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Best Practices to Encourage Landfill Diversion in Waste Management Programs

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Abstract:

Waste generation in the United States is at an all-time high. Over half of the country's waste goes to landfill, yet 70 percent of this waste can be recycled or composted. Since landfills pose one of the largest manmade threats to the environment, sustainable waste management strategies should focus on landfill diversion. A successful waste recovery program needs to engage the public, and ensure individuals participate correctly in available waste management systems. This paper sheds light on effective education and awareness strategies used to encourage participation in local waste management systems and promote landfill diversion. By highlighting successful programs employed in San Francisco, a city with the nation's highest landfill diversion rate, and other communities around the nation, I synthesize a list of measures that can change community behavior surrounding waste management.

Preface:

Trash, waste, litter, garbage, refuse. When an item has stopped serving its original purpose, we use these words to describe its new state; something that needs to be thrown away, made to disappear, and most often forgotten. Most individuals do not give a second thought to where their waste goes once it is taken away. After all, it's trash, and once it is off our hands and out of sight, we feel as if it is no longer our problem. Unfortunately, it is our problem since the flow of waste from domestic and commercial consumers to a final disposal site contributes to air and water pollution, fossil-fuel dependency, land-use problems, and a variety of environmental justice concerns.

Growing up in Pennsylvania, I never paid attention to how my family disposed of our waste. All I had to know was that we put our paper, glass bottles, and plastics labeled one and two in a small nine gallon green recycling bin, and everything else went into our huge blue landfill bin. I did not question this recycling system until we moved to the Bay Area, where I was shocked to see a very different and much more comprehensive program. Now we throw our paper, cardboard, glass, and plastics labeled one through five in a 64 gallon blue bin. We also have two 64 gallon green compost bins for our food waste, soiled paper products, and yard trimmings. When they are rolled out for curbside collection each week, these bins tower over the small 32 gallon black landfill bin that rarely fills up.

Moving states and adapting to new recycling rules opened my eyes to the differences in local waste management systems, namely what certain places send straight to landfill compared to others. Since living in the Bay Area, I have grown accustomed to

limiting my landfill waste, and even feel a little pang of guilt every time I throw something into that small black bin. However, this personal attention to recycling and composting does not exist in other communities, whether it be due to minimal resources, lack of participation, or both.

While most people know to recycle their plastic water bottles, aluminum soda cans, and glass pickle jars, there are a multitude of products that still confuse us when choosing trash or recycling. This confusion grows when we travel to the next town or state over, and a whole new set of recycling and compost rules apply. Sending our waste straight to the landfill is a problem, but so is contaminating recycling with non-recyclable materials and rerouting waste back to landfill. To maximize the supply of our resources, industries and individuals must manage and dispose of waste properly.

The most important thing people can do to reduce their waste footprint is to limit how much they consume, and therefore how much they produce. However, in a nation guided by the principles of capitalism and a culture of consumerism, curbing consumption requires a paradigm shift and much more time to implement long lasting and sustainable solutions. In the meantime, maximizing the potential of current waste recovery programs through enhanced participation can help remediate the deleterious impacts of waste production and landfill use.

Introduction:

In the United States, the average person generates about 4.5 pounds of municipal solid waste a day. That adds up to 1,642.5 pounds of trash per year per person, over half of which goes straight to landfill. Even though about 70 percent of the waste we generate can be recycled or composted, only 35 percent of it actually reaches a recycling plant or a compost facility. The rest is commingled with the rest of our garbage, and trucked often over long distances to a landfill or incinerator. In fact, the majority of landfill space is taken up by food, plastics, and paper, all materials with the potential to be diverted from this waste stream (EPA 2015).

Although landfills provide a convenient place to store trash, they serve as one of the largest manmade threats to the environment. Dumping tons of waste in a pit to fester and slowly decompose produces a range of pollutants that easily escape the confines of the landfill and spread throughout the atmosphere, soil, and groundwater sources. When discarded adhesives, household cleaners, plastics, and paints accumulate in landfills, they emit Hazardous Air Pollutants and Volatile Organic Compounds, both which accumulate in the atmosphere and are harmful to human respiratory systems. Furthermore, leachate, the liquid collected from deposited and decomposing waste, often contains hazardous, toxic, or carcinogenic chemical contaminants that pose a threat to ecological and human health if improperly contained and exposed to groundwater sources (Danthurebandara et al. 2012). Developers also tend to build landfills in disproportionately rural, poor, and minority communities. These communities often need revenue streams to support their schools and public services and do not have the social and political capital to oppose

undesirable land uses (Thomson 2009, 13). The distribution of who benefits from landfills versus who faces the health costs situates landfills as not just an ecological concern, but also a significant environmental-justice issue.

Landfills also hold high concentrations of carbon dioxide and methane, two greenhouse gasses that trap heat in the atmosphere and contribute to global warming. When organic materials decompose in anaerobic conditions such as a covered and crowded landfill, they produce carbon dioxide and methane as byproducts. Since organic waste makes up almost 40 percent of landfill space, large amounts of carbon dioxide and methane build up in landfills. In fact, landfills rank as the third largest emitter of human-related methane in the United States, accounting for 14 percent of the emissions in 2016 (EPA 2015; EPA n.da). The United Nations Environment Program estimates that improving waste management systems can reduce greenhouse gas emissions by 15-20 percent, making landfill diversion a priority when combating climate change (Wilson et al. 2015).

Landfill alternatives such as recycling and composting pose viable, yet temporary, solutions to our waste problem. Manufacturing with recycled plastics uses less fossil fuel and emits less air and water pollution than manufacturing with virgin materials. Recycling also conserves energy and natural resources such as timber, water, and minerals. In fact, the energy saved by recycling is worth five times the cost of dumping trash in landfills (Rogers 2005, 174). The production and use of compost creates jobs, protects watersheds, reduces greenhouse gas emissions, and improves soil quality. When organic materials decompose in anaerobic conditions such as a covered and crowded landfill, they produce high levels of methane, a greenhouse gas 30 times more potent than

carbon dioxide. However, decomposition in aerobic conditions, as is the case with compost, generates no methane gas. The plant life that compost goes to support captures carbon in the air through photosynthesis and sequesters it into the soil. Compost also improves soil quality and structure through erosion control and increased water retention. It serves as a natural fertilizer, reducing the need for chemical products that contribute to non-point source water pollution (Platt et al. 2014).

Another, and more important, way to combat landfill growth is by reducing consumption and waste generation altogether. Although the United States houses just four percent of the world's population, its residents consume 30 percent of the planet's resources and generate 30 percent of the planet's waste (Rogers 2005, 2). This country's capitalist economy and society thrives on the constant production and consumption of goods, even when these items are unnecessary or superfluous. After World War II, many raw materials were no longer considered a scarce resource, and as technology evolved, the cost of producing goods declined. To make a larger profit, manufacturers engaged in planned obsolescence, and designed their products with a short lifespan so that consumers would quickly throw them away and buy more. Now, the majority of consumable goods are disposable or wrapped in disposable packaging, and about 80 percent of US products are discarded after a single use (Rogers 2005, 5). By making a conscious effort to consume less and take care of the goods they already have, consumers can effectively reduce the amount of waste they send to landfill. Additionally, producers can take more responsibility for the disposable products they build into their goods.

While these landfill alternatives have many benefits, if people do not properly utilize these recycling and composting programs or limit their consumption of disposable

goods, they will make little impact in managing waste sustainably. This issue of available resources but limited participation plagues communities around the world, including Loja, a small city in southern Ecuador. While studying abroad, I spent a month researching the municipal waste system of Loja, a city renowned for its innovative waste management system. This city had a forward-thinking mayor who pioneered and prioritized a program that composted, recycled, and sent the remainder to landfill. However, the system altogether was not as successful as it could have been due to lack of participation and public engagement (Abruzzo 2018). Aside from manufacturers generating less disposable goods, the people have to know how and want to manage their waste sustainably in order to really reduce the environmental impact of the waste stream.

As such, I argue that a key approach to landfill waste reduction is to focus on public education and participation in local waste management programs. When individuals are confused about how they should dispose of their trash, they often divert incorrectly or resort to throwing everything into the landfill. By contrast, an educated and engaged public can contribute to successful waste recovery networks and become a critical part of the solution to our waste management problem. Through this thesis, I aim to shed light on effective measures used to encourage participation in local waste management programs.

In chapter one, I outline the history of waste management as well as the current state of recovery programs and public participation in the United States. This broader information on United States waste management practices contextualizes the importance of education and awareness strategies and lays the foundation for further analysis on how to improve. Chapter two explores San Francisco, a city and county on the cutting edge of

landfill diversion and progressive waste management. In 2002, the city set a goal of zero waste by 2020, and has been formulating new ways to encourage landfill diversion ever since. By examining policies and public responses in San Francisco, I will explore how policymakers and other groups attempt to make their local waste management system clear and easy to use, what factors contribute to a successful education program, and what incentives or tools are necessary for citizens to prioritize alternate waste diversion methods. Finally, chapter three synthesizes successful educational strategies employed in San Francisco and across the country that promote landfill diversion. These strategies include door to door outreach, school education, waste to art programs, standardized labeling, and an overall emphasis on reducing consumption through consumer and producer responsibility. By uncovering education and awareness strategies that resonate with people, we can make strides towards broader scale landfill waste reduction.

Chapter 1: History and Current State of Waste Management in the US

To fully understand what strategies help promote landfill diversion, one must understand the state of United States waste-management practices, and the public responses to them. I first outline a brief history of waste management in the nation to contextualize the systems we have in place today. I then explore how the public participates in current recycling, composting, and other landfill diverting systems. By laying the foundations of current waste policy and practice, I demonstrate why effective educational and awareness programs that promote landfill diversion are essential to the current waste management system. In this way, this chapter sets the stage for a broader analysis of various educational and awareness programs, and what strategies may or may not be useful.

The first efforts towards waste management in the United States began in the early 1800s, when street workers gathered discards like animal manure, kitchen slop, street sweepings, and fireplace ash from streets, shops, and homes to sell to farmers as fertilizer. It was not until after the Civil War, when industrialization sped up manufacturing and the distribution of goods, that the quantity and quality of municipal waste began to change. As industry developed and goods became cheaper and easier to access, new wage earners tended to buy new products rather than repair old and damaged goods. This shift in consumption led individuals to produce more trash, adding material waste to the piles of slop, manure, and decaying animal carcasses in the streets. Corrupt local officials often neglected to address the cleanup of this decaying trash, leaving city dwellers to deal with serious sanitation problems. Class conflicts soon arose as the lower

classes found themselves fronting most of the costs of unsanitary living conditions. Struggling to maintain social order, the middle and upper classes organized to reform the city governments and improve health and cleanliness on the streets, essentially laying the groundwork for modern municipal sanitation programs (Rogers 2005, 30). In New York City, Colonel George E. Waring brought about innovative sanitation reform by requiring New Yorkers to source separate ashes and food scraps from their other refuse materials into three different receptacles. Trash was then picked up from households and shipped to Barren Island off the coast of Brooklyn where workers converted organic waste into fertilizer or grease and sorted through trash to salvage any repurposable items (Rogers 2005, 56).

By the turn of the century, individuals were rapidly consuming cheap disposable goods and growing even more disconnected from the waste they generated. By 1930, all cities with a population over 100,000 adopted some form of refuse collection and disposal which often ended with sanitation engineers dumping municipal waste into open pits or bodies of water on the outskirts of town (Rogers 2005, 83). The first sanitary landfill emerged in 1934 outside of Fresno, California as a response to the environmental and health concerns raised from unprotected dumping. Landfill workers would pack down the waste in a large ditch, and cover it with dirt to contain the harmful materials in one place.

It was not until the 1970s environmental movement that this form of disposal was reexamined. Subtitle D¹ in the 1976 Resource Conservation and Recovery Act set new

¹ Subtitle D banned the open dumping of waste and set a federal criteria for the operation of municipal solid waste and industrial waste landfills. These criteria include design standards, location restrictions, financial assurance, cleanup measures, and closure requirements (EPA n.db)

standards for landfill safety, and required the EPA to oversee compliance with these standards. Over the following ten years, EPA landfill surveys showed that 94 percent of waste disposal sites were not up to Subtitle D's standards, causing hundreds of landfills to shut down. Even the landfill outside of Fresno, once regarded as a novel waste management solution, was declared a superfund site. As landfills shut down due to environmental and human health risks, garbage output continued to increase, causing landfill prices to surge (Rogers 2005, 89-155). Policymakers and waste management companies again faced the complex question of where to put society's ever growing mounds of trash.

Recycling gained popularity in the 1980s as a viable solution to the growing waste issue. By sending certain products to a new waste stream, where they could be broken down and reprocessed into new materials, localities reduced the volume of trash being trucked into landfills. Although this system cut down on the energy and water costs associated with manufacturing, it normalized consumption and did nothing to address the root of the waste problem: the increasing amount of disposable goods in the United States. Nevertheless, recycling continued to gain momentum, and by the late 1980s there were more than 5,000 municipal recycling programs in the US, compared to just 10 in 1975 (Rogers 2005, 157). As privately and publicly owned programs spread across the country, and improved technology diversified the materials one could recycle, this diversion technique took hold. The amount of municipal solid waste recycled shot up from 6.6 percent in 1980 to 25.8 percent of total waste generated in 2015 (EPA 2015).

Present State of Waste Management Systems

The continued increase in population, consumer spending, and waste generation over the past fifty years led to large amounts of landfilled waste and high tipping fees, the cost to dump waste in landfills. The EPA found that in 2015 Americans sent 137.7 million tons of waste to landfill. Thanks to the adoption of recycling and composting programs, this number is actually 5.2 percent lower than landfilled waste in 1990 (EPA 2015). Nevertheless, the average tipping fees are at their highest price yet. In 2017, the average price to dispose municipal solid waste in landfills was \$50.60 per ton. This figure shows a 3.5 percent increase since 2016 and a 16.9 percent increase since 2010 (Thompson 2017).

The high cost of maintaining landfills coupled with unprecedented levels of waste generation put the future of landfills in the United States at risk. Although smaller in number, landfills are larger in size than ever before, taking up large expanses of land far away from urban development. Whereas most cities used to have their own local dump just outside of their limits, they are now exporting trash across city, county, and even state lines to landfills large enough to accommodate all their waste. The number of landfills shrank from more than 7,600 in the mid-1980s to 1,900 in 2013, forcing certain localities, especially in the high density Northeast, to move their trash across greater distances. New York City used to send its trash to Fresh Kills landfill in Staten Island, however after its closing in 2001, trucks haul the city's waste to landfills in Ohio, Pennsylvania, and West Virginia (Palmer 2011). These distant landfills not only pose a land use problem, but require extra transportation that emit even more greenhouse gasses. While future levels of waste volume, waste production, and waste diversion practices ultimately determine landfill capacity, current estimates show that landfills in the United

States are nearing their limits (Zimlich 2015). Bryan Staley, the president and CEO of Environmental Research and Education Foundation estimates that the US has 62 remaining years of landfill space, while data collected from the Waste Business Journal show that the US only has 20 remaining years (Zimlich 2015, Thompson 2017). Although projections vary from source to source, the fact that landfill space is running out remains a common theme, underlying the importance of reducing our reliance on this waste disposal option.

The most common response of policy makers to address the need for landfill alternatives has been to bolster local recycling programs. The US population has steadily improved its recycling rate since 1960 to 25.8 percent, now recycling 66 million tons of material each year (EPA 2015). Providing easy access to recycling programs is essential to fostering public participation. A 2016 study conducted by the Sustainable Packaging Coalition estimates that 94 percent of the United States population has some sort of recycling program available to them. Thirty percent of the population has access to curbside collection only, 43 percent have curbside and drop off programs, and 21 percent have only drop off services (Desilver 2016). While the vast majority of the population has access to recycling, many local options are not convenient or easy to use. This may be one of the factors explaining why the amount of recyclable items in the waste stream is almost double the amount that actually gets recycled (EPA 2015). Although the recycling rates and availability have greatly improved over the past forty years, there is still plenty of room for improvement. Unfortunately, efforts to increase recycling rates face new obstacles that impede its continued progress.

One of the most enduring challenges to successful recycling is the constant contamination of recycling loads. Recycling programs only work if the materials they break down are clean. When unrecyclable and soiled items enter the recycling stream, they can compromise the entire load. Often, residents have a general idea of what they can recycle, but are not fully aware of all the rules. This ambiguity results in “aspirational recycling,” where individuals set aside items for recycling they believe or hope are recyclable, even when they are not. People mistakenly throw tricky items like coffee cups, dirty pizza boxes, and plastic bags into the recycling, without realizing it can ruin a load. Others go a bit further than “aspirational recycling”, and treat their recycling bin as any other garbage container. Brent Bell, the vice president of recycling at Waste Management, has seen a range of unlikely contaminants in the recycling such as Christmas lights, artillery shells, and bowling balls. Many recycling facilities encounter dirty diapers on the daily. Seeming recyclable or not, the build-up of contaminants ruins recycling potential of all the remaining materials in the load, forcing it all to landfill. Waste Management reports that about 25 percent of all the collected recycling is contaminated to the level where it must be sent to landfill (Albeck-Ripka 2018). The switch to “single stream” or “commingled” recycling which allows individuals to throw glass, paper, cans, and plastics in the same bin, also causes individuals to throw away a greater diversity of materials in their recycling bins.

These challenges to recycling are exacerbated by the new Chinese trade policy that drastically limits the amount of recyclables exported to the country. As a result of this regulation, local governments and waste management companies in the United States lost their primary buyer for recyclables, and struggle to find places to send this post-

consumer material. The United States exports one third of its 66 million tons of recycling, the majority of which China has accepted since the early 1990s (Albeck-Ripka 2018). However, in 2017, China announced its “National Sword” policy aimed at reducing the amount of contaminated recyclables imported into the country. To address the environmental degradation of the country and move away from being the world’s dumping ground, China banned imports of 24 materials, including various types of plastic and paper, and shifted its contamination standard for recyclables from 4-5% to 0.5% (Jaquiss 2016). The nation had already launched a “Green Fence” policy in 2013, increasing the number of inspections of recycling shipments entering the country. Although this reduced the amount of waste exported to China, many companies still snuck past the standards and continued business as usual. It wasn’t until the National Sword crackdown that recycling exports for most American companies ground to a halt (Resource Recycling 2018). The resulting oversupply of recyclable materials in the United States leaves cities and waste management companies confounded, and complicates the role of recycling as a sustainable landfill diversion option.

As a result of the Chinese import ban, many recycling facilities struggle to find adequate markets to send their recyclable materials. With nowhere to send their recycling hauls, many companies and cities end up sending thousands of tons of curbside recycling to landfill. Western states especially feel the effects of this ban. In the Pacific Northwest, Republic, one of the largest waste hauling companies, sent more than 2,000 tons of paper to landfills, while smaller companies like Rogue Disposal and Recycling in Oregon have no choice but to divert all their recyclables to landfill. Local waste management programs also limit the types of recycling they accept, and instruct customers to throw most

plastics, glass, and certain types of paper in the trash. However, fearing the difficulties involved in instructing residents to stop recycling, then restart later on, other communities, like Grants Pass, Ore., encourage their residents to recycle as usual, and send the products to landfill themselves. In other parts of the country, companies stockpile material in the hope that countries like India, Vietnam and Indonesia will import more materials than they do now (Albeck-Ripka 2018). Moving forward, residents and businesses who recycle will need to be extra vigilant about the cleanliness of their recycling, or risk their waste being sent to landfill. Education policies are therefore more important than ever in order to ensure that recyclables meet the new contamination standards.

In addition to recycling programs, composting serves as a crucial pillar to any landfill diversion plan as it dramatically decreases the amount of organic waste sent to landfill. Although still a fairly new waste option for many communities, localities continue to adopt more composting programs and facilities across the country. Composting programs took root in the 1990s, and have grown throughout the United States so that 23.4 million tons of waste now get composted in a year. As of 2015, 3,860 community composting programs exist in the country, with food waste curbside collection offered to 3.8 million households, and drop off food collection programs available to 5.4 million households (EPA 2015). More comprehensive legislation regarding composting is also gaining traction in states and local governments that are on the forefront of waste management policy. In 2016, the California State Assembly amended the Integrated Waste Management Act to require a business that generates 8 cubic yards or more of organic waste per week to arrange for composting collection. The

amendment went further to add that after 2019, any business that generates 4 or more cubic yards of solid waste must arrange for organic waste recycling (CalRecycle 2018). Compost programs also support domestic markets by providing organic waste to local businesses using it as fertilizer. Separating organics from the rest of waste also reduces contamination of recyclables, ameliorating the effects of the Chinese National Sword policy.

However, compost programs struggle to take root due to lack of technology and an aversion to its “yuck” factor. Cities without the right infrastructure to handle compost loads cannot include organics in their collection services, reducing accessibility for many businesses and residents. The smell and dirt, as well as time and space demands, push individuals away from starting their own home composting systems. Although a variety of manufacturers now provide convenient at-home composting appliances, they fail to reach a broader customer base (Gootman 2013).

Those who have compost collection services may also find it difficult to keep up with the evolving composting rules. The specifics of what one locality can compost depend on that facility’s composting infrastructure. While some facilities can take all organic waste including compostable cups, plates, and utensils, others can only process vegan food scraps. Although most individuals successfully put their food waste and yard trimmings in the compost, since these items are obviously organic waste, items like food soiled paper products leave many unsure. In Alameda County, California, only 36 percent of residents answered correctly that products like paper coffee cups, dirty paper towels, and used napkins should be composted. The majority of the responses were therefore split between recycling and landfill, where these items would either contaminate recycling

bales or contribute to landfill growth (FM3 Research 2018). The ongoing confusion about how to correctly to sort one's waste undermines the success of waste management systems, and underscores the importance of public awareness.

Public Engagement with Waste Management Programs

Given the current diversity of waste management programs, the levels to which individuals participate in these programs vary across the United States. Participation represents an essential second step in the development of a waste management policy. Even if programs are accessible, public participation determines whether or not these programs are truly successful in diverting waste from landfill. According to a 2011 Ipsos Public Affairs Survey², nine out of ten adults in the United States recycle. While this figure may seem promising, only half of the respondents recycle daily, and one third recycle even less frequently than that. The greatest barrier to recycling, according to survey respondents, is lack of accessibility to recycling programs (Ipsos 2011). Convenience plays a huge role in determining whether or not individuals will participate in the available recycling program or not. Roughly one quarter of Americans do not have access to curbside recycling, forcing many to go out of their way to drop recyclables off at a center or just not recycle at all. Even when recycling centers do exist, individuals may not know about their existence due to poor publicity, communication, or hidden location (Shumaker 2016).

² The survey took a national sample of 1,004 adults ages 18 and older, and engaged respondents through an online interview. Surveyors weighed the demographics of respondents to accurately reflect the United States demographic makeup.

Beyond the issue of accessibility, ten percent of respondents state that recycling is too time consuming, another ten percent forget, and 8 percent are unclear about what is and is not recyclable (Ipsos 2011). Lack of information regarding recycling rules leads many individuals to throw things in the trash by default. Claremont, California resident Mark Merritt told the *Claremont Courier* that uncertainty keeps him from recycling as much as he could. His hesitations about recycling oily bottles, cardboard milk containers, and various plastics cause him to landfill most items. In regards to any citywide recycling education programs, Mr. Merritt states, “I’m sure the city has tried to make it clear, but I’m not certain,” (Bobrowski 2018). The Ipsos survey responses align with Mr. Merritt's experience as nearly half of the survey respondents claim that they haven't learned anything about recycling in over six months, and 12 percent report that they have never learned anything about recycling (Ipsos 2011). Although it is better to throw items in the trash than risk contaminating a recycling load, the amount of recycling that goes to landfill due to lack of education can be remediated with proper awareness tools.

Social norms also have a strong impact an individual's predisposition to recycle. Those who live in recycling friendly communities are more likely to be aware of recycling rules. They are also more likely to believe they have more options for recycling, and see more of their waste diverted from landfills. A Pew Research Center survey found that 30 percent of Americans believe their local community's social norms encourage recycling and reuse while 20 percent live in areas that do not promote recycling. The remaining portion of the population live in areas they believe to be neutral about recycling in general (Desilver 2016). Since social norms and community values

affect individual's willingness to recycle, educational techniques need to draw on these values in order to promote landfill diversion.

While shaping the social mindset to prioritize landfill diversion is essential to garnering participation, clarity on recycling rules is necessary to ensure accurate participation. Policymakers and waste management companies must navigate the tension between getting people to participate and making sure to end with a recyclable product. The city of Portland, Oregon, serves as a current example of how recycling too much can have deleterious effects. The culture of recycling is so strong in Portland that it has become a point of civic pride for the city. In 2017, the average Portland household threw 614 pounds of materials in their blue recycling bins. However, since the city introduced commingled recycling ten years ago, recycling has become even more contaminated, and at least 9 percent, if not more, of what goes into recycling bins is actually meant for landfill. The ease of tossing all seemingly recyclable materials in the blue bins, as well as a strong enthusiasm for recycling, cause residents to throw a wide range of items into the blue bins. At this point, Portland's levels of recycling contamination are more than thirty times greater than China's strict contamination standards (Jaquiss 2016). Even with high levels of participation, recycling programs are only successful if individuals are using these services correctly.

Educational and awareness strategies call attention to the importance of landfill diversion, and help individuals utilize recycling and composting programs correctly. Not only do landfills threaten environmental health, their future as a catch all for our waste is uncertain. Shifting waste streams towards recoverable alternatives like recycling and composting is essential to maintain a productive waste management system. Since these

alternatives face challenges of their own, individuals should also make a conscious efforts to reduce the waste they generate in the first place. The American waste management system is comprised of a mishmash of policies from different cities, counties, and states. Participation in these systems ranges from communities dedicated and excited about landfill diversion to communities with few resources or little motivation for waste recovery. Either way, if citizens learn how to utilize their local waste recovery networks, and understand the importance of doing so, all communities can make strides towards responsible and sustainable waste management. Communities seeking to increase participation can learn from various cities around the country who continue to pave the way towards progressive waste recovery and serve as examples for effective educational strategies.

Chapter 2: Case Study of San Francisco

San Francisco stands out as one of the nation's greenest cities, ranking first in sustainable waste management practices (Sumner and Barchfield 2011). As a result of the city's progressive policies, partnerships, and outreach efforts, San Francisco sends less trash to landfill than any other major US city. In 2002, it set ambitious goals to reach 75 percent landfill diversion by 2010 and achieve zero waste by 2020. To achieve these goals, the city and its waste hauling partner, Recology, implemented a variety of measures to encourage residents and businesses to divert their waste. The city's progress with landfill diversion has caught the attention of other localities on both the national and international scale, and serves as a beacon for sustainable waste management. By exploring the history of San Francisco's waste management policy, I hope to shed light on what factors led to the city's adoption and execution of a zero waste policy. I also highlight the various educational strategies employed to engage San Francisco residents and businesses in landfill diversion. Chapter two singles out San Francisco's ongoing journey to zero waste as an example of successful programming that may be translated to other regions working to reduce landfill waste.

History of San Francisco Waste Management

San Francisco waste policy came from humble beginnings when organized scavenger groups collected and sorted the city's waste. However as the environmental movement of the 1970s gained traction, and the federal government signed the Clean Air Act and Clean Water Act into legislation, San Francisco revamped its recycling

programs. In 1980, the city established the San Francisco Recycling Program tasked with developing recycling programs throughout the city. With a \$120,000 and a \$20,000 grant from the state, the program established buy back centers and launched its first curbside recycling program. Gaining momentum in landfill diversion, the city set out waste diversion goals, calling for a 32 percent reduction in the waste stream, or what goes to landfill, by 1992 and a 43 percent reduction by 2002 (EPA 1993, 154). These goals soon evolved as a response to California waste legislation passed at the same time.

Part of San Francisco's success pushing for stringent waste management policy stems from the political support and legal precedent from the state capital. In the late 1980s, the state was already aware of the environmental degradation caused by landfills, and ready to act. Continuing their commitment to reduce the amount of waste sent to landfill, the state legislature passed the California Integrated Waste Management Act of 1989, which required counties to reduce, reuse, and recycle as much municipal solid waste as possible. This law mandated that cities or counties divert at least 50% of their waste from landfills by the year 2000 or face fines up to \$10,000 a day (CalRecycle 2018). As a result, California's diversion rate improved from ten percent in 1990 to 58 percent in 2008, and San Francisco's diversion rate improved from 25 percent to 77 percent over that same period (Pollans 2012).

The same year that California passed the Integrated Waste Management Act, San Francisco implemented its own successful curbside recycling program. The city rolled out a two stream recycling service, collecting bottles and cans in one bin, and paper products in another. In 1996, San Francisco moved even further and began a pilot program for compost collection for commercial establishments, extending the program to

residential spaces one year later. By 2000, the city rolled out its “Fantastic Three” program, where residents and businesses would separate their waste into a blue recycling bin, a green compost bin, and a black landfill bin (Macy 2000). The composting portion was voluntary, and residents who wanted to participate only had to request one kitchen compost pail and a larger curbside green bin from Recology. Composting and recycling collection from the city’s waste hauling company, Recology, came at no extra cost (Pollans 2012). This “Fantastic Three” program served as one of the most advanced waste management programs in the country, and marked San Francisco as the first city in the nation to establish a large scale food composting program (EPA 2017).

Zero Waste Resolution

Having officially met California’s 50 percent diversion goal in 1999, San Francisco took the initiative to craft new goals for landfill diversion. The next year, the City Board of Supervisors officially adopted a goal of 75 percent landfill diversion by 2010 and zero waste by 2020. This resolution came as a response to the 1997 San Francisco Sustainability Plan which made it a priority “to maximize sustainable uses of natural resources and to eliminate solid waste generation in the City and County of San Francisco,” (City and County of San Francisco 2002). The city also faced new landfill diversion requirements as a condition of the waste disposal agreement with Alameda county. San Francisco dumped its waste in its neighboring county’s landfill, so when Alameda county set a goal of achieving 75 percent waste diversion rate by 2010, San Francisco was held to that standard as well. Finally, since other regions such as Santa Cruz and Del Norte Counties in California, Seattle, Washington, Toronto, Canada and

various Australian states had adopted zero waste as a long term goal, San Francisco officials saw this goal as attainable, and joined the zero waste movement (City and County of San Francisco 2002).

The San Francisco Department of the Environment, commonly known as SF Environment, describes Zero Waste as a system whereby products are designed and used according to the waste reduction hierarchy: reduce and reuse first, then recycle and compost if need be (SF Environment 2016). San Francisco officials viewed a zero waste goal as way to reduce waste and pollution in resource management. They hoped a strict target limiting landfilled materials would push individuals to rethink how they manufacture, use, and dispose of materials to create a “material cycling based economy for long term true sustainability” (City and County of San Francisco 2002, 3). Explaining the rationale behind such a far reaching goal, Jared Blumenfeld, former head of SF Environment, told *The Guardian*, “We agreed on an ambitious zero waste target and then on a date, which was far enough away for us to find the means of achieving it, but close enough for everyone to feel immediately concerned,” (Pouchard 2014).

The success of zero waste relies on both producers and consumers taking responsibility for the materials we inevitable force into the waste stream. Not only do producers need to be held accountable for the entire life cycle of their products, but consumers should also be reusing items, and recycling and composting the majority of their waste (SF Environment 2016). Ensuring producer and consumer responsibility requires strategic planning and programming by SF Environment. Through a strong partnership with the city’s waste hauling company, Recology, forward thinking policies,

and extensive outreach and education program, San Francisco progresses towards its zero waste goals.

Partnership with Recology

The long history of cooperation between San Francisco and Recology enables these two entities to coordinate goals and strategies towards waste minimization. San Francisco has been served by the same hauling provider since its early days of organized waste management. In order to protect citizens from unfair rates, the city government established maximum rates that waste hauling companies could charge residents. Throughout the 1920s, small waste hauling cooperatives consolidated into Recology, a vertically integrated, employee-owned waste services company. In 1932 the city government passed the Refuse Collection and Disposal Ordinance providing Recology with exclusive rights to serve the city. Although some criticize this exclusivity, the public continues to support the arrangement. In fact, voters rejected the latest measure to eliminate Recology's exclusive rights with 77 percent in favor maintaining the company's rights over San Francisco waste hauling (Pollans 2012). As a result of this long standing partnership, residents view Recology as a part of the city, and many take pride in the company's innovative and sustainable practices.

Recology shares the city's zero waste vision, and has invested in ways to minimize what ends up in landfill. For one, the company shaped its profit model around materials reuse rather than tipping fees, fees paid when disposing waste in a landfill, or collection fees. Recology also invests in the newest waste sorting technology to collect as much uncontaminated recycling as possible. Recology's waste collection and processing

facility at Pier 96 holds one of the world's most advanced recycling plants. The elaborate system of conveyor belts, advanced sorting technology, and human power enable the plant to process about 40 to 45 tons of materials each hour (Brigham 2018). The company also handles 650 tons of compost each day, sending the waste to local composting facilities who use the waste to create compost and mulch (Borja 2017).

Recology's "Pay as you Throw" Program further encourages individuals to increase what they recycle and compost while decreasing what they throw in their black landfill bins. Recology and SF Environment designed the "zero waste rate structure [to] incentivize residents to recycle and compost more, instead of tossing recoverable materials in the trash bin,"(Recology n.dc). The waste hauling company sets prices so that customers who opt for a smaller landfill bin and a larger recycling bin can lower their monthly bill. The standard service includes a 32 gallon composting bin, a 64 gallon recycling bin, and a 16 gallon landfill bin. With a composting bin double the size of the landfill bin, and a recycling bin four times the size, residents naturally alter how they dispose of their waste to accommodate the given bin sizes. Although pushing smaller landfill bins on residents may lead to contamination of recycling, the option to purchase larger landfill bins for a higher price and the use of warning labels and potential fines for contamination minimizes this problem. Apartment buildings and commercial businesses receive even more incentives to sort correctly with the "Diversion Discount." Business owners that consistently and properly separate their materials into compost, recycling, and landfill qualify for up to 75 percent off their monthly service bill (Recology n.dc).

Beyond the plant, Recology also invests in ways to connect with the San Francisco community. Recology's sustainability team meets weekly with SF

Environment to track operations and progress towards zero waste. The company adds to SF Environment's educational efforts by providing Recology site tours, online resources, and social media outreach. The free educational tours help community members and outside visitors understand where the public's waste goes, how it is processed, and why it is important to recycle and compost properly (Borja 2017). Additionally, due to its long history with the city, Recology waste haulers know their neighborhoods and customers well, and can easily accommodate the needs of their customers. Residents and business owners who want to share trash bins, request different bin sizes, or request special pickup locations can easily contact Recology to address these concerns. The company's willingness to problem-solve and accommodate specific collection needs on a house-by-house basis is evidence of its commitment to collecting trash in the most effective and sustainable way (Pollans 2012).

Recology also hosts an Artist in Residence Program that gives Bay Area artists the opportunity to create artwork from San Francisco's trash, challenging the ways the public views their waste. Since its inception in 1990, the program has housed over 120 professional artists and 30 student artists. Recology sponsors three artists over a four month period, giving them scavenging privileges to the transfer station's discarded material, and 24-hour access to the company's art studio. At the conclusion of the residency, artist showcase their work in a two day public exhibition and reception, and donate some pieces to the programs permanent collection. Artists speak to elementary school classes and other tour groups about the experience of working with recycled materials. The overall mission of the program is to support local artists, encourage the reuse of materials, and prompt visitors to question their own consumption practices

(Recology n.dd). Recology hopes that by viewing trash in new and creative ways, individuals will be able to invent even more creative solutions to increasing landfill diversion (Borja 2017).

San Francisco Waste Policies

San Francisco has also pushed progressive policies to limit the amount of waste going to landfill. One of the greatest contributions in achieving zero waste is the Mandatory Composting and Recycling Ordinance passed in 2009. Gavin Newsom, the mayor at the time, proposed the idea in 2008 when faced with the impending 75 percent diversion rate for 2010 as set out in the Zero Waste Resolution (Coté 2009). Since composting and recycling depended on voluntary action alone, landfill diversion rate slowed, growing only one percent from 2005 to 2006, and flattening out at 70 percent by 2007 (Pouchard 2014). Since 36 percent of what the city sent to landfill was compostable and 31 percent was recyclable, there was still plenty of potential for improvement (CalRecycle 2018). Therefore, to revitalize the movement towards zero waste, the Board of Supervisors passed legislation *requiring* all San Francisco residents and businesses to separate their recyclables, compostables, and landfill trash in separate bins.

The San Francisco Board of Supervisors voted 9-2 in favor of Mayor Gavin Newsom's proposal for the nation's most comprehensive mandatory recycling and composting law. It was actually co-sponsored by Newsom critics, Supervisors Chris Daly and Ross Mirkarimi, while opposed by two of his most reliable allies, Supervisors Carmen Chu and Sean Elsbernd. The primary concerns of the latter twos rested in the unpleasant idea of city workers snooping through residents' garbage to monitor if people

were correctly sorting their trash. Many residents expressed this same unease about “garbage policing” and any subsequent fines for noncompliance. However, instead of issuing fines, SF Environment enforces the ordinance primarily through notices and phone calls to non-complying residents and businesses (Coté 2009). Only in the most extreme cases would the Public Works Department levy fines on repeat offenders. The adoption of this ordinance gave the city the push it needed to surpass its goal of 75 percent diversion by 2010 (Pouchard 2014). While the city already had recycling and composting programs, the mandatory nature of the ordinance pushed individuals to further utilize these resources and sort their trash correctly. In fact, city employees credit the law as the best measure to increase composting participation and landfill diversion yet.

The city also passed a plastic bag ban and a food service and packaging regulation to encourage landfill diversion and get closer to zero waste. The Checkout Bag Ordinance prohibited single use plastic checkout bags for all retail stores in 2012 and all food establishments in 2013. All businesses were required to charge a minimum of ten cents on all compliant check out bags which included compostable plastic bags, paper bags made with 40 percent post-consumer recycled content, and long term reusable bags (SF Environment n.da). Then in 2017, San Francisco prohibited the sale of food service waste and packaging materials made from polystyrene foam or non- recyclable and non-compostable materials. This Food Service and Packaging Waste Reduction Ordinance built on the previous 2007 polystyrene foam ban by extending the reach of the ban to all materials, and ensured that substituting materials were still compostable or recyclable.

These policies effectively reduced materials in the waste stream that contributed to landfill growth or contaminated recycling and composting bins (SF Environment n.db).

Educational Tactics

San Francisco's comprehensive waste reduction policies are only effective when the public understands them and makes the conscious decision to participate. Therefore, SF Environment's Zero Waste team makes it their mission to educate residents on these policies and promote landfill diversion. With input from residents, businesses, and community leaders, the team develop multifaceted approaches to waste education.

One of the most effective tactics employed by SF Environment in reaching zero waste is the door to door outreach program. The program begins in the early morning as cart monitors inspect residential and commercial trash bins before the Recology trucks come to collect the waste. The monitors take notes on each household's sorting behavior, and enter it into a database for the outreach crew to analyze. If monitors find too many materials in the wrong bin, they will post a tag on the resident's bin with a warning label explaining where they went wrong. Later in the day, the outreach crew uses the collected data to check in with someone from each non-complying household. Crew members with a variety of language skills explain the rules of the three bin system, and answer any questions the residents may have. SF Environment also sends letters or visits non complying businesses, advising them to order composting and recycling services as necessary. They then schedule a face to face check-in visit to make sure the businesses follow suit. Former director of SF Environment, Melanie Nutter, supports this type of outreach explaining to a *Citylab* reporter, "policies and programs are great, but without

community participation they don't mean anything and they don't help us get toward our sustainability goals," (Boyer 2013).

To further engage with residents and provide education that resonates with them, the city piloted a zero waste Community Council Program in 2016. The Community Council helps SF Environment and Recology workers create programming and outreach strategies that encourage greater neighborhood participation in waste diversion. Community and business leaders, as well as city staff and partners meet to better understand the neighborhood specific barriers and challenges to reaching their zero waste goals. They then create or tailor existing programs to engage residents in enhanced composting and recycling practices (SF Environment 2015).

SF Environment chose to pilot the program in one of the most dense and diverse neighborhoods in the city: Chinatown. Adjusting programming to the values of Chinatown, the Community Council launched a "Turn Food into Gold" campaign that drew on the importance and symbolism of food in Chinese culture to encourage composting in restaurants. The campaign was successful due to the culturally competent messaging and adequate support services (SF Environment 2015). Taking the extra steps to analyze existing environmental performance and communicate with residents about programming enables policymakers to create effective education strategies tailored to specific audiences.

To hold residents accountable for properly storing their waste, SF Environment places up to date signage on and around trash bins. The Zero Waste team collaborates with Recology to create distinct, eye-catching stickers, posters, and double sided fliers for landfill, recycling, and compost bins. All trash bins provided by Recology come pre-

labeled with a large sticker atop each lid. The labels are mainly comprised of clear pictures of what can go in the bin. Residents or businesses who wish to create their own signs with more specific images can use the “Signmaker Tool” available on SF Environment and Recology’s websites. The only writing on the signs consists of the name of the bin, clearly and boldly located at the top, and a small list of items prohibited from the bin at the bottom. All important information on the signs is available in English, Spanish, and Chinese (Recology n.db).

SF environment and Recology also provide a plethora of online tools with more resources and information about waste practices. They launched *SFRecycles*, an interactive website where one can easily search for an item and learn how to properly dispose of it. The website is available in English, Spanish, and Chinese, and includes pictures next to most trash items listed. San Francisco also partnered with Alameda County, Contra Costa County, and Palo Alto to create RecycleWhere, another database for residents and businesses to find information on how to recycle almost anything in the region. Users just have to type in the item they wish to toss and their zip code, and the site provides disposal instructions and a list of drop off locations (SF Environment 2016). Although these websites are helpful and user friendly, not many people use them as an educational resource in part because they do not know about the site or they don’t take the time to look up what and where to recycle certain items.

SF Environment’s website also contains a Zero Waste Toolkit with services and resources to help businesses implement more composting and recycling programs. Here, business owners can find pre-made signs in a variety of styles, or can choose to customize signs that cater to their own business. The Toolkit provides links to contact the

Zero Waste team at SF Environment with any questions, and a link to the SFRecycles.org site. The Toolkit also lists various case studies of restaurants, offices, and hotels that saved money and reduced waste by successfully diverting waste from landfill (SF Environment 2011b).

In compliance with the Mandatory Recycling and Composting Ordinance, all events held in San Francisco must offer recycling and composting services. Education and resources are especially important for event producers since they curate events that attract hundreds to thousands of attendees, many of whom are unfamiliar with San Francisco's waste rules. SF Environment provides all event coordinators with a comprehensive checklist outlining the various requirements to host an event in the city. These include having an extensive recycling plan, ordering a sufficient number of waste bins, and providing containers with pre-printed labels. Additionally, SF Environment requires event producers, caterers, clean up crews, and other event vendors to attend a free zero waste training. This training explains how the mandatory recycling and composting ordinance will affect the event, how to have a water bottle free event, where to obtain compostable food service ware, and how to track an event's waste diversion rate (SF Environment 2011a). Having proper planning and resources enable San Francisco to greatly reduce the amount of waste generated by its many music festivals, parades, and athletic competitions.

Not only do adults need to know about San Francisco's waste policies, but waste education for children is also valuable for the success of zero waste. In 2016, San Francisco Unified School District created district goals to meet a variety of environmental sustainability standards. Among them was increasing waste diversion from

landfill to 85 percent by 2025. The district aims to reuse, recycle, or compost as many items that enter San Francisco public schools as possible (SFUSD Sustainability Office n.d). SF Environment contributes to these goals by offering a wide range of lessons and materials for teachers to implement in their classrooms. Many of these lessons cover the environmental costs of consumption and landfill use, and learning how to limit individual waste generation. Members of the Zero Waste team also give presentations on topics like lunchroom composting and stopping litter. Finally, the department offers free field trips to the Recology transfer station to show kids exactly where their trash goes, and how it gets processed (SF Environment n.d). Although, San Francisco public schools currently divert 66 percent of their waste from landfill, the district has high hopes for the future (SFUSD Sustainability Office n.d).

Results of the Zero Waste Efforts

The combination of these efforts earned San Francisco the title of most successful city in the nation for sustainable waste management (Sumner and Barchfield 2011). In 2012, the city reached an unprecedented 80 percent landfill diversion rate. Compared to Boston with a 17 percent diversion rate, or New York City with a 15 percent diversion rate, San Francisco stands out as a large city with an incredibly successful waste recovery program. Even Portland, a city that also offers extensive recycling and composting services, falls below San Francisco's high standards with a 70 percent diversion rate (Pollans 2012). Inspired by San Francisco's progress, many other cities both on the national and international scale are interested in improving their own waste management technology and implementing new recycling and compost friendly policies.

With just two years until 2020, San Francisco's zero waste initiative remains more of a vision than an attainable goal. In addition to individual noncompliance, there is still a plethora of materials entering the waste stream that are neither recyclable nor compostable. In fact, the city sends ½ million tons of waste to landfill each year, and 60 percent of trash in the black bins can still be composted or recycled. SF Environment claims that if all residents sort their waste into the correct bins, the city can reach 90 percent diversion. The remaining 10 percent of landfilled goods comes from items like single use plastics, non-recyclable electronics, and furniture (Airhart 2018). The growing popularity of mail ordered items like meal kits, groceries, and everyday items pre-wrapped in plastic packaging increase the waste sent straight to landfill. Instead of enacting more stringent, and likely unpopular, policies that phase out these remaining products, the city rearranged its goals so that it can focus on waste minimization in general. At this point, the most effective outreach should raise awareness of how constant consumption of goods leads to increased waste generation, and encourage limiting consumption only to things we need and that can be diverted from landfill.

Another challenge facing San Francisco's waste goals stems from China's crackdown on imported recycling. China used to take all of Recology's recycled cardboard, but since February of this year, it only accepts 10 percent. While recycling bales still fall within the four to five percent impurity range, Recology strives to adapt its sorting practices to meet the new contamination standards (Coté 2009). The company recently invested 11 million dollars in new recycling equipment that allows for deeper inspection of materials for less contaminated bales. The company continues to emphasize the importance of public education, especially now since what goes into the recycling

must be cleaner than ever. Recology and SF Environment remind consumers of specific rules like rinsing bottles and jars, bagging plastic bags and film plastics together, and composting food scraps that are essential to reducing contamination. They send out informational letters to customers and update posters and bin stickers to reflect the current information about what items go in which bin (Recology n.da).

As San Francisco struggled to push past its 80 percent diversion rate, it reassessed and redefined its original waste goals. This past September, Mayor London Breed conceded that the city will not achieve zero waste by 2020, and instead announced new diversion targets for the future. At the Global Climate Action Summit hosted by San Francisco in September 2018, she challenged other cities, states, and regions to join San Francisco in the path towards zero waste. Cities that sign onto this “Advancing Towards Zero Waste Declaration” agree that by 2030 they will reduce municipal solid waste generation by 15 percent and reduce disposal to landfill and incineration by 50 percent (Alexander 2018). Debbie Raphael, the current director of SF Environment describes the new commitment as one that “builds on San Francisco’s original goals, sets new, bold targets, and invites cities on a global scale to join us in proactive efforts to educate and motivate residents and businesses to achieve zero waste together.”(SF Environment 2018b). The mayors of Washington DC, New York City, London, and 22 other cities tentatively signed on to the agreement, now looking towards San Francisco as an example of waste reduction (Alexander 2018).

Chapter 3: Synthesis of Educational Tools

Although one city's success in reaching an 80 percent diversion rate is groundbreaking, more cities need to generate a movement towards waste reduction to impact the nation's landfill problem. Drawing from San Francisco's success in educating and motivating residents to divert from landfill, I explore how these strategies can translate over to different regions and governments. In fact, various non-profits, government organizations, and waste management companies around the country are taking action to promote waste recovery. This chapter synthesizes some of the most commonly used and effective strategies across multiple organizations, and highlights the successful aspects of these programs. It also underscores the importance of reducing consumption and overall waste generation to slow the amount of trash going to landfill.

Factors Unique to San Francisco

Before applying San Francisco's strategies to other locations, it is important to contextualize the city's success and recognize the political, geographic, and socioeconomic factors contributing to its achievements in landfill diversion. When it comes to environmental policy, San Francisco is a progressive city within a progressive state. Policies such as California's Integrated Waste Management Act set a precedent for San Francisco to create its own goals for waste diversion. With almost twenty years of cutting edge environmental laws, San Francisco residents accept and even expect ambitious goals regarding sustainable waste management. At this point, the waste diversion program is part of the image and identity of the city, both in the internalized

feelings of the residents and the city's portrayal in the media. San Francisco's political leadership reinforces this culture of environmental responsibility with their vocal support for the city's waste diversion programs.

Many other cities do not have this same political support and legislative history to successfully adopt more rigorous goals towards waste diversion. Even small pieces of legislation can hinder the effectiveness of progressive waste management policy. For example, in 2016, the Washington State Superior Court ruled unconstitutional a Seattle ordinance authorizing trash collectors to "visually inspect" residential garbage bags when monitoring compliance with composting and recycling mandates. Seattle requires separation of recyclables and allows trash collectors to put an educational tag on the trash bins if more than 10 percent of contents are recycled materials. However, since the State Superior Court ruled against the inspection of trash on the basis of invasion of privacy, waste management groups have had a harder time enforcing the separation law (Kinney 2016). Without full legislative and public support to back certain policies, cities will not be as successful in fully reaching their diversion goals.

San Francisco's geography also contributes to its progress in waste diversion. Its location on the peninsula restricts the size of the city, making it easier to organize and collect waste. The city also sends its waste to neighboring counties that support waste diversion. San Francisco compost travels less than an hour to Jepson Prairie Organics in Vacaville, where organic waste is turned to fertilizer for Central Valley and wine country farmers (Brigham 2018). Since San Francisco no longer has a landfill within its city limits, it trucks its landfill waste to counties that share similar waste reduction goals.

Therefore, the city still faces political pressures to reduce the amount of trash going to landfill.

Finally, San Francisco has developed into an incredibly wealthy city where most residents have the means to pay for more labor and technology intensive programs. San Francisco currently holds the highest metropolitan income in the country, with the average household earning \$97,000 in 2016 (Varathan and Kopf 2017). For this reason, the city can afford to employ a team specifically tasked with promoting zero waste in San Francisco.

Despite these unique factors aiding San Francisco's progress towards zero waste, many tactics and tools promoting landfill diversion function in a variety of contexts. Successful education programs strive to increase participation in recycling and composting, reduce contamination, and contribute to a greater understanding of why waste recovery is essential for a healthy environment. The best outreach is easy for individuals to understand and adopt. It should reduce any barriers that were once preventing people from participating in waste management programs. People should also see this activity as beneficial, in accordance with their own values, and feel that their peers also view the results positively (Nixon 2003). When individuals can easily learn about the rules and structures of their waste management system, internalize these guidelines, and integrate them into a part of their normal routine, cities make real progress towards landfill diversion and waste reduction.

Door to Door Outreach

Personal interaction while initiating community outreach is essential when generating local action and participation. By establishing direct contact and meaningful relationships with residents, local waste management companies and civic groups can present local waste regulations clearly. This quality time provides individuals with the opportunity to engage with waste policies, ask any lingering questions, and acquire more educational resources. Since most people normalize their garbage habits, they grow blind to the environmental implications of their personal actions. Therefore, when households and businesses are confronted with issues regarding waste and reminded of ways to manage it sustainably, they make garbage a priority again.

Just as door to door outreach aided San Francisco in moving closer to zero waste, a similar strategy helped residents in Washington state improve their residential diversion rates. When Washington state's recycling rates fell from 51 percent in 2011 to 48.9 percent in 2013, the regional waste hauling company Waste Management employed a variety of strategies to boost diversion rates. In the Puget Sound Area, Waste Management interns cover 26 cities for 10 to 12 weeks conducting site visits, checking dumpsters to assess recycling habits, and chatting with residents about how they can improve. Although individuals living in single family homes recycle about 60 percent of their waste, residents in multifamily housing recycle only 20 percent. This discrepancy largely occurs because of the high turnover rate in apartment buildings, and the fact that one individual's incorrect recycling can contaminate that of the entire apartment complex. With the property manager's permission, interns go door to door to talk to individual families about what goes in the recycling bin. They also give guides and flyers available in English, Amharic, Chinese, Hindi, Korean, Russian, Somali, Spanish, and

Vietnamese. This intern program led to a seven million pound increase in recycling since the program began (Rusk 2016).

Other localities are also finding it extremely important to include multilingual and culturally competent outreach in all of their door to door visits and community programming. In King and Pierce Counties in Washington state, about one in ten individuals speak little to no English. Therefore, Waste Management crafted outreach strategies that were more accessible and inclusive to the Latino/Hispanic community. They hired bilingual outreach staff that could fully communicate with target communities, understand whatever challenges they face, and explain recycling information in a clearer way (Rusk 2016).

In conjunction with bilingual communication, culturally competent programming helps make educational programs more accessible to different communities. Before San Francisco piloted their Community Council program in Chinatown, King County began its own community outreach program in 2013. The county partnered with Waste Management and a multicultural steering committee to develop and implement a door to door outreach program that included information and tips specifically geared towards Latino multifamily residents. Members of the outreach group visited each apartment, reminded residents of their local recycling guidelines and supplied them with a recycling tote bag. They also distributed door hangers or recycling reminder cards to residents about contaminants often found in the recycling bins. When creating educational flyers and dumpster stickers for the property, the project team collaborated to decide on slogans and images that would resonate with the Latino community. Additionally, the project team had at least two translators review any translated content to not only fix errors, but

catch subtle cultural and linguistic nuances. The combined efforts of door to door communication, recycling reminder cards, and appropriate on-site recycling collection contributed to a 85 percent increase in recycling of targeted multifamily buildings. These sites also saw a 19 percent decrease in recycling contamination (Waste Management of Washington 2013). Programs that bring awareness of waste management programs to the front door, and use culturally inclusive content when applicable, make waste education easy and memorable for residents.

School Education

Educational programs at K-12 schools enable different organizations to reach a large portion of the population often left out of other outreach campaigns. Children and teenagers make up nearly a quarter of the population, yet most residential and commercial outreach does not target this demographic. Additionally, nearly 75 percent of a typical school's waste stream comes from paper, paperboard, food, and compostable paper, and can be diverted from landfill. However, industry estimates project that 40 percent or less of America's public schools actually conduct recycling and composting programs. When students, teachers, and administrators learn the importance of waste recovery, they may treat recycling and composting programs as a standard rather than a luxury (Nestor 2015). The environmental education of young people is also crucial since they make up the future generation of waste disposers and play a direct role in finding solutions to our impending waste problem.

Curious about the impacts of waste education in schools, a Polish study found that both school children and their parents benefitted from these lessons. The researchers

created a program that addressed waste generation, disposal, treatment, and utilization of municipal solid waste, waste threats to the environment, and principles of waste management. Teachers administered the program to 284 primary school students over a four month period. At the program's conclusion, researchers asked students a variety of follow up questions regarding what they learned and how the program affected their practices. Overall, the program improved students' knowledge and awareness of why landfill diversion is important and how to dispose of waste in more environmentally responsible ways. This improved knowledge also encouraged kids to share what they learned with their families, as 70 percent of the students discussed the program with their parents and 34 percent made suggestions to their parents regarding ways to improve home waste management practices. Both parents and teachers agreed that the program was valuable and school education programs are beneficial for all (Malgorzata et al. 2003).

Many local organizations offer classroom guides, resources, and field trip opportunities to promote waste education in schools. Government agencies, waste management companies, and local non profits curate programs designed to teach about waste issues in fun, engaging, and memorable ways. Stopwaste, a public agency governed by the Alameda County Waste Management Authority, used the North American Association of Environmental Education's "best practices in environmental education" to create a 24 lesson classroom activity guide aimed at teaching students the 4R's: Reduce, Reuse, Recycle, and Rot. These lessons focus on natural resource use, reducing consumption, reusing items, and learning how and why to recycle and compost. One of the many recycling lessons specifically outlines what items go in the recycling,

compost, and landfill bin. The group also offers field trips to one of the county's transfers stations where students get to visit the educational center, garbage pit, and material recovery facility. Trips like these enable students to trace the path of compostables, recyclables, and garbage from the curbside to its remanufacturing or disposal (Stop Waste n.d).

Another program run by Waste Management in Snohomish County, Washington integrates an assembly show, classroom workshops, action projects, and family outreach booths into one comprehensive educational strategy. At the end of the program, 95 percent of students reported that they learned something new and will recycle more. Not only did teachers find the assembly and classroom workshops as effective in educating students, but 82 percent of them made improvements to their own classroom recycling set up. Teachers also agreed that the workshops prompted students to teach others, an essential step in developing a culture around waste recovery. These educational efforts ultimately led all participating schools to increase their recycling rates (Metzler 2017). The impact that school wide educational programs have on local communities and future generations can shape how the country conceptualizes and handles its waste.

Connection to the Arts

Many cities and organizations use art to encourage recycling and challenge dominant notions of waste. Transforming waste into something new and beautiful places a newfound value on it and causes many people to rethink their disposal habits. In fact, numerous studies show that placing a value on waste will make a person more likely to recycle it. Jennifer Argo, a marketing professor at the University of Alberta School of

Business, investigated what affects an individual's decision to recycle. After finding that people recycled plastic cups less when their name was spelled wrong on it, she concluded that "We are averse to trashing something that is tied to our identity as it would be conceptually similar to trashing a part of the self, which makes people more likely to recycle," (Prisco 2017). She also found that when a recyclable item loses its whole form, or undergoes any damage that changes its shape, people are more likely to throw it in the garbage. Argo suggests that this is due to individual perception of garbage as something worthless. However, when she gave a group of participants a piece of paper, and asked them to do a creative writing task on it, participants attributed a new value to the paper, and recycled it 80 percent of the time (Prisco 2017). Local organizations draw on these findings to create programs that showcase waste in artistic and creative ways.

Similar to Recology's Artist in Residence program, Northeast New Jersey created AWE, the Arts from Waste Experience. This community arts education program hosts a full time artist who creates sculptures from the region's discarded waste, and showcases their art in public areas. Volunteer instructors also offer free workshops on recycled art techniques for all ages, challenging community members to think about waste in new ways. AWE strives to teach art production skills in conjunction with principles of recycling and sustainability to students and community members (McCullough 2012). In Sacramento County, ReCreate, a nonprofit centered on reducing waste, collects safe, clean, and unwanted items from local businesses to use for creative projects. By collecting materials that businesses would otherwise throw away, ReCreate diverts over 70 million tons of material from landfill each year. The nonprofit's "More Art! Less Waste!" program visits grade school students to teach them about waste and enables them

to create their own art pieces. Workers start with a lively presentation about the waste cycle, and what happens to garbage when we throw it away, instructing them on why and how to reduce, reuse, and recycle. Then students visit the “Rolling Recreate truck” where they craft and make new things with the nonprofit’s salvaged materials (Recreate n.d.).

Beyond using art to attribute value to the waste itself, cities such as Houston, Texas and Detroit, Michigan use creative methods to publicize and promote waste management infrastructure. In 2014, the Houston Arts Alliance collaborated with the Houston Solid Waste Management Department to create the Art Recycling Trucks project. The groups commissioned six artists to each transform a city recycling truck into a mobile piece of art. Trucks covered in large images of fig ivy, or x ray blueprints of recyclable materials, or patchwork quilt of recycled materials drive through the city streets collecting curbside recycling. This program intended to raise awareness about the newly rolled out curbside recycling program, and draw attention to the work of repurposing materials otherwise destined to be trash. In Detroit, the non profit recycling drop off center Recycle Here! enlivens the experience of waste sorting through art. The colorful center covered in murals provides reusable materials for sculptural art projects and serves as a venue for musical and theater performances. Recycle Here!’s owner and founder created this atmosphere specifically to incentivize people to visit, recycle, and take ownership of their waste (Clark 2014). Programs that inspire the public to rethink their relationship to trash help change the culture around waste generation and disposal.

Labeling

Finally, uniform labels on trash bins serve an important final step towards waste education and landfill diversion directly at the point of decision making. By providing easy to understand labeling on the trash bins, individuals can make more informed decisions on where to deposit their waste as they throw it away. Although environmental concern is an important factor, convenience and accessibility serve as the primary determinants of recycling behavior. A study conducted in 2007 found that while nearly all survey respondents identified as favorable towards environmental responsibility, only approximately 42 percent self-reported recycling habits. Since recycling is often a voluntary behavior, ambivalence can often sneak in when making the decision to sort one's waste (Verdonk et al. 2017). Clear labeling directly on waste bins combats this ambivalence by quickly informing individuals where to place their trash. For example, the University of Toronto, Mississauga increased the campus landfill diversion rate by 164 percent by using standardized text and relevant images to label each recycling and landfill bin (CleanRiver 2018).

Uniformity in language and images among these labels reduces confusion surrounding recycling rules. Therefore, creating a reader friendly label has been a point of interest for different organizations. A study conducted by Keep America Beautiful found that the majority of individuals understood the term "mixed recycling" over "single stream" or "commingled". While 77 percent of respondents understood the concept of mixed recycling, only 61 percent understood that commingled meant the same thing, and 11 percent were familiar with the term single stream. Results also showed that including imaging in labels can be misleading if they show only generic images that do not represent all the acceptable items. Additionally, listing the products that one can place in

the bins such as cans, plastic, and bottles is clearer to individuals than listing the materials such as aluminum, paper, and plastic due to the ambiguity of what exactly constitutes acceptable plastics. Keep America Beautiful aims to improve their conclusions by furthering their research on recycling messaging, notably what icons and words best resonate with individuals (Resource Recycling 2018).

Recycle Across America (RAA), a 501c3 non-profit organization, made it their mission to address the issue of public confusion surrounding proper waste sorting. With input from a variety industry leaders, the organization chose colors, wording, and images to correspond with 19 different variations of sorting requirements. RAA sells standardized labels at discounted prices to schools, businesses, and government organizations. Over hundreds of businesses and organizations including NBCUniversal, Procter and Gamble manufacturing, and Hallmark, as well as over 2,000 schools use RAA's labels. The nonprofit sends labels that organizations can attach to existing bins, or can help make customized labels that fit onto all bin types (Recycle Across America, n.da). RAA stands by the effectiveness of standardized labeling, finding real results from partners using this simple concept. The City of Winter Park, Florida saw a 26 percent increase in the city's residential recycling levels after labeling their residential carts with RAA standardized labels. The University of Denver's use of labels reduced the amount of contamination by about 90 percent, and nearly doubled recycling levels university-wide (Recycle Across America, n.db).

In 2018, Rhode Island Resource Recovery Corporation collaborated with RAA to implement a statewide standardized labeling program. This campaign earned a gold status for the Solid Waste Association of North America's Awareness Campaign Excellence

Award. The Rhode Island Resource Recovery Corporation is a quasi-state agency that owns and operates the state's central waste facilities. Since introducing mixed recycling, the state's recycling contamination rate shot up. This prompted Resource Recovery to launch an awareness campaign communicating to residents that trash in recycling costs you money and puts workers at risk. Although this campaign reduced contamination by nine percent, Resource Recovery was still not happy with the high contamination levels and decided to reroute their communication strategy (Noiseux 2018).

The main complaints about Rhode Island's past education strategies included the fact that people do not like to read, and there are too many rules. Drawing inspiration from the success of Recycle Across America's campaigns, Resource Recovery decided to create and implement statewide labels that could be applied to all bins in publicly owned spaces or sold by Resource Recovery. In 2016, Rhode Island launched their Let's recycle R!ght! campaign, which combined standardized and widespread labeling with a media ad campaign. They adopt customized Recycle Across America labels that catered to the state specific recycling capabilities, and contained both English and Spanish instructions. They supplemented the education from labels with a comprehensive ad campaign that featured local Rhode Island celebrities in radio, online, social media, and billboard advertisements promoting the act of recycling. In just one year of implementing the campaign, the state decreased contamination rates by 18 percent, doubling their improvement rate from the previous awareness campaign (Noiseux 2018). Compared to other strategies, the success of standardized and easy to read labels underscores the importance of integrating this type of messaging in any educational campaign.

Reducing from the Start

Perhaps the most crucial aspect of any educational strategy is addressing the first of the three “R”s, reduction. Although increased participation in recycling and composting programs benefits the environment by diverting millions of tons of waste from landfill, it fails to address and solve the root of the problem: waste production. One of the surest ways to encourage landfill diversion is to reduce the amount of trash that enters the waste stream in the first place. Recycling and composting still require high energy inputs and resources to function, and with the future of recycling unstable due to China’s National Sword Policy, reducing consumption is the most sustainable way to manage our waste. Unfortunately, efforts to change consumption behavior lack strength and support when our society is hardwired to continue purchasing goods.

Over the past two centuries, the American economy and society shifted to value and even rely on the constant purchase of new goods. In the 19th Century, Americans of all classes valued ideals of thrift and reuse, as it was important to respect and take care of one’s own property. However, with the turn of the century, advertisers displaced the ideals of durability and reusability with aspirations of leisure, luxury, convenience, and cleanliness. Manufacturers also adopted assembly line production strategies that enabled them to put more goods on the market for a cheaper cost. These changes made it easier than ever for shoppers to discard their goods rather than mend or recycle them (Thomson 2009, 53). Once the economy integrated itself with the need to consume, the American psyche followed suit, leading to the formation of the citizen-consumer.

Consumer society during the 20th century served as a manifestation of the country’s political ideals of democracy and liberalism. American values of individualism

and “pulling oneself up by their bootstraps” relied on the economic freedom to buy goods and develop one’s status. By acquiring, using, and exchanging items, individuals expressed their right to curate their own social identity. Consumption also gave buyers a sense of meaning and dignity when they contributed to the market economy, equating being a good consumer with being a good citizen. The wealthy could now buy goods to display their affluence and role as a productive and respectable citizen. Urban infrastructure also changed to reflect this association when shopping areas functioned as the new community social centers where the public could congregate and engage (Gabriel 2013). The social pressures to buy and accumulate things contributed to a “competitive consumerism,” where middle and lower classes spent on more than they needed in order to keep up with the trends (Thomson 2009, 54).

The power and status that accompanied consumption led citizens to demand protection of the rights, safety, and fair treatment of individual consumers in the private market. In the mid- 1900s, consumer rights took center stage as the politically favorable rhetoric, as opposed to alternative discourse like racial and gender rights. Citizen-consumers were urged to contribute to society by exercising their purchasing power rather than engaging with politics and government representatives. In fact, during the Civil Rights Movement, advocates aroused more sympathy by pushing for access to mass consumption and the marketplace. Responding to the demand for consumer rights, presidents Ford, Carter, and Reagan passed legislation deregulating the economy and diminishing the authority of the federal government in the private sector (Gabriel 2013). When notions of being a good citizen intertwine with expressing one’s purchasing power, the idea of reducing consumption becomes unfavorable and even destructive to society.

Advertising and the increased use of social media also add to the social expectations and pressures to consume. The advertising industry effectively circumvents rational thought, manipulating individuals to buy into an economy that relies on increased consumption. When manufacturers realized the effect advertisements had on consumers, they pushed for the rapid growth of the industry. Supporting the wishes of the private sector, President Coolidge declared in 1926 the government should not interfere with advertising, allowing the industry to police themselves. However, with little regulatory oversight, advertising shot up in the United States. Spending on advertisements increased from \$1 billion in 1920 to \$10 billion in 1956 to \$219 billion in 2018 (Rogers 2005; Statista 2018). Now, people see advertisements embedded into their daily lives. Linda Thaler, the chief executive of a New York ad agency explains “We never know where the consumer is going to be at any point in time, so we have to find a way to be everywhere,” (Story 2007). In fact, the market research from Yankelovich estimates that a city dweller will see up to 5000 advertisements each day (Story 2007). Advertisements shifted the focus from the product to the buyer, no longer showcasing a product’s qualities, but rather how an individual could be transformed by the product. This type of marketing offers the public a group membership to a brand if they buy a certain product (Gabriel 2013).

The rise of social media magnified the impact of advertising as individuals also faced social pressures from friends and celebrities to buy certain products. Not only are social media apps like Facebook and Instagram littered with tailored advertisements, but brands pay social media “influencers” to showcase their products in a more personal and relatable way. Friends can also use social media to showcase new items they bought and

recommend things to one another. A Deloitte report found that those who use social media during the shopping process are four times as likely to spend more on their purchases. Shoppers are also 30 percent more likely to make same day purchases when they use social media to help them shop (Deloitte 2015). Nearly half of millennials use social media while shopping, leaving the future of advertising and consumption even more dependent on this form of connectivity.

Americans save less and consume more than any other industrialized nation in the world (Thomson 2009, 54). We live in an economy dominated by excessive packaging, disposable products, and unrepairable goods. Manufacturers have altered product design to prioritize convenience and trendiness over durability. In order to provide more products at cheaper costs, manufacturers construct individual parts less carefully while using cheaper materials. They also make the products harder to repair to encourage more buying once the original product wears out or breaks. The amount of packaging already included in the items we buy contributes the copious amounts of extra, unnecessary waste (Durning 1992). In fact, packaging makes up nearly 30 percent of the municipal solid waste generated in the United States (EPA 2015).

Since our global economy relies on a continuous cycle of consumption and disposal, consumers continually pour money into the market by purchasing new things to replace their short lived items. In fact, 68 percent of the United States GDP consists of consumer expenditures (Amadeo n.d). This structural dependence on purchasing goods makes the idea of lowering consumption to address the impending waste issue seem destructive to the economy. In fact, most waste management plans and policies avoid challenging the status quo of our production, purchasing, and waste generating habits,

and instead focus on what to do with the trash once it is disposed of. However, the economic repercussions of climate change largely caused by our unrelenting consumption and stress on the environment cannot be ignored. Therefore educative techniques that aim to raise awareness and promote behaviour change around consumption altogether are important for minimizing waste generation and landfill growth.

Consumer and Producer Responsibility

Organizations and governments committed to making big and lasting reductions in landfilled waste have begun encouraging consumer responsibility. Consumers should hold themselves accountable for the environmental costs and consequences of their buying habits and lifestyle. This responsibility includes purchasing new items only when they are needed, not just wanted. Often times, individuals can eliminate the need to buy new products by reusing and repurposing old items. They can also reduce their reliance on single use items by incorporating reusable mugs, bags, servingware, and other containers into their daily lives. Choosing to purchase items made with recycled content or produced locally also alleviates the environmental costs of creating new products (SF Environment 2018a).

More environmental groups are also educating younger generations about reducing waste, since they will soon become the country's future consumers. Among their list of lesson plans, SF Environment includes presentations and activities focused on analyzing and critiquing our consumer society. One lesson titled "I Want it! I Need it!" evaluates and analyzes students' consumption habits, drawing attention to the environmental costs of buying more than what one needs. Another lesson titled

“Targeting Teens” analyzed advertisements geared towards teenagers and how they promote consumption (SF Environment 2018c). Other educational programs employ similar tactics, with the similar goal of getting students to think critically about how they can change their consumer behavior for the better. Unfortunately, these efforts towards education are often counteracted by a bombardment of advertisements specifically directed towards children. Nonetheless, educating younger generations on how to navigate consumer culture while remaining an environmentally conscious citizen will help them think critically about their role in a consumer society.

Although asking consumers to make environmentally informed decisions and purchase responsibly reduces per capita waste generation, it also shifts a disproportionate amount of blame onto individuals rather than industries and manufacturers for the creation of waste. Many manufacturers now construct their products with shorter life spans and large amounts of single-use packaging. This leaves consumers with the burden of waste disposal, and waste management companies with the question of where to store it.

Policymakers are now considering implementing Extended Producer Responsibility legislation as a way to redirect the costs of waste onto those who are actually manufacturing it. Producer responsibility requires manufacturers to take an active role in developing and funding collection, recycling, and disposal programs for their products at the end of that product’s useful life. Charging manufacturers with the costs and management of a product throughout its lifespan incentivizes product redesign to include more reusable or recyclable materials (SF Environment 2017).

While educational strategies aid communities in reducing their landfilled waste and refining their preexisting waste management programs, taking the next step towards systematic waste reduction requires greater policy implementation. SF Environment recognizes that in order to reach zero waste, the city will need to advocate for stronger policies to hold industries accountable. Therefore, the department plans to advocate for more state legislation requiring stricter producer responsibility and partner with various industries to develop more sustainable business plans (SF Environment 2017). When cities, counties, and states collectively push for sustainable waste reform, the nation can better tackle its waste dilemma.

Conclusion:

Waste management systems affect all individuals, yet so many people do not give a second thought to what they consume and how they discard it. Product manufacturing, consumption, and disposal typically follow a linear path, with manufacturers passing disposable products onto the consumers, who then throw the waste away, absolving themselves from the responsibility of the waste. If the trash gets recycled or composted, these products have the chance to circle back into the market as a useful material. However, once the trash is landfilled, it loses its value and contributes to the environmental harm posed by landfills. A circular economy, on the other hand, would promote the recovery and reintegration of all discarded resources at the end of their service life. Circular economies value the world's limited resources, trying to make the most out of all the materials in use. This cycle of production still enables people to buy and consume things, just in a more thoughtful and sustainable way.

When individuals participate in recycling and composting programs, they add to the small circular economies present in the United States. In order to encourage this participation, a variety of organizations and governments need to create incentives for public action. Passing legislation that increases resources for landfill diversion or pushes more stringent action towards waste minimization greatly increases participation. However, not all communities have the political will to push these policies. Even the cities that pass forward-thinking waste legislation rely on public participation for these policies to succeed. Therefore, widespread education and awareness of local waste management policies and the importance of landfill diversion are essential aspects of any successful waste minimization plan.

Drawing from the programs employed in San Francisco and other communities, I synthesized a list of education strategies that contributed to a change in community behavior surrounding waste management. Programs such as door to door outreach, school education, waste to art projects, and standardized labeling all contribute to enhanced participation in waste diversion programs. Depending on the community, waste management companies, local governments, or non profit organizations took on the lead roles in implementing these programs. While all cities and counties in the United States cater to different demographics and levels of waste infrastructure, the programs mentioned above have the potential to be altered and adapted to a variety of communities. City workers, waste management representatives, or non profit employees can utilize these strategies to connect with their target audiences and make an impact on how individuals understand their local systems.

Future research on this topic could delve into other educational, political, and economic strategies to increase landfill diversion. By investigating other cities with both low and high diversion rates, one can uncover different barriers to waste recovery and analyze more measures taken to tackle the issue. Although cities like Boston and New York City still have recovery rates below 20 percent, they are already setting their own zero waste goals. Tracking how these cities navigate the challenge of waste diversion with a constituency, geography, and history much different from San Francisco will help paint a broader picture of how cities can promote sustainable waste management. Researching the effects of economic incentives such as garbage collection fees or subsidies will also contribute to a greater understanding of what motivates individuals to divert from landfill. These interdisciplinary fields are all necessary parts to developing comprehensive approaches to waste minimization.

Furthermore, this kind of research is especially relevant given the dramatic increase in throwaway packaging that is changing the future of our waste practices. Online shopping, meal kit services, and individually packaged grab-and-go items are entering the waste stream at an increasing rate (Robinson 2014). Humans produce three hundred million tons of plastic each year, half of which is intended for single use. Meal kits, for example, wrap almost every ingredient in plastic, and as a growing 5 billion dollar industry, they produce a significant amount of landfilled waste. Since about 90 percent of plastics fail to reach the recycling bin, the imminent increase in plastics and other materials to the waste stream will require new strategies for waste recovery (McCool 2018).

Engaging with the public to promote sustainable waste management can have far reaching and long lasting effects. Even without advanced recycling and composting infrastructure, educated residents make for more environmentally responsible citizens. An understanding of the harmful impacts of increased landfill use and the importance of waste recovery can inspire individuals to fully utilize their local waste management systems. With an appreciation for landfill diversion, individuals without convenient curbside collection programs may be more likely to bring their recycling to a drop off location or start their own at-home composting systems. Taking the initiative to internalize local sorting rules and remind friends and neighbors about these rules enables communities to come together and keep the systems functioning properly. These efforts help foster a culture of sustainable waste disposal.

Individuals may also alter their consumption practices when they have a greater knowledge of consumer responsibility. Reducing consumption should be the ultimate goal of any waste diversion program. While it may be easier to use recycling and

composting programs to alleviate the environmental damage incurred from our waste production, this “solution” fails to address the unsustainable nature of our consumptive practices. Reconceptualizing the ways manufacturers create products and how consumers buy, utilize, and dispose of these items can fundamentally alter how much waste our society sends to landfills, recycling plants, and composting facilities.

Additionally, through a reevaluation of our consumptive methods and a movement towards less waste generation, cities and counties may have more political support for more sustainable waste management plans. Consumer society emphasizes the rights of the individual rather than the community, discouraging people from organizing around greater social concerns, and distracting them from the negative environmental impacts of their habits (Gabriel, 2013). This culture also encourages individuals to use their dollars and purchasing power to voice their opinions rather than use community activism. However, when individuals learn more about the social ramifications of their waste generation and reject these notions of political participation through consumption, they regain political agency to drive change. Community support for comprehensive waste systems can push politicians to invest in more advanced waste recovery infrastructure. The role of education and awareness is not only important for increased landfill diversion, it also helps promote a culture of environmental responsibility and advocacy within communities.

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