a “symbol of community” and associated their desire to participate in the program as part of an effort to create and maintain a “web of social relations” (2007:126).

It may be that one of the most difficult barriers to sustainable waste management is getting people to care about plastic packaging that was intentionally designed for convenience and disposability, with no emotional durability. However, this research suggests that reusables can become a symbol of both care and community. Unfortunately, such considerations of sociality are largely missing from sustainable materials management theory, programming, and policy (Berry et al., 2022).

While it is often assumed that the only barrier to the adoption of pro-environmental behaviors is informational, these examples make it clear that barriers and enablers can be emotional, economic, social, and institutional. Schanes and colleagues (2018) found that cognitive theories, like the theory of planned behavior, are often applied despite the fact that these theories can only partially explain behavioral intentions, and, to an even lesser extent, predict behaviors. Following Pollans, (2017), we explore the complex assemblage of barriers
extending beyond individual behaviors that prevent transitions to more sustainable materials management:

*a variety of social, institutional, political, and financial barriers trap the actors and organizations with daily responsibility for waste management in a 'disposal mode'; actors and policies driven by more environmentally protective rationalities lack enough influence over operations and decision-making processes to overcome barriers to mode transition* (Pollans, 2017 p.2301).

A "disposal mode" (Pollans, 2017) governs what Reno characterizes as "mass waste" - that which "must be contained forever, encased in a landfill because it is thought threatening to everything it comes into contact with and yet it cannot die, cannot be finally destroyed" (Reno, 2014 p.19). Transitioning toward reusables involves "dramatic and transformative action" (Pollans, 2017 p.2302). Existing research suggests that education is a necessary but insufficient strategy to achieve such a transformation, because these shifts also require attention to policies, business models, and common understandings of safety in addition to personal behaviors.

Recognizing the challenges with single-use plastics, growing public concern about plastic pollution and the economic inefficiencies associated with disposability, many actors are promoting the growth of reusable and refillable packaging. Upstream, a non-profit organization that promotes alternatives to single use goods, is documenting the growth of businesses that are adopting alternative packaging models. Our analysis of these cases suggests that while each system of reuse is different, most fall into one of four models of reuse (Appendix A):
• **Deposit systems** (Appendix F) work by charging customers a deposit each time they take a clean container with their food. Customers may return the dirty container when they are finished to either receive their deposit back or to obtain a fresh container with their next meal. This model is typically employed by individual restaurants, who must clean the containers but are not required to track the packaging for the system to run effectively.

• **Purchase systems** (Appendix H) are similar to deposit systems, except that the initial charge for the container is usually much higher and is non-refundable. In this model the consumer owns the packaging but can exchange it for a clean version with each visit. It is common for restaurants to offer a small discount to customers who bring their container back. The business must wash returned containers but the system does not require the packages to be tracked.

• **Subscription services** (Appendix G) charge customers a monthly fee in order to be able to check-out a specified number of reusable packages. Packages may be returned or swapped out at any time, but customers are charged extra for lost or damaged packaging. Third-party businesses often handle the cleaning and redistribution logistics for restaurants, who pay a monthly fee for this service.

• **Lending services** (Appendix I) allow subscribing participants to check-out containers for free during a grace period after which the container is considered late. Fees for late returns are collected until the value of the container is completely recuperated. In this model restaurants enroll in third-party services to provide tracking, cleaning and distribution.

Upstream’s “Reuse Wins” report clearly illustrates the economic and environmental advantages of all these reuse models (Gordon et al., 2022) which can outperform disposable
service ware in as few as 10 uses. However, despite these potential benefits and the significant burden of disposable food packaging in Maine, generated by the millions of tourists who visit each summer, the adoption of reusable packaging models has been slow in Maine. As such, this research focused not only in understanding the barriers that prevent adoption, but also how barriers might be addressed to facilitate a transition beyond a “disposal” mode of waste governance.

Methods

To understand barriers to implementing reusable take-out packaging among stakeholders in Maine, we draw on a statewide survey of restaurant owners and foodservice professionals, several stakeholder workshops, and interviews with key stakeholders. These methods, described in detail below, helped us to explore both stakeholders' perceptions of reusable take-out packaging and the actions they take (or do not take) to implement reusable programs in practice.

Survey Methods:

The survey focused on Maine restaurant owners’ and managers’ perceptions of reusable take-out packaging. Participants were recruited through a series of emails sent to the members of two partner organizations: Hospitality Maine and the Maine Brewers Guild. Three rounds of emails were sent; an initial explanatory email followed by reminder emails sent at two and four weeks following the initial email. In total, the survey was sent to 1,500 restaurant owners and foodservice professionals. The survey was administered through Qualtrics, a web-based survey platform. While survey responses were anonymous, participants who were interested in testing

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1 To protect the privacy of the research participants, we have used pseudonyms for individuals. Organization and municipality names have remained unchanged.
reusable packaging were given the option to self-identify during the survey to be included in a pilot program in the state.

The survey was composed of 32 open-ended, multiple choice, and scaled-response questions and was designed to explore three broad categories of inquiry: characterization of current business operations, assessment of opinions on specific reuse models, general assessments of respondents' views on reuse and environmental issues. All survey respondents gave their informed consent to have the contents of their survey responses included in the findings of this study. No compensation was offered to participants.

**Stakeholder Workshop Methods**

On September 13, 2021, we conducted a 90-minute stakeholder workshop with Maine-based restaurant owners, materials waste managers, and state-level officials. The goal of the workshop was to identify the barriers and benefits of reusable packaging systems as perceived by stakeholders who are closest to the inputs and outputs of a reusable packaging system.

Participants were recruited due to their professional roles related to waste management, food packaging regulation, and food safety, with initial contact being made through organizational partners in Hospitality Maine and The Maine Brewers Guild. The workshop was hosted via Zoom, a secure video conferencing service, and was recorded with the permission of participants. The workshop consisted of an ice breaker exercise, a 15-minute presentation on reusable packaging followed by two discussion sessions in which participants were separated into groups to answer a set of questions about reusable packaging. Questions in the first breakout room focused on what reusable packaging models or systems stakeholders thought would work well in Maine, while the second breakout room centered around the barriers that exist for reusable packaging and what stakeholders view as the solutions to those barriers. A second series
of workshops were held in the spring of 2022 with restaurants who indicated in our survey that they would like to learn more about reusable take out models. During these meetings we presented participants with more information about each model and then held open discussions about which models might work best in Maine and for their business. Research team members transcribed and analyzed workshop data to develop themes around stakeholder perceptions of reusable take-out packaging and barriers to the adoption of reusable take-out packaging in practice.

**Interview Methods**

In order to expand upon the findings from the stakeholder workshop, we conducted a series of interviews with stakeholders who were either close to the issues or had first-hand experience with reusable packaging. Interviews were designed to inquire about the participants’ thoughts on reusable packaging, what concerns they had for implementing these strategies, and what models of reuse interested them the most. Due to the ongoing COVID-19 pandemic, all interviews were conducted either online (via Zoom) or on the telephone. Interviews were recorded with the consent of participants. Interviewees were identified through market research of the existing reusable packaging landscape and were contacted through publicly available email listings. Some participants also chose to self-identify as interviewee candidates at our September, 2021 stakeholder workshop. All interviewees signed an informed consent and agreed to have the contents of their interview included in the findings of this study. No compensation was offered to interviewees.
Results and Discussion

Survey Results

Of the 1,500 invitations to take the survey, 294 (19.6%) of the email addresses were no longer active. While 409 (27.2%) individuals opened the survey invitation, only 37 completed the survey, for a final response rate of 2.5%. The majority of the individuals that responded provided take-out (89%) and dine-in services (78%) at their establishment with fewer than half providing catering (41%), remote sales (19%), and delivery (11%). Remote sales were defined as operations that included a food truck or other option to sell food offsite. Four respondents (10.8%) indicated providing “other services” with three of those respondents indicating they operate “shipping services” and one indicating that they ran a bed and breakfast.

Survey respondents predominantly used paper/paperboard (76%) and biodegradable products (76%) followed by plastic (46%) and foil (27%) take-out containers. Among the 13 respondents who provided an estimate of the number of take-out packages used per week, plastic and paper packaging products were used in the greatest numbers, as respondents reported using 4,665 and 4,390 units respectively. In contrast, biodegradable products were used about half as frequently (1,849 units per week), while only 170 foil containers were used in an average week (Figure 1). In the aggregate, survey respondents used an average of 518 paper/paperboard, 439 plastic, 205 biodegradable, and 57 foil containers per week.

Figure 1 - Weekly Container Usage by Material Type. Based on 13 responses. Averages are based on the number of respondents for that materials category.
respondents reported using a total of 11,074 take-out packages per week, or an average of just over 850 units per location per week. During discussions with business owners and operators we frequently heard them lament how much waste their businesses were producing as well as their interest in ways to try to reduce that waste. Some also saw reusable packaging systems as a way to avoid packaging supply chain shortages that have recently wreaked havoc on their businesses. When participants were asked if they had experienced packaging supply shortages over the past year, over half (56.7%) responded yes. Businesses that used plastic take-out packaging reported the highest supply shortage (70.6%), followed by plant-based or biodegradable packaging (64.3%), paper products (60.7%), and foil containers (60%).

Survey respondents were also asked to rate the relative importance of the following five factors when making decisions for their business: finances and profit margins, environmental sustainability, convenience and operational feasibility, health and safety, and customer perceptions and satisfaction. Participants were given 100 points to distribute among the 5 factors, meaning that each score represented the proportional weight they placed on a given factor when making a decision. Environmental sustainability was rated the highest of the five factors with an average rating of 25%. While there was very likely a self-selection bias in the survey (meaning that those interested in sustainability were more likely to respond to an invitation for a survey about take out packaging), we find this remarkable given that most environmental campaigns suggest that a lack of interest or awareness is the primary barrier which was clearly not the case for these respondents. Participants considered customer perceptions and finances as slightly less important for business decisions, at an average score of 21.4% and 21.1% respectively. The
lowest ranked factors were operational feasibility and health and safety concerns, rated at an average of 17.4% and 15.1% respectively (Figure 2). Of the responses, only environmental sustainability (t=2.058, p=0.047) and health and safety (t=-3.433, p=0.002) were statistically different from an expected indifference score of 20%.

Several questions focused on respondents’ perceptions and preferences for the four most popular reusable packaging models. The four reusable packaging systems (Appendix A) evaluated in the survey were: deposit (Appendix F), purchase and discount (Appendix G), subscription (Appendix H), and lending (Appendix I). Respondents were asked to rate each system based on convenience, operational feasibility, and financial feasibility. Answers were based on a 10-point scale with 0 being the lowest and 10 the highest. Only the averaged answers from two questions emerged as statistically different from an indifference score of 5 based on a two-tailed t-test: customer convenience for both the lending and subscription systems were viewed negatively by respondents (t=-3.046, p = 0.004 and t= -6.993, p<0.001 respectively), most likely due to the need to track packaging in both models (Figure 3).
Similarly, participants ranked the different models by their preference for those systems. Preference was rated by asking participants to list the models according to their preference, with the top choice being assigned a score of 1 and the lowest assigned a score of 4. While the deposit system ranked the highest on average (2.17), this did not represent a statistically significant difference from the expected indifference mean of 2.5 ($t=-1.726$, $p = 0.093$). The lowest ranked systems were the subscription and lending models, which both received an average rank of 2.81 ($t=1.605$, $p=1.17$ and $t=1.928$, $p=0.062$ respectively). While research participants were attracted to the convenience of these models in workshops and the possibility of having a third party manage package tracking, washing and stocking, surveys and interviews suggest that these models also have higher barriers to entry due to the costs and the need to add software applications to operations to track packaging.

Finally, participants were asked to rate the degree to which they agreed with a series of eight questions that focused on reuse, business operations, and climate change more generally. Respondents rated their agreement to these statements on a scale from 0 (completely disagree) to

![Figure 3 - Average Ratings of Convenience, Operational Feasibility, and Financial Feasibility of the Four Reuse Archetypes. N=37. Statistically significant values are outlined.](image-url)
10 (completely agree). While, on average, respondents were indifferent to statements that asked if reusable packaging could improve brand loyalty, reduce the business risk of supply chain shortages, would be inconvenient to implement, or represented a health risk at their business, their responses to questions about reuse and climate change were much more telling. On average, respondents were concerned with the impacts of climate change on their business \( (t=6.138, p<0.001) \) and growing waste streams \( (t=5.319, p<0.001) \) and believed that reusable packaging would help their business reduce its environmental impact \( (t=5.081, p<0.001) \) (Figure 4).

Further, respondents generally believed that their business decisions could make an impact on the environment \( (t=6.152, p<0.001) \). While we were working with a small sample size and there is certainly self-selection bias in the sample, we note that it is remarkable that these aware, interested and engaged business owners and operators, despite their interest in reusables, have not yet implemented reusable models. This suggests that there are other barriers in place, beyond awareness and interest.

Figure 4 - Averaged Responses to Likert Style Questions. 0=completely disagree, 10 = completely agree. N=37
Stakeholder Workshops and Interviews

Our first workshop was held on 9/13/2021 with 25 attendees representing 10 food service establishments, 7 municipal governments, 2 non-profit organizations, 3 waste management organizations, and 3 independent researchers. We also conducted two follow up workshops with businesses who indicated in our survey that they were interested in piloting reuse systems. Finally, we conducted nine interviews which included experts from third-party reusable packaging providers, food-service providers operating reusable packaging systems, and a municipality that started its own reusable take-out packaging program. In workshops and interviews four major themes emerged as important opportunities and barriers that might determine the success or failure of reusable packaging systems: logistics, incentives and finances, health and safety, and the role of municipalities.

Logistics:

According to the workshop attendants, there are two major aspects to logistics: back-end (e.g., restaurant- and supplier-side) and consumer-facing (e.g., how the consumer interacts with the system). Among back-end logistics, the need for storage and washing capacity appeared to be a large logistical hurdle. One participant mentioned that the decision not to “use single-use is because they don’t have kitchen facilities for the sanitation or the work, and storage” while others noted that “twenty-five percent of the food serving industry in Maine is somebody that doesn’t have the capability to process those reusable containers.” Donald, an owner of a local restaurant, noted that limited operational space has both financial and operational considerations:
“It’s going to create extra room for storage and then… if you rent at a high rental area… will the restaurant [be] willing to pay those costs to keep those extra… reusable containers?” (Donald, 9/13/21, Workshop)

Adding additional processes and material to current restaurant operations presented a significant barrier for participants, even those most interested who attended our workshops. The pandemic, in particular, caused several participants to note that a smaller than average workforce limited their ability to significantly shift business operations. To illustrate, we note that a large portion of restaurant representatives who initially accepted our workshop invitations were ultimately unable to attend, citing staffing shortages. Out of the 38 restaurants representatives invited, 17 agreed to attend and 10 attended (30% of the invited). In contrast, out of the 22 non-restaurant participants invited to join, 15 managed to attend (68% of those invited). Other logistical concerns focused on the consumer convenience factor of returning packaging material. For these reasons, in workshops participants thought a third-party collection, cleaning and redistribution service would be the most favorable logistical method. Several respondents noted that central collection locations would allow consumers an avenue to easily dispose of soiled packaging. Participants also noted that a third-party service would also alleviate the burden of storage space and staffing issues for participating restaurants. However, we note that in the survey businesses ultimately preferred the deposit and purchase models, perhaps because they don’t require a third-party contract (which are still scarce or non-existent) or the need to integrate tracking software into their systems.

Incentives and finances:

Several participants noted that a significant barrier is the lack of good incentives systems for participation. While many felt their customers would be interested in reusables programs,
they were worried that customers would not participate or return packages without the right incentives. Despite this consensus, participants expressed uncertainty about which incentives they believed would work best. Some participants did not believe deposit or purchase systems would work due to the high buy-in cost:

“A deposit system or something like that... I don’t see that working in our restaurant very well...It would have to be something easier for the customer than a membership or an app or a... deposit.” (Arnold, 9/13/21, Workshop)

“An upfront cost to the consumer is a barrier to entry, even if they end up making money on the discounts each time you use [your] coffee mug.” (Tara, 9/13/21, Workshop)

Others mentioned that deposits may suffer from a sunk cost fallacy, in which consumers perceive that deposit as already spent and the money is not recoverable, minimizing the value of the packaging product:

“OK, five-dollar deposit, bring back the pie plate. But in a short amount of time, we end up without any pie plates. I’d have to buy more because people ... just kept them.” (Yvette, 9/13/21, Workshop)

While systems that only charge for missing containers can theoretically levy higher prices for missing packaging, participants believe this would not convince Maine’s large influx of tourists during the summer months to return packaging:

“I think for where I’m set up in Northeast Harbor, honestly, money isn’t going to be an issue, charging people would[n’t] work. They would just say ‘sure, put it on
my house account, whatever you say.' But I think for the tourists, money isn't as great of a solution.” (Adelle, 9/13/21, Workshop)

Because of Maine’s diverse customer base, participants noted it is unlikely that there is a one-size-fits-all approach to incentives. For instance, many customers in the summer come from out of state. Compared to year-round customers, tourists are likely to need more convenient drop off locations and higher incentives to return the packaging. Noting this, several participants advocated for mixed modal systems to allow for different modes of participation:

“...that mixed modal approach of a grocery store, paper or plastic, now becomes reusable, single-use, that might be able to satisfy some of those restaurants and more touristy areas that are concerned that they won’t get the return rate... If the third-party provider was also like the distributor of the single-use stuff. I know it’s not ideally where we want to ... But it is a step in the right direction to build better awareness and a model where people can do better. And I think we’d be surprised how many people opt into the reusable.” (Abel, 9/13/21, Workshop)

“I think there would need to be a combination of things like... subscriptions in some places where people could bring things back and then maybe services in other areas where people would have the ability to drop it off because they're not coming back.” (Hollie, 9/13/21, Workshop)

Despite the optimism for mixed modal reuse systems, it was noted by several attendants that this complexity will also increase how hard it is for restaurants to keep up and participate in a meaningful way.
Several interviewees touched on the idea that the perceived durability of reusable packaging created issues with return rates as “we were finding them in the roads in the woods on the quad” (Rhonda, 10/22/2021, Interview) despite extensive efforts to make the return of packaging easy. Other reusable packaging providers consciously made the decision to use more durable materials, such as metal packaging, to combat this effect. However, passing higher material costs onto customers as an upfront cost is a major barrier to entry for customers. For some providers, this also highlights environmental justice issues with systems that carry additional or sustained costs for customers. This sentiment was echoed by users of reusable packaging who noted that consumer adoption often came down to “people who care about sustainability” rather than access for the entire customer base (Delano, 1/21/2021).

**Safety and Liability:**

Most of the safety concerns appeared to stem from an awareness of the COVID-19 pandemic with one respondent stating, in reference to safety and liability concerns, that it might be better to use a third-party service to avoid any liability. He said, “We have the central repositories collecting and cleaning and then the restaurants redistribute…then you avoid …the whole health and safety part of it.” (Terrance, 9/13/21, Workshop). Another participant argued that the additional inspections by health officials needed to start a reusable packaging program would create a barrier to entry for restaurants:

“You know, most people [restaurateurs] are hoping that the health inspector doesn’t come... And, again that’s not necessarily the right thing. But if I perceive it to be a barrier…I just question the need for somebody to have to come in and look at it” (Hollie, 9/13/21, Workshop)
Both of these quotes speak to the nature of safety and liability concerns within the restaurant industry. Industry professionals present at the workshop tended to think of reusable packaging as similar to any other plate or bowl that would be washed, both in the workload it creates and in their concern for its safety. This caused some to question the necessity of the additional health inspections currently required for reusable packaging systems. Others noted that shifting the responsibility from restaurants onto the third-party vendors would be important from a liability standpoint, as they viewed the introduction of additional soiled material as a potential source of health and safety issues. Despite these concerns, participants' rankings in the survey suggest that issues of sustainability are more important than health and safety concerns when it comes to decisions about packaging.

Another issue of safety centered around the tracking of packaging assets, with some participants being concerned that tracking the packages could threaten the privacy of consumers. If packages are tracked by an app, participants reasoned, then the movements of those people are also tracked. This concern highlights the need for transparency and effective communication to inform the user. It also highlights another potential benefit of multi-modal reuse systems; allowing consumers to opt into a system which does not track packages, such as a deposit system.

**Financial Barriers and the Role of Municipalities**

The final major theme that emerged from the workshop was the high cost of entry for businesses that need to purchase packaging and the role municipalities could play in removing these barriers to reuse systems. Participants overwhelmingly agreed that government intervention would be necessary in order to start these systems in a way that would not be cost prohibitive:
“I think we have to face the fact that it’s going to cost more than doing it the disposable way, but it has to be done because the long-term consequences of not doing it... cost a lot more... I think that’s where our municipalities, and possibly the state, could come in by putting in some money to make it happen. And then ... once the system’s rolling, we can then focus on minimizing costs as much as possible.”

(Terrance, 9/13/21, Workshop)

Our interviews with third-party providers also suggested the need for an outside funding source to initiate a successful program, as the startup costs for packaging and app development can be expensive. For for-profit businesses, this can often present a challenge, as the government will “only grant to non-profit organizations” (Barret, 8/30/2021, Interview) and investors can be hard to find, even when using crowd funding services. One strategy that has found success in several instances is municipalities funding the purchase of the packaging material, allowing the third-party business to focus on app development and logistics without the burden of material costs.

Another participant questioned what might motivate municipalities to get involved:

“What might motivate a municipality to want to engage on this topic generally, because in my experience, if there's not a stick that's aggressively forcing you, or a financial incentive that's going to cause you to save money - there's no reason for any action at all. Everything else is a political risk. So, we’re not able to make any money off of recycling right now. If there's some way that the municipality can make up some of that loss by being the transportation mechanism for collecting up containers and then either providing them to that third party, washing and distribution facility, and that's a way of securing some of those revenue lines that help to secure our whole...
resource process. To a certain degree, that's a different revenue source that would cause us to be like, oh, now the problem being every municipality has a different relationship with how they collect garbage [and how they] monitor it.” (Anastasia, 9/13/21, Workshop)

Others envisioned multiple municipal entities working together on collection, in recognition that much of the state’s tourism traffic and population is concentrated in coastal communities:

“And I wonder if in [the] Acadia area, the Park Service - or other parks in general, and a lot of municipalities would be a good partner because people are often eating in those public spaces for receptacles” (Franklin, 9/13/21, Workshop)

At the heart of these conversations is the recognition that municipalities and the state will likely play a large role in the success or failure of these systems. Participants recognized that the state has a stake in supporting the waste hierarchy written into Maine law and municipalities have an interest in waste reduction to cut collection, hauling and disposal costs. While many participants recognized that entrepreneurs would need to initiate these processes, it was apparent that starting these programs without support for government agencies would not be likely. For municipalities, the issue will likely revolve around what benefit can these programs provide. While participants believed that municipality-initiated campaigns to increase adoption of reusable food ware in a community has the potential to significantly reduce waste management costs, it is not clear to what extent municipalities will be receptive to the potential benefits.

Discussion and Conclusion

From our results, three major barriers that prevent the adoption of reusable packaging in “vacationland” begin to emerge. The first is simply that the novelty and lack of support for
solutions higher on the waste hierarchy caused stakeholders to view reusable packaging systems as risky endeavors due to operational concerns. Several survey respondents indicated that they had not yet heard of reusable take-out packaging models nor seen examples of such systems in use. Indeed, when asked if participants were aware that reusable containers were allowed in Maine restaurants, only 8 (22%, p<0.001) responded that they were aware of this policy. This unfamiliarity may explain a lack of decisive results from the survey with regards to the different models of reuse. Other studies have shown that because reusable packaging systems are relatively new, they are often the subject of confusion resulting in a hesitancy to participate (Šuškevičė & Kruopienė, 2021). This was evident in the case of Steven, a cafeteria supervisor, who noted that the confusion regarding the state's food code policy led the cafeteria to delay their initial reusable packaging program. Steven also elaborated other concerns regarding the ability to start a program stating “Staffing, we weren't getting folks in to kind of work at the unit...we were running at like, say, 40 or 50 percent and trying to run the operations” (Steven, 4/5/2022, Interview). Here we note that lack of staffing may have had a large impact not only on restaurateurs' hesitation towards reusable packaging but also their ability to participate in this research project. It was often an issue throughout this study, as an unprecedented labor shortage caused by the COVID-19 pandemic was the stated reason that many business owners gave when abstaining from participating in this research.

Another barrier that emerged was that high startup costs and a lack of government support often precluded entry into systems that are perceived as more environmentally friendly. While our survey respondents indicated that they based business decisions on environmental factors and believed their business decisions could impact the environment, they also acknowledged the tension between the desire to be environmentally-friendly and the cost of such
actions. Terrance, a staff member at an institution of higher education, noted the struggle between financial and environmental sustainability, commenting that “we have to face the fact that it’s going to cost more than doing it the disposable way, but it has to be done because the long-term consequences of not doing it… cost a lot more” (Terrance, 9/13/2021, Workshop).

This tension between environmental attitudes and the cost of pro-environmental business strategies made it clear to many of our participants that government funding will be an important component in the successful adoption of reusable packaging.

The third barrier identified was that the comparative complexity of reusable packaging systems versus disposable packaging appeared to create confusion among stakeholders. For example, when asked about specific aspects such as operational feasibility or customer convenience, restaurateurs were largely indifferent. However, when asked, respondents largely agreed that reusable packaging is an effective strategy to reduce their environmental impact. This is also reflected in the answers regarding business operations and brand loyalty, where respondents were indifferent to the idea that reusable packaging could help reduce packaging shortages or increase brand awareness. What is interesting about this result is that the majority of participants were acutely aware of their vulnerability to supply shortages under the current disposable packaging system. Accorsi et al., (2014) suggests that restaurateurs are typically hesitant to adopt reusable packaging systems as the perceived logistical complexity and financial burdens often surpass the perceived environmental and social benefits. In contrast, the practical application of reusable packaging systems often saves businesses space due to the reduced need for a backstock of containers (Accorsi et al., 2014; Vöröskői et al., 2020), allowing for operational flexibility and opportunities to expand other unrelated services or stocks. This, again, points to the deep embeddedness of the current disposal mode of waste governance, revealing
"the ways that barriers not only reinforce current practices, but how they simultaneously limit the viability of alternatives already at work within the system" (Pollans, 2017 p.2317).

Given that the state of Maine has waste reduction goals and a hierarchy for how to accomplish those goals, why do our stakeholders perceive so many barriers related to the adoption of reusable take-out packaging? Our findings suggest a complex response to our question of why restaurants "remain stuck in the disposal mode of governing waste" (Pollans, 2017 p.2301). Our participants seemed to demonstrate strong pro-environmental views; however, their actions were constrained by the uncertainty and costs associated with a transformational shift from disposables to reusables. While interviewing participants, it was clear that successful reuse programs were often reliant on government funding to compete with the incumbent waste strategy: disposal. Yet despite the economic (Clark & Beneski, 2021; Sharma & Jain, 2020) and environmental (Vendries et al., 2018; Gallego-Schmid et al., 2019) costs of our packaging and waste systems, the entrenchment of disposability perpetuates this mode of waste governance.

Our work demonstrates that pro-environmental attitudes and education are insufficient to overcome the durable barriers that trap restaurateurs in a disposal paradigm. Despite strong environmental motivations among restaurateurs, the inequities of tourism-based municipalities bearing the burden for the waste produced by the tourist industry, and discursive support for reuse at the state level, the implementation of reusables is largely out of reach for many of our participants. Here we see an important role for municipalities and governments. By offering incentives to adoption and, thus, lowering the perceived and actual barriers to starting reusable packaging systems, governments can effectively increase the relative benefits of participating in such systems versus continuing business as usual. Additionally, owing that single-use packaging is often disproportionally disposed of at municipal sites, municipalities stand to gain from
making investments that support waste reduction activities such as reusable packaging. Some opportunities to incentivize reuse include policy changes that make reuse easier, making funding available for reuse activities, partnering with businesses to enable reuse, and establishing information sources for interested parties. As several workshop participants noted, there is an opportunity for government institutions to work towards solutions and it has precedent for doing so, but in order to effectively press these boundaries, it is necessary for durable impressions of current waste management systems to be dissolved. Future research could, for example, focus on the quantitative impacts of municipal run reuse programs, such as that outlined in Appendix F.
CHAPTER 3: INSIGHT FROM A MAINE WASTE AUDIT: BAR HARBOR, MAINE

Introduction

Throughout this research project four reusable packaging models emerged as the most popular systems to implement on a commercial scale. These four archetypes of reuse, which we have dubbed Deposit (Appendix F), Purchase (Appendix G), Subscription (Appendix H), and Lending (Appendix I), each utilize a distinct mix of the reusable characteristics outlined in Chapter 1. In the Deposit and Purchase archetypes, programs use fees and upfront charges that correspond to the individual package and ensure customer participation. Both of these systems reward customers for returning used packaging through a form of charge reduction. In the Purchase system, customers buy the initial package and are, usually, eligible to receive a small discount on future purchases when they swap a used container for a clean one. In contrast, Deposit systems collect a deposit on each container, which can be offset or recouped when the customer returns used packaging at future visits. These two models often lack a centralized infrastructure, leaving individual businesses to run the programs independently. Lending systems and Subscription programs, in contrast, typically involve a logistics infrastructure that is coordinated by a third-party provider. This provider tracks packaging whereabouts, and, in some cases, washes and redistributes used packaging. Lending systems operate by collecting a payment method from customers and allowing the free use of packages so long as that packaging is returned within a set number of days. After this grace period, the customer is charged a late fee until the cost of the package is recuperated. Subscription services, by contrast, charge the customer a set monthly fee and allow them to simultaneously check out an amount of packages that corresponds to their subscription terms. In both Lending and Subscription services,
customers are able to withdraw and return the packaging at any participating location within the system network.

Within these four models, there are many opportunities for the program to be tailored to the needs and use patterns of their customers. While the archetypes provide an overview of popular systems, the business case for implementing these systems is heavily dependent on how communities use packaging. In Maine, the issues and opportunities associated with reusable packaging vary greatly depending on geographic location. For instance, restaurants near tourist attractions will face much larger seasonal variation in customer volumes than those operating in less visited areas. Thus, understanding where and how much single-use packaging is being disposed of is key for understanding how effective a reusable packaging program could be. In tourist towns, like Bar Harbor, footing the bill for handling all of the waste created by tourism activities has been a continuing concern. In searching for an answer to this problem, town officials partnered with this project to conduct a waste audit in order to better understand the difference in their waste system between summer (high-tourism) and winter (low-tourism) months. It should be noted that, while there are important lessons to be learned from the Bar Harbor waste audit, the audit itself was conducted to understand the entire scope of Bar Harbors municipal waste. Thus, any insights into reusable packaging must be interpreted within the larger context of the audit. The rest of this chapter presents the findings of the summer waste audit in Bar Harbor as a canvas for understanding the existing opportunity for a reusable packaging system.

Waste Audit Methods

The town waste audit was conducted on July 18th, 2022 in conjunction with the Town of Bar Harbor Maine, A Climate to Thrive, The College of the Atlantic, and Jackson Laboratories.
Researchers and volunteers set up a drive-thru drop off station on Great Meadow Drive, roughly 1/3 of a mile from the entrance to the Bar Harbor Transfer Station. This site was selected for its ability to accommodate the needs of the waste audit and because its strategic placement allowed participants to benefit by saving time (volunteers helping unload). The audit was conducted by asking the drivers of cars heading to the transfer station to participate in the waste audit. A script was created to include the purpose and process of the study and to inform participants that our study did not collect any personal information. Participants were directed to the study’s drive-through area where the weigh station attendant collected and categorized each sample by its source: Municipal, Residential, Retail, Restaurant, Hotel, and Weekly Rental. The drive-through attendant then weighed and delivered each sample to a corresponding sorting station. Attendants at the sorting stations then separated the contents of each sample by spreading the waste onto a large tabletop covered with a waterproof barrier. To ensure the safety of volunteers, sorting station attendants wore full length Tyvek suits, thick rubber gloves, eye protection, and masks. Tools were used to sift through the waste to avoid injury to the station attendants. Any objects that were deemed to pose a potential threat to people or the environment were disposed of by the project’s safety manager. An initial sort of each sample collected material from just three categories (Single-use Containers, Reusable Items, and Bottle Deposit items), which were weighed before being sorted into an official waste category (see below) according to their material composition. Because the contents of these three categories were effectively weighed twice, they were only included in official weight tallies after being re-sorted into one of these 14 waste categories: Cardboard, Office Paper, Compostable Paper, Other Paper, Glass, Metal Containers, #1 and #2 plastic, Other Plastic, Textiles, Yard debris, Construction Debris, Hazardous Material, Food Waste, Pet and Baby Waste, and Trash (See Table 1 for descriptions).
The weight from each category was recorded and the combined weight was tabulated to ensure accuracy between the sorting station and the initial weigh station.

<table>
<thead>
<tr>
<th>Official Waste Categories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardboard</td>
<td>Any type of recyclable cardboard. Contaminated samples were categorized as Trash</td>
</tr>
<tr>
<td>Office Paper</td>
<td>Printer paper and other common paper materials</td>
</tr>
<tr>
<td>Compostable Paper</td>
<td>Paper that could be composted, such as napkins and paper towels that were uncontaminated by chemicals or other non-compostable substances.</td>
</tr>
<tr>
<td>Other Paper</td>
<td>Any paper materials that did not fit into the Office or Compostable categories</td>
</tr>
<tr>
<td>Glass</td>
<td>Any item whose weight was predominantly made of glass</td>
</tr>
<tr>
<td>Metal Containers</td>
<td>Any clean metal container, such as food tins, that were not contaminated or coated with substances that prohibited recycling.</td>
</tr>
<tr>
<td>#1 and #2 Plastics</td>
<td>Commonly recyclable plastics with the #1 or #2 imprint</td>
</tr>
<tr>
<td>Other Plastic</td>
<td>Any plastic that was not recyclable</td>
</tr>
<tr>
<td>Textiles</td>
<td>Any fabric</td>
</tr>
<tr>
<td>Yard Debris</td>
<td>Any uncontaminated yard debris, such as grass clippings, branches, or leaves that could have otherwise been composted</td>
</tr>
<tr>
<td>Construction Debris</td>
<td>Debris or items used in construction. Examples might include pieces of drywall, pressure treated wood, and electrical outlets</td>
</tr>
<tr>
<td>Hazardous Material</td>
<td>Any material that contained a substance considered to be a risk to environmental or human health. Examples include acid-containing batteries and medical needles.</td>
</tr>
<tr>
<td>Food Waste</td>
<td>Any food items that could have otherwise been composted or eaten.</td>
</tr>
<tr>
<td>Pet and Baby Waste</td>
<td>Used baby diapers and dog bags.</td>
</tr>
<tr>
<td>Trash</td>
<td>Any item that did not fit into any other category</td>
</tr>
<tr>
<td>Pre-sorted Packaging</td>
<td></td>
</tr>
<tr>
<td>Single-Use Containers</td>
<td>Any food container that was intended to be disposed of after one use.</td>
</tr>
<tr>
<td>Reusable items</td>
<td>Any item that is readily reusable and was discarded before the end of its useful life</td>
</tr>
<tr>
<td>Bottle Deposit</td>
<td>Any glass or metal container that qualifies for Maine’s Bottle Redemption program</td>
</tr>
</tbody>
</table>

Table 1 - Waste Category Descriptions

Waste Audit Results and Discussion

On the day of the sort, researchers and volunteers collected and sorted a total of 753.95 pounds (lbs.) of waste. The top 5 categories across all waste materials were: Food Waste (217.7
lbs, 28.87%), Trash (139.8 lbs, 18.54%), Pet and Baby Waste (94.7 lbs, 12.56%) (See Figure 5), Compostable Paper (78.3 lbs, 10.39%), and Other Plastics (38.7 lbs, 5.13%). From the data, it appears that the waste coming from Bar Harbor’s Restaurants are streamlined, with the majority of the weight coming from just three sources. Food waste (49.76%), Trash (20.52%), and Compostable Paper (19.73%) accounted for 89.92% of the sample weight collected from Restaurants (Figure 6). This is especially striking because despite Restaurants consisting of just 15.19% of the overall sample weight, they...
represented a large proportion of the weight in the Compostable paper (28.86%), Food waste (26.18%), and Trash (16.81%) categories.

Like restaurants, weekly rental locations also produced the majority of their waste in just a few categories: Food waste (40.46%), Pet and Baby Waste (20.55%), Trash (12.37%), and Compostable paper (10.48%) accounted for 83.86% of all Weekly Rental waste (Figure 7).

**Figure 7** - Composition of Weekly Rental Waste: All Other Waste is the combined total of #1 & #2 Plastics, Yard Debris, Construction Debris, Hazardous Waste, Glass, and Office Paper.

Commercial, Municipal, Hotel and Residential waste streams appear to be more evenly distributed among a wider range of waste categories. However, within these waste sources, it’s important to note one important trend: Municipal and Hotel sources contributed 52.71% of the weight in the Other Plastics category despite these two sources combining to equal under 20% of the total collected sample weight.

**Single-Use Containers**

While the Single-Use Category cannot be analyzed in conjunction with the final waste categories due to the risk of double counting materials, there are several trends that should be
noted. First, it is important to note that Single-Use Containers contributed 71.2 pounds, or 9.44% of the total waste audit sample weight. While we cannot include Single-Use Containers when ranking the top-5 heaviest categories without the risk of double counting waste material, it is striking because each item of single-use packaging is designed to be lightweight. The two largest producers of Single-Use Container waste were Municipal and Hotel sources, which compromised 29.07% and 25.14% of the categories weight respectively (Figure 8). This is particularly alarming considering that the weight of Municipal and Hotel sources of waste combined to account for only 17.48% of the total collection weight (10.8% and 7.68% respectively). Restaurants and Residences were also a significant source of Single-Use Containers, each contributing approximately 18% of the total weight of single use containers.

From these results, it would seem that Bar Harbor could have the greatest impact on waste rates by focusing on food waste reduction, especially as it relates to restaurants. While turning to reusables could have a positive impact on reducing municipal waste, there are several factors that need to be taken into account first. For one, the audit was overwhelmingly skewed toward residential sources, which contributed 48.7% of the overall sample weight collected. In
the future it will be important to vary the amount of material collected from each source in order to create a more representative sample. Secondly, as Bar Harbor faces natural boom and bust business cycles, future audits should focus on time-constrained sampling to allow for a better understanding of waste creation during the summer. Finally, an in-depth analysis of the town’s economy could help understand how economic activity relates to waste generation.
CHAPTER 4: REUSE ME: A BUSINESS PLAN FOR REUSABLES IN MAINE

Business Description:

Mission Statement:

Reuse ME is a full-service reusable packaging program that is dedicated to promoting reuse and circularity in Maine’s economy as a means to reducing the negative environmental impacts of plastic waste. Reuse ME is dedicated to promoting a better economy for all and, as such, will maintain a strong focus on Diversity, Equity, and Inclusion.

Business Overview:

Reuse ME is a to-be-formed LLC based in Portland, Maine. Operations will be led by the founder, Jared Wildwistle. Jared has over 10 years of experience in the Restaurant industry and 3 years of experience running and operating a business. Operations will take place out of a rented facility, with the exact location TBD.

Reuse ME will initially focus on providing reusable packaging management services to restaurants that offer takeout food in the Portland, ME area, with plans to expand operations in the future. Main operations will include collecting and washing soiled containers and redistributing clean reusable containers to locations that contract with Reuse ME. Reuse ME will use software developed through a partnership with Usefull, a Boston-based circular solutions technology company, and contracted through Portland-based app developer Rideout. The software and adjoining app will be a customized version of the Usefull software, which will allow Reuse ME to save on development costs but will incur a licensing fee of $100 per month through the course of business as usual. App-development will be funded by an EPA Sustainable Business Innovation Research (SBIR) grant that provides up to $100,000 to create and test technology that has the potential to improve environmental impacts of the economy. Customers
who enroll in the program will be charged a monthly membership fee of $2 per month and will be able to check-out containers at participating locations. There will be no limit to how many containers customers can check-out, but if containers are not returned within 7 days, the container will be considered lost and the customer’s account will be charged a $5 fee. “Lost” containers can still be returned at any participating location, but customers will be unable to receive a fee refund. Soiled containers returned at participating restaurants will be scanned to indicate they need to be cleaned. Reuse ME staff will then collect and clean the soiled containers at a rented facility. Participating restaurants will be charged a flat monthly fee of $30 per month and a $0.20 charge per container restocked at the businesses location. Assuming single-use alternatives to Reuse ME’s packaging cost $0.25 per unit, restaurants will reach cost-parity when using 1,000 Reuse ME containers per month. As Reuse ME will be washing containers on behalf of subscribing restaurants, the company will need to file a group variance with the Maine Health Inspection Program and have written contracts with each facility in the program network. In addition, the Reuse ME washing facility will need to be licensed as a commercial kitchen. Reuse ME will be subject to all applicable sales and income taxes that apply to sole-proprietorships, including 5% sales tax and sole-proprietor total income tax rate which ranges between 22-30% of net income. Reuse Me will obtain insurance through The Hartford Insurance company to cover liabilities resulting from the normal course of operations.

**Operation and Location:**

Reuse Me will start operations in Portland, ME to take advantage of its healthy and sustained restaurant scene. The city of just over 66,000 consistently receives national attention for the quality and number of restaurants. A review of the health inspections for the prior three years reveals over 500 inspections of unique restaurant locations. While the restaurant industry
does have an inherent instability and uncertainty due to the rapid opening and closure of new locations, public estimates tend to agree that Portland hosts somewhere between 300 and 500 open restaurants at any given time (Richardson, 2009). As a Business-to-Business service, operating hours will be between 12 PM and 8 PM Wednesday through Sunday, reflecting a complimentary schedule to the restaurant industry. Operations will initially be run by Jared Wildwistle until the budget allows a staff member to be hired for at least 20-hours per week.

While a facility has not been secured as of yet, the company has identified several potential locations. Fork Food Lab represents the most likely location as it operates as a kitchen for hire and would be ideally suited to Reuse ME’s specific needs. However, a strategic partnership will be sought with Portland-based restaurants to find a location that is closer to downtown Portland, thus minimizing the amount of time spent driving for deliveries and pick-ups. The ideal partner will hold an existing commercial kitchen license, be centrally located in Portland, have extra storage space, and be available for use between the hours of 2 PM and 8 PM. Fork Food Lab, a rental kitchen in Portland, charges $468 per month will be used as a baseline price to estimate a rental partnership with other entities. As most operations will need the use of a vehicle, Reuse ME will purchase a small cargo van for the purpose of deliveries and pickups. The van will need one custom modification of an adjustable separator wall to ensure that collected dirty containers remain separate from clean containers while in transit. Because Reuse ME’s places high importance on reducing the environmental impact of restaurant services, the company will opt to purchase or lease a zero-emission vehicle or, if no viable options exist, lease an internal combustion vehicle until a viable zero-emission replacement is found.
Products and Services:

Reuse ME services will be marketed as a wholistic inventory management service. Reuse ME’s basic offering will the software developed through a partnership with Useful to track the status of each container as it moves between end-users and participating restaurants. Each restaurant customer can set up an account using a credit card, which allows them to participate in the Reuse ME system. As restaurant customers check out containers, the software tracks how long they have retained possession and sends a reminder to return the packaging. Restaurant customers who fail to return the packaging before the allotted 7-day grace period will be charged a $5 non-refundable fee by Reuse ME. Customers may still return late packaging, but may not recoup any late fees if they do so. The Usefull software will be further modified to charge customers a $2 monthly membership fee. As staff at participating restaurants will need to scan packages as they are checked out and in, Reuse ME will provide initial training services in how to integrate the system into their operations.

Once a participating restaurant is properly set up and trained, operations will be conducted in three phases: Delivery and pickup, Cleaning, and Setup. Delivery and pickup operations will be conducted at the beginning of each day and will consist of Reuse ME staff delivering clean packaging to restaurants to maintain a minimum container stock. Staff will also pick-up used containers at each location, ensuring that clean containers and soiled containers remain on opposite sides of the delivery vehicle’s cargo separator. Once staff has collected and delivered all of the packaging for that day, the soiled containers will be brought back to the cleaning facility where large food residues will be scraped into compost bins. At that point, all soiled containers will be run through the dishwasher and allowed to dry. Once a container is dry, staff will scan the clean containers into the Reuse ME system and sort them for the next day’s delivery. In order to
ensure proper deliveries, staff will then perform an analysis of the inventory management system and create a plan for the next day’s drop-off and pick-up route. At the end of the month, each participating location will be billed according to the number of containers Reuse Me restocked for that location.

Cost Assumptions:

A service agreement with Usefull is estimated to cost $100 per month per centralized regional system and will include scheduled maintenance of the software environment and technical support which will be paid for at the time of service. A regional system, in this context, refers to the grouping of restaurants that are serviced through a central Reuse ME washing and redistribution location. When a restaurant signs up to participate in the Reuse ME program, they will be charged an initial set-up and training fee of $100. Restaurants requiring scanning equipment may order hardware at a 30% mark up through Reuse ME, who will install the equipment as part of the setup fee. Reuse ME will collect a monthly service fee of $30 per restaurant, which will help cover the cost of operations. Restaurants will be charged a per unit Cleaning and Redistribution (C&R) fee of $0.20 per container restocked at that location. C&R will be charged on a monthly basis and contracts will be given one week payment terms. In Portland, the minimum wage is set to rise to $15 per hour in 2024 and recent ballot initiatives are considering a rise in minimum wage to $18 per hour in 2024. Thus, to keep ahead of wage trends, employees will be paid $16.50 per hour in 2023 and $18 per hour in 2024. After 2024, wages will increase yearly based on federal estimates of inflation for the previous year. While current legislation does not require businesses with less than 5 employees to offer fringe benefit, management is committed to offering fringe benefits, such as health care and PTO, and will
conduct a yearly audit to determine when such benefits can be sustainably supported by revenue streams.

**Market Analysis and Competition**

There are several factors that make a market analysis for this business plan difficult. Firstly, this type of service is novel to the United States and, as such, there aren’t enough direct comparisons to support any conclusions about how competitive Reuse ME would be. Nationally, reusable takeout packaging was only allowed in the restaurant industry starting in 2013, when the USDA adopted Food Code policies that included refillable food containers. Since then, reusable packaging has been slow to catch on with most operations starting in Western United States in the mid-late 2010’s. The nearest competitors to Maine are located in Boston, Massachusetts, where 2 tech-oriented businesses began operations in 2019 and 2021. In Maine, reusables were not allowed prior to the summer of 2021, when the Health Inspection Program adopted an internal policy to allow for reusable packaging in restaurants. The second major stumbling block for the reuse industry was the COVID-19 pandemic, which caused the closure or slowdown of operations for nearly all restaurant services and provided a major stumbling block to early-stage reusable packaging programs. Concerns over COVID-19 exposure led to many customers and businesses to depend on disposable packaging (Zimmermann & Bliklen, 2020). These two factors have caused Maine to lack any direct competitor and, as such, Reuse ME’s main competitors would be established restaurant suppliers that supply single-use packaging.

While COVID-19 led to staggering increases in single-use packaging, the reality is that the rising popularity of takeout and food delivery services has been driving this trend since before 2019 (Zimmermann & Bliklen, 2020). While this leaves an opportunity for Reuse ME, it
doesn’t negate the ability of restaurants to start their own reusable packaging systems. However, Reuse ME offers two key services that differentiate our services from in-house options. Firstly, because Reuse ME collects membership fees from the end-users of the packaging, we can afford to charge less per unit than single-use competitors. Secondly, Reuse ME offers complete inventory management, a service which providers of single-use containers do not. Restaurants that join the Reuse system benefit by spending less time ordering and managing packaging inventory, fewer supply chain disruptions, and shrinking inventory space. Marketing efforts will need to focus on these benefits as well as the environmental implications of switching to reusable takeout packaging. Recent concerns over inflation do make cost considerations more important to restauranteurs and that is something Reuse ME will need to consider very carefully. However, under normal market conditions, there is evidence to suggest that consumers are willing to pay as much as an extra $0.40 per order to receive packaging they view as healthier and better for the environment (Fischbach et al., 2022).

Marketing Strategy

Reuse ME has two main customer bases: Restaurants and Restaurant Customers (referred to as End-Users). In Portland, where Reuse ME will initially offer services, publicly available information suggests that there are between 300 and 500 restaurant locations in Portland during any given year which, collectively, generate nearly $500 million of revenue per year (Richardson, 2009; U.S. Census Bureau QuickFacts, 2021). According to a recent study, the majority of restaurant customers are young and middle-aged adults (Fischbach et al., 2022) with household incomes between $50,000 and $150,000. US Census Bureau demographic analyses of Portland indicate that the majority of residents fall into the category of high restaurant patronage
(64.4% of the population) and income levels ($61k median income) indicated by Fischbach et al. (*U.S. Census Bureau QuickFacts*, 2021).

Offline:

Reuse ME’s offline strategy will be to target restaurants based on publicly available information and through connections at the Greater Portland Council of Governments, Portland’s Sustainability Office, Hospitality Maine, and the Portland Regional Chamber of Commerce, each of which directly interface with restaurants and can help Reuse ME reach a wider audience. Outreach to restaurants will be conducted through following methods, listed in order of priority: target outreach through the founders’ personal contacts, targeted outreach through the organizations listed above, cold-emailing through accessible listservs, and individual location visits. When a restaurant contracts with Reuse ME, their contract will include an obligation to passively market Reuse ME services and program details to their customers. This will take the form of informational material displayed in highly visible areas, such as on the menu, at the ordering counter, or in the shop window. This will also act as the first contact for End-Users. As the purpose of Reuse ME is to reduce the amount of waste, all promotional materials will focus on connecting users to electronic information sources to keep physical promotional material, such as fliers and posters, to a minimum.

Online:

As part of online marketing efforts, all promotional material will include a QR code that links to Reuse ME’s website. The website will display the company’s logo and important program information, including which restaurants participate in the program and how End-Users can sign up. Social media for Facebook, Instagram and Twitter will be connected to enable cross-platform messaging and increase the opportunities for awareness. All online accounts will
be managed by Jared Wildwistle and will aim to actively engage users by cross-promoting participating locations and providing updates on Reuse ME’s growth. By maintaining active accounts and cross-linking each post, Reuse ME will maximize awareness on search engines, such as Google.

**Risk Analysis:**

The restaurant industry has a robust history in Portland, where it is often used as a testing ground for concepts headed to more expensive urban areas, such as New York City. However, the restaurant industry as a whole experiences high turnover, with over half of all restaurants failing within the first three years of opening (Goad, 2018; Healy & Mac Con Iomaire, 2019). This presents one of the largest forms of risk to operations as this high rate of turnover creates instability in the number of restaurants that Reuse ME can market to on a year-to-year basis. Reuse ME can mitigate this risk by targeting more established restaurants during initial outreach and employing an aggressive account acquisition strategy to compensate for lost contracts due to turnover. In order to achieve the path to success laid out in the 3-year financial plan, Reuse ME will need to grow accounts by 75% in the first year, 60% in the second year, and 40% in the third year. While this plan is attainable, it should be noted that reliance on quick and consistent account creation also forms a source of risk. However, because Reuse ME has few construction and financing needs at start-up, this risk is somewhat mitigated by the ability of the organization to have a short start-up period, allowing the founder to focus on account acquisition before operations officially start.

Another source of risk is that of being a small operation. Reuse ME will start with the owner-operator, Jared, managing operations solo until a part-time (at least 20-hours per week) employee can be supported by the revenue from operations. While hiring an employee will
create some redundancy, if Jared or the sole employee become ill, are injured or are otherwise suddenly indisposed, operations could stop or cease altogether. To mitigate this risk, Reuse Me will acquire key personnel insurance to help with the monetary considerations of suddenly losing either individual. Additionally, contingency plans will be created to ensure smooth operation for customers. In the event that Reuse ME must cease operations altogether, the company’s assets are primarily composed of the delivery vehicle ($48,000), containers ($17,718), and the software ($25,000), all of which can be sold relatively easily. Because the software developed for Reuse ME is intellectual property and a market pricing is not available, a total liquidation value of assets at startup would likely be in the range of $75,718 – $100,718. Finally, as Reuse ME does not rely on traditional supply chains, instability in global markets will likely have minimal impact on business operations. While minimizing this risk is a low priority, Reuse ME should be aware of supply chain disruptions as they could signify opportunities for business development.

Management

Jared Wildwistle will be the Operating Manager of Reuse ME and will attend to the organizational needs. Jared has been involved in the restaurant industry for over 10 years, working in all-positions within the restaurant industry. Jared was a founder and managing partner at Flight Deck Brewing between 2016 and 2020, when he left to continue his education. His awareness of small business operations and financials is evident in the success of that business, which is still in operation today. His thesis project for his degree program at the University of Maine focused on reusable packaging as a method of reducing waste in the restaurant industry and was one of the reasons that the Maine Health Inspection Program adopted internal policies to allow for reusable packaging in the restaurant industry. Jared has good working relationships with several influential people in the reusable packaging scene, including Alison Rogers, the
founder of Boston-based Usefull. Jared also has good working relationships with officials in the State of Maine and Portland, and can utilize those to ensure the best chance of success for Reuse ME.

Financials

Underlying Assumptions:

Below is a list of the underlying assumptions for which the financials are based off of:

- **Container Loss Rate:** This rate is based off of the findings from several studies that suggest packaging return rates can range between 75 and 90 percent (Šuškevičė & Kruopienė, 2021). To be conservative, we have chosen an annual loss rate of 25%, which Reuse ME must replace to maintain operations.

- **Delivery Vehicle:** It is assumed that an electrical vehicle will be available and ready for use at the time. However, due to the nature of the automotive industry and the fact that much cheaper alternatives exist, it is likely that Reuse ME will end up purchasing or leasing a much cheaper vehicle than is proposed on the financials. The EV was included to display the financials that most closely reflect Reuse ME’s mission statement.

- **Nominal Value:** all values in the financial projections are calculated at nominal rates and do not take into account the time value of money.

**3-Year Financial Projections:**

Reuse ME will seek funding through three sources: a federally subsidized grant, founders’ investment, and an auto loan. Reuse ME will seek to take advantage of an EPA grant meant to spur technological solutions to the economies most pressing environmental impacts. This grant, the Sustainable Business Innovation Research grant (SBIR) is awarded to for-profit businesses for the purpose of developing and testing green technology. Awards for Phase 1
grants can be made up to $100,000 and phase 2 grants are available in amounts up to $600,000. Grant funds may be used for development costs and operating expenses. The founder will utilize a personal investment to secure an auto loan and to seed cash reserves prior to the start of operations. A break-even analysis for Reuse ME was conducted by calculating all of the expenses and income based on three input categories: number of restaurant accounts, number of end-users, and the rate of packaging usage. Microsoft Excel Data Analytics was then run to calculate which combination of these three input categories led to monthly income equaling monthly expenses. The Data Analytics parameters were set to minimize the number of End-Users while keeping the number of participating restaurants to under 30 (~10% of Portland restaurants). The analysis produced a break-even point at 944 End-Users (1.4% of Portland’s population) using a total of 3,777 reusables per month, or an average of four units per End-User per month. As our study to date indicates, each restaurant location uses about 850 takeout containers per week. The number of packages indicated by the break-even analysis represents 3.4% of the total amount of takeout packages that would be used by 30 restaurant accounts in a month, as calculated using the findings from Chapter 2 of this thesis.

Given the three-year financial analysis in Appendix C, Reuse ME will hit a net zero cash balance in June 2024, 16 months after operations begin. Although Reuse ME is not expected to turn a profit until June 2025, the cash balance does increase between these dates. This is due to depreciation being accounted for in the net income calculations but having no realized effect on cash reserves. Overall, in 2024 Reuse ME is estimated to end with a cash balance of $1,600 and in 2025 will reach a net profit of $785 with a cash balance of $9,493. Key to hitting these milestones is the ability to continually acquire new restaurant accounts at a rate of 75% through the first year. Although adding accounts is key to Reuse ME’s awareness among End-Users, and
thus revenue generation, it is important to note that slower than anticipated growth will not
dramatically affect the 3-year financial plan. For instance, halving restaurant account acquisition
does not affect the month in which Reuse ME turns profitable. Reuse ME’s strength in this
regard is the company’s low overhead allowing operations to scale with demand. Halving
account growth rates – from 75%, 60%, and 40% to 37.5%, 30%, and 20% over the first three
years – only requires an additional $541 in capital. Such capital can easily be raised as needed
through loans, and additional investment or by taking proactive approaches, such as decreasing
cash outflows (i.e., purchasing a cheaper vehicle) or raising the amount requested on the SBIR
grant. Reuse ME may also consider raising subscription dues, but care should be taken with this
strategy as consumers may be price conscious of this service.
CHAPTER 5: CONCLUDING THOUGHTS

Just as with reusable packaging, this project hit many barriers and opportunities to its completion. While the pandemic broadened the opportunities to connect with a geographically dispersed group of stakeholders through services such as Zoom, it also presented many barriers. For one, restaurant owners and managers who would have otherwise participated in the research project stated that the staffing shortages related to COVID-19 created a barrier to their participation. As our research relied heavily on interactions with those stakeholders, it is important to note that this created a weakness in some of our results. Researchers looking to build on our findings should focus on acquiring a larger sample size to obtain more robust results. Secondly, reusable packaging systems were completely halted at the onset of the pandemic, which led to a dearth of examples to study. The businesses and cities we were able to connect with often did not have much data to share with us as their programs had been fully operational for less than a year. Additionally, those programs that were operating frequently needed to modify their programs to fit health and safety guidelines that were rapidly changing due to the ongoing pandemic. Owing to the timeline of the COVID-19 pandemic coinciding with the start of many reusable takeout packaging programs, there is a lack of information on how efficient the different models are on many of the key metrics for success (ie. return rate, customer satisfaction, cost to restaurant, cost to customer). Future research should focus on analyzing the efficacy of reusable takeout programs that have been in operation long enough to establish a baseline of operations.

Despite these setbacks, the stakeholder engagement aspects of this project yielded useful insights. While no overarching consensus was reached on which reuse incentives would be best, it is clear that Maine’s unique customer base requires a thoughtful approach to formulating
incentive mixes. Stakeholders largely voiced that year-round residents were more likely to favor cheaper options while out-of-state visitors would likely be less concerned about financial barriers than they would be incentivized by convenience. This points to two insights that programs in Maine should consider: 1) programs may need to consider utilizing different tiers of incentives to reach different market segments and 2) success will likely be dependent on the amount of cooperation between the logistics networks of restaurants, reuse program providers, and municipalities. Whether by making funding available or being actively involved in reuse logistics, it’s clear that stakeholders view the role of municipalities to be an important part of making reusable packaging feasible in Maine.

One point that emerged as a consideration for future research is to understand the spatial considerations of storing reusable packaging. As Donald expressed in the workshop (9/13/2021), space comes at a premium in the restaurant industry leading owners and managers to maximize its utilization. Adding items that don’t create much revenue to their inventory would effectively take space away from items that have a much larger return on investment. In theory, because a restaurant only needs enough reusable packages to keep pace with the packaging return rate, reusable packaging would take up less inventory space than single-use packaging systems, which need enough stock to cover all takeout orders that occur between dry good deliveries. This creates a conundrum for single-use systems; order less packaging and pay standard pricing rates to preserve inventory space for items with a higher return or order more packaging that’s eligible for bulk discounts but takes room away from high value items. Ultimately, these issues were only discussed tangentially during our project, so whether these spatial and financial dynamics play out in reality remains a question for future research to answer.
While these insights and others from this thesis help to provide a high-level understanding of reusable takeout packaging, there are several important questions that this project did not attempt to answer. Firstly, the findings suggest that municipalities can play a role, and may even benefit from, reusable takeout programs. However, we were unable to quantify exactly what the benefit to a municipality would be. From our waste audit, we can see that as much as 10% of municipal waste (by weight) in Bar Harbor could be reduced through reusable packaging, but it does not help us understand the budgetary implications of reducing that waste. Future research should look at this issue more closely to understand how much a municipality stands to save per dollar invested in reuse. Additionally, because municipalities are a source of unification for many centralized services (ie. trash, water), many stakeholders believed they could serve a role in centralizing reusable packaging services. This paper did not explore the implications of doing so, and future research is needed to understand what role a municipality in the US could play in centralizing a reusable packaging program.

While the natural collection point for reuse services may be at the municipal level, it is still important to think of the private sector’s role. The business plan presented in Chapter 4 details one way this could happen, but it is important to note that the profitability of such a company is limited. I wrote the plan the way I did as an exercise in writing a workable for-profit business plan. In reality, the best opportunity for the Reuse ME plan would be as an additional service to an already established business. By eliminating the cost of rent and parking and spreading out the costs associated with professional fees, repairs, cleaning supplies, and miscellaneous expenses across all business operations, Reuse ME would only need $38,987 to start. The majority of these funds would go towards the cost of app development, purchasing the packaging, and a down payment on a vehicle. With these changes, Reuse Me would be cash
positive at month 8, as opposed to month 19, and would create a $33,066 surplus at the end of three years. In short, a program like Reuse ME is best suited for an established business looking to increase the revenue potential of their commercial kitchen by diversifying the services they offer.

Finally, I want to reiterate a few concepts that are key to making reusable packaging successful. Chief among them is how consumers perceive packaging. Our current mode of disposal is perpetuated by the idea that plastic packaging has a low value. The price of packaging is often baked into the price of goods making them indistinguishable from the product that we are meant to consume. This system promotes plastic packaging as products with low emotional durability (Woods & Bakshi, 2014) and reinforces our waste mode of disposal (Pollans, 2017).

The difficulty in disrupting this form of waste governance lies in the fact that reusable packaging is seen as a cost added on top of your order whereas disposable packaging is not. In practice, this dynamic hides the financial benefits of reusable packaging to the consumer. To illustrate, take into consideration the industry standard of managing costs of goods sold to be ~30% of the final menu price (Restaurant COGS, 2022). That means that if a container costs a restaurant 25 cents to purchase, they will add an average of 83 cents to menu price. Disassociating this cost from the menu item will help customers realize the full cost of disposable packaging and make the economics of switching to reusables more clear.

While it is unlikely that restaurants add exactly 83 cents to the price of every menu item, the reality is that the cost of disposable packaging is hidden within their pricing structure. Thus, by separating this cost out, restaurants can play an important role in how consumers perceive the value of disposable packaging. Further, by correcting these conceptions of value, the expense of reusable packaging can be more accurately weighed against the expense of disposable
packaging. Here again is a point at which municipalities, and states, can play a role in the success of reusable packaging programs. In Maine, laws such as Extended Producer Responsibility and so called “Bag Bans” – which don’t necessarily ban bags, but more often require businesses to place a charge on each plastic bag they give at checkout – help customers conceive of the packaging as a product of its own. As we look toward the future of packaging, it is likely that this concept will need to be understood and addressed in order to create lasting solutions for waste reduction.
REFERENCES


75
<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposit</td>
<td>Customers place a deposit with the restaurant when they take a reusable container with their order. The restaurant holds onto this deposit as a liability until the customer returns. When the customer returns, they may either: place a new order and swap the container they received with their first order for a fresh container; return the container from their first order and receive their deposit back or; place a new order without returning their original container and pay a deposit for a second reusable container. When the restaurant receives a soiled container back, they must wash it per local regulations before returning it to circulation.</td>
</tr>
<tr>
<td>Purchase</td>
<td>Customer purchase the container outright and are allowed to swap containers any time they make an order from the restaurant. In this way, the customer isn’t really purchasing the container, but rather they are purchasing the ability to participate in the reusable system. When restaurants receive soiled packaging, they must wash them according to local regulation before returning to circulation. Restaurants may sometimes offer discounts in order to incentivize customers to participate in the program.</td>
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<tr>
<td>Lending</td>
<td>In a lending system, customers are allowed to use reusable containers for free, but must return them within a set timeframe. Should a customer fail to return the packaging before the timeframe is over, they will start to accrue fees from the restaurant. In this archetype, restaurants usually need to hire the services of a third-party provider who can provide asset tracking services.</td>
</tr>
<tr>
<td>Subscription</td>
<td>Subscription services allow customers to check-out a predetermined number of containers simultaneously depending on their level of subscription. Customers may swap soiled packaging for clean packaging as often as they please, so long as they do not exceed their quota of checked out containers. Subscriptions systems usually rely of asset tracking software and, thus, often require restaurants to contract with a third-party service provider.</td>
</tr>
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Table 2 - Reuse Model Descriptions
Appendix B: Major Qualities of the Reuse Archetypes

<table>
<thead>
<tr>
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<th>Purchase and Discount</th>
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<th>Subscription</th>
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<td>Reusable Container</td>
<td>Reusable Container</td>
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<td><strong>Product Ownership</strong></td>
<td>Sequential: Restaurant</td>
<td>Exclusive: Customer</td>
<td>Sequential: Third-Party Vendor</td>
<td>Sequential: Third-Party Vendor</td>
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<td><strong>Infrastructure</strong></td>
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<td>Restaurant Provided</td>
<td>Third-Party Vendor</td>
<td>Third-Party Vendor</td>
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<td><strong>Incentive Structure</strong></td>
<td>Return of Deposit</td>
<td>Discounts for Participation</td>
<td>Fees for Late Containers</td>
<td>Monthly Charge and Fees for Missing Containers</td>
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*Table 3 - Major Qualities of the Reuse Archetypes*
## Appendix C: 3-year Financial Projections

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<thead>
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<th>Year</th>
<th>2023</th>
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<tr>
<td>Month</td>
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<td>Starting Cash</td>
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<td>Less Cost of Goods Sold</td>
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<td>Gross Wages</td>
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<td>Professional Fees</td>
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<td>Operating Profit</td>
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<td>Taxes</td>
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<td>Net Profit (Loss)</td>
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<td>Ending Cash Balance</td>
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### Operating Expenses

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### Operating Profit

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### Taxes

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### Net Profit (Loss)

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</table>

### Ending Cash Balance

<p>| Ending Cash Balance       | $1,083 | $671 | $333 | $122 | $0   | $6    | $100  | $301  | $634  | $1,061 | $1,600 | $2,233 |</p>
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<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
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<td>Gross Wages</td>
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<td>Professional Fees</td>
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### Appendix D: Source and Use of Funds

#### Startup Funds Summary

| Amount Needed          | $ 53,844 |

| Management Contributions | $ 21,719 |
| SBIR/STTR grant          | $ 32,125 |
| **Total**                | $ 53,844 |

#### Startup Costs Summary

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Appendix E: Break-Even Analysis

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Appendix F: Freiburg Cup Case Study

Deposit Model - Freiburg Cup

The deposit model works in the same way as returnable bottle systems in the US. The customer pays a deposit for each container they receive with their order. When the customer returns the container, their deposit is returned to them. This incentivizes the customer to return the package, and ensures that the restaurant doesn’t have to pay to replace the container if it’s lost.

In Freiburg, Germany the cities deposit model for reusable coffee cups has helped Freiburg become known as the greenest city in Germany. The project was created by the mayor of Freiburg in 2016, who placed the Waste Management and City Cleaning Department in Freiburg (ASF) in charge of creating and managing the iconic cup.

When customers order a beverage in a Freiburg Cup, they are charged a 1 euro deposit. When they finish their drink, they can return the cup to any participating vendor in Freiburg- it doesn't have to be the same location they originally purchased from- and receive their deposit back.

The cup is made of light, reusable plastic. The reusable lid is made of silicone, which the customer purchases and is responsible for.
Within five years of launching, 130,000 Freiburg Cups have been produced and distributed throughout the city and over 70% of coffee shops in the city are part of the system. The system remains balanced internally, meaning that cups circulate enough on their own such that ASF rarely has to redistribute them. However, if a business does run out of cups, they can simply request more from ASF.

Now, Freiburg is hoping to become even greener. The town is currently in the process of phasing out their famous Freiburg Cup so that they can partner with ReCup, a reusable packaging provider. The system will continue to operate on a deposit model but, by partnering with ReCup, Freiburg hopes to incorporate even more businesses and introduce bowls into their reusable container system.

The Freiburg system is unique for its top-down implementation. The Freiburg government recognized that litter and single use cups were an issue, and changed the way that businesses and consumers approached reusable containers. This change in attitude has made it possible to have a large system connecting multiple businesses, and has changed the culture of their town to make reusable containers the new normal.
Appendix G: Go Box Case Study

Purchase - University of Southern Maine

In a Purchase Discount model customers buy a reusable container and receive a discount of future purchases when they return the packaging. Because the customer only receives a small discount on each visit, they’re encouraged reuse the container in order to recoup the value of their initial purchase.

In partnership with Sodexo, the University of Southern Maine sells their “WasteWatch” reusable cups and clamshells, which offer customers discounts when they use them. The clamshell, made of heavy duty plastic, costs $5 to buy and offers the customer a 25¢ discount each time, paying for itself within twenty uses. Additionally, refills in any reusable cup are priced lower than drinks served in single-use cups. Since most of the customers at a dining facility at University of Southern Maine are students with limited spending capacity, these savings are especially appealing. This system is campus wide, meaning that customers can reuse a container at any dining facility on campus.
After each use, customers can swap their used clamshell out for a clean one. If they don’t want to carry a clunky clamshell around they can take a carabiner instead, which they can replace for a clean clamshell whenever they are ready. This allows the customer to have a physical representation of their participation in the program and allows employees to easily keep track of containers and customer involvement.

When the clamshells are returned, they’re cleaned on-site and redistributed between the dining facilities as needed. Since other containers, like cooking equipment, are already being cleaned, cleaning the clamshells does not add much extra work. When a customer reuses the WasteWatch mug, they’re responsible for cleaning the cup themselves.

The biggest issue identified by the University of Southern Maine has been a shortage of workers due to issues surrounding the COVID-19 Pandemic. This has made it difficult to maintain current operations, let alone introduce a new system. While the reusables system is currently on pause, the university is hoping to resume the reuse program in Fall 2022, when they anticipate more stable staffing conditions.
Appendix H: UMaine Case Study

Subscription Model- GO Box

The subscription model works just like any other subscription service, treating take out containers similar to products like magazines or cable TV. The consumer pays a subscription fee that allows them to simultaneously check out a specified number of containers. When a third party vendor is involved, restaurants pay to have a certain amount of containers stocked at their location.

Go Box is a Portland, OR-based company trying to create a more circular system by keeping products in use longer, making them less harmful to the environment than single use containers.
With GO Box, customers choose what level subscription to purchase, and whether to purchase an annual or monthly subscription. A GO Box subscription gives customers the ability to check out as many containers as they please, but their subscription level determines how many containers they can have checked out at once. Once their limit of containers is reached, the customer must return their container in order to check out additional containers.

To use GO Box, customers order their food through the GO Box app and choose to receive their food in a reusable container. Each restaurant has their own code, which tells customers that GO Boxes are used at that location and allows GO Box to track where containers are being checked-out.

To return a container, the customer scans a QR code on the lid of the container and returns it either at a participating restaurant or a drop box. A full map of participating locations is available on the app.

For the business, there is little effort involved as GO Box handles the cleaning and restocking the containers on the restaurants behalf.

This system allows many restaurants to be connected, offering more options to the customer. Because of this, the subscription model works best in highly populated areas.
Appendix I: Useful Case Study

Lending Model - USEFULL

The lending model operates similarly to a library. Customers “check out” a container for free, and return it to the restaurant or a partnering drop-location within an allotted time period or pay a late fee. In order to participate, customers need to have have a membership with an associated payment method. With this system, the container often belongs to a third party vendor.

Originally the Coffee Cup Collective, the founders of USEFULL started with distributing reusable coffee cups to businesses in Boston, MA. That system proved so successful, that the creators decided to expand their idea.

USEFULL is a third-party vendor that works with corporations, businesses, and campuses to implement a plastic-free reusable system. The creators of USEFULL recognized that many systems used hard plastic containers, which eventually ended up in landfills. Their solution is to use stainless steel reusable bowls and cups with silicone lids that won’t easily be mistaken for trash.
When a business signs up with USEFULL, they only pay to rent the containers. Costing $0.10 per cup and $0.25 per bowl, the price is comparable to most single use containers. The cups can hold up to 16 oz and the bowls up to 40 oz, but there are markings inside to easily accommodate smaller portions. The containers are double-wall vacuum-sealed, insulating both hot and cold food and improving product quality.

In order to participate in the Usefull program, customers need to download an app, which allows USEFULL to track how long a customer has had a container checked out. When a customer checks out a container they have two days to return it free of charge, after which time they are assessed a $1 per day late fee. For an additional charge, customers can choose to purchase a premium subscription, which extends their free return period to five days. After fourteen days, the package is presumed lost by USEFULL and the customer must pay for it to be replaced. There is no additional cost to participating businesses.

Depending on location, some businesses sanitize the containers themselves, while USEFULL handles the sanitization of others. USEFULL provides training to businesses on how to clean the containers.
BIOGRAPHY OF THE AUTHOR

Jared Wildwistle was born in Portland, ME on October 31st, 1989 and was raised in Arundel, ME by his parents, Beth Bejcek and John Entwistle. Jared gained an appreciation for the outdoors and food service at an early age as his family spent the summers camping in the Maine woods and operating a food stand at the Common Ground Country Fair. After graduating from Waynflete High School, Jared attended the University of Vermont, where he received a bachelors in Psychology with a minor in Ecological Agriculture in 2013. In 2013, he moved back to Maine and worked in the mental health field before turning his brewing hobby into a profession. Jared cofounded Flight Deck Brewing in 2016 and managed operations there until his departure in February 2020. It was through his time with Flight Deck that Jared’s interest in private sector solutions to climate change and environmental issues took hold. He enrolled in dual Master’s degrees in Fall 2020. As of Fall 2022, Jared is the Business Climate Action Program Manager at the Gulf of Maine Research Institute. He is a candidate for the Master of Business Administration degree in Business Administration and the Master of Science degree in Ecology and Environmental Science from the University of Maine in December, 2022.