An Evaluation of Public Space Recycling Options for Massachusetts

Photo taken by espos.de, modified and used under the Creative Commons license

Trevor Behlman
Qiuyi Hong
Neda Seyedmahmoud
Yunqiu Sun

Sponsors:

Massachusetts State Senator Michael Moore
Chief of Staff Shelly MacNeill

Advisors:

Professor Ingrid Shockey
Professor Chickery Kasouf

March 5, 2014

Abstract

The goal of our project was to identify solutions in other communities in and around the United States to provide opportunities to recycle in public spaces such as parks, beaches, stadiums, and marinas. We interviewed local stakeholders and experts on the environment, and selected cases for further study based on their recommendations and our preliminary research on recycling in the United States. Our report highlights programs and legislation in eight communities in and around the United States that address the issue of public space recycling, and makes suggestions for a statewide public space recycling program for Massachusetts.

Executive Summary

Introduction

Excessive amounts of solid waste in landfills are the largest source of human-related methane, a greenhouse gas that contributes to climate change ("Overview of Greenhouse Gases," n.d.). Recycling is therefore an effective solution to reduce greenhouse gas emissions as well as conserve energy and natural resources. As a result of recycling in Massachusetts alone, greenhouse gas emission rates were reduced by 1.9 million tons of carbon per year in 2010 ("2010 Solid Waste Data," 2011, pp. 3, 4).

Our project was the result of a meeting of bottlers, legislators, and environmentalists, in which all parties recommended seeking a plan to provide recycling opportunities in public spaces such as parks, beaches, stadiums, and marinas. This study focused on identifying the solutions used in communities in and around the United States to address the issue of public space recycling, and makes suggestions for a statewide public space recycling program or policy to be considered for Massachusetts.

Background

A study conducted by the Northern Shenandoah Valley Audubon Society reported 69% of the litter on a two-mile stretch of road in Clarke County, Virginia to be composed of beverage containers ("Virginia Adopt-a-Highway Report," 1998). In addition, a study conducted in 2009 by Keep America Beautiful observing disposal behaviors at 130 different locations nationwide reported that miscellaneous paper and food wrappers are also common forms of litter found in public places ("Littering Behavior," 2009). If these materials were recycled instead of being left behind, public spaces would be cleaner and more comfortable environments for people to spend their leisure time.

The phrase "Reduce, Reuse, Recycle," was popularized during the first Earth Day on April 22, 1970 (Rogers, 2005). These "three R's" are the main solutions to the problem of excessive solid waste generation. Reduction and reuse eliminate waste at the source, while recycling gives resources a second life. The Environmental Protection Agency (EPA) recommends source reduction and reuse above recycling and composting ("Waste Management Hierarchy," 2013). The figure below depicts an example of reduction in product packaging.

An example of reduction in product packaging

In order to ensure our suggestions would address all necessary aspects of an effective recycling program, we investigated the three pillars of recycling: access, incentive, and education. Access refers to how easy it is for residents to find convenient opportunities to recycle, as well as the quality of the opportunities themselves. Lack of access in public space, caused by a shortage of well-maintained receptacles, contributes to littering behavior ("A Review," 2007). Maintenance of receptacles is also required for access to recycling opportunities, especially in public spaces ("Littering Behavior," 2009). Proper access to recycling opportunities alone, however, does not guarantee an effective recycling program. Incentives encourage people to take advantage of the recycling opportunities that are provided. Education and awareness are also two important components affecting the consumers' willingness to recycle. According to research on the factors influencing the recycling rate of Minnesota counties, it was examined that "communities with grant allocation for recycling education or equipment recycle significantly more than communities without any allocation" (Sidique, Joshi, and Lupi, 2009, p. 244). To ensure the efficiency of recycling programs, various states have utilized different educational methods including the dissemination of information, activities and events, and competition.

Methodology

The goal of our project was to compile a report on public space recycling policies in the United States and to suggest a policy for Massachusetts based on the findings of our report. To accomplish our goal our objectives were to:

1. Interview key stakeholders to understand their criteria for an effective public space recycling plan.

2. Collect data on key public space recycling programs and policies in states and communities outside of Massachusetts, including the agencies, funding, and costs associated with them, as well as the materials recycled and the kinds of open spaces included.
3. Analyze the case studies and create a set of recommendations for recycling in public spaces in Massachusetts.

Results

Interviews

We interviewed four representative stakeholders: a consultant on environmental issues, a representative of an environmental organization based in Massachusetts, a business leader in the beverage and bottling industry, and the director of a local department of public works.

The environmental stakeholders we interviewed stressed the importance of the three components to recycling: access, incentive, education. Their view was that in order to make public space recycling cost effective, bins must be placed adjacent to trash bins, labeled clearly, colored accordingly, and be consistent in appearance throughout the state. Both experts we interviewed recommended against placing bins as close together as the twenty to thirty foot measurement observed by Keep America Beautiful and Disneyland, as the cost of installing and maintaining so many bins would likely outweigh the benefit.

From our interview with the business leader in the beverage and bottling industry we were able to gather insight on the beverage industry's perspective on recycling as a whole. Bottling companies have reduced the amount of raw materials necessary to manufacture their bottles and cans and use second-life plastic and aluminum where the price is satisfactory and the durability of the final product is reasonable. From the industry's perspective, green practices such as source reduction, reuse, and recycling translate to financial benefit.

We also interviewed the director of a municipal public works department in Massachusetts, who spoke of a lack of recycling opportunities to complement the trash containers. The interviewee also mentioned that there are excessive amounts of empty bottles mixed in with garbage, which are full of air and therefore take up unnecessary amounts of space in garbage bins. According to the interviewee, this problem is most noticeable on and around sports fields, where water and sports drinks contained in disposable plastic bottles are consumed in large amounts.

Case Studies

Our research uncovered two common forms of public space recycling, which we referred to as event recycling and permanent recycling. Under event recycling, provision of recycling opportunities at special events in public places is recommended or required by law. By "permanent recycling" we to refer to any program which involves the long-term placement of recycling opportunities, whereas event recycling opportunities are temporary. Our team was able to find statewide legislation in California, Vermont and Wisconsin. We also identified several programs or municipal laws. Our findings are summarized in the table on the next page.

	California	Minnesota	New Jersey	New York City	Palm Beach County, FL	Vermont	Wisconsin	Manitoba, Canada
Statewide/Municipal Legislation	Statewide	Municipal	Municipal	Municipal	Municipal	Statewide	Statewide	Statewide
Policy/Program	Policy	Program	Program	Both	Program	Policy	Both	Program
Event Based/Permanent Placement	Event	Both	Both	Both	Permanent	Permanent	Event	Both
Public/Private Funded	Private	Unspecified	Public	Public	Unspecified	Both, mostly private	Both	Private
Parallel Access	Yes	No	Unspecified	Yes	Yes	Yes	Unspecified	Some
Single/Dual Stream	Single	Single	Unspecified	Dual	Single, no paper	Unspecified	Unspecified	Single
Cost	Unspecified	$790 per pair of bins	Unspecified	$500 per bin	Unspecified	Estimated $1000 per ton	Unspecified	Education: $1,261,500
Education	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Recommendations

Our research suggested two common forms of public space recycling, which we will refer to as event recycling and permanent recycling. Under event recycling, provision of recycling opportunities at special events in public places by is recommended or required by law. In this report, we use the term "permanent recycling" to refer to the purchasing of bins for full time use in public space.

For optimal access, we recommended parallel placement of recycling and garbage receptacles, regular servicing and maintenance of bins, monitoring of collection frequency and tonnage of contaminants in recycling, follow-up research, and relocation of underperforming bins. In order to catalyze the growth of a new program, we recommended financial assistance for municipalities to implement permanent recycling or lending of receptacles to event coordinators. In the case of event recycling, coordinators who do not collect recyclables may be fined. In order to educate the public on public space recycling, we recommend requiring municipalities to include provisions for holding educational events or distributing educational materials in their programs. Information about recycling should use mediums such as newspaper, television, and websites.

The design of a recycling bin can contribute to all three aspects of recycling. We recommended the use of visual hints and clear labeling to encourage proper use of receptacles and to prevent contamination. Lids of plastic and metal recycling bins should use round holes to indicate the collection of bottles and cans. If there are to be different separation methods in a public space recycling program due to differences between the way municipalities are able to separate recycling, appropriate labeling should be designed to accommodate all of these methods prior to the implementation of a state program.

Durable receptacles in public space are highly recommended as it may be subject to harsh weather conditions and scavenging of beverage containers for their associated deposits. Durable bins require less maintenance and will need to be replaced less often than fragile or otherwise inadequate bins, leading to lower costs over time. Capacity should also be efficient in order to reduce the need for frequent servicing ("American Beverage," n.d.).

Conclusion

Through our research, it became clear to us that public space recycling is underdeveloped at this time. There was not enough data on the cost of the programs we studied and their impact on recycling as a whole to perform a cost-benefit analysis on the types of public space recycling which we examined. This is mainly due to a lack of public reporting on the outcomes of pilot programs and policies alike. Another reason may be that the impact of recycling education and the educational benefit of public space recycling are difficult to determine. What is clear to us is that permanent public space recycling is an expensive investment, but there are options such as pilot programs which could be used in an experiment to better understand how public space recycling might work for Massachusetts. We appreciate the opportunity to contribute to this worthy cause and thank our sponsors, advisors, and interviewees for supporting and guiding us through this experience.

Acknowledgements

We would like to express our sincere gratitude to our sponsors, Senator Michael Moore and Chief of Staff Shelly MacNeill, and to our advisors, Professors Ingrid Shockey and Chickery Kasouf, for giving us the opportunity to serve the State of Massachusetts by seeking solutions on this ongoing issue and for supporting us through the completion of this project. We also greatly appreciate the cooperation of the helpful individuals who agreed to participate in brief interviews and provide comments on the work that we did.

Table of Contents

List of Figures

List of Tables

Chapter 1. Introduction

Excessive amounts of solid waste in landfills are the largest source of human-related methane, a greenhouse gas that contributes to climate change ("Overview of Greenhouse Gases," n.d.). Recycling is therefore an effective solution to reduce greenhouse gas emissions as well as conserve energy and natural resources. According to the Massachusetts Department of Environmental Protection (MassDEP), recycling also contributes $3.2 billion of annual revenue and 14,000 jobs to the state. In 2010, for example, recycling saved an amount of energy equivalent to burning 650 million gallons of gasoline, and facilitated the reuse of 1.2 million tons of iron, coal, and other natural resources in Massachusetts alone. Greenhouse gas emission rates were also reduced by 1.9 million tons of carbon per year in 2010 ("2010 Solid Waste Data," 2011, pp. 3, 4).

Enacted in 1983, the Beverage Container Recovery Law, also known as the "Bottle Bill," focused on reducing solid waste by promoting the recycling of beverage containers. Under this law, consumers pay a five-cent deposit on select beverages and may redeem their deposit by returning the empty container to a retailer ("What is a Bottle Bill," n.d.; "Bottle Bills in the USA," n.d.). It provides an incentive for consumers to recycle beverage containers that are covered in the law. The Bottle Bill has contributed to the recycling of more than 75 percent of all deposit beverage containers consumed in Massachusetts since the day it took effect on January 1, 1983 ("Top Five Reasons," 2009). Even with the success of the Bottle Bill, there is room for improvement with regard to recycling in Massachusetts.

In 2010, the Massachusetts state recycling rate (as calculated by the number of tons of recycled material per one ton of solid waste) was 37% ("2010 Solid Waste Data," 2011, p. 8). In order to keep this rate above the national average of 34%, MassDEP and the Executive Office of Energy and Environmental Affairs (EEA) drafted a Solid Waste Draft Master Plan for the ten years after 2010 ("Municipal Solid Waste Generation," 2011). The Plan's major goal for Massachusetts is "to reduce the amount of waste disposal by 30 percent from 2008-2020, from 6,550,000 tons of disposal in 2008 to 4,550,000 tons of disposal in 2020," ("2010 Solid Waste Data Update," 2010, p. 2). An updated or new recycling program or policy could be considered to help meet such goals.

What the Bottle Bill has not solved is the lack of opportunities to recycle in publicly owned open space, such as parks, beaches, stadiums, and marinas. MassDEP believes that collecting the bottles and cans consumed in these spaces could improve Massachusetts' recycling rate, provide cleaner public space, save municipalities money, and create jobs ("Top Five Reasons," 2009). Our project was the result of a meeting of bottlers, legislators, and environmentalists, in which all parties agreed that a comprehensive solution to this problem is not only desirable, but also necessary. Although these groups introduced the idea of proposing a statewide policy, there are other stakeholders who may be concerned. Massachusetts residents, food and beverage retailers, waste management and recycling companies, and government agencies are also paying attention and would likely be affected by the changes in state policy we will suggest. Other interested groups include non-profit organizations such as the Massachusetts Public Interest Research Group (MassPIRG) and Clean Water Action, as well as private interest groups such as the Massachusetts Food Association and Real Recycling. The latter interest group is composed primarily of commercial stakeholders, including retailers like Shaw's and Stop and Shop, and bottling companies like Polar Beverages and Poland Spring ("Who We Are," n.d.).

We sought to understand the concepts and best practices of public space recycling before constructing a working plan to conduct our research. In order to achieve our goal, we began our research by interviewing key stakeholders to understand their motivation to improve public space recycling. The knowledge gained through these interviews informed our collection of data on key open space recycling programs in states and communities outside of Massachusetts, including the agencies, funding, and costs associated with them. We then compiled a set of options and recommendations for an effective public space recycling program in Massachusetts. This final report was presented at the end of our project to our sponsors, Senator Michael Moore and Chief of Staff Shelly MacNeill.

Chapter 2. Literature Review

This chapter explores the context of public space recycling by discussing problems such as littering and solid waste generation and how these problems can be avoided. We also briefly describe solutions other than recycling in order to understand where our objectives stand with the broader goal of reducing the consumption of raw materials and preserving the beauty of public space. This information supplemented our thinking as we conducted our research on public space recycling.

2.1 The problem of littering in public spaces

For decades, the problem of littering has been a concern for the public, environmentalists, and legislators. In particular, beverage containers account for a large percentage of litter. A study conducted by the Northern Shenandoah Valley Audubon Society reported 69% of the litter on a two-mile stretch of road in Clarke County, Virginia to be composed of beverage containers ("Virginia Adopt-a-Highway Report," 1998). If these bottles were recycled instead of being left behind, public spaces would be cleaner and more comfortable environments for people to spend their leisure time.

Discarding empty bottles in public space is a byproduct of technological development. Decades ago, beverages such as soft drinks and beer were sold in refillable glass bottles which would be reused many times before being discarded. After World War II, steel beverage cans gradually replaced refillable glass bottles; "the decade of the sixties witnessed a dramatic shift from 'deposit' bottles to 'no-deposit, no-return, one way' bottles and cans" ("History of Bottle Bill," n.d.). These disposable cans and bottles caused an explosion of litter in the form of discarded beverage containers. Consumers were "encouraged" to throw these "one-way" bottles anywhere (see Figure 1) ("History of Bottle Bill," n.d.).

Figure 1: An advertisement for the early aluminum beer cans ("History of Bottle Bill," n.d.)

The laws, policies, and programs of the time had not caught up with the progress made in technology. According to the Beverage Packaging Environmental Council, "34% (by weight) of all beverage containers are consumed away from home" ("Best Practices," 2011). Containers consumed away from home receptacles can be recovered with public space recycling.

In addition, a study conducted in 2009 by Keep America Beautiful observing disposal behaviors at 130 different locations nationwide reported that miscellaneous paper and food wrappers are also common forms of litter found in public places ("Littering Behavior," 2009). This report will discuss recyclables in general in public space, not just the ones mentioned above. Litter does not only burden public works facilities, but also wastes valuable resources that could be used to create new products at a reduced energy cost. Addressing the problem of littering in public space does not only include the prevention of littering, but also the recovery of valuable resources.

2.2 Sustainable strategies for solid waste management

The phrase "Reduce, Reuse, Recycle," was popularized during the first Earth Day on April 22, 1970 (Rogers, 2005). These "three R's" are the main solutions to the problem of excessive solid waste generation. Reduction and reuse eliminate waste at the source, while recycling gives resources a second life. The Environmental Protection

Agency (EPA) recommends source reduction and reuse above recycling and composting ("Waste Management Hierarchy," 2013).

Reduce

Excess consumption of raw materials can be alleviated by reducing the amount of materials used in packaging, a practice known as source reduction. Packaging accounts for more than 30 percent of municipal waste, of which 40 percent is made of plastic (Rogers, 2005). As mentioned earlier, this packaging also accounts for a significant amount of litter in public spaces. Some companies have made progress in source reduction. Pictured below is a comparison of old and new Poland Spring bottles, the latter of which uses less plastic than the former with a difference of approximately 5.4 grams of plastic. The resulting bottle has a smaller cap and thinner sides (Stevenson, 2012).

Figure 2: Source reduction in Poland Spring bottles (Stevenson, 2012)

Reuse

The problem of littered beverage and food packaging largely stems from the fact that these containers and wrappers are intended to be used only once. In the United States, over 125 million disposable cups are consumed per day (Rogers, 2005). Early campaigns to promote disposable products advertised the ease of throwing away the once-used product over washing a reusable one (Rogers, 2005). Widespread use of reusable food and beverage containers could greatly reduce the amount of disposable containers found left behind in public spaces and disposed of in landfills.

Recycle

Recycling is not the most effective strategy to reduce solid waste as a whole, however recycling saves an amount of energy equivalent to five times the cost of disposing of the same material in a landfill (Rogers, 2005). The process by which recycled materials are reprocessed for use in new products does not always produce material of the same quality as is initially processed. This problem is referred to as "downcycling." Rogers (2002) highlights the difficulty of recovering popular recyclable materials:

> All substances, except for some metals, lose their molecular integrity during reprocessing, eventually rendering them unusable. For example, each time it gets recycled, paper's long fibers break, becoming shorter and less able to hold together. Similarly, remelted glass loses its workability and durability with successive reprocessing. The least recyclable of packaging materials, plastic, loses its infrangible flexibility when made molten again. …a huge proportion of virgin resin must be mixed in to reinforce the weakened plastic to create a useful substance (p. 177).

In addition to the issue of downcycling, many recyclables are only reprocessed once because of downcycling and the fact that some products made from recyclable materials are not recyclable themselves (Rogers, 2005).

Opposite of downcycling is a practice known as upcycling, defined as a process

by which a product or material is given a new purpose which is more valuable than its original use. An upcycling process has been invented by which recycled PET plastics can be converted to smaller amounts of a more valuable grade of plastic known as PBT ("Plastic Compounder's," n.d.). The term "upcycling" is also commonly used to describe the reuse of items that lost their original purpose for some new application.

Since the most common types of litter in public spaces are disposable packages such as food wrappers and beverage containers, an effective way to manage them is to recycle them ("Littering Behavior," 2009). This process would involve collecting used, unused, or reused material that would otherwise be considered as waste, sorting and processing the recyclable materials into raw material, and remanufacturing them into new products ("Waste Management Hierarchy," 2013). Good practice should consider a thorough plan that includes all the steps.

2.3 Effective and efficient recycling

As mentioned before, recycling is an efficient way to utilize materials, prevent emission of greenhouse gasses and water pollutants, save energy, and reduce the need for new landfills and incineration plants. Access, incentive, and education are all necessary components to an effective recycling program, and are therefore known as the three pillars of recycling.

Access

The first step of a recycling program is to provide adequate access to quality recycling opportunities. Access refers to how easy it is for residents to find convenient opportunities to recycle, as well as the quality of the opportunities themselves. Lack of access in public space, caused by a shortage of well-maintained receptacles, contributes to littering behavior ("A Review," 2007). Disneyland officials have made the same observation, concluding that 30 steps how far guests would carry trash in their hands before dropping it if they cannot find a receptacle ("Magic Kingdom," 2014). Research suggests that if the average distance from a consumer to a garbage receptacle were to decrease from more than 60 feet to 10 feet, the littering rate could be reduced by 18% ("Littering Behavior," 2009). This decrease in littering rate also suggests that the

recycling rate in public spaces could be increased by improving access to recycling receptacles.

The quality and design of receptacles are also determining factors in accessibility. Considering the large number of the recycling bins that may need to be placed in public space, durable and easily-identifiable recycling bins are necessary in order to ensure their popularity. Well-designed bins might attract more attention and therefore encourage more people to use them. Maintenance of receptacles is also required for access to recycling opportunities, especially in public spaces ("Littering Behavior," 2009). The existence of unkempt receptacles might discourage consumers from recycling.

Incentive

Proper access to recycling opportunities alone does not guarantee an effective recycling program. Incentives encourage people to take advantage of the recycling opportunities that are provided. Recycling is a personal responsibility that requires all parties to participate.

A common type of recycling incentive is an economic incentive, including rewards and penalties. People are more willing to participate if they are to be rewarded for their behavior (Koch, 2010). It is important to establish an incentive in a recycling program to increase participation in the early stage before recycling becomes a habit. Vermont's first Bottle Bill, established in 1953, was not renewed due to a lack of incentive ("History of Bottle Bills," n.d.). Many states have adopted Bottle Bills or Pay-As-You-Throw (PAYT) programs, two successful systems with incentives to encourage the public to recycle.

Bottle Bill

Massachusetts passed its own Bottle Bill in 1983, which instituted a five-cent deposit on selected beverage containers that could be redeemed by the consumer by recycling the bottle at a retail store. For thirty years, the Massachusetts Bottle Bill, formally the Massachusetts Beverage Container Recovery Law, has continually achieved the goals of reducing the amount of publicly discarded beverage containers and conserving natural resources while reducing the solid waste flowing into landfills. As

mentioned earlier, the Bottle Bill contributed to the recycling of more than 75 percent of all beverage containers consumed in Massachusetts since the day it took effect on January 1, 1983 ("Top Five Reasons," 2009). Other than Massachusetts, the states of California, Connecticut, Hawaii, Iowa, Maine, Michigan, New York, Oregon, Vermont, and Delaware (repealed in 2010) have used or are using Bottle Bill as an incentive to increase their recycling rates.

Pay-As-You-Throw (PAYT)

Under a Pay-As-You-Throw program, residents must pay a fee for every bag or container of waste they generate. When residents throw less trash away, they pay less. PAYT creates a direct economic incentive to reduce waste and increase recycling, since the more material they recycle (at no additional cost), the less trash they must pay to dispose of. More than 4,000 communities across America have implemented PAYT programs ("Pay-As-You-Throw," 2012). PAYT has been shown to directly affect recycling habits among consumers. In a survey of Massachusetts residents, communities with PAYT programs had a higher percentage of people who report that they "always" recycle than communities without PAYT ("PAYT in Massachusetts," 2007). In more than half of these communities, recycling rates have risen to 40% ("PAYT in Massachusetts," 2007).

A study of the effects of an economic incentive on recycling motivation concludes that an economic incentive does not always increase recycling. Economic incentives may "cause the initial motivations of recycling to be replaced by reframing the behavior from a 'domain of morality' to a 'domain of economy'" (Estensen 2008, p.2). For example, states with Bottle Bills have witnessed the redemption of bottles that were purchased in a state without a Bottle Bill. This behavior is not representative of a positive attitude toward recycling, which has led researchers such as Iyer and Kashypa (2007) to conclude that economic incentives may be of more use in the short term than the long term.

Incentives cannot stand alone as a solution to continuously increasing recycling rates (Estensen 2008). The ultimate goal of incentivizing and educating people about recycling is to increase individual responsibility for the environment; that ideally in the

future, even without an incentive, recycling would become a daily habit.

Education

Education and awareness are two important components affecting the consumers' willingness to recycle. According to research on the factors influencing the recycling rate of Minnesota counties, it was examined that "communities with grant allocation for recycling education or equipment recycle significantly more than communities without any allocation" (Sidique, Joshi, and Lupi, 2009, p. 244). The study explored the cumulative effect of education expenditure on the recycling rates. The results showed that "cumulative expenditure on recycling education increased recycling rate, at the 10% level of significance" (Sidique, Joshi and Lupi, 2009, p. 249). Iyer and Kashypa support this finding, saying "disseminating information that increases the consumers' knowledge has a more lasting effect on recycling output than offering incentives" (2007, p. 38). The study goes on to suggest that a long term recycling program begin by relying on incentive, while gravitating toward educational campaigns over time in order to turn recycling into a habit for consumers.

To ensure the efficiency of recycling programs, various states have utilized different educational methods including the dissemination of information, activities and events, and competition. As we discuss in the next section, one or more methods could be used in order to target different audiences.

Dissemination of information

The Arizona Recycling Program has provided public recycling and waste reduction education since 1990 through the distribution of "how-to" brochures, manuals, case studies, and newsletters throughout the state ("Annual Report," 2000). This program has organized an inventory of the educational publications accessible for the use of educators, schools, municipalities, non-profit organizations, as well as general public in order to advance the development and exchange of educational material ("Annual Report," 2000).

According to the Oregon Administrative Rules 340 Division 90, Oregon counties and cities are required to provide to residential and commercial entities with essential

education packets, inform them at least four times per year of the collection of recycling material, and provide them with annual recycling information ("Waste Recovery and Compost," n.d.).

Recycling activities and events

Activities to promote environmental awareness and the "three R's" have been widely used to educate the public. The Arizona Recycling Program uses this theme in their recycling workshops, conferences, and seminars.

The impact of recycling and waste reduction activities is most pronounced when younger age groups are targeted. According to a study on the impact of recycling education, "environmental education that focuses on school age children and closely links environmental knowledge with specific behaviors can be effective" (Cruey, 1997, n.p.). The report goes on to suggest that a "hands on experiential approach" is an effective method to change the children's attitude toward recycling.

Planning cleanup events in public spaces is another common method to increase awareness of recycling. For example, an initiative in Eastern Kentucky known as Personal Responsibility in a Desired Environment (PRIDE) "fosters environmental stewardship through education and awareness in PRIDE cooperates with schools to organize cleanup events on rivers and roadways to increase students' environmental knowledge and get them involved in community service ("Personal Responsibility," n.d.).

Competition

Since 1999, the Arizona Recycling Review Advisory Committee has held the Recycling Essay Contest for high school students in order to increase recycling awareness and to inspire school activities on recycling. Participants have the opportunity to win a university scholarship by submitting a written essay describing their ideal solid waste awareness program for their school. The school can also receive funding from the Committee if they choose to implement the project in the following year ("Arizona Department," 2000). Similarly, the New Jersey Department of Environmental Protection sponsors a statewide poetry contest for students of grades 4 through 6 to teach the

importance of recycling and increase recycling participation. (“Recycling Poetry Contest,” 2013).

Chapter 3. Methodology

As stated earlier, our goal was to compile a report on public space recycling policies in the United States and to suggest a policy for Massachusetts based on the findings of our report. Our objectives were to:

1. Interview key stakeholders to understand their criteria for an effective public space recycling plan.
2. Collect data on key public space recycling programs and policies in states and communities outside of Massachusetts, including the agencies, funding, and costs associated with them, as well as the materials recycled and the kinds of open spaces included.
3. Analyze the case studies and create a set of recommendations for recycling in public spaces in Massachusetts.

In this chapter, we will discuss the data collection strategies that were used to complete each of these five objectives.

3.1 Understand the expectations of the stakeholders

To understand our stakeholder's expectations about what changes should be made to improve public space recycling, we constructed semi-standardized interviews with key local stakeholders. Interviewing was a useful means for us to understand the local stakeholders' perceptions of a better recycling program (Berg, 2011). We identified key local stakeholders as bottling companies, MassPIRG, the Sierra Club, the Massachusetts Food Association, the Environmental League of Massachusetts, and the Massachusetts Joint Committee on Environment, Natural Resources, and Agriculture, all of which were present at the meeting that inspired our project. We expected each of these groups to have a distinct perspective on recycling, given that because they represent private businesses, environmental organizations, private interest groups, and state government.

Using interview questions listed in Appendix A, we gathered information on how each stakeholder understood the current state of public space recycling and how he or she

envisioned its future in Massachusetts. We asked the stakeholders to elaborate on the reasoning behind their positions, and asked follow-up questions typical of semi-standardized interviews (Berg, 2012). From the first three questions on the list, we learned about the stakeholders' points of view, attitudes, and their concerns about the current state of public space recycling in Massachusetts. By asking them what they thought could be improved in questions four and five, we came to understand their needs as stakeholders as well as their vision for open space recycling solutions. These two open-ended questions encouraged the stakeholders to consider what they believed was necessary for a successful program in their point of view, which guided our thought process as we separated the needs of other states from that of Massachusetts. Questions eight and nine allowed us to create a snowball sample of our stakeholders, in which each stakeholder could recommend other individuals or groups for us to interview.

We conducted phone interviews with our stakeholders and took notes. When we approached the stakeholders for the first time, we introduced ourselves and our sponsors, described our project, explained its importance, and explained our intention to understand their expectations of our project. We conducted further analysis of the interviews in terms of the perspective of each to ground our findings from our research.

3.2 Collect data on notable open space recycling programs

To compile our report on public space recycling policies across the United States, we began by collecting preliminary data on each of the fifty states. This information was used as criteria for selecting cases for more detailed study. The table below describes how the data were organized. For our recycling rates, we chose to use the formula for Municipal Solid Waste diversion rates, which is equal to the amount in tons of Municipal Solid Waste recyclables divided by the total generation of Municipal Solid Waste (including recyclables).

State	Municipal Solid Waste recycling rate	Legislation on public space recycling

Table 1: Preliminary research matrix

We conducted archival research on legislation and policy briefs, meeting minutes and solid waste reports by the government agencies that maintain each state's programs. Where solid waste reports were not available, we consulted studies made by other parties on the generation of solid waste in the states in question. We found only three states with statewide legislation on public space recycling, so we broadened our search to include municipal pilot programs.

We selected the three states that have legislation pertaining to public space for further study. The other five case studies were either selected based on our stakeholders' recommendations or the availability of data on the public space recycling. Focusing on eight case studies narrowed our research and allowed us to develop a deeper understanding of public space recycling. Appendix B describes the research questions we answered for each case study, which examine the agencies, funding, and costs associated with them, as well as the materials recycled and open spaces included. Many of the questions were inspired by our sponsor's description of the project, while the others were added to complement our later analysis. We found answers to the first five questions, which examined how the legislation was enforced, in the text of the legislation or in reports on the program. Questions six to ten examine how the program has performed, and the impact if the necessary data is available. We searched these answers in additional resources, such as newspaper articles and reports by non-profit organizations.

3.3 Analyze the case studies and create recommendations

In this stage of our research we analyzed the programs and policies we studied. We created a table listing our findings from case studies. This allowed us to highlight their similarities and summarize our findings to provide further recommendations. In this stage we tried to focus on features of these programs that can be implemented in Massachusetts. We categorized our recommendations according to the three pillars of recycling (access, incentive and education) which we identified in our literature review as the determining factors of a successful recycling program. Under each pillar, we listed our recommendations and referred to one or more cases where more information could be found. We also discussed how bins could be designed to encourage usage and reduce contamination by summarizing major findings about bin design from our case studies.

All raw data that was collected during our research was stored in a password-protected computer, was not shared, and was destroyed at the end of the project.

Chapter 4. Results and Analysis

This chapter discusses the findings of our research as we carried out the steps outlined in Chapter 3. Following our findings is an analysis of the data collected for the purpose of creating a set of recommendations for public space recycling in Massachusetts.

4.1 Understand the expectations of the stakeholders

We interviewed four representative stakeholders: a consultant on environmental issues, a representative of an environmental organization based in Massachusetts, a business leader in the beverage and bottling industry, and the director of a local department of public works.

The environmental stakeholders we interviewed would only recommend a public space recycling program if it met certain standards. Their view was that in order to make public space recycling cost effective, bins must be placed adjacent to trash bins, labeled clearly, colored accordingly, and be consistent in appearance throughout the state. Both experts interviewed recommended against placing bins as close together as the twenty to thirty foot measurement observed by Keep America Beautiful and Disneyland, as the cost of placing so many bins would likely outweigh the benefit. One stakeholder believed that a public space recycling program should be biased toward, or limited to, communities with high traffic in public space in order to ensure that bins are being used enough to justify their expense. Both stakeholders also stressed the importance of the three components to recycling described in Chapter 2.3: access, incentive, and education. Without an incentive to use the bins in public space, the throughput of the bins would depend upon the public's recycling habits; and without educating the public on the existence of the bins and what can and cannot be recycled, the contents of the bins may become contaminated with materials which cannot be recycled. These stakeholders' years of experience and dedication to environmental issues were beneficial to our research.

Our discussion with a business leader in the beverage and bottling industry did not yield much information in the way of public space recycling; however, we were able to gather insight on the beverage industry's perspective on recycling as a whole. The

interviewee spoke at length of how recycling impacts his business, and how his business recycles. Because bottles and cans are often littered, and account for a major portion of unrecycled material, the beverage industry, according to our interviewee, has faced scrutiny by the environmentally concerned members of the public. In response, the industry has taken measures to promote the recycling of their bottles and cans by funding organizations such as Keep America Beautiful. In addition, bottling companies have reduced the amount of raw materials necessary to manufacture their bottles and cans, and use second-life plastic and aluminum where the price is satisfactory and the durability of the final product is reasonable. Our interviewee gave us a tour of the local plant, pointing out stations where used water cooler tanks were washed and refilled, and balers were used to compact paper, cardboard, and plastic into large bales to be sold to a processing company. All cardboard and plastic packaging used to ship pallets of empty bottles were collected to be recycled. Cardboard rolls used in the packaging of bottle labels were collected and shipped back to the labels' manufacturer for reuse. There was also a dedicated workshop for the repair of wooden pallets using scraps of wood. According to our interviewee, the plant fills their only dumpster once a month. When asked if these strict recycling and reuse practices were common in the industry, our interviewee replied that plants owned by other companies are likely even more efficient in their practices. From the industry's perspective, green practices such as reduction, reuse, and recycling translate to financial benefit. The stakeholder used the phrase "green in the pocket" to describe the financial motivation.

The director of a municipal public works department in Massachusetts spoke of the recent installation of Big Belly Solar trash compactors in public spaces in his community. These bins compact trash so that they do not need to be emptied as often as trash barrels. There are currently no recycling opportunities in place to complement these containers. This can be especially helpful when there are excessive amounts of empty bottles mixed in with garbage, which are full of air and therefore take up unnecessary amounts of space. According to our interviewee, this problem is most noticeable on and around sports fields, where water and sports drinks contained in disposable plastic bottles are consumed in large amounts. These locations would likely benefit most from adequately placed recycling bins.

4.2 Collect data on notable open space recycling programs

To meet our second objective for collecting data on public space recycling legislation and programs, our team started by researching recycling rates in each of the fifty states and their legislation on public space recycling to gain a broad understanding of recycling effort across the United States. We originally decided to use the data collected as criteria to select our case studies, but later determined the data did not accurately indicate that a public space recycling program was present. For example, Maine was found to have the highest recycling rate, but did not have a public space recycling program.

We experienced some difficulties in finding recycling data in general. Not every state requires their municipal solid waste (MSW) management departments to publish annual reports on solid waste. It was also challenging to compare recycling rates across the United States because not all states use the same definition of MSW, and therefore calculate recycling rates using a different formula. A report on a national survey conducted by the Earth Engineering Center at Columbia University made our comparison easier. This report calculated MSW recycling rates in all fifty states according to the Environmental Protection Agency's definition of MSW by compiling, analyzing, and adjusting detailed waste management data provided by the each state (Shin, 2014). These rates use the same formula for diversion rates as we described in Chapter 3. Appendix C depicts recycling rates in the US according to Columbia's report.

Once we understood the progress each state has made in recycling, we conducted research on statewide legislation on public space recycling. Since public space recycling is a relatively new and undeveloped concept in most parts of the United States, we predicted that states with high recycling rates would be more likely to have such programs. Only three states, California, Vermont, and Wisconsin, specifically addressed recycling in public space in their state legislation. During our search, we also found municipal laws, regulations, and programs pertaining to public space recycling. These states and cities are further explored in our case study section.

The interviews in the first stage and preliminary research in the second stage of our research helped us select states and communities with public space recycling legislation or programs. Each case study documented here follows the research questions

listed in Appendix B. At the end of each case study is a paragraph discussing what lessons may be learned by Massachusetts.

Below is a table summarizing our findings from each of our eight case studies. The table describes whether each community had a public space recycling policy or program, whether it applied at the municipal or state level, and whether the policy or program is a form of event recycling or permanent public space recycling. Additionally, the table describes how the program is funded, how receptacles are arranged, how recyclables are separated, how much the program cost, and whether there was an educational program included.

	California	Minnesota	New Jersey	New York City	Palm Beach County, FL	Vermont	Wisconsin	Manitoba, Canada
Statewide/Municipal Legislation	Statewide	Municipal	Municipal	Municipal	Municipal	Statewide	Statewide	Statewide
Policy/Program	Policy	Program	Program	Both	Program	Policy	Both	Program
Event Based/Permanent Placement	Event	Both	Both	Both	Permanent	Permanent	Event	Both
Public/Private Funded	Private	Unspecified	Public	Public	Unspecified	Both, mostly private	Both	Private
Parallel Access	Yes	No	Unspecified	Yes	Yes	Yes	Unspecified	Some
Single/Dual Stream	Single	Single	Unspecified	Dual	Single, no paper	Unspecified	Unspecified	Single
Cost	Unspecified	$790 per pair of bins	Unspecified	$500 per bin	Unspecified	Estimated $1000 per ton	Unspecified	Education: $1,261,500
Education	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2: Summary of cases studied

California

California's Public Resources Code Section 42648 (PRC 42648), enacted in 2004, requires communities to encourage proper collection of recyclables at large events. The legislation defines a large event as a gathering of "more than 2,000 individuals per day of operation," including employees and volunteers working the event, and either charges an admission price or is hosted by a local agency such as a city or county ("California Public Resources Code," 2004). Coordinators of large events are required to submit a report on the solid waste generated at their events at the request of the city or county they took place in.

Some communities in California have expanded on PRC 42648. Oakland requires coordinators of large events to develop a plan that abides by a set of standards for waste management. The plan must be submitted for review 90 days in advance of the event, and a report on the materials collected must be submitted within 30 days after the event ("Recycling at Large Events," n.d.). San Francisco requires event coordinators to submit proof of waste collection and attendance at a waste training workshop 30 days before the event. No design, placement, or throughput standards are included in PRC 42648, although San Francisco requires that recycling bins are blue in color, labeled clearly, and placed adjacent to trash and compost bins. A minimum 20% recycling rate is also required by San Francisco ("San Francisco Uses Public," n.d.).

The California Department of Resources Recycling and Recovery (CalRecycle) enforces PRC 42648 at the state level, although the legislation does not specify how it should be enforced at the municipal level. San Francisco delegates this responsibility to its Department of Parking and Transportation and Recreation and Park Department. Because the legislation shifts the responsibility to collect garbage and recycling to event coordinators, there is little cost associated with it and therefore no dedicated funding ("Report to the Legislature," 2009).

CalRecycle authored a report in 2009 on the impact of PRC 42648, stating that "the legislation has been beneficial and the program is worth continuing," ("Report to the Legislature," n.d., p. 3). Data collected from reports submitted by event coordinators suggests that diversion rates at large events increased by nine percent in the first two to

three years after the law was passed. The report recommends the renewal of expired portions of the legislation and a proposed statewide requirement for recycling at large events ("Report to the Legislature," 2009).

California's policy on event recycling, along with the extensions made by San Francisco and Oakland, stood out from our other cases with event recycling policies as being particularly thorough. The requirements for event coordinators are clearly stated, and data is routinely collected and analyzed. San Francisco's requirement for recycling bins to be blue in color and labeled clearly offers a unique example of ensuring consistency in recycling bin design throughout the policy's reach. The requirement for event coordinators to attend a recycling workshop was also a new concept to us, as it represents an educational program not for the general public, but for those responsible for the distribution of receptacles. San Francisco's policy addresses all three pillars of recycling for this reason.

Minnesota

Minnesota has long maintained one of the highest recycling rates in the United States ("Generation and Disposition of MSW in the United States," 2014). According to their annual report, the Minnesota's 2011 recycling rate was 46% (Vee, 2013). This is in part because Minnesota state law has required a 50% recycling rate in metropolitan counties and a 35% recycling rate elsewhere since 1996 ("Solid Waste Management," n.d.). Although Minnesota does not have any state laws related to public space recycling, some communities have established related pilot programs.

Eureka Recycling is a non-profit organization based in Twin Cities, Minnesota with a mission to achieve "zero-waste," a trash-free state ("Development of Best Practices," 2013). Eureka Recycling plans to reach this goal in the city of Saint Paul by the year 2020 ("Recycling and art," 2014). In 2005, the community of the Twin Cities asked Eureka Recycling and city of Saint Paul to focus on public space recycling. In 2008, Eureka Recycling, along with management of the involved public spaces and the city of Saint Paul set programs in motion in zoos, parks, and urban park pavilions. The materials that can be recycled depend on the space, while plastic bottles and aluminum cans are always included.

At the Como zoo, new trash bins were also purchased and installed next to the new recycling bins. In total, 13 sets of containers are set up and the cost was $10,250 ("Development of Best Practices," 2013). Information on how and where to recycle is posted on the website and displayed in the lobby. Additionally, a show involving a sea lion and trainer is used to advertise how easy it is to recycle and how recycling can help reduce pollution (see Figure 3). The Como Zoo saw an increase in capture rate from 62% to 72% ("Development of Best Practices," 2013).

Figure 3: Photograph of a show used to educate guests of the Como Zoo on the zoo's recycling program ("Development of Best Practices," 2013)

At Mears Park in downtown Saint Paul, a group of artists designed hand-crafted recycling bins to make the idea of public space recycling more attractive (see Figure 4). Since the pilot program, the recycling rate of Mears Park varies from 2% to 6% daily. According to Eureka Recycling, "more than half (by individual container) to two-thirds (by weight) of the recyclables still are thrown in the trash" ("Development of Best Practices," 2013, p. 57).

Figure 4: Recycling bin in Mears Park ("Creating art," 2009)

Eureka Recycling reported that parallel access to recycling and trash receptacles does increase the recycling rate when compared to separated bins. The urban park pavilions reported an increase from 30% to 85% using parallel access ("Development of Best Practices," 2013).

During our preliminary research, we found that Minnesota is one of the four states with a diversion rate above 40%. Collaborating with Eureka Recycling, a non-profit organization, worked well in Minnesota for both event recycling and permanent recycling. This cooperation also helped the local communities to learn more about public space recycling before they implemented their own programs. As Minnesota has harsher winter conditions when compared to Massachusetts, these programs are worth observing from a weathering perspective as well.

New Jersey

New Jersey became the first state to demand statewide recycling in 1987 with the enactment of the Statewide Mandatory Source Separation and Recycling Act. In 1995, New Jersey achieved a state MSW recycling rate of 45 percent, not far from the state's designated goal of 50 percent. In 2003, however, New Jersey's MSW recycling rate dropped to 32.7 percent. This drop was the result of "federal court rulings that struck

down state solid-waste flow rules that allowed counties to direct trash to their facilities," and the expiration of legislation which provided funding for recycling efforts (DEP News Releases, 2011). In order to reverse New Jersey's declining recycling rate, the Recycling Enhancement Act (REA) was enacted in 2008 by the New Jersey Department of Environmental Protection (NJDEP) to "promote recycling" by enforcing a tax on solid waste management facilities of $3.00 per ton of solid waste ("Solid Waste and Recycling," 2012). According to the Act, 60% of the funds go to municipalities and 30% to counties for the purpose of promoting and expanding their recycling programs (Chapter 311, 2008).

The Atlantic County Utility Authority promotes event recycling by loaning "Clear Stream" containers at no cost. Clear Stream containers are convenient to assemble, use and transport. These containers consist of a clear bag held up by metal crossbars and a lid designed to only receive plastic bottles and aluminum cans (see Figure 5). The borrowers of the containers are required to provide information to ensure the return of the containers. The event recycling program is advertised through Atlantic County Utilities Authority website where forms are available to request containers.

Figure 5: A Clear Stream container ("Event Recycling," n.d.)

The New Jersey Coastal Management Program sponsors the Monofilament Fishing Line Recycling program in collaboration with the BoatU.S. Angler Foundation.

In 2010, this program had assembled a cumulative total of 30 collection bins and signs in various Marina locations and state parks throughout the state for collecting monofilament fishing lines (see figure 6 below). The contents are shipped to Berkeley Conservation to be recycled. Educational signs and stickers were created for the collection bins. An assessment of the program reported that aluminum cans, cigarette butts, and bait were also found in the bins ("New Jersey Coastal Management Program," 2010).

Figure 6: Collection bins made of PVC designed to collect fishing lines for recycling ("Monofilament Fishing Line Recycling," n.d.)

The Atlantic County Utility Authority offers an incentive to event coordinators by offering to loan receptacles to them for free. Loaning the temporary bins for event recycling can be implemented in Massachusetts at the municipal level. As far as we were able to determine, Monofilament Fishing Line collection bins were not always located near garbage or recycling bins, which may explain why contamination rates appeared to be high. There was also a lack of data being collected on the contents of the bins to evaluate their performance. These mistakes would be good lessons for Massachusetts to learn.

New York City

New York City (NYC) initiated its pilot public space recycling program in 2007 and enacted an amendment to the city's administrative code to include public space

recycling on Aug 14th, 2010 (“A Local Law,” n.d.). The program has been considered to represent an important part of the city's overall commitment to a greener, cleaner New York (“BWPRR Public Space Recycling,” n.d.). New York City public spaces that have adopted the program use citywide dual stream recycling: a green bin for paper and a blue bin for metal, glass, and plastic (MGP).

Figure 7: New York City’s dual stream recycling system in a public place (“Getting Expanded,” 2010)

Legislation

The public space recycling amendment, Administrative Code section 16-310, requires an expansion of recycling opportunities to collect recyclable materials, including but not limited to “metal, glass, plastic, and paper” in “public locations in the city, which shall be in or near public parks, transit hubs, or commercial location with high pedestrian traffic” (“Public Space Recycling,” n.d.). The amendment sets the goal of increasing the public recycling receptacles to “a cumulative number of at least five hundred in five

years, and to a cumulative number total of at least one thousand in ten years" ("Public Space Recycling," n.d.). The amendment also emphasized that in all business improvement districts, public space recycling receptacles should be placed adjacent to public litter baskets. The law also requires the department's annual report to include the total number of public space recycling receptacles added each year and their locations.

Not only are the public spaces described above included, New York City Administrative Code also details street event coordinator responsibilities in section 16-327. This section defines a street event as a "street fair or festival on a public street where such activity may interfere with or obstruct the normal use by vehicular traffic" ("Responsibilities at street events," n.d.). It requires the producer and event manager, or sponsor when the above is not applicable, to ensure that a sufficient number of recycling opportunities are provided in parallel with trash receptacles, and that all solid waste is properly disposed of or recycled.

Public Space Recycling Infrastructure and Cost

New York City has not only legislation to support public space recycling, but also a complete recycling infrastructure to implement the program. Different government agencies handle recycling according to the type of public space in New York City. The New York City Department of Sanitation (DSNY) collects the recyclables in public parks; the Metropolitan Transportation Authority (MTA) collects the ones on subway platforms and states; the Port Authority of New York & New Jersey collect the ones in NYC airports and bus terminals ("Public Space Recycling," n.d.). All of these recyclables are then brought to vendors contracted by the Bureau of Waste Prevention, Reuse, and Recycling (BWPRR) for sorting and processing ("What Happens to Recyclables," n.d.). All of the above agencies are funded either by the city or state, while the contracted vendors could either be for-profit or non-profit corporations or district management associations ("Public Space Recycling," n.d.). For example, Sims Metal Management Municipal Recycling, a private firm holding a long-term contract with New York City, owns and operates one of the Materials Recovery Facilities (MRFs) to accept, process, and market these materials ("About BWPRR," n.d.).

The annual reports required by city law do not include information related to cost and funding. However, the NYC public space recycling pilot program in 2007 did provide this information. The program, "City's 2006 Comprehensive Solid Waste Management Plan," was implemented in six parks and two ferry terminals for the collection of paper and commingled metals, glass, and plastic (Lange, 2007). This program aimed to "look at the potential for public space recycling to increase the City's waste diversion rate" through the combined effort of the NYC Department of Sanitation, NYC Department of Parks and Recreation, NYC Department of Transportation, Metropolitan Transit Authority, Port Authority of New York and New Jersey (Lange, 2007). DSNY reported that every pair of paper and MGP recycling bins, made of heavy gauge steel, and color-coded bag liners, used to identify their origin, cost $500. Not only are the receptacles very expensive, the program also requires intensive labor and additional collection trucks for different recyclables.

Public Education

In addition to a complete collection, processing, and marketing system, New York City is also devoted to educating the public about recycling and public space recycling program. To sustain its public space recycling program, BWPRR adopted various means to educate the public. BWPRR develops and distributes promotional materials, conducts site visits, and participates in public events and social media to help increase awareness of public space recycling ("About BWPRR," n.d.). It also redesigned their NYCWasteLess website and designed NYC's Recycling Game for mobile devices to educate New Yorkers about recycling and waste prevention ("Recycling and Waste Prevention," n.d.).

A more specific education plan was included with the 2007 pilot program. DSNY reported various ways of publicizing public space recycling. As seen below in figures 8 and 9, a large number of posters about source separated recycling were placed in bus shelters and phone kiosks around each park prior to the program to educate the public about the green and blue bins and solid waste separation (Lange, 2007).

Figure 8: Poster used to reinforce DSNY's blue and green color themes for source separated recycling in a bus shelter beside a public park (Lange, 2007)

Figure 9: Poster illustrating how common solid waste should be separated (Lange, 2007)

BWPRR also formed an outreach team to hand out morning copies of the daily Metro wrapped in promotional flyers to commuters. The outreach team was responsible for hosting special events with their recycling mascots at ferry terminals and other

transportation terminals during rush hour. For example, the outreach team handed out free bottled water with labels that encouraged using the new recycling bins during the first week of the Pilot (figures 10 and 11, below).

Figure 10: Flyers given out through the St. George Ferry terminal on April 2nd, 2007 (Lange, 2007)

Figure 11: Recycling mascot and free giveaway during rush hour at Whitehall Ferry Terminal (Lange, 2007)

The 2007 report on NYC's pilot program suggested several major findings that should be considered for a successful public space recycling program. A responsible department needs to consider the choice between single stream and multi-stream recycling with respect to labor, cost, and contamination. As the research reported, "public space recycling works well for paper, but not for bottles and cans" (Lange, 2007,

n.p.). The non-recyclable trash found in paper recycling bins accounted for less than 5% of total contents while contamination in MGP recycling bins was more than 37%. The tonnage of recyclable paper was also higher than beverage containers at all sites. Multiple streams might result in less contamination but high cost in labor and budget. As discussed in Chapter 2, bin placement is also an important factor to determine the success of the program. According to the report, "Public space recycling is best in downtown areas dense with commuters and lunching office crowds" (Lange, 2007, n.p.). After the pilot program, DSNY rearranged some recycling bins to new locations for higher efficiency (Lange, 2007). Before adopting a public space recycling law, Massachusetts might need to consider initiating some pilot programs to test the effectiveness and efficiency of a proposed plan. Success in public space recycling requires more than just setting out bins; it also requires regular maintenance for bins and bags on a long term basis. Responsible departments need to monitor the program over time, conduct follow-up research, and make changes to sustain a public space recycling program. Even though public space recycling could be labor intensive and costly, it is a good opportunity to raise the public's awareness about recycling as a whole.

Palm Beach County, Florida

The Solid Waste Authority of Palm Beach County (SWA), in partnership with the American Beverage Association, started a pilot public space recycling program in 2012. Five municipalities within the county distributed a total of 126 recycling bins to twelve different sites, including parks, streets, beaches, and marinas ("American Beverage," n.d.). These bins collect metal, glass, and plastic recyclables. Custom decals were designed and placed on all bins ("Palm Beach County," n.d.). The three different types of bins that were used are depicted in Figure 12 below. Information on the costs of these bins was not available.

Figure 12: The three types of recycling bins used in Palm Beach County's pilot program ("American Beverage," n.d.)

The SWA promotes the pilot program in a number of ways. A "kick-off" event was held on America Recycles Day in 2012 to raise awareness about the new bins. Fliers and posters were distributed and displayed throughout the county. SWA also advertised the use of the bins using a booth constructed for the county fair ("Palm Beach County," n.d.).

Both feedback from the public and the impact on the environment were positive. Litter was reportedly reduced by 39% and the prevalence of beverage containers in trash bins was reduced by half ("Palm Beach County," n.d.). 27% of the material found in the recycling bins was found to be trash. All municipalities involved were interested in expanding the program, while others reported a desire to start their own program ("American Beverage," n.d.).

Palm Beach County's pilot program addresses access to receptacles and recycling education. Their collaboration with the American Beverage Association is not unlike St Paul, Minnesota's collaboration with Eureka Recycling. Palm Beach's follow-up report identifies the lessons they learned and how they might improve upon the program in the future, which is valuable for future programs in Florida and in similar communities.

Vermont

In 2012, Vermont passed the Universal Recycling Law, Act 148, with the goal of achieving zero waste (Mclean, n.d.). Act 148 places a ban on landfilling recyclables, effective July 1, 2015 (10 V.S.A. § 6621a). It requires that all publicly owned buildings and land provide parallel access to recycling bins, where all recycling receptacles are paired with and placed adjacent to trash receptacles, by July 1, 2015. A "public building" is defined as a "state, county, or municipal building, airport terminal, bus station, railroad station, school building, or school," and "public land" is defined as "all land that is owned or controlled by a municipal or state governmental body" (10 V.S.A. § 6605l). These definitions cover a wide range of public spaces both inside and outside, excluding bathrooms. By 2015, Vermont will provide universal access of recycling for its residents. The recycling system collects all the mandated recyclables, which Act 148 defined as the following source separated materials:

> ...aluminum and steel cans; aluminum foil and aluminum pie plates; glass bottles and jars from foods and beverages; polyethylene terephthalate (PET) plastic bottles or jugs; high density polyethylene (HDPE) plastic bottles and jugs; corrugated cardboard; white and colored paper; newspaper; magazines; catalogues; paper mail and envelopes; boxboard; and paper bags (10 V.S.A. § 6602, p. 3).

Residents can refer to the law's definition of a recyclable material if they are confused about what they can recycle. The law also introduces a plan to divert food scraps from landfills by 2020, which could potentially reduce contamination in recycling (10 V.S.A. § 6605l).

The Universal Recycling Law requires the Vermont Agency of Natural Resources (ANR) to implement a comprehensive statewide strategy for solid waste management by the end of 2013 and revise every five years (10 V.S.A. § 6604). ANR is also responsible for filing an annual report for waste analysis, cost analysis, local governance, infrastructure analysis, natural resource and environmental analysis, and legislative recommendations. Facilities and programs to ensure the success of universal recycling

are necessary at the state, regional, or local level. Act 148 passed without a specified means to fund its implementation ("Act 148 Implementation," n.d.). The 2013 ANR System Analysis report estimated that "$17 million is needed for trucks and carts to collect both recyclables and organics" ("Act 148 Implementation," n.d., p. 7). The ANR report also pointed out that much of the funding will be provided by the "private sector," with additional investments and funding from district solid waste departments and with support from the state. It recommends raising state funds by increasing the "franchise fee" from $6 to $12 to generate estimated 3.3 million additional revenue to fund a grants/loans program for private and public sectors equipment investments necessary for implementation of Act 148 ("Act 148 Implementation," n.d., p. 7). As requested, DSM Environmental Service and Tellus Institute submitted a draft report to ANR comparing system costs and materials recovery rates associated with an expanded Bottle Bill and universal access to single stream recycling. As the report stated under a comprehensive universal single stream system:

> Public space recycling is an important component of the system because there is no deposit to recover some portion of this material. The Project Team is aware of no good data on public space recycling costs. However, based on an analysis that DSM conducted for the National Mall in Washington, D.C. it is estimated that the cost per ton to provide and service public space recycling containers could be as high as $1,000 per ton. This is at best a very rough estimate that would need to be refined if such a system were implemented (Oakleaf, p. 33).

Overall, public space recycling is estimated to be expensive, and the Universal Recycling Law does not specify any funding for public space recycling.

Act 148 does not require any public education and outreach programs specifically for public space recycling, but does require establishing a program to promote universal recycling and recommends the use of media such as "television and radio advertising; use of the internet, social media, or electronic mail; or the publication of informational

pamphlets or materials" (10 V.S.A. § 6604). ANR unveiled symbols for unifying recycling effort across Vermont to help achieve the state recycling goal (see Figure 13).

Figure 13: Standardized symbols for recycling, food scraps and trash in Vermont ("Universal Recycling Symbols," n.d.)

The symbols have already been adopted by the Central Vermont Solid Waste Management District ("Universal Recycling Symbols," n.d.). Since the Universal Recycling law will not be effective until July 1, 2015, no report has been published on the effect of the law's provisions for public space recycling.

Even though Vermont's Universal Recycling Law covers all public buildings and public land, it does not specify how the program will be funded. As the 2013 ANR System Analysis report estimated, public space recycling will be a costly investment due to the expense of the necessary bins and processing facilities ("Act 148 Implementation," 2013). Specifying funding for such programs could help ensure a positive outcome. The standardized symbols for recycling, food scrap, and trash can save the state money if they are implemented on existing bins rather than purchasing new bins. It would be helpful for Massachusetts to adopt symbols with a similar design to help consumers identify recycling bins and increase their awareness of recycling.

Wisconsin

Based on Wisconsin's Solid Waste Reduction, Recovery and Recycling law, "responsible units" such as a municipality, county, or solid waste management system are required to develop and implement a recycling or other solid waste management program within their jurisdictions. Responsible units may also "adopt an ordinance to enforce the

program established" ("Chapter 287," n.d., p. 5). According to this law, state financial assistance is only available for responsible units who have been determined to have "effective programs" ("Chapter 287," n.d., p. 17). The State of Wisconsin enacted an administrative code to direct the development of recycling programs and set criteria to determine their efficiency. The administrative code considers a program as effective if the owners of "non-residential facilities and properties or their designated agents provide for the recycling [of the designated material] at their facilities and properties" ("Chapter NR 554," n.d., p. 202). An effective recycling program is also required to include a "public information and education program" to teach the general public about which materials should be recycled and the recycling program itself on a regular basis ("Chapter NR 554," n.d., p. 202). Based on the definition, such a educational program must provide information on how and why community members should recycle. The ultimate goal is to promote recycling behavior ("Chapter NR 554," n.d.). Under this code, the definition of non-residential facilities and properties includes locations "used for special events such as, but not limited to, fairs, festivals, sport venues, conferences and exhibits" ("Chapter NR 554," n.d., p. 201). Recyclable materials include aluminum, glass, steel, and plastic containers, "foam polystyrene packaging," "corrugated paper or other container board," as well as office paper, magazines, and newspapers ("Chapter 287," n.d., p. 2).

In order to educate the general public to recycle away from home and at special events, Department of Natural Resources (DNR) introduced an online electronic toolkit in addition to providing informative fliers. This toolkit called "Public Place Recycling" includes how-to resources, case studies, and tips pertaining to recycling in various public places ("Public Place Recycling," 2010). DNR also recommends that local governments include requirements for recycling at events on permit applications ("Recycling Away from Home," 2012).

To enforce recycling, Waukesha County requires the non-residential owners to "provide adequate, separate containers for the [recyclable] materials" and to accommodate the "collection of the separated materials and the delivery of the separated materials to a recycling facility" ("Chapter Fourteen," n.d., p. 34). The county purchased 50 Clear Stream recycling bins, at a cost of $50 per bin, to assist the event planners. In

order to raise awareness about the state law requiring recycling at non-residential locations and events, the county sends out informative letters to "event coordinators, as well as chamber of commerce members and park and recreation department staff" ("Wisconsin Uses Ordinances," n.d., p. 5). In 2012, Waukesha County "ensured special event recycling at 48 community events by providing technical advice and assistance and loaning temporary event recycling bins when needed" ("Waukesha Solid Waste Report," n.d., p. 1). The county provides event planners with these services at no cost, but event organizers are responsible for managing the recycling and disposal of materials at the event ("Public Place Recycling," 2011).

The city of Madison requires that a recycling plan be submitted as a part of a special event permit application for review and approval by the City Recycling Coordinator for "events that include service of beverages in recyclable containers or the use of corrugated cardboard" ("Chapter 10," n.d., p. 10-4i). The recycling plan must outline a procedure for the collection and transfer of recyclable materials, and to provide proper instructions and opportunities for vendors and participants to recycle ("Chapter 10," n.d.). If the recycling plan does not meet these requirements, the City Recycling Coordinator "shall work with the applicant to develop an approvable plan" ("Chapter 10," n.d., p. 10-4i).

Because Wisconsin provides state financial assistance for municipalities based on their enforcement of the state's policy on event recycling and the existence of a recycling education program, Wisconsin addresses all three pillars of recycling at the state level. This may serve as an effective model for Massachusetts. Because there are no required standards, bins on different non-residential properties may be unique, and therefore harder to recognize. Waukesha County joins New Jersey in offering to loan Clear Stream recycling bins to event coordinators at no cost.

Manitoba, Canada

As a leader in recycling, the Canadian province of Manitoba has discovered different ways to improve recycling rates. Its "blue box" program has contributed to household recycling for 15 years, while its Bottle Bill, also known as Manitoba Product Stewardship Plan, has served the province since 1995 ("Making Manitoba a Recycling

Leader," n.d.; "Recycling Legislation in Canada: Manitoba," 2011). Manitoba does not have any law related to public space recycling; however, it launched a permanent, state-wide, on-the-go bottle recycling program in 2010 with the help of the Canadian Beverage Container Recycling Association (CBCRA) ("Making Manitoba a Recycling Leader," n.d.). As of December 31, 2012, the number of bins introduced by the program reached 10,000 with the participation of around 174 communities ("Full of Value," n.d.). CBCRA offers free beverage container recycling bins to "municipalities, industry, commercial businesses, government offices and parks, and institutions as well as to festivals and events," as provided by Manitoba municipalities ("Full of Value," n.d., p. 3). The program cost C$4,289,393 in 2011 and C$4,842,358 in 2012 ("Full of Value," n.d.).

Although a survey from 2013 and a study from 2012 both indicated that Manitoban residents have a widespread understanding of the importance of recycling, CBCRA continues to promote the program to keep up with its annual 75% beverage container recovery goal. Its advertisements are found in newspapers, on the radio, and on vehicles wrapped with Recycle Everywhere decals ("Full of Value," n.d.). CBCRA also sponsored local sport teams for further exposure to the public. In the three years after the program's implementation in 2010, Manitoba's beverage container recovery rate increased by 11% ("Full of Value," n.d.).

As Manitoba aims to be the recycling leader in Canada, their permanent program turns out to be very efficient. Their funding comes from CBCRA, an organization made up of bottling companies in the region, which is similar to Palm Beach County's program, which did not disclose how its expenses were paid, but was the result of a collaboration with the American Beverage Association.

4.3 Create a set of recommendations

Our research suggested two common forms of public space recycling, which we will refer to as event recycling and permanent recycling. Under event recycling, provision of recycling opportunities at special events in public places is recommended or required by law. In our case studies, the definitions of a special event or public space, who was responsible for providing the opportunities, and what universal standards are in

place varied according to legislation. In California, New York City, and Atlantic County, New Jersey the coordinator of the event is responsible for providing recycling opportunities, while in Washington it is vendors at the events who sell products in recyclable containers who are responsible ("Chapter 70.93," n.d.). In this report, we use the term "permanent recycling" to refer to any program which involves the long-term placement of recycling opportunities, whereas event recycling opportunities are temporary. The permanence of recycling opportunities refers not to their location, but their usage. Under permanent recycling, bins are purchased for full time use in public space and may be moved to new locations in order to collect recyclables more efficiently. We were not able to determine whether one is more effective than the other, and thus offer both types of programs as options for Massachusetts. While most of our recommendations are applicable to both, we identified some as only being applicable to one. In order to implement recommendations such as bin design and parallel access in an event recycling plan, event coordinators may be required to adhere to certain standards or face fines.

Access

Most of our case studies suggest that parallel access, the placement of recycling receptacles next to trash receptacles, is an effective method of collecting recyclables; however, parallel access can be very expensive because of the high cost of durable recycling bins and the additional facilities and laborers required. These costs were highlighted in the New York City and Minnesota reports, as well as the estimated expenses identified in a report on Vermont's Universal Recycling Law. It would be more feasible to start with pilot programs or limiting requirements for recycling to high traffic areas. The potential benefits of public space recycling which can be measured, such as the tonnage of recycled material collected and impact on local diversion rates, are trivial compared to that of commercial and residential recycling (Lange, 2007). This can be observed in Figure 14 below, which is taken from New York City's pilot program's report.

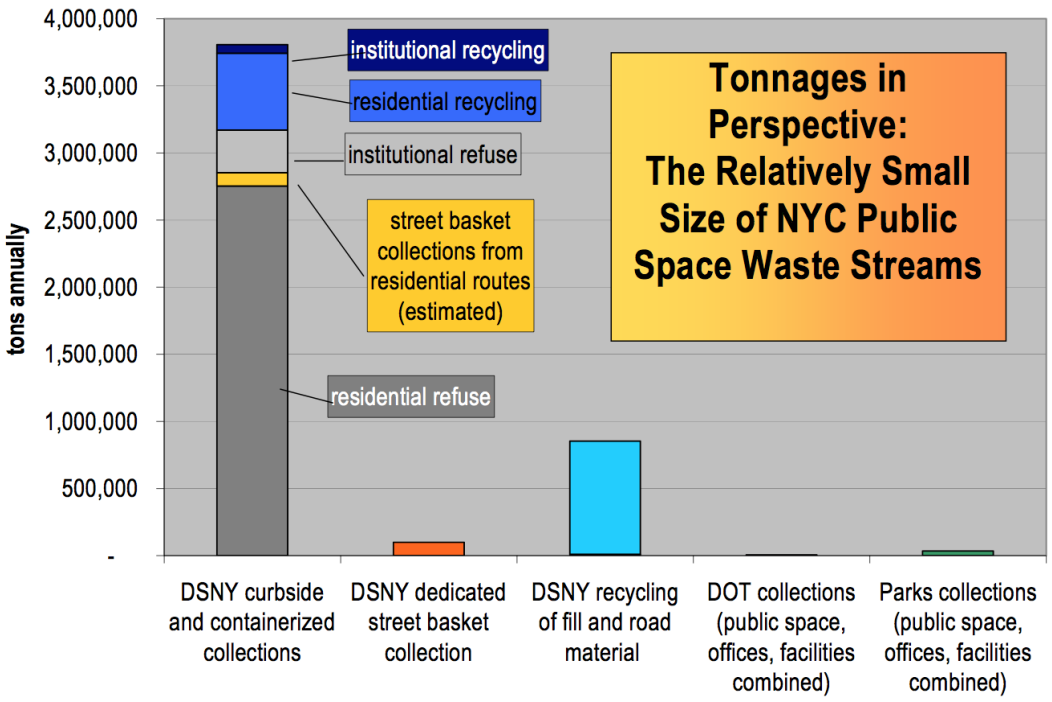

Figure 14: Waste collection distribution in residential, commercial, and public areas in New York City (Lange, 2007)

Success in public space recycling requires more than just placing bins; it also requires regular servicing and maintenance of the bins on a long term basis. Responsible departments need to monitor the collection frequency and contamination rates over time, conduct follow-up research, and relocate underperforming bins to sustain a public space recycling program. After New York City's pilot program, bins in low traffic parks were moved to new areas or to the perimeter of the park, bins at more popular locations were serviced more often, and it was recommended that "more sites with characteristics similar to these should be sought for small scale, symbolic expansion of public space recycling" (Lange, 2007). Not only should bins be rearranged to locations where more materials are collected, but also to locations which are more accessible for users, are safer for servicing and maintenance, and less scavenging of aluminum and containers with deposits will occur ("American Beverage," n.d.). Regular service and timely reporting can improve the efficiency of public space recycling.

Incentive

Some of our case studies have used incentives such as financial assistance and penalties to catalyze public space recycling. Financial assistance from the state for municipalities to implement permanent recycling may serve as a major incentive for public space recycling. Requirements can be used to limit the number of communities who qualify to the ones that would benefit most, and also to provide an incentive for communities to start their own pilot programs. For example, the state of Wisconsin requires municipal recycling programs to meet certain standards in order to qualify for state financial assistance. In the case of event recycling, recycling bins may be loaned to event coordinators, and coordinators who do not collect recyclables may be fined. Some other local communities also provide reverse vending machines in public spaces to reward those who recycle.

Education

In order to educate the public ~~on~~ about public space recycling, some of our case studies required municipal programs to include provisions for educational events to be held or materials to be distributed using mediums such as newspaper, television, or websites. Manitoba has spent more than C$1 per person on education for their public space recycling program. One of Wisconsin's requirements for eligibility in their financial assistance program is a plan for educating the public on recycling ("Full of Value," 2012; "Chapter NR 554," n.d.).

Public space recycling is a good opportunity to educate the public on recycling as a whole. It contributes to showing people how to recycle, rather than simply give them an opportunity to recycle. New York City decided to continue its pilot program because of its educational benefit, even though not much recyclable material was collected compared to residential and commercial recycling. They concluded that people understanding and participating in public space recycling reinforced its educational purpose:

> Carefully located public space recycling can be an important symbolic and educational feature of NYC's recycling program. Contrary to popular

> opinion, waste generated in public spaces is only a tiny fraction of residential, public maintenance, and commercial wastes overall. While public space recycling won't raise the city's diversion rate by more than fraction of a percentage point, it is an important way to reinforce the Reduce, Reuse, Recycle message (Lange, 2007).

Bin selection and design

The design of a recycling bin can contribute to all three of the above aspects of recycling. Most of our case studies used a consistent bin design, or even limited the entire program to a single bin type, to make them easy to identify.

Also prevalent in our case studies was the use of visual hints and clear labeling to encourage proper use of receptacles and prevent contamination. Round holes on the lids of recycling bins indicate the collection of bottles and cans ("Development of Best Practices," 2013). Many of our case studies have used labeling which is both simple and specific, identifying bins as intended for the collection of bottles and cans rather than plastic, glass, aluminum, and tin. Palm Beach County's report noted that collecting recyclables in the way that they are collected by existing local recycling programs simplified the communication with the public on what could be recycled and how ("American Beverage," n.d.). It would be important to take this into consideration when implementing a public space recycling program at the state level, where municipal recycling programs and local transfer stations might have conflicting requirements for separation. Ideally, all municipalities would be able to collect materials in the same streams, so that there would be no conflict in how residential and public space recycling is collected in different public spaces in Massachusetts; however this may require an expensive investment in recycling technology in several Massachusetts counties. If there are to be different separation methods in the public space recycling program due to differences between municipalities, appropriate labeling should be designed to accommodate all of these methods prior to the implementation of a state program.

The durability of a receptacle in public space is important to its cost, as it may be subject to harsh weather conditions, scavenging of beverage containers for their associated deposits, and other forms of vandalism. Durable bins require less maintenance

and will need to be replaced less often than fragile or otherwise inadequate bins, leading to lower costs over time. Capacity should also be efficient in order to reduce the need for frequent servicing ("American Beverage," n.d.).

Discussion

The lack of data on the performance of recycling efforts in public spaces indicates that the issue of public space recycling is an underdeveloped topic, although it has been a subject of interest for some states and municipalities. Based on the data we collected, public space recycling is an investment which requires careful monitoring and adjusting in the long term in order to maximize its impact. The stakeholders we interviewed are looking forward to the development of such programs.

Chapter 5. Recommendations and Conclusion

In accordance with our goal of making suggestions for a statewide public space recycling program for Massachusetts, this chapter discusses our final recommendations. In addition, we discuss gaps in our research, steps to take as a result of our research, and other findings that are not directly related to our topic but could contribute to better public space recycling.

5.1 Recommendations

To recap the recommendations made in Chapter 4.3, we suggested two common forms of public space recycling, event recycling and permanent recycling. For optimal access, we recommended parallel placement of recycling and garbage receptacles, regular servicing and maintenance of bins, monitoring of collection frequency and tonnage of contaminants in recycling, follow-up research, and relocation of underperforming bins. To incentivize public space recycling, we also recommended financial assistance for municipalities to implement permanent recycling, lending of receptacles to event coordinators, and fines for violations of policies related to public space recycling. In order to educate the public on public space recycling, we recommend requiring municipalities to include provisions for holding educational events or distributing educational materials in their programs. In the case of bin design, we recommended the use of visual hints and clear labeling to encourage proper use of receptacles and to prevent contamination. Durable receptacles in public space are highly recommended, as they may be subjected to harsh weather conditions, scavenging of beverage containers, and other forms of vandalism.

5.2 Additional observations

In the course of our research, we encountered additional findings that may be of relevance. We list them here for the benefit of our sponsors and those who wish to expand upon our research.

Some communities do not only promote recycling, but also discourage the use of nonrecyclable materials. The Vermont Universal Recycling Law suggests placing a tax

on “all nonrecyclable, nonbiodegradable products or packaging” to provide an incentive for producers (10 V.S.A. § 6604). The City of Seattle prohibited “the use of expanded polystyrene food service containers” and required the “food service business to transition from disposable plastic food service ware to compostable and recyclable alternatives” in 2008 (“City of Seattle Legislative,” n.d.).

Massachusetts may also consider requiring producers to put recycling or disposal labels on their product packaging. Vermont has developed universal symbols for trash, recycling, and food scraps, which are used on their recycling bins. If these same symbols were to be printed on packaging, they could serve as straightforward instructions on what should be recycled and how, as well as remind the consumer to recycle. If the labels were printed on both product packaging and recycling bins, the consumer can simply dispose of their waste in the matching bins. Figures 15 and 16 show how symbols on London’s food packaging matches the recycling bins used during the London 2012 Summer Olympics (“Zero Waste Game,” n.d.).

Figure 15: A Recycling bin, a composting bin and a trash bin used at the London Olympics (“Zero Waste Game,” n.d.)

Figure 16: Color-coded recycling and composting symbols on food packaging in London (Sullivan, 2012)

5.3 Next steps for Massachusetts

The time constraints on our research did not allow us to perform the analysis or receive the feedback on our recommendations as we initially proposed. The next step for Massachusetts might be to take our recommendations to a focus group or conduct more interviews with stakeholders to obtain feedback from a broader range of viewpoints. The stakeholders may have more informed opinions on event recycling and permanent recycling. After that, follow-up research on the feasibility of implementing one or both of the options suggested by this report may be conducted to guide the proposal of a detailed plan or piece of legislation for Massachusetts.

5.4 Conclusion

Through our research, it became clear to us that public space recycling is underdeveloped at this time. There was not enough data on the cost of the programs we studied and their impact on recycling as a whole to perform a cost-benefit analysis on the types of public space recycling which we examined. This is mainly due to a lack of public reporting on the outcomes of pilot programs and policies alike. Another reason may be that the impact of recycling education and the educational benefit of public space recycling are difficult to determine. What is clear to us is that permanent public space

recycling is an expensive investment, but there are options such as pilot programs which could be used in an experiment to better understand how public space recycling might work for Massachusetts. We appreciate the opportunity to contribute to this worthy cause and thank our sponsors, advisors, and interviewees for supporting and guiding us through this experience.

Bibliography

2007 Public Space Recycling Pilot. (2007): New York City Department of Sanitation; Bureau of Waste Prevention, Reuse and Recycling.

2010 Annual Report: Making Manitoba a Recycling Leader. (2010).

2010 Solid Waste Data Update (2011). Retrieved November 10, 2013, from http://www.mass.gov/dep/recycle/priorities/10swdata.pdf

2012 Annual Report: Full of Value. (2012).

A Local Law to amend the administrative code of the city of New York, in relation to public space recycling and a citywide textile reuse and recycling program, and the repeal and reenactment of section 16-310 of the administrative code of the city of New York, relating to batteries and tires., 2010/038 C.F.R. (2010).

A Review of Litter Studies, Attitude Surveys and Other Litter-related Literature. (2007).

About BWPRR. New York City Department of Sanitation; Bureau of Waste Prevention, Reuse, and Recycle.

Arizona Department of Environmental Quality Annual Report. (2000) Public Education in Recycling.

Bottle Bills in the USA: Massachusetts. (July 25, 2013). Bottle Bill Resource Guide. Retrieved November 10, 2013 from http://www.bottlebill.org/legislation/usa/massachusetts.htm.

Buwalda, T. American Beverage Association and Palm Beach County. Retrieved February 11, 2014, from http://recyclefloridatoday.org/proceedings/2013ac/buwalda.pdf

California Public Resources Code Section 42648-42648.7 (2004).

Chapter 10. Streets, Alleys, Sidewalks and Gutters.

Chapter 70.93 RCW. Waste Reduction, Recycling and Model Litter Control Act.

Chapter 287. Solid Waste Reduction, Recovery and Recycling.

Chapter 311 (2008).

Chapter Fourteen. Parks and Land Use.

Chapter NR 544. (2013) Effective Recycling Programs.

Christie Administration Awards $13.1 Million in Grants to Bolster Local Recycling Efforts (2012). Retrieved February 8, 2014, from http://www.nj.gov/dep/newsrel/2012/12_0123.htm

City of Seattle Legislative Information Service. Retrieved February 26, 2014, from http://clerk.seattle.gov/~scripts/nph-brs.exe?s1=&s3=&s4=122751&s2=&s5=&Sect4=AND&l=20&Sect2=THESON&Sect3=PLURON&Sect5=CBORY&Sect6=HITOFF&d=ORDF&p=1&u=%2F~public%2Fcbory.htm&r=1&f=G

Combs, M. (2009). Creating art to change public behavior. Retrieved February 9, 2014, from http://blogs.mprnews.org/state-of-the-arts/2009/06/creating-art-to-change-public-behavior/

Cruey, L., Magness, S., Rechenberg, C., Sandman, P., & Smith, J. (1997). The impact of recycling education on the knowledge, attitudes, and behaviors of grade school children. Education.

Definitions § 6621a.

DEP Awards $13 Million in Grants to Assist Local Recycling Efforts; Statewide Recycling Rates Trending Upward. (2011). Retrieved February 8, 2014, from http://www.state.nj.us/dep/newsrel/2011/11_0005.htm

Development of Best Practices in Public Space Recycling. (2011): Eureka Recycling.

Estensen, E. V. (2008). A Qualitative Study of the Effects of an Economic Incentive on Recycling Motivations and Behaviors at Household Waste Level. (Master), Norwegian University of Life Sciences. Retrieved February 1, 2014 from http://brage.bibsys.no/umb/retrieve/4716/Estensen2013.pdf

Iyer, Easwar S. and Kashyap, Rajiv K. (2007). Consumer recycling: Role of incentives, information, and social class. Journal of Consumer Behaviour.

Kalan, Lesley G. and Feiock, Richard C. (2001). Assessing the Performance of Solid Waste Recycling Programs over Time. SAGE, 30-31.

Koch, W. (2010). Getting Paid to Save Energy, Recycle? Incentives Expand, USA Today. Retrieved February 2, 2014 from http://content.usatoday.com/communities/greenhouse/post/2010/03/getting-paid-to-save-energy-recycle-incentives-expand/1#.Uu6wnHddUgB

Lambert, J. (2007). Pay-As-You-Throw (PAYT) in Massachusetts.

Landfill Disposal Requirements § 6621a.

Lange, R. (2007). New York City Public Space Recycling Pilot Program. In J. J. Doherty.

Littering Behavior in America: Results of a National Study. (2009): Action Research, Inc.

Maclean, A. Universal Recycling Act 148.

Magic Kingdom Facts. Retrieved February 2, 2014 from http://www.disneytrivia.net/park_pages/wdw_mk_facts.php

Meinhold, B. (2010). New York's Recycling Program Finally Getting Expanded!

Monofilament Fishing Line Recycling. (2012). Retrieved February 8, 2014, from http://www.nj.gov/dep/njcleanmarina/fishing_line_recycling.html

Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010. (2011). http://www.epa.gov/wastes/nonhaz/municipal/pubs/msw_2010_rev_factsheet.pdf

New Jersey Coastal Management Program. (2010). Retrieved February 10, 2014 from http://www.state.nj.us/dep/cmp/2010-309-assessment.pdf

Non-Hazardous Waste Management Hierarchy. (2013, 2013, November 22). Retrieved January 16, 2014, from http://www.epa.gov/waste/nonhaz/municipal/hierarchy.htm

Oakleaf, B. (2013). Comparison of System Costs and Materials Recovery Rates-Implementation of Universal Single Stream Recycling With and Without Beverage Container Deposits.

Overview of Greenhouse Gases. Retrieved February 10, 2014 from http://epa.gov/climatechange/ghgemissions/gases/ch4.html

Palm Beach County and ABA. Retrieved February 11, 2014, from http://mydelraybeach.com/sites/default/files/assets/boards%20and%20committees/green%20implementation%20advancement%20board/Public%20Space%20Recycling%20Pilot%20%20Post%20Start%20Presentation.pptx

Patten, S. (1998). Virginia Adopt-a-Highway Report.

Pay-As-You-Throw (2012). Retrieved January 28, 2014, from http://www.epa.gov/epawaste/conserve/tools/payt/index.htm

Personal Responsibility in a Desirable Environment. (2014). Retrieved February 2, 2014, from http://kypride.org/educate/

Plastic Compounder's PET Project: Recycling. (2008). Retrieved January 31, 2014, from http://machinedesign.com/archive/plastic-compounder-s-pet-project-recycling

Public Collection Containers for Solid Waste § 6605l.

Public Place Recycling (2010). Retrieved February 12, 2014, from http://www.publicplacerecycling.org/

Public Place Recycling (2011). Retrieved February 13, 2014, from http://www.waukeshacounty.gov/defaultwc.aspx?id=40017

Public Space Recycling. Retrieved February 5, 2014, from http://www.nyc.gov/html/nycwasteless/html/recycling/publicspace.shtml#street_corners

Public Space Recycling § 16-310 (2010).

Public Space Recycling on NYC Street Corners, on Subway Platforms and Stations, in NYC Airports and Bus Terminals. New York City Department of Sanitation; Bureau of Waste Prevention, Reuse, and Recycle.

Recycle Outreach and Education. (2014). Retrieved February 2, 2014, from http://www.dec.ny.gov/chemical/8506.html

Recycling Away From Home. Retrieved February 15, 2014, from http://dnr.wi.gov/topic/Recycling/awayfromhome.html

Recycling and Art Meet in Mears Park. Retrieved February 3, 2014, from http://www.ci.stpaul.mn.us/index.aspx?NID=3293

Recycling and Waste Prevention. Public Education and Outreach. Retrieved February 4, 2014, from http://www.nyc.gov/html/nycwasteless/html/about/about.shtml

Recycling at Large Events in Oakland. Retrieved February 6, 2014, from http://www2.oaklandnet.com/oakca1/groups/pwa/documents/agenda/oak032150.pdf

Recycling Education/Community Outreach Programs. Retrieved January 30, 2014, from http://www.mcia-nj.com/content/119/519/default.aspx

Recycling Legislation in Canada: Manitoba. (2011). Retrieved February 14, 2014, from http://www.bottlebill.org/legislation/canada/manitoba.htm#ref2

Recycling Poetry Contest (2013). Retrieved February 9, 2014, from http://www.state.nj.us/dep/seeds/brpposc.htm

Report to the Legislature: Large Venue and Event Waste Reduction, Recycling, and Composting Programs (2009). Retrieved February 7, 2014, from http://www.calrecycle.ca.gov/Publications/Documents/Reduce%5C2011012.pdf

Report to the Vermont Legislature: Act 148 Implementation. (2013).

Rogers, H. (2005). Gone Tomorrow: The Hidden Life of Garbage. New York: The New Press.

San Francisco Uses Ordinance to Promote Recycling in Public Places. Recycle on the Go Success Story. Retrieved February 3, 2014, from http://www.epa.gov/epawaste/conserve/tools/rogo/documents/sf-ca-ord.pdf

Shin, D. (2014). Generation and Disposition of Municipal Solid Waste (MSW) in the United States A National Survey. (Master of Science), Columbia University. Retrieved February 1, 2014 from http://www.seas.columbia.edu/earth/wtert/sofos/DollyShinThesis.pdf

Sidiquea, S., Joshib, S., & Lup, F. (2009). Factors influencing the rate of recycling: An analysis of Minnesota counties. Resources, Conservation and Recycling. Retrieved February 9, 2014, from https://www.msu.edu/~lupi/Minn_recycle_rates_Sidique-Joshi-Lupi_2010_RCR.pdf

Solid Waste and Recycling. (2012): New Jersey Department of Environmental Protection.

Solid Waste Management Plan.

Solid Waste Management Policy and Programs (2013).

Sponsor and producer/event manager responsibilities at street events § 16-327.

Stevenson, S. (2012). Why Are Poland Spring Bottles So Crinkly? Retrieved February 1, 2014, from http://www.slate.com/articles/business/operations/2012/06/poland_spring_s_new_bottles_why_are_they_so_thin_and_flimsy_.html

Sullivan, D. (2012). London Strives for Zero Waste Summer Olympics 2012. Biocycle, 53(9), 32.

Top Five Reasons Massachusetts Needs an Expanded Bottle Bill. (2013). Retrieved November 10, 2013, from http://www.mass.gov/eea/agencies/massdep/recycle/reduce/top-5-reasons-mass-needs-expanded-bottle-bill.html

Universal Recycling Symbols. Retrieved February 15, 2014, from http://www.anr.state.vt.us/dec/wastediv/solid/urs/

Vee, A. (2013). Report on 2012 SCORE Programs. Retrieved from http://www.pca.state.mn.us/index.php/view-document.html?gid=20438.

Waste Recovery and Compost. Retrieved February 8, 2014, from http://www.deq.state.or.us/lq/sw/recovery/recyclingeducation.htm

Waukesha County Recycling and Solid Waste Program Report (2012). Retrieved February 14, 2014, from http://www.waukeshacounty.gov/uploadedFiles/Media/PDF/Parks_and_Land_Use/Recycling/Reports_and_Charts/2007%20RSW%20Prog%20Report%20FIN%2002_12_08.pdf

Wisconsin Uses Ordinances and Permits to Promote Recycling in Public Places (2007): United States Environmental Protection Agency (EPA).

What Happens to Recyclables. New York City Department of Sanitation; Bureau of Waste Prevention, Reuse, and Recycle.

What is a Bottle Bill? Bottle Bill Resource Guide. Retrieved November 10, 2013, from http://www.bottlebill.org/about/whatis.htm

What is a Bottle Bill? Retrieved November 21, 2013, from http://www.bottlebill.org/about/whatis.htm

Who We Are. Retrieved October 30, 2013, from http://www.realrecyclingmass.com/who-we-are

Zero Waste Game (2012). Retrieved February 20, 2014, from http://www.hometowndumpsterrental.com/blog/sustainable-london-olympic-games

Appendix A. Interview Questions

1. What is your opinion on the current state of recycling in public spaces? For example: parks, ball fields, and marinas.
2. Do you believe enough material is being recycled, or do you think there is room for improvement?
3. What kinds of recyclables, if any, have you identified as being disposed of as trash in public spaces due to inadequate access to recycling opportunities, or any other reasons?
4. What would you suggest to improve public space recycling?
5. Are there any public spaces that you would consider as needing more attention in terms of recycling than others?
6. Would you prefer that a statewide public recycling program for Massachusetts be managed by the government, or by private companies? If the government should manage the program, should it be at the state or community level? Why?
7. What outcome in particular do you want to see from a public recycling program?
8. What do you think the obstacles to public space recycling would be? What do you think could go wrong?
9. Do you believe your view represents a popular opinion, or are there individuals or groups you can think of who disagree?
10. Are there any individuals or organizations you can suggest that we could talk to for more information?

Appendix B. List of Research Questions

1. What are the state policies related to public space recycling?
2. What spaces are considered to be public spaces?
3. Which materials are recyclable in the spaces?
4. Which government agency or private organization is responsible for managing the program? Is the agency state or community based?
5. How does the program receive funding?
6. What recycling opportunities are made available in the public space?
7. How much does the program cost?
8. How has the introduction of the program affected recycling rates?
9. How is the policy or program advertised to the public?
10. How well do residents recognize and support the program or policy?

Appendix C. Recycling Rates in the United States