



Worcester Polytechnic Institute

Improving WPI Campus Community Recycling

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Abstract

This IQP produced recommendations for WPI to increase overall recycling rates on campus. Our team interviewed sustainability and facilities management at WPI and third party waste collection providers. We surveyed and interviewed WPI community members consisting of students, staff, and faculty. We explored logistical variables that could effect recycling behavior, including waste bin uniformity and recycling signage. We initially explored the viability of a bottle return center on campus; however, our final suggestions relate to recycling education and infrastructure.

Executive Summary

The goal of our project was to increase recycling rates on campus and reduce the waste stream. This project began as a study of the viability and utility of bringing a bottle return center to WPI's campus as an incentive to recycle. Introducing a redemption center on the WPI campus would provide its community members with an accessible method to redeem the five cent reward for returning specific recyclable containers which may encourage thorough recycling behavior.

In order to develop recommendations our team completed the following tasks. We collected data regarding current community recycling habits through an on-line survey of 358 students, faculty, and staff at WPI. Additionally, we conducted community interviews of students in the Rubin Campus Center in which we asked more detailed questions about current recycling habits. For evaluating feasibility, we conducted semi-structured interviews with relevant stakeholders at WPI within the facilities department, sustainability department, residential services, and dining services. In order to understand the process of handling and sorting recyclables after they leave our campus, we made visits to two external recycling facilities. First, we visited Waste Management's Materials Recycling Facility in Avon, Massachusetts, a post-consumer recycling plant which handles waste from municipalities and institutions like WPI. Lastly, we visited Warehouse Plastics, a post-industrial recycling plant which primarily handles manufacturing waste from companies like McDonalds, Ford, CVS, and Gillette.

Our on-campus community interviews were the most informative in helping us understand recycling behavior and perception on campus. We learned that while most people would be willing to utilize a bottle redemption center, it would not significantly increase recycling rates. Because redeemable recyclables are some of the most commonly understood items to be recyclable, nearly everyone who said they would use the bottle redemption center also said it would only divert their recyclables into the center, not cause them to recycle more. The most prevalent concern we learned about through these interviews was a consistent lack of understanding about what is and what is not recyclable in single stream recycling. This caused many people to reduce their recycling, defaulting to trashing anything they were confused about, or unknowingly contaminating the trash. Though our research led to the conclusion that a redemption center would not be a useful initiative to invest in, we found other avenues to increase recycling we recommend be pursued.

This project concludes with recommendations to improve recycling on campus, for future project work, and for more in depth studies.

Acknowledgements

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1 Introduction

The goal of the WPI Sustainability Plan is to create solutions to problems associated with each component of sustainability: ecological stewardship, social justice, and economic security [31]. In order to accomplish this goal, WPI strives to offer its students and staff resources to help them engage in sustainable practices both on and off campus. One of the services WPI offers to the campus community is single stream recycling.

In 2015-2016, the WPI Sustainability Department conducted a waste audit of three buildings on the WPI campus: the Rubin Campus Center, Daniels Hall, and the Gordon Library [32]. In the audit, members of the WPI Student Green Team worked alongside WPI staff to weigh the contents of trash and recycling containers on a certain day. They found that 28% of the total waste they measured was recycled. Total waste refers to all items placed in both recycling and trash containers.

This measurement does not take into account the weight of trash improperly placed in the recycling bins. For example, 20% of waste in the Gordon Library was recycled; however, only 60% of the contents in the recycling bin were appropriate materials for recycling and 40% of items in the recycling bins were trash [24]. The audit also measured the amount of recyclable materials placed in the trash across campus and determined that 32% of the total waste produced in these buildings could have been recycled in on-campus recycling bins. The difference between the measured and potential recycling rates produced by the waste audit shows that the recycling rates on-campus have not yet reached their maximum potential. In an interview conducted with Liz Tomaszewski, the sustainability coordinator of WPI, she stated that there is a need for improvement in the area of recycling rates on the WPI campus [18].

In order to increase recycling rates, we needed to understand the motivation, or lack thereof, that WPI community members have toward making use of available recycling options on campus. Initially, the focus of this IQP was to investigate the viability and effectiveness of an incentive program to improve campus recycling rates of redeemable bottles, redeemable cans, and non-redeemable plastics. Understanding behavioral patterns that influence people to recycle is crucial to improve WPI community members' motivation to appropriately dispose of waste. Through understanding the apparent lack of motivation and confusion from students surrounding proper recycling techniques, we produced recommendations that WPI could implement to increase recycling rates. After preliminary research, the focus of the IQP moved away from incentive programs and toward on-campus recycling practices in general. The goal of this research was to ultimately increase WPI's recycling rates through developing specific recommendations, suggesting potential further research, and targeting key variables contributing to inefficient recycling practices.

2 Background

In this chapter we summarized relevant, published, and available material related to our topic of college campus recycling. The chapter begins by introducing the current state of WPI campus recycling, including existing recycling practices, and then goes on to discuss the impact of recycling on the environment. The next section shows how recycling programs at other colleges, specifically UC Davis, Kalamazoo, and RIT, are run. The background then shifts to discuss incentive programs and how they affect WPI students, with an emphasis on recycling based initiatives. This chapter concludes with a description of interview formats.

2.1 WPI's Recycling Program

During WPI's annual waste audit on November 9, 2016 [24], students in the Green Team, staff, and faculty volunteered to sort through the waste, which is comprised of both trash and recycling, of three buildings on the WPI campus. Gordon Library, Rubin Campus Center, and Daniel's hall were the buildings selected for the audit.

The bags of waste were initially weighed and recorded then the contents were sorted into several categories: landfill, bottles and cans, cardboard, paper, liquids and food waste [24]. As these sorting bags were filled up, their new weights were recorded, and the process continued until each building was finished [24].

The waste audit analyzed what was in recycle bins of the three buildings using three different formulas shown in Equations 1, 2, and 3. The first formula represents the weight of items in the recycling bins divided by the total weight of waste, referred to as pre-sort rate. This measurement was used as a way for the Student Green Team to compare recycling rates with those of past years [24].

For the purpose of our study, we focused on Equations 2 and 3 since they calculate true recycling rate and potential recycling rate respectively. The true recycling rate represents the weight of only the correctly recycled materials in the recycling bins that were observed as a percentage of total waste [24]. The true recycling rate provides an estimate of how much material thrown away is really recycled. The third formula is potential recycling rate, defined as the weight of all recyclable items placed in either bin divided by the total weight of waste. This shows how much waste being produced is recyclable [24].

$$\frac{\textit{TotalWeightOfItemsInRecyclingBins}}{\textit{TotalWeightOfAllWaste(trash + recycling)}} = \textit{recyclingratebyweightofbins} \quad (1)$$

$$\frac{\textit{TotalWeightOfItemsCorrectlyRecycledInRecyclingBins}}{\textit{TotalWeightOfAllWaste(trash + recycling)}} = \textit{truerecyclingrate} \quad (2)$$

$$\frac{\textit{TotalWeightOfAllRecyclableItems}}{\textit{TotalWeightOfAllWaste(trash + recycling)}} = \textit{potentialrecyclingrate} \quad (3)$$

Each of the examined locations' true recycling rate was at least 10% lower than the calculated potential recycling rate. This demonstrates a potential for increasing campus recycling rates by addressing recycling issues in these buildings. The true vs. potential rates for each building were 12% vs. 22% for the Gordon Library, 12% vs. 22% for the Rubin Campus Center, and 20% vs. 33% for Daniel's Hall.

As shown in Figure 1, 42% of materials placed in recycling bins were non-recyclable items proving that the recycling and trash bins are being inappropriately utilized. This figure is the sum of non-recyclable items including trash, food waste, liquid, or interesting items. 12% of materials placed in trash bins were recyclable items. This figure is the sum of the percentages of recyclable items including paper, cardboard, and plastic. Similar results occur with the 2 other buildings included in the waste audit: Daniel's Hall and the Rubin Campus Center.

The graphs for both The Rubin Campus Center and Gordon Library waste audit data can be found in Appendix B. Recycling behavior on campus may be improved by addressing issues regarding inappropriate utilization of waste receptacles in these buildings.

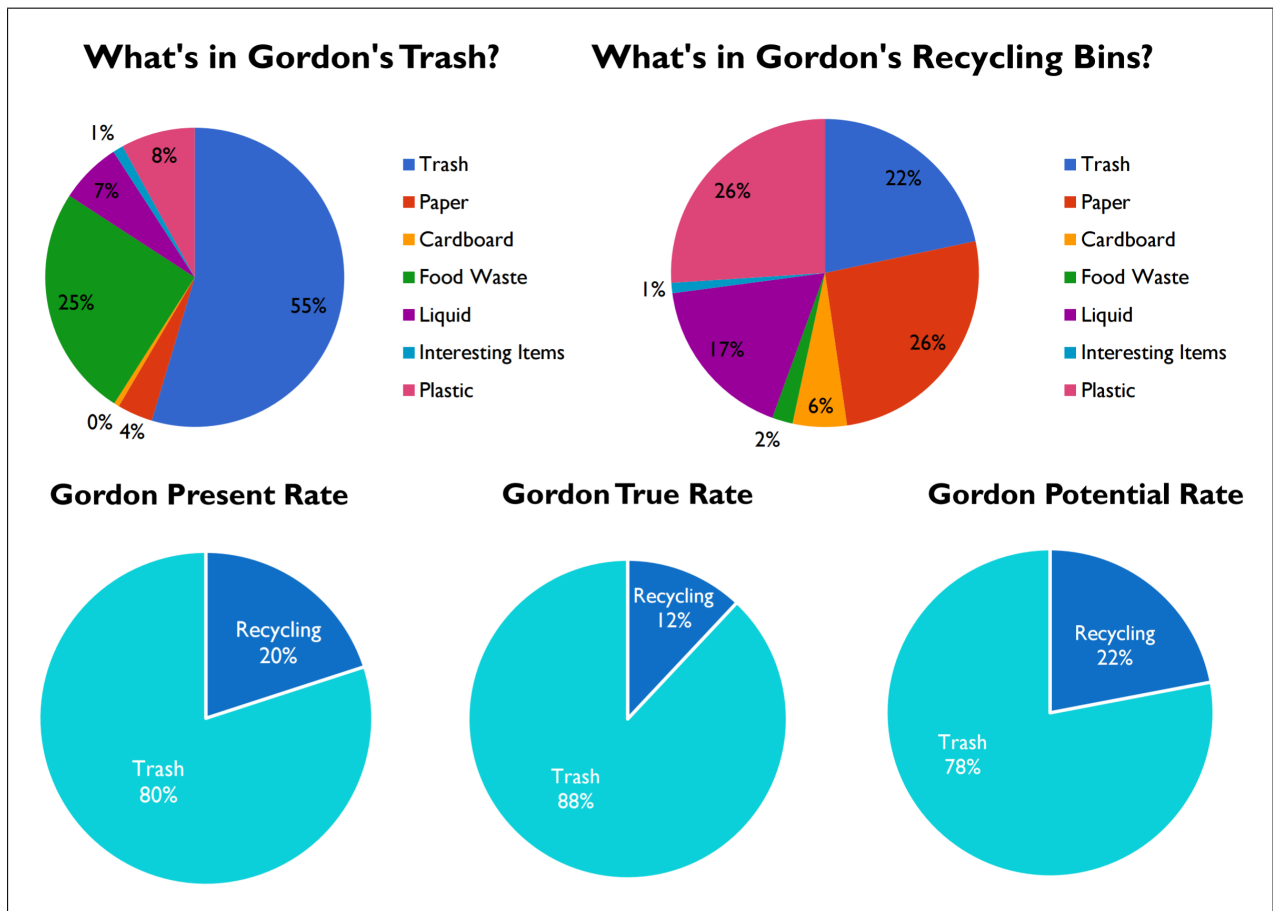


Figure 1: Pie charts showing what constitutes waste and trash in Gordon Library [24]. The two graphs at the top are raw measurements shown as percentages. The three graphs at the bottom of the figure are derived from the top two.

It is also important to note that the measurements presented in Figure 1 represent one day's worth of waste and therefore can vary depending on many conditions. The data can still be compared to previous years which used the same approach of one day's worth of trash [24]. When examining the waste audit data from 2014 and 2015, some patterns were identifiable.

In 2014 WPI switched recycling methods from dual-stream to single-stream in the hopes that it would improve recycling rates on-campus. However, the recycling rate for Gordon Library was only 4% [22]. Since 2014, the recycling rate for Gordon Library increased from 4% to 14.1% in 2015, and was 12% in 2016. However, the potential rates decreased from 40% in 2014, to 24% in 2015, and 22% in 2016, showing the relative decrease of recyclable material being thrown in the trash stream. The 10% difference between the true and potential recycling rates stayed constant from 2015 to 2016, showing no increase in recycling behavior

between years. Recorded current recycling rates for the Rubin Campus Center, Morgan Hall, and Daniels Hall were all the lowest in 2014.[22]

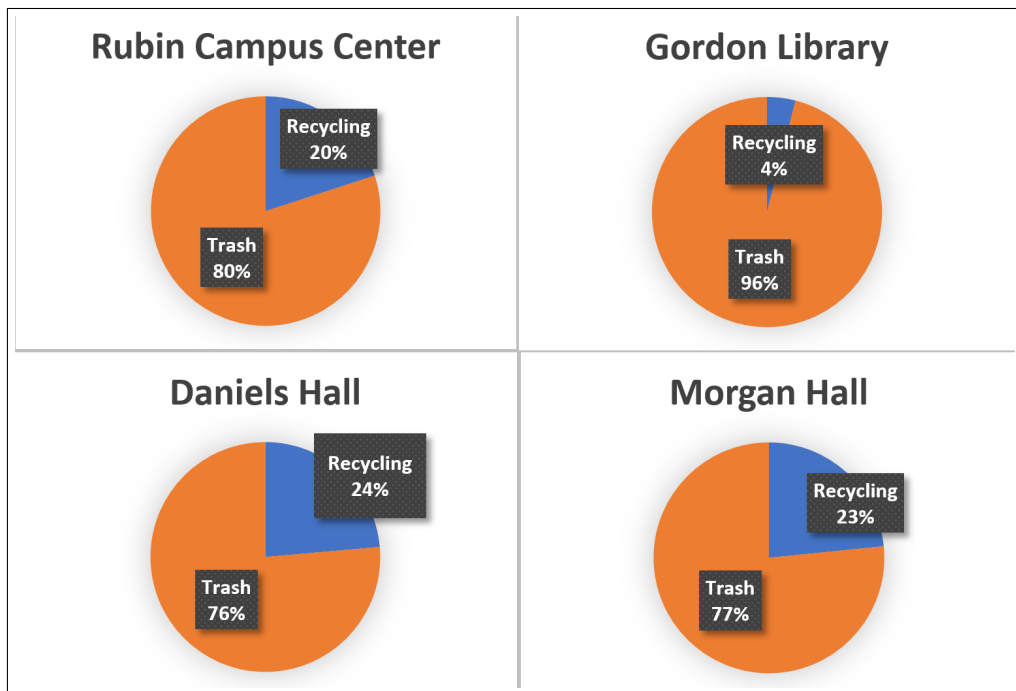


Figure 2: Pie charts showing the recycling rates from the 2014 Waste Audit for the Rubin Campus Center, Gordon Library, Morgan Hall, and Daniels Hall [22]

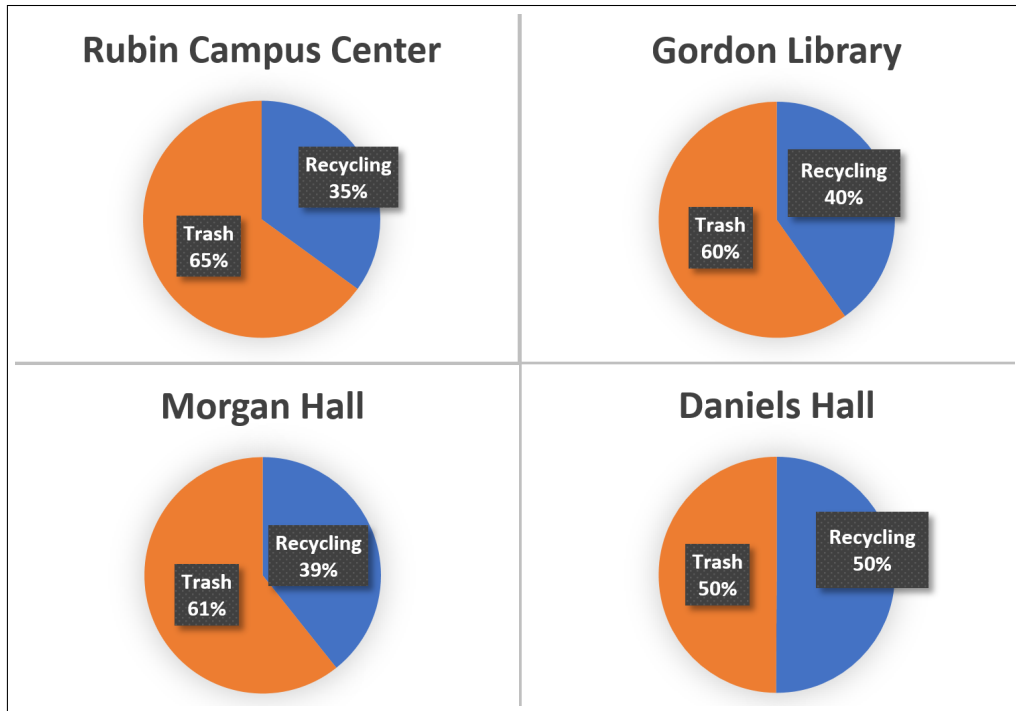


Figure 3: Pie charts showing the potential recycling rates from the 2014 Waste Audit for the Rubin Campus Center, Gordon Library, Morgan Hall, and Daniels Hall [22]

Due to inclement weather, the 2015-2016 waste audit occurred in the spring of 2016, unlike the 2014-2015 and 2016-2017 waste audits which occurred in the fall of their respective academic years. The pre-sort rates were higher in this audit, but still showed potential rates that were much higher. However, other patterns involving trash in recycling were evident in the data. In Daniels Hall and Gordon Library in 2015, trash in recyclables represented 2.6% and 4.4% of the overall waste stream, respectively. For Daniels, this meant that 29% of the recycle stream was actually non-recyclable materials incorrectly placed in the recycling bins. Gordon Library's recycling stream was 31% non-recyclable waste.

The Campus Center had the highest recycling rate and the lowest rate of trash in recyclables. The bulk of the recycling was cardboard, as seen in Figure 4. Because of the commercial nature of the Campus Center, cardboard packaging usage rates are much higher than residential buildings or the library. Plastic and paper recycling only accounted for a combined 2.8% of the overall waste stream in the Campus Center.

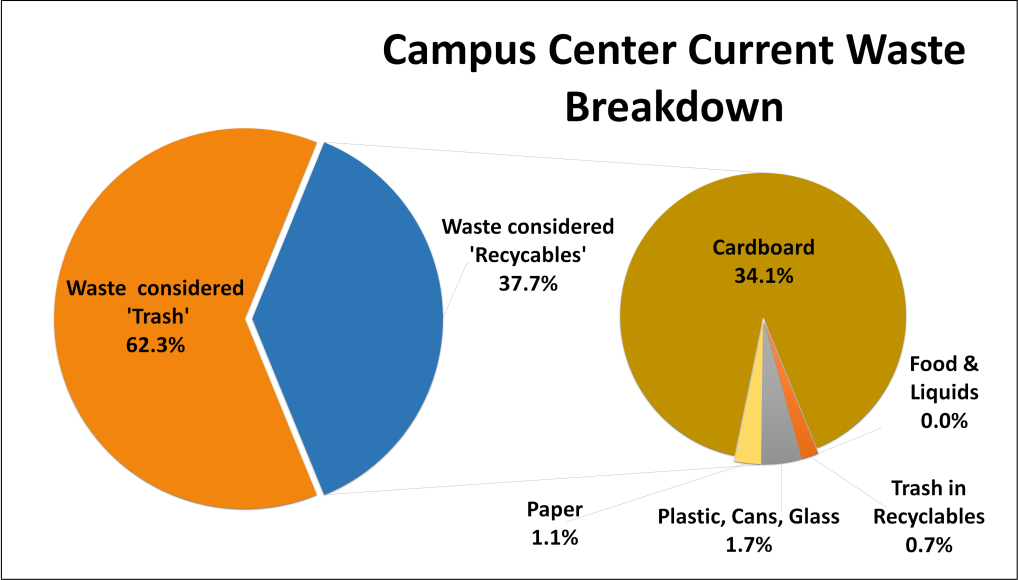


Figure 4: Pie charts showing the ratio and breakdown of the waste and recycling streams from the 2015 Waste Audit in the Rubin Campus Center [23]. The chart on the left shows what percentage of waste is trash and recycling. The chart on the right shows the breakdown of recycling by type.

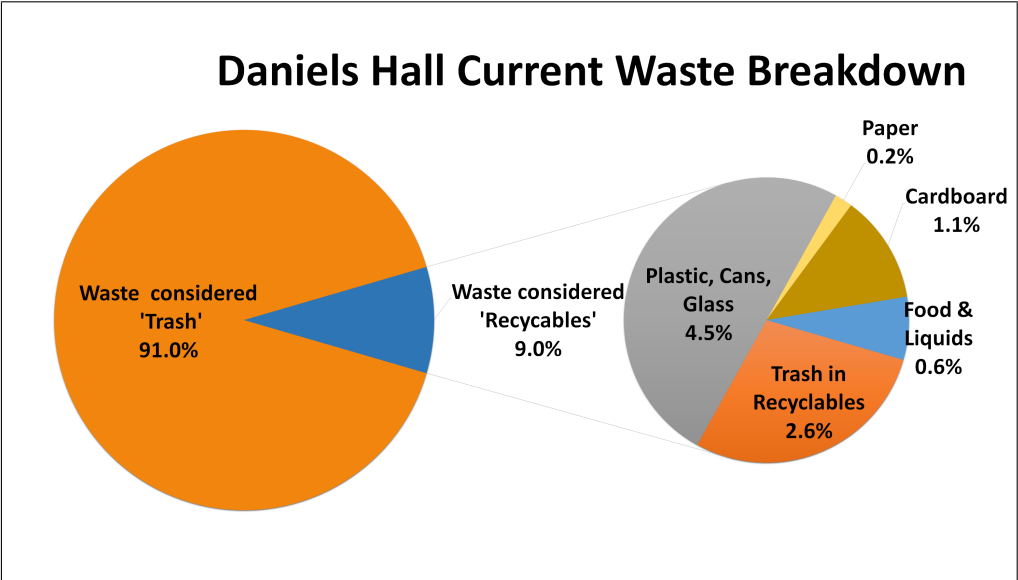


Figure 5: Pie charts showing the ratio and breakdown of the waste and recycling streams from the 2015 Waste Audit in Daniels Hall [23]. The chart on the left shows what percentage of waste is trash and recycling. The chart on the right shows the breakdown of recycling by type.

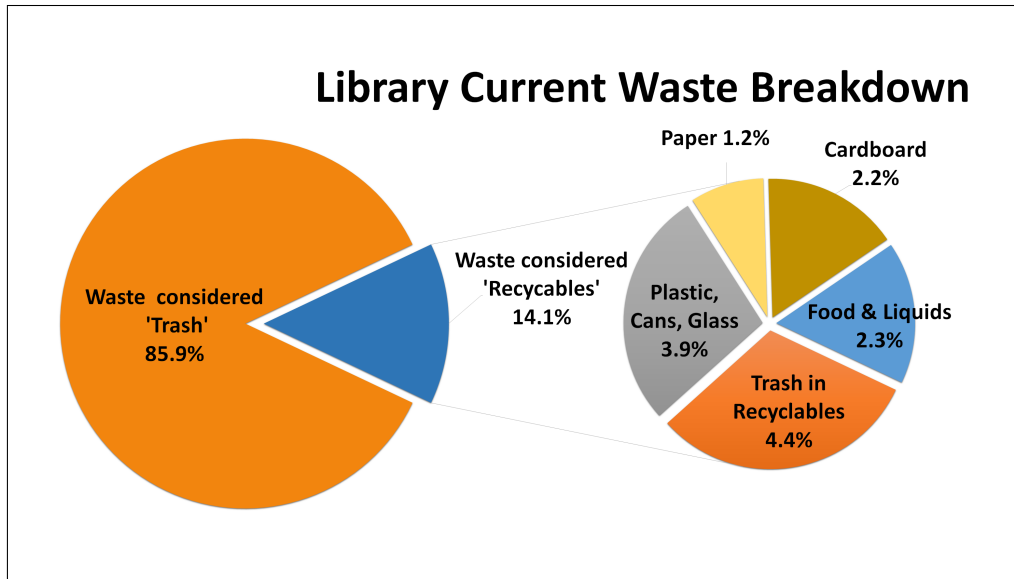


Figure 6: Pie charts showing the ratio and breakdown of the waste and the recycling streams from the 2015 Waste Audit in Gordon Library [23]. The chart on the left shows what percentage of waste is trash and recycling. The chart on the right shows the breakdown of recycling by type.

2.1.1 Campus Recycling Procedures

In 2008 an IQP by Kocsis and Tui looked into the apparent lack of recycling options on the WPI campus [26]. At the time, only electrical waste and office waste were recycled, leaving most recyclables to be trashed. The team noted the lack of options, and through its research and suggestions led to the implementation of single stream recycling on-campus.

The 2015 IQP research project by Chaves et al. examined waste management on-campus [13]. This study gave a more recent comprehensive analysis of trash and recyclable materials generated as well as illuminating trends in recycling behavior. In 2014, WPI officially switched from a dual stream recycling system to single stream in an attempt to increase the rate at which recyclable materials are placed in recycling bins. In contrast to this prediction, the team observed a decrease in usage of recycling receptacles on campus. This was attributed to a lack of proper communication to the WPI community on the switch to single-stream recycling. Information, such as appropriate recycling behavior and acceptable items to be recycled, was not properly disseminated regarding the new recycling system [13].

2.1.2 Motivation Regarding Recycling

There are many factors that contribute to students and staff not participating in recycling on-campus. According to the IQP study conducted by Chaves et al., lack of motivation is

one of the most prevalent reasons behind the lack of student recycling on-campus [13].

Figure 7 provides a graphical representation of student responses to a survey question asked by Chaves et al. in 2015. Students were asked what they would do if they needed to dispose of a water bottle at the end of a class and no recycle bin was in sight. Of the 276 responses gathered, 76 (28%) said that they would just throw the bottle away in the trash. 93 (34%) of the participants responded that they would wait to find a recycling bin to dispose of the bottle. 100 (36%) of the participants responded that they would reuse or refill the plastic bottle in their hands. This demonstrates that about 193 (70%) of students would practice sustainable behavior in a hypothetical situation. Improvements in overall community practices can still be made.

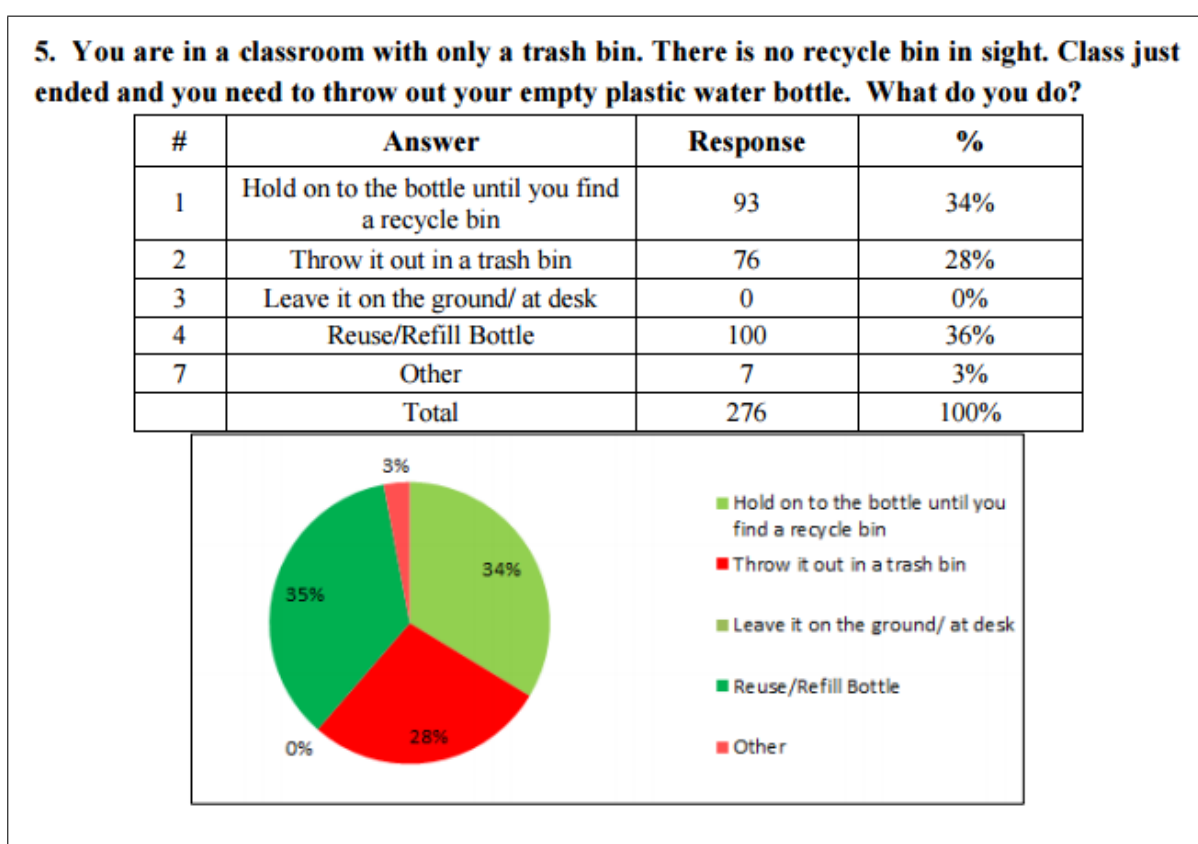


Figure 7: A graph of results of one question asked by Chaves et al in their IQP survey [13]. The data represents the behavior of students in a hypothetical recycling situation.

2.1.3 Waste Management Data

WPI currently contracts Waste Management to collect and dispose of recycling and trash streams on-campus. Our contact at Waste Management, Michelle Lee Guiney, shared data from the 2016 WPI Waste Stream Summary. Figures 8 and 9 detail the waste stream

breakdowns by tonnage for each major component of trash and recycling: paper, plastic, glass, aluminum, cardboard, and organics; as well as the environmental impact of the diverted waste streams.

Figures 8 and 9 also detail how much material went to waste-to-energy facilities, how much waste was diverted through the recycling stream, and a breakdown of the diverted single stream. Below the Waste Stream Summaries, Waste Management provides comparative figures to describe the energy usage, natural resource usage, and greenhouse gas (GHG) emission prevention that occurred through diverting waste into recycling.

This data presented in Figures 8 and 9 shows more comprehensive year-round average recycling rates than the WPI annual waste audit can provide. During January through June of 2016, WPI produced a waste stream that was 82% trash and 18% recycling. During July through December of 2016, WPI produced a waste stream that was 80% trash and 20% recycling. These rates are still well below the projected potential rate for the school [18].

Waste Management also provided data on the metric tons of carbon equivalent (MTCE) conserved by the recycling stream. For the entirety of 2016, diverting trash from the waste stream conserved a total of 523 MTCE in GHG emissions (represented at the bottom of the Figures 8 and 9 as MTCO₂E).

Worcester Polytechnic Institute 2016 Waste Stream Summary

Jan. through June



WTE*	319.14 tons	82%
Diverted	70.79 tons	18%
Total	389.93 tons	100%

* Waste-to-Energy: Providing clean energy and saving space in landfills!

Diverted material includes:

Single Stream Material:

Paper	11.80 tons	Organics	0.00 tons
Plastic	6.29 tons		
Aluminum	1.57 tons		
Glass	2.36 tons		
Cardboard	48.77 tons		

These recycling efforts conserved the following resources:



382,106 kW-hrs of electricity
Enough to power 36 homes for a full year



868 mature trees
Enough to produce 10,759,971 sheets of newspaper



423,990 gallons of water
Enough to meet the fresh water needs of 5,653 people



279 cubic yards of landfill airspace
Enough airspace to meet the disposal needs of a community of 358 people



255 metric tons (MTCO2E) of GHG Emissions
The recycling of these materials prevented these GHG emissions!

Created on January 6, 2017

The recycling and waste data used in this report is based on actual customer data and historic WM studies.

Figure 8: Waste Management data presenting how much recyclable material was diverted from the waste stream between January and June in 2016 and the positive environmental impacts. The upper half of the figure shows the measured waste produced by WPI which goes to landfills and recycling centers. The lower half of the figure shows measurements of resources conserved expressed in various units as a result of the recycling weight.

Worcester Polytechnic Institute 2016 Waste Stream Summary

July through December



WTE*	300.66 tons	80%
Diverted	74.50 tons	20%
Total	375.16 tons	100%

* Waste-to-Energy: Providing clean energy and saving space in landfills!

Diverted material includes:

Single Stream Material:

Paper	12.42 tons	Organics	0.00 tons
Plastic	6.62 tons		
Aluminum	1.66 tons		
Glass	2.48 tons		
Cardboard	51.32 tons		

These recycling efforts conserved the following resources:

- 374,386 kW-hrs of electricity**
Enough to power 35 homes for a full year
- 914 mature trees**
Enough to produce 11,323,468 sheets of newspaper
- 446,180 gallons of water**
Enough to meet the fresh water needs of 5,949 people
- 294 cubic yards of landfill airspace**
Enough airspace to meet the disposal needs of a community of 377 people
- 268 metric tons (MTCO2E) of GHG Emissions**
The recycling of these materials prevented these GHG emissions!

Created on January 6, 2017

The recycling and waste data used in this report is based on actual customer data and historic WM studies.

Figure 9: Waste Management data presenting how much recyclable material was diverted from the waste stream between July and December in 2016 and the positive environmental impacts. The upper half of the figure shows the measured waste produced by WPI which goes to landfills and recycling centers. The lower half of the figure shows measurements of resources conserved expressed in various units as a result of the recycling weight.

2.2 Impact of Plastics on the Environment

Of the recyclable materials that end up in the trash at WPI, plastics represent the biggest threat to environmental health and safety as a result of improper disposal [5]. Plastics are polymeric materials that are usually low in cost and synthetic and can be either organic or inorganic. Most new plastics are developed from petrochemicals, compounds derived from refining oil and natural gas [17]. This production process results in GHG carbon emissions. However, the process of recycling plastics produces less GHG emissions than creating new plastics [12]. Data gathered by the EPA compares the MTCE produced by both creation and recycling of the two main sources of plastic for beverage containers: polyethylene terephthalate (PET, also referred to as #1 plastics) and high-density polyethylene (HDPE, also referred to as #2 plastics). The total process emissions for recycling both PET and HDPE are drastically lower than emissions released through creation of new material.

Total Process Emissions (MTCE)		
	PET	HDPE
Virgin Material	0.58	0.53
Recycled Material	0.04	.04

Table 1: Data from an EPA analysis showing the metric tons of carbon equivalent (MTCE) from producing 1 ton of virgin plastic material and 1 ton of recycled plastic material [12]

Unfortunately, plastics are non-biodegradable and often end up in landfills where weathering and chemical degradation can cause their slow breakdown. This breakdown can potentially introduce toxic substances into the environment [5] and the breakdown of larger plastic items can create microplastics, plastic particles smaller than 1 mm [7]. Microplastics are a potential pollution source groundwater, as well a saltwater and freshwater environmental [14].

An additional environmental risk posed by introducing plastic waste to an ecosystem is physical harm to the fauna. Small pieces of plastic have been found in the gastrointestinal tracts of many marine and avian organisms, which eventually resulted in permanent injury or death [16]. The harm caused to animals by plastics in these ecosystems can be avoided by disposing of plastics properly in landfills or recycling facilities.

2.3 AASHE and STARS®

The Association for the Advancement of Sustainability in Higher Education (AASHE) is a non-profit organization that monitors and supports sustainable practices on North American

college campuses [4]. AASHE helps shape educational policies as well as consults with campuses on best available sustainable practices.

One of AASHE’s methods is a program titled Sustainability Tracking, Assessment & Rating System™ (STARS®). This is a self-reporting, hierarchical analysis of individual campus’s sustainable practices [3]. Each participating school is responsible for submitting data on energy sources and usage, waste stream management, emissions output, health and safety, water usage, and grounds-keeping. They are then rated for each subcategory within the sustainability framework by a certain number of points, which are ultimately summed to represent one overall score for each school. Participating schools can receive 5 different rankings from STARS: Reporter, Bronze, Silver, Gold, and Platinum. Schools can view their rank on the AASHE website [4].

AASHE has created educational incentives to encourage not only participation in their STARS program, but efforts on behalf of college campuses to improve their rankings within it as well. As of April 16, 2015, WPI was assigned a Silver rating with a score of 56.9. Figure 10 shows the current distribution of STARS ratings for active AASHE college campuses [3]. It is important to note that over one third of participating schools have achieved a gold ranking, showing the possibility for improvement in WPI’s sustainability performance.

Achieving a higher rating in the STARS program would benefit WPI by asserting the school’s presence in the college campus sustainability community, improving public opinion of the school. According to the Princeton Review, 61% of students report that having information regarding a school’s sustainability efforts would influence their decision to attend the college [21].

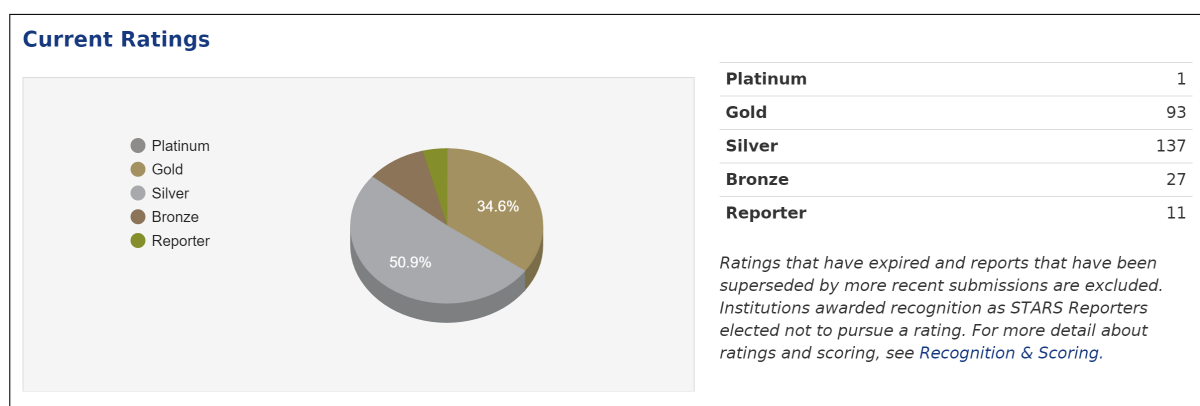


Figure 10: A representation of the schools currently ranked in the STARS program and the distribution of rankings.

2.4 Sustainability Practices at Other Colleges

In order to successfully implement a recycling incentive program at our own institution, it is important to look at how recycling programs operate at other colleges and universities. By looking at how other colleges run effective (or noneffective) recycling programs, we were able to apply similar principles to ensure that our own suggestions will be effective on our campus.

2.4.1 UC Davis

In 2009-2010 UC Davis achieved a waste diversion rate of 67% [27] representing the amount of material recycled, composted, or reused which would have otherwise ended up in a landfill. A major goal of UC Davis' sustainability program is to make the campus "zero waste" by 2020 [9].

In order to achieve this goal, the sustainability program at UC Davis hosts a number of different programs to reduce waste [27]. At the start and end of each school year, UC Davis hosts a drive to recycle and reuse much of the trash from students moving in and out of campus dormitories and other housing facilities. This trash often ends up in front loader waste containers and consists of paper, cardboard, appliances, and clothing. Another program on UC Davis' campus occurs each Wednesday throughout the duration of RecycleMania, a national competition promoting waste reduction at colleges and universities during which students and staff gather to promote waste reduction techniques. In addition to the national competition, residence halls at UC Davis compete in a recycling competition [9].

UC Davis is able to report high participation rates in its recycling activities by holding regularly scheduled promotional events throughout the entire year for recycling. These events run by the UC Davis recycling program are not necessarily the primary means that drive their high recycling rates, but are able to capture the attention of a wider audience, promoting sustainable culture.

2.4.2 Kalamazoo College

Kalamazoo College, a liberal arts college in Michigan, utilizes single stream recycling similar to WPI [20]. In the 2016 RecycleMania competition, Kalamazoo College reported a 56% recycling rate [19]. In that same year, WPI reported 38%. The Kalamazoo College recycling program is run by a student organization that manages pickup and sorting of recyclables. It also operates other programs including a Resource Exchange Program (REP), food composting program, and free bicycle rental and repair program.

The student sustainability program at Kalamazoo has a dedicated space where they operate their initiatives and programs from. At this location is a room designated for use with the REP, where students can go to recycle unused items back to the community. The

REP requires storage space and student volunteers to manage and sort donated items. Items returned to the REP include textbooks, furniture, school supplies, clothing, and others. Kalamazoo College is able to increase the opportunities to recycle for students by offering this general item reuse program. The amount of waste produced on campus is reduced as discarded items are sometimes returned to the community rather than sent to a landfill.

Kalamazoo demonstrates that a recycling facility can be run and managed efficiently by student volunteer groups on-campus. Experimental recycling programs not commonly found at other colleges and institutions, like the REP at Kalamazoo, can benefit from direct management by sustainability groups on campus because these kinds of programs are operated in a unique manner.

Kalamazoo is a member of AASHE and previously participated in the STARS® program, however their rating was not updated in the school reports [3].

2.4.3 Comparison to WPI

According to their website, the WPI Student Green Team is a "...student run organization dedicated to making WPI a more sustainable place and educating the WPI community about sustainability" [25]. The WPI Student Green Team holds 5 annual events promoting sustainability [25]. Of these events, two directly relate to recycling: Recyclemania and the E-Waste Drive. These events are promoted through table sitting and fliers posted around campus.

Unlike Kalamazoo College, the WPI Student Green Team does not have any dedicated space inside buildings on campus for recurring sustainability programs [25]. The only long-term ongoing sustainability effort on WPI campus run by students is Gompei's Gears, a bike-share program on campus maintained by the Student Green Team. Kalamazoo College benefits from having a dedicated space on campus for sustainable activities and improves the campus presence of sustainability allowing for more sustainability programs to occur.

2.5 Bottle Redemption Programs

Deposit-refund systems are incentive programs used to promote recycling of specific products [28]. A prominent example of a deposit-refund system is a bottle bill. A bottle bill imposes a tax on the consumption of beverages sold in plastic bottles and aluminum cans with a rebate that is claimed when the beverage container is returned to a redemption center. Bottle and can redemption centers offer a way for people to receive monetary compensation for their participation in recycling. Redemption centers are often placed in or near local businesses such as a liquor or grocery stores [10]. Recycling participants deposit their bottles and cans in the redemption machines to receive a recycling receipt which they must redeem with the business to receive their compensation.

2.5.1 Incentive Program Effectiveness at WPI

Information regarding incentive program usage at WPI has been previously investigated by a number of IQPs. According to data collected for Worcester Art Museum student admission in 2015 [8] and free WRTA student passes in 2011 [11], in order for incentive programs targeted toward campus community members to promote a change in their behavior, the program must meet certain criteria. An incentive program targeting a campus community must be convenient to use in terms of both time and location. Students and staff are often unwilling to leave campus or change their schedules in order to take advantage of free or sponsored services [11]. Student participation rates in incentive programs like these one were low despite the fact that the offered services are located less than a block from campus. Davis et al. reported that locating an incentive program in an area that sees student traffic throughout the school day is an effective way of reminding community members that the program exists [8]. In addition, it could also improve ease of use as students would be more willing to go to a location that is nearby, familiar, and convenient. A program would also need to have well-known and frequent hours of operation, as students and staff can have tight and conflicting schedules based around classes and/or social groups or clubs. Meeting these criteria is important to ensuring the long-term effectiveness of the program.

2.6 Interview Formats

Structured interviews are standardized interviews with no deviation from question order [6]. The interviewer asks each question exactly as written without adjusting the language of the questions. The interviewer may not provide clarification or responses to questions regarding the interview itself and they may not add additional questions. These interviews are similar in format to pencil-and-paper surveys.

Semi-structured interviews are less formal than structured interviews [6]. The interviewer may alter the ordering, wording, and level of language questions during the interview. The interviewer may provide answers and clarifications to questions brought up by the interviewee. The interview may contain fewer or additional questions between subsequent subjects.

Unstructured interviews are completely informal interviews [6]. There is no predetermined ordering or wording to questions. The interviewer may adjust the level of language for the interview. The interviewer may provide answers and clarifications to questions brought up by the interviewee. The interview may contain fewer or additional questions between subsequent subjects.

3 Methodology

The primary focus of this project was initially to explore the viability and effectiveness of using an incentive program in order to improve the recycling rates of redeemable bottles, redeemable cans, and non-redeemable plastics. After conducting interviews with campus community members and WPI facilities stakeholders (see Results chapter), we determined that consumer recycling incentive programs would not increase recycling rates on campus enough to offset the financial, space, and labor costs to run them.

As a result, the revised goal of this project was to encourage stakeholders responsible for sustainable practices on campus to improve sustainability infrastructure related to recycling. We accomplished the following tasks.

1. Discover how an incentive program would impact bottle and plastics recycling behavior on-campus.
2. Research the feasibility of two recycling incentive programs: bottle redemption and bulk plastics recycling.
3. Develop an understanding for the motivation, or lack of, that community members have toward making use of available recycling options on-campus
4. Create a set of recommendations for WPI to improve campus sustainability in the area of consumer recycling.

Throughout our methodology, we use the terms "redeemable items" and "bulk recyclables" to refer respectively to redeemable containers (plastic bottles and aluminum cans) and non-redeemable but scrap recyclable plastics.

3.1 Research Goals

In order to develop a methodology that provided us with necessary data to complete our goals, we constructed the following research questions.

- Can a monetary recycling incentive increase recycling rates?
 - Asked community members if they would be more likely to recycle if they received compensation or some other direct and immediate benefit.
 - Determined which campus demographics an incentive program would capture.
 - Researched the significance of convenience as a factor in recycling.
- How do WPI community members dispose of redeemable items and bulk recyclables?

- Defined what items we are classifying as redeemable items and bulk recyclables.
- Asked community members about their current recycling habits specifically in regards to redeemable items and bulk recyclables.
- What do community members currently know about bottle redemption recycling, current on-campus recycling parameters, and bulk recycling?
 - Asked campus community members about their willingness to use recycling facilities on campus.
 - Asked community members about their knowledge of existing recycling services and programs
 - Asked community members to self-report their current recycling habits.
- What recycling services are currently in place on campus?
 - Photographed a variety of bin setups and current signage.
 - Interviewed facilities staff about logistical and operational details
 - Interviewed staff and toured a Waste Management facility
- How should a new recycling program or facility be structured on-campus?
 - Explored further into the role that location, convenience, ease of access, and awareness have in the overall success of a new recycling program.
 - Explored the logistics involved With operating bottle and can redemption and scrap plastic recycling facilities.
 - Interviewed staff at local redemption centers and recycling facilities.
 - Called and sent emails to any vendors, transporters, and contractors as necessary.

3.2 Campus Community Surveys

In order for us to better understand the current behaviors relating to and perceptions of bottle and plastics recycling within the WPI community, our team surveyed students and staff. In addition to demographic information, questions in our survey corresponded to one or more of our research questions. Survey responses were recorded securely and anonymously through Qualtrics, an on-line survey platform endorsed by WPI [30].

We created and distributed a survey via email to various undergraduate major mailing lists at WPI, including electrical & computer engineering and civil & environmental engineering . In addition, we utilized convenience and snowball sampling [15] by distributing the survey to personal contacts at WPI. The final survey questions are listed in Appendix A.

3.3 Interviews with WPI Students

In addition to the general body survey which we distributed digitally, we conducted semi-structured interviews with WPI students in the Rubin Campus Center. These were conducted over the course of 4 days, during peak hours. The intent was to interact with a wide range of community members to represent the WPI campus demographics. We used an abbreviated version of our list of digital survey questions, shown in Appendix A, as a short set of interview questions. We used these interviews to learn more about student awareness and perception of bottle and plastic recycling on-campus. They were intended to provide a more in-depth dialogue with the community regarding plastics and bottle recycling behavior and practices, which cannot be conveyed through an on-line survey.

A group member summarized the responses to these interviews. The interview summaries are not a verbatim recording of the responses and were intended to capture the general ideas and thoughts produced by the students interviewed for later interpretation.

3.4 Interviews with Stakeholders

The goal of our interviews was to gather information from people who have experience and knowledge related to recycling practices. In order to determine the most effective means to conduct our interviews for the purposes of answering our research questions, we explored interview methods and formats. We determined that semi-structured interviews were the best solution for us as we needed to build healthy relationships with our interviewees (see Background section 2.5 for interview format descriptions). We wrote a specific list of questions that were asked during the interviews but encouraged our interviewees to volunteer any additional relevant information.

We scheduled interviews with administrators in facilities and residential services in which our team learned more about the feasibility of a recycling incentive program on-campus. Speaking with residential services administrators gave us a better sense of how recycling services on-campus can be better promoted. Members of the WPI facilities department, such as Bill Spratt, provided us with a realistic assessment of the feasibility of an on-campus bottle redemption center or a bulk plastics redemption station. Our team also interviewed members of the WPI student green team to learn more about which on-campus sustainability initiatives have been successful and which have failed so that we could produce more promising recommendations.

Further our team interviewed Michelle Lee Guiney, the Leadership in Energy and Environmental Design (LEED) Green Associate and Sustainability Consultant at Waste Management. LEED is a worldwide green building certification program which rates the environmental sustainability of various buildings [2]. Mrs. Guiney has worked alongside WPI recycling IQP groups in the past and is extremely knowledgeable about the recycling process.

In Table 2 we have compiled a list of intended interviewees including WPI's Associate Director of Facilities, the WPI Facilities Systems Manager, The Assistant Vice President of Facilities, Residential Services and the Sustainability Consultant at Waste Management. The interviewees were contacted via email or phone to schedule meeting times and locations. Our summaries of the interviews have been added as appendices at the end of our report. We recorded the audio from these interviews with a digital off-line audio recording device obtained from the WPI Academic Technology Center. These recordings were saved on an off-line storage device. At the conclusion of our project, the files were turned in to our advisors.

When conducting our interviews our group started with some brief small talk to learn more about the background of our interviewees. Instead of starting with our formal questions, a brief background conversation better allowed us to develop relationships with those we talked to. These relationships we built with our interviewees will prove critical when it comes time to put our final recommendations into action.

Interviewee	Position
	Department: Facilities
William (Bill) P. Spratt	Director of Facilities Operations
Terrence J. Pellerin	Associate Director of Buildings and Events
	Department: Residential Services
Amy Beth Laythe	Sr. Assoc Director of Res Ops, Res Services
	Department: Sustainability
John Orr	Director Sustainability
Liz Tomaszewski	Assoc. Director of Sustainability.
Ryan Cooney	Student Green Team President
Meghan Trahan	Student Green Team Member
	Department: Waste Management (WM)
Michelle Lee Guiney	LEED GA, WM
	Department: Dining Services
Joe Kraskouskas	Director of Dining Services

Table 2: A list of our interviewees.

3.5 Investigate and Analyze Feasibility of Incentive Programs

We collected and analyzed data regarding two recycling incentive programs: bottle and can redemption and bulk scrap plastic recycling. We had originally planned to develop a set of suggestions for how WPI could increase recycling rates based on data we collected regarding incentive program viability. This information was acquired from static resources provided by the private companies which offer these services.

3.5.1 Redemption Center Feasibility

We researched the feasibility of bringing a redemption center to campus.

We used the campus community survey questions to establish the viability of implementing a bottle redemption center on-campus. Through this data we were able to describe current redemption practices of WPI community members and determine the usefulness of such a facility. Our team also interviewed two key stakeholders in the WPI facilities department, Bill Spratt and Terry Pellerin. Bill Spratt, the Director of Facilities Operations, would have to approve any new facility on campus, while Terry Pellerin, the Associate Director of Buildings and Events, would be responsible for the actual implementation and maintenance of said facility.

3.5.2 Bulk Scrap Plastic Recycling Center Feasibility

We explored the feasibility of bringing a bulk scrap plastic recycling center to WPI campus as an incentive for consumer or industrial recycling. As a consumer incentive, the program would allow students to bring plastic items where they would receive a cash incentive based on the weight of items they return. As an industrial incentive, the program would collect large recyclable items produced by institutional departments, such as the dining services, facilities, and academic buildings. These departments would be asked to collect recyclable packaging and shipping waste for sale to a bulk scrap purchaser. Revenue from an industrial scrap recycling program would be returned to the campus department that conducted the service. We interviewed Henry Coz, an employee at Warehouse Plastics, and toured their post-industrial plastics recycling facility in Millbury, MA. He provided us with logistical plastic collection stipulations and explained the process and marketability of scrap plastic recycling.

3.6 Waste Facility Visits

We scheduled and completed visits of two waste collection and processing facilities. We first visited Waste Management, a post-consumer materials recycling facility in Avon, MA, to learn about the recycling process and why certain items are or are not recyclable. We

then visited Warehouse Plastics, a post-industrial plastics recycling facility, to learn about the viability of selling bulk scrap recyclable plastics from WPI. Most importantly we learned what plastics are taken, why certain plastics or items are not taken, what quantities are acceptable for processing, and how the shipments are processed.

4 Results

Our team compiled data from stakeholder interviews, campus community survey responses, and informal community interviews. We grouped the results from our preliminary research into two central areas that encompass on-campus recycling culture:

- Current State of On-Campus Recycling
 - Self-reported community recycling behavior
 - General campus community knowledge of recycling practices
 - Uniformity of current signage and bins across campus.
- Consumer recycling incentive program
 - Effectiveness of the program
 - Feasibility of implementation

As we progressed in our research, our initial findings revealed additional considerations and areas of interest that necessitated further exploration. This secondary research was conducted as a result of our reaction to the initial findings. The final sections of this chapter detail this progression in the following order:

- Reaction to initial findings
- Addressing plastics manufacturing waste on-campus
- Assessing the use of non-sustainable products on-campus

4.1 Current State of On-Campus Recycling

In order to accomplish the initial goals of our IQP, we needed a thorough understanding of how community members practice recycling and how recycling is structured for students. We examined the community member participation in recycling practices on-campus.

4.1.1 Self Reported Community Recycling Behavior

We conducted an on-line survey of 358 WPI students, faculty, and staff. Figure 11 shows the what type of respondents we received with our survey. The plurality of our survey-takers were students; however, we managed to reach a significant portion of WPI's total staff and faculty.

Q13 - I am a:

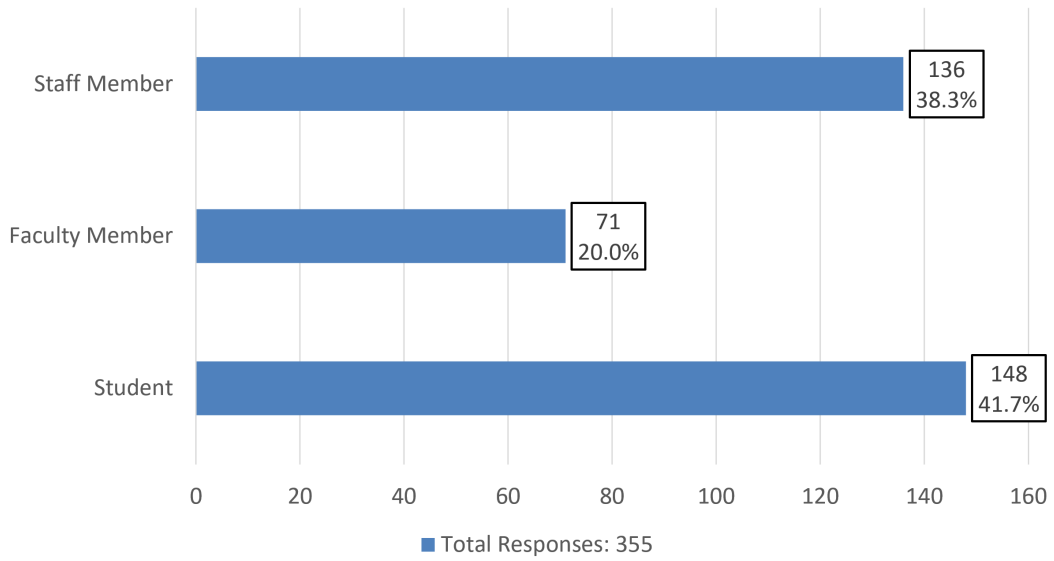


Figure 11: The breakdown of survey respondent demographics by relationship to WPI. This question received 355 responses.

Figure 12 shows how survey-takers responded when asked how carefully they separated redeemable bottles from their trash. 83.9% (298 of 355 total) of respondents stated that they either somewhat or strongly agree that their recycling habits are careful. This shows that a majority of campus community members believe that they currently practice good behavior regarding redeemable bottles.

Q1 - 1) I regularly separate redeemable bottles from my trash and recycle or redeem them

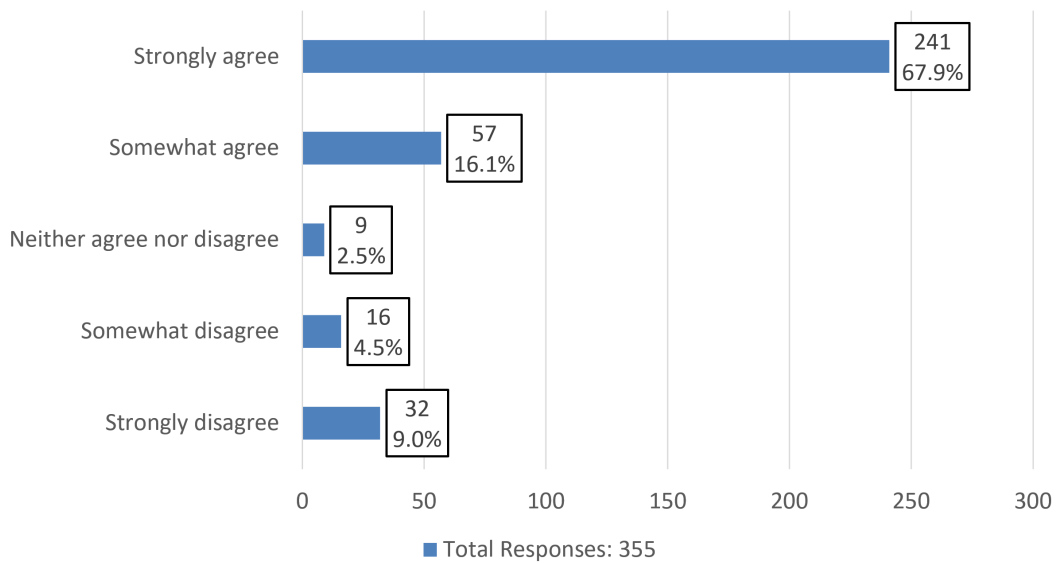


Figure 12: Responses received when asked to self-report recycling habits regarding bottles. This question received 355 responses.

Figure 13 shows how often respondents said they used bottle redemption centers. 54.4% (193 of 355 total) of respondents stated that they either somewhat or strongly disagreed that they used a redemption center. This suggests that the positive respondents to question 1, shown in Figure 12, tend to not redeem their bottles but rather recycle their bottles through conventional means (such as curbside recycling in their residences or single stream recycling on WPI campus). A limitation of our on-line survey was that we did not get reasons for why survey-takers do not use redemption centers.

Q4 - 4) I regularly utilize a deposit redemption center

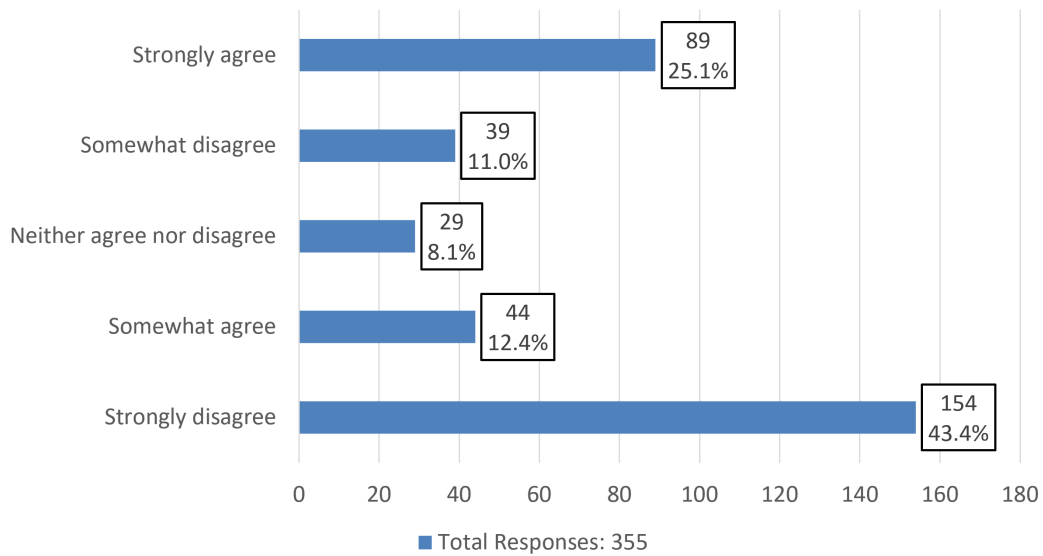


Figure 13: Responses received when asked to self-report usage of bottle redemption centers. This question received 355 responses.

4.1.2 Community Knowledge of Recycling

Table 3 shows a count of mentions of certain categories of items throughout 3 days of community interviews conducted with students in the Campus Center. We conducted these interviews in an attempt to get a representation of general recycling and waste stream knowledge. We asked students about their understanding of what is acceptable to place in our single-stream and what isn't. 22 (74%) of our participants mentioned paper as being recyclable in the WPI single stream system at least once during the interview, 28 (58%) mentioned plastics, and 14 (37%) acknowledged that food waste and liquid contamination were not allowed. Only 2 people were able to identify #6 plastics as being banned from WPI's recycling stream. This is important because all of the clamshell containers used for food in the Campus Center are #6, and therefore cannot be included in the WPI recycling stream. This lack of understanding can lead to contamination of the stream.

The results of the community survey may not accurately represent WPI students on campus as a whole due to the small sample size and our survey methods. We conducted 38 interviews but there are 4,123 undergraduate students at WPI (in the 2015-16 academic year) [29]. We also utilized snowball sampling for selecting interviewees, which may have biased our sample to more sustainability oriented students on campus.

What is recyclable?	Number of mentions
Paper	22
Plastics	28
Cans	16
Glass	4
No Number 6	2
No Contamination	14

Total Participants = 38

Table 3: The frequency that certain categories of items were mentioned throughout our community interviews in response to the question "What is recyclable in the standard recycling bins on campus?"

4.1.3 Signage and Bins

As shown in Figure 14, the waste receptacle setup varies between different buildings and even different areas within the same building on campus. The information and labeling near each bin also varies. Recycling bins can have a poster detailing recyclable items, a label near the opening showing recyclable items, or only a symbol labeling the bin as recycling. Newer buildings, such as East Hall, Faraday Hall, and the Sports and Recreational Center have triangular recycling bins for both paper and bottles. Other buildings on campus have only single-stream recycling bins. Those bins have varying sizes, shapes, and covers.

In a previous IQP, an inventory of all of the existing trash and recycling bins was conducted during D term 2015 [13]. Their team discovered that despite the change from dual stream to single stream recycling, multiple varieties of bins existed all over campus. This inventory included trash bins, recycle bins (single stream), recycle bins (paper only), recycle bins (bottles and cans only), as well as disparities in signage for each location [13]. However, we did not have enough time to conduct our own campus-wide inventory to determine how many of these different waste stream setups still exist. Figure 14 also shows four different examples of trash and recycling bin setups in the same building: Atwater Kent.



Figure 14: Pictures of various recycling bin setups around campus. Left to right: Sports and Recreational Center (first floor lobby), Atwater Kent Laboratories (basement), Atwater Kent Laboratories (2nd floor), Atwater Kent Laboratories (basement conference area).

Figure 15 shows the recycling information placard which is placed at multiple locations around campus. The information includes names and pictures of generic items separated into recyclable and non-recyclable sections. The items presented on the signs are not necessarily items that are widely used on campus. For example, the current signs have a picture of a soup can in the recyclable section but students are not likely to be carrying a can of soup, or any can for that matter, around campus. Further, the sign includes items such as a detergent bottle and a jug of juice which again are unlikely for students to be carrying with them throughout the day.

Similarly, many widely distributed items on campus are excluded from the signs. For example, A Styrofoam Dunkin' Donuts cup filled with hot coffee is placed in the non recyclable section of the poster but there is no picture or bullet point explaining the recyclability of a plastic Dunkin' Donuts cup for iced coffee. During our facility visit with Thomas Henry at Waste Management, we learned that the proper way to recycle a plastic Dunkin' Donuts cup is to trash the straw and remaining contents first. The summary of this facility visit can be found in appendix D.



Figure 15: Picture of recycling information placard placed around campus.

4.2 Consumer Recycling Incentive Program

Our initial plan involved investigating the effectiveness and feasibility of consumer recycling incentive programs, specifically a bottle return center or a consumer bulk plastics recycling center. We collected data throughout the project in order to be able to predict and describe how the two proposed recycling centers could affect recycling behavior and recycling rates on campus.

4.2.1 Effectiveness

In order to evaluate the effectiveness of a redemption center to increase recycling rates, we first gauged the likely utilization of such a program. From the on-line survey responses, we filtered the data to show only the students that lived within a mile of campus that also did not regularly use a redemption center. This group would represent the target demographic for an on-campus recycling incentive program. Figure 16 shows the filtered responses to the statement "I would be likely to use a deposit redemption center:"

85 (70.2%) respondents replied that they either "Strongly Agree" or "Agree" with the condition "if it was on campus near my daily route." This shows that a majority of community members expressed willingness to utilize the program. However, only 41 (34.7%) of responses

agreed with the condition "if it was located on campus away from my daily route" and only 41 (34.2%) of responses agreed with the condition "if it was located within 1-2 blocks of campus". Approximately half of the respondents who would have used the program if it was on their route would not participate if it were located elsewhere. This data shows that locating a redemption center in a remote location either on or off campus may result in having nearly half the number of users compared to if the service were located in a convenient location directly on campus.

Q5 - 5) I would be likely to use a deposit redemption center:

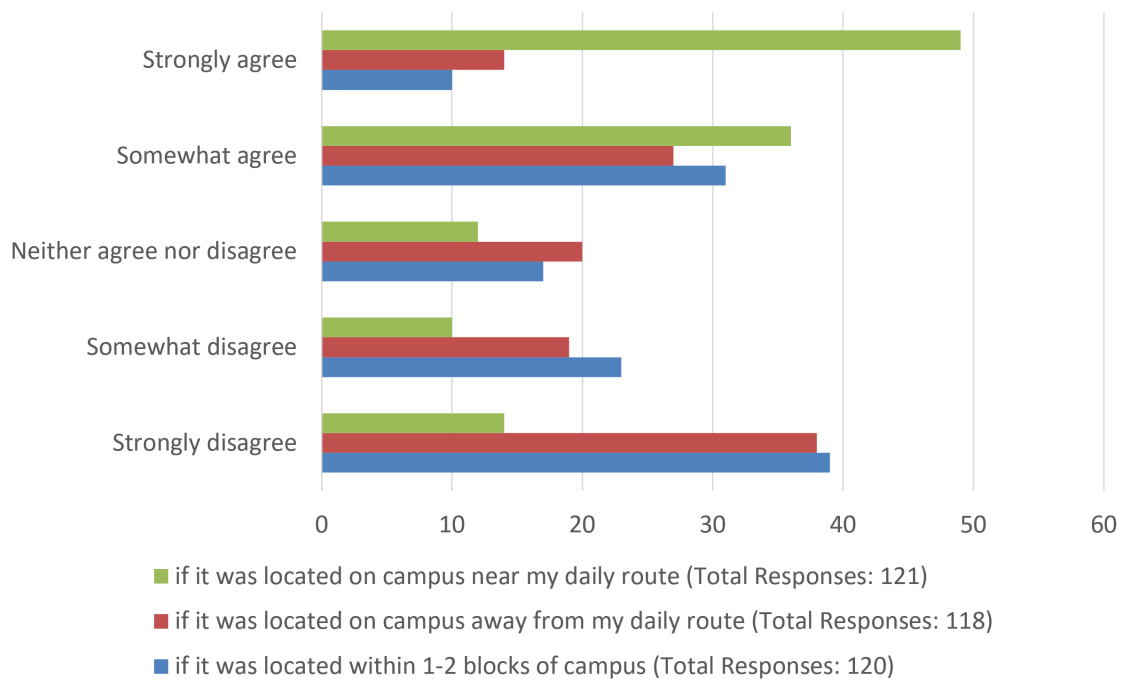


Figure 16: Filtered responses to 3 survey questions which asked about convenience and location.

Table 4 shows responses from our informal community interviews to the question "Would you use a bottle redemption center?" During our community interviews, almost every response indicated willingness to participate in this program.

Would you use a bottle redemption center?	
Yes	26
Only if convenient	7
No	4

Table 4: Responses from 37 community members after being asked if they would use a bottle redemption center.

However, while we found that the program would be used, we needed to assess if it would increase recycling rates or simply divert recycling from normal recycling bins to the redemption center. When we asked community members if they thought their utilization of the program would increase their personal recycling rate or divert recycling from their current disposal stream, 9 out of 15 stated it would divert their recyclables to a different stream. From our conversations with them it seems that most of the failures in recycling habits stem from a lack of awareness, a knowledge gap between the current waste stream stipulations and current practices, and a perceived lack of convenience. This is a different result from our previous assumption that problems associated with recycling are from an insufficient variety of options or lack of incentives. From the survey as shown in Figure 17, most people find convenience to be a contributing factor to their recycling habits.

I would be likely to recycle more without monetary compensation if it was more convenient

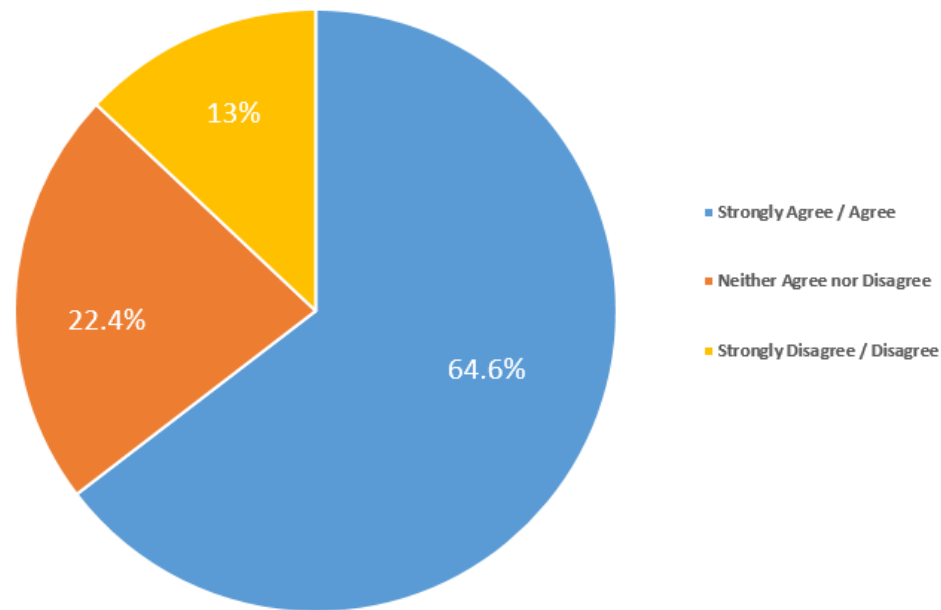


Figure 17: Results from 322 unfiltered responses to one of our survey questions. Strongly and somewhat agree are grouped into one category as well as strongly and somewhat disagree.

Table 5 shows a summary of open-responses to question 10 of our on-line survey, "I would be likely to recycle more WITHOUT monetary compensation if." Of the responses, 38.8% mentioned convenience or ease of use in their answer, making it the most commonly mentioned issue. This suggests that addressing problems regarding inconvenience in campus recycling infrastructure may be an another solution to increasing recycling rates. The full set of open-responses to question 10 can be found in Appendix E.

Convenience	Education	Reminders	Visible Impact	I already recycle
81	29	5	8	61

Table 5: A summary of 209 open responses to question 10, "I would be likely to recycle more WITHOUT monetary compensation if," from our on-line survey.

Figure 16, survey data again filtered by those who did not respond to "I live:" with "Commuter, over a mile off campus", and did not respond to "I regularly utilize a deposit redemption center" with either "Strongly Agree" or "Agree", shows that the number of

people willing to utilize a program drops off sharply if they must go out of their way to use it.

4.2.2 Feasibility

Currently, it would not be feasible to implement a bottle redemption center on campus. According to an interview with Meghan Trahan, a member of the WPI student Green Team, there are requirements for a student led initiative or program that relies on institutional involvement or funding to be approved. One requirement is that the program should be self-sustaining. This means that any financial costs incurred by the program must be recuperated by the program's revenue. Another requirement Meghan spoke to us about was the programs initial cost. Any proposed program should either have no more than a very small upfront cost for the institution or have a plan which proves that the program will be profitable to the institution.

In addition to speaking with Meghan, our group conducted an interview with Bill Spratt, the Director of Facilities and Operations at WPI. He told us that he wished he could be less skeptical of a program that would require a recycling center but that we really needed to, "[consider] how much labor is involved in moving trash on campus" and that this cost, "will far exceed what you would get in recycling". Facilities currently has two full time employees whose entire job responsibility is moving waste around campus. Their day to day schedule is very tight and Bill Spratt explained that he cannot add anything additional to their current workload. Further, there is not enough room in the budget to add another one of these employees; any type of recycling center on campus would need to be completely self hosting. The labor required to clean and operate the recycling incentive program would need to be provided by students or contracted out to a third party company.

Our discussion with Bill Spratt then shifted to the topic of available space on campus for a proposed recycling center. Bill could not think of any suitable locations for a recycling center and said that, "Everyone needs space and [facilities] just [doesn't] have it". Unfortunately, there is simply not enough space to go around.

From that same interview with Bill Spratt we also learned that WPI saves money by correctly recycling. Under the current contract WPI has with Waste Management, we pay a rate of 35 dollars per ton of recyclable material and 130 dollars per ton of waste material. When community members incorrectly recycle by placing recyclables in our trash bins, WPI is subject to a greater cost. The large difference in cost per ton is due to Waste managements ability to produce revenue from recyclable material. Waste Management can sort and sell recyclables on the open market as a commodity. If an incentive program could reduce the weight of trash produced on campus, it would save WPI money.

4.3 Reaction to Initial Findings

After conducting interviews with Bill Spratt, Terry Pellerin, and WPI community members, we determined that consumer recycling incentive programs on campus may not be feasible. In response to this, we changed the scope and direction of our research, widening the focus from plastics recycling to overall recycling on campus.

From our preliminary evidence, we found two routes of research for us to explore.

- Looking at scrap plastic produced from manufacturing processes on campus
- Reducing presence of non-recyclable products on campus

4.4 Plastics Manufacturing Waste on WPI Campus

Washburn Shops houses manufacturing equipment, such as CNC machines, lathes, and a laser cutter, which often are used in engineering education to process and manufacture plastics such as acrylic and polycarbonate [1]. Acrylic and polycarbonate have the Resin Identification Code of #7. The current waste disposal procedure for the Washburn Shops includes collection receptacles for steel, aluminum, and other non-plastic materials to be recycled. The procedure for acrylic, polycarbonate, and other plastics is that the user of the tools must supply their own raw materials and dispose of waste and scrap by themselves either in the trash or by taking it outside of the shop.



Figure 18: A photograph of scrap acrylic in the Washburn Machine Shop.

In our visit to Waste Management's Materials Recycling Facility, we discovered that #7 plastics are not processed by single stream recycling plants. However, post-industrial plastics recycling companies, like Warehouse Plastics, will recycle acrylic and polycarbonate. These facilities generally only collect plastics in bulk shipments meeting a minimum of 1 to 2 gaylords, large cardboard boxes usually around 48" x 40" x 36" in size.

4.5 Non-sustainable Products on Campus

WPI food services currently use numerous plastic items, many of which are not processed in our current recycling stream. At Dunkin' Donuts, for example, iced coffee cups and lids are recyclable if the straw is removed and the liquid and ice is poured into the trash or a sink. The brown bags that contain food items are also recyclable.

Other items to note are straws, plastic utensils, and other small plastic items found on campus. According to Thomas Henry, a Major Account Representative of Waste Management, these items are not processed by the Materials Recycling Facility due to their likeliness of getting caught in the machinery and falling through the slotted sections of the conveyor belt. This is despite the fact that the types of resins used to make these items are recyclable.

In the Campus Center, the plastic clamshells used in the salad bar are #6 plastic, which are not processed by the Waste Management facility. #6 and #7 plastics are not processed due to economics as the cost to recycle does not exceed the market price of those plastics. Similarly, all plastic lids for disposable hot liquid to-go cups used on-campus are #6. According to Joe Kraskouskas, director of dining services at WPI, WPI dining services uses 108 cases of non recyclable plastics monthly (see Appendix C).

One of the programs currently in place to reduce disposable plastics use on campus is the Green Reusable Food Container exchange [25]. Students pay a \$5 refundable deposit and obtain a marked green carabiner. At meal times, students exchange the carabiner for a clean, reusable food container for Food To Go. Once used, the soiled container is then placed in a bin and a green carabiner is returned to the student. In our interview with Joe Kraskouskas, Director of Dining Services at WPI, we learned that the program saw a rate of approximately 50 exchanges per day near its introduction, but has since dropped to approximately 10 per day (see Appendix C).

5 Recommendations

In this chapter, we discuss three recommendations for WPI to pursue in the goal of improving on-campus recycling. These recommendations are based on the data collected throughout our project. We also make observations regarding future research to be conducted and highlight one of the main issues leading to less than optimal recycling rates.

5.1 Develop and Operate a Bulk Plastic Scrap Recycling Pilot Study in Campus Manufacturing Shops

There is currently no collection area specifically for plastics in the Washburn Shops. This makes it difficult to measure how often scrap plastics could be collected to meet the minimum amount that would warrant delivery to a post-industrial plastics recycling facility. Our recommendation is for the school to conduct a trial for scrap plastics collection in the Washburn Shops. The school should place collection bins for 2 types of scrap plastic; acrylic and polycarbonate. The bins should be emptied and measured periodically throughout one 7-week term in order to assess how much scrap is produced as a byproduct of usual undergraduate course and project work. At the conclusion of the trial, facilities should contact third-party post-industrial scrap plastics recycling facilities in order to determine if the amount of scrap produced on a regular basis by Washburn shops is sufficient to be worth instituting regular collection.

5.2 Introduce Specific and Relevant Recycling Signage

The current recycling signage is not uniformly distributed on campus and could benefit from updating. The items on the current signs are not necessarily widely used on campus and therefore should be edited. For example, the current signs have a picture of a laundry detergent bottle in the recyclable section, but students are not likely to be carrying a detergent bottle with them unless they are in a laundry room. In addition, many of the items reported as most confusing are not currently represented on the signs. These items can be seen in Figure 15.

We recommend that the school update the signs for recycling commonly located throughout campus to include fewer items that are more ubiquitous than are currently displayed. The signs along with the depictions on them should be increased in size so that a community member can more easily view them. We also recommend creating similar signs above trash bins, to encourage community members put thought into trash disposal.

Figure 19 shows an example of signs from College of the Holy Cross in Worcester, MA. The signs on their campus are eye-catching, have large, legible wording and are strategically placed above each bin.



Figure 19: An example of trash and recycling signage at College of the Holy Cross, Worcester MA.

In addition, we propose that unique signs be produced for specific vendors to show people what items they are receiving are recyclable. This would both target the correct people and inform them of the correct actions to take before they approach a receptacle with their waste. For example, a sign could be made specifically for the line at Dunkin' Donuts. This sign should depict all individual Dunkin' Donuts items including the coffee cups, straws, and brown bags, as well directions for proper recycling. The information provided would

delineate which items are recyclable and which are not. The sign should be placed in a clearly visible location near the order pickup location. Customers would be able to see if what they are buying is recyclable before they make the decision of how to properly dispose of their waste. When someone buys an iced coffee, they learn from the sign that the cup and lid are recyclable, but the straw and contents must be thrown away.

5.3 Replace Non-Recyclable Items with Sustainable Alternatives

Based on an interview with Joe Kraskouskas, there are a few options to mitigate the usage of non-recyclable plastics on campus. The first option would be to address the purchasing of non-recyclable plastics. One issue is the prominence of the thin plastic salad containers in the Campus Center. The clamshells alone add 400 lbs of trash monthly to the waste stream. Joe stated that switching to compostable containers, similar to the ones used at the Goat's Head Restaurant, could be a viable option.

The next issue would be replacing the plastic utensils. Joe informed us that compostable options had already been looked at for a possible replacement of plastic utensils. The primary issue was the lack of compatibility between the compostable utensils and the school's need for automatic dispensers. There are not any dispensers available that fit the shape of the compostable utensils and WPI requires their utensils fit the dispensers for ease of access and sanitation reasons. Also, the compostable utensils have been observed to change physical properties when introduced to hot food. He said that if there was more space available, he would consider having both compostable and plastic utensils.

Another approach to reducing the use of non-recyclables would be to further promote the use of reusable containers. Very few people currently make use of the reusable salad containers. Also, the ability to bring your own mug to places like Dunkin' Donuts is not widely known. Both of these programs should be promoted, and similar programs could be devised. We also recommend instituting and publicizing incentives to participate in such programs, such as reduced costs of salad or drink purchases with your own container.

5.4 Future Work on our Project

Future teams working toward initiatives on campus that affect community recycling behavior or infrastructure should consider and understand student, staff, and faculty motivation and awareness regarding recycling. Having a better understanding of the effectiveness of their initiative and how it will change community behavior will allow the team to structure their program to produce the changes that they desire. Our research and recommendations will provide critical background for further implementation of improved recycling practices.

5.4.1 Improving Recycling Knowledge

John Orr, Director of Sustainability, and Elizabeth Tomaszewski, Associate Director of Sustainability, mentioned there is no ideal method of communication between students, faculty, staff, and administration. Therefore, the Directors of Sustainability, Sustainable clubs, and other individuals find it difficult to promote, engage, or assess students in sustainable topics (See Appendix C). Our team believes that WPI needs a more effective communication gateway for sustainability between the administration, faculty, and students. A future IQP project may assess and determine a feasible method to improve campus-wide communication and cooperation regarding sustainability initiatives.

5.4.2 Future Research

Throughout our project, there were several topics brought up in discussion that were not thoroughly explored. We speculated that they may have been useful avenues for improving campus sustainability; however, our research did not provide useful concrete evidence supporting it. It may be useful for future IQP groups to research the following topics.

- Whether or not uniform recycling bin selection and presentation has an effect on recycling behavior.
- More effective forms of incentive to increase recycling behaviors
- The feasibility of eliminating the use of plastic bags on the WPI campus.

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Appendices

A User Study Survey

Our IQP group is exploring current recycling habits of WPI's community. Specifically we are looking at the recycling habits of students and staff pertaining to redeemable plastic containers, redeemable aluminum containers, and non redeemable plastics. Redeemable containers are those which you can receive a 5 cent return for at a redemption center. Non redeemable plastics refer to all plastic waste which can not be redeemed. During this survey answer questions as per your recycling habits on and near wpi campus.

I am a ___
Student
Faculty Member

I live___
In a freshman dorm
In an upperclassmen dorm
Fraternity housing
Sorority housing
Within a mile of campus
Commuter, over a mile off campus

Likert Scale
Strongly Disagree / Somewhat Disagree / No Opinion / Somewhat Agree / Strongly Agree

I regularly separate redeemable bottles from my trash and recycle them
I regularly separate redeemable aluminum containers from my trash and recycle it
I regularly separate non-redeemable plastics (packaging or containers) from trash and recycle them
I regularly utilize a deposit redemption center
I would be likely to use a deposit redemption center
 if it was located on campus near my daily route
 if it was located on campus away from my daily route
 if it was located within 1-2 blocks of campus
I would be likely to recycle more without compensation if it was more convenient
I would be likely to recycle more without compensation if I was reminded
I would be likely to recycle more without compensation if I was better informed
> The following two questions relate specifically to recycling with or without compensation
I would be likely to recycle more without compensation if _____ (short response)
I would be likely to recycle more with compensation if _____ (short response)

B Waste Audit Data

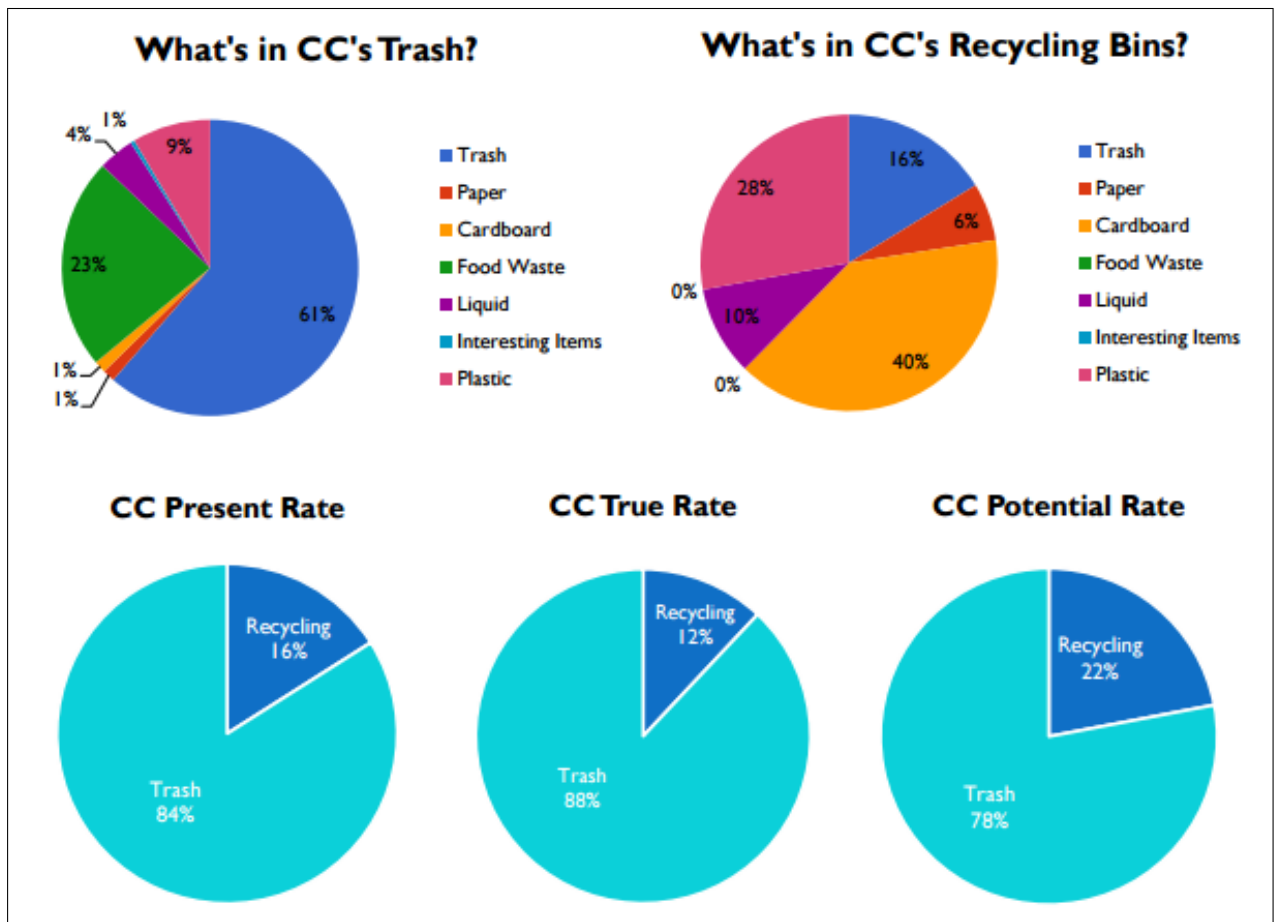


Figure 20: Pie charts showing what constitutes waste and trash in the Campus Center [24]

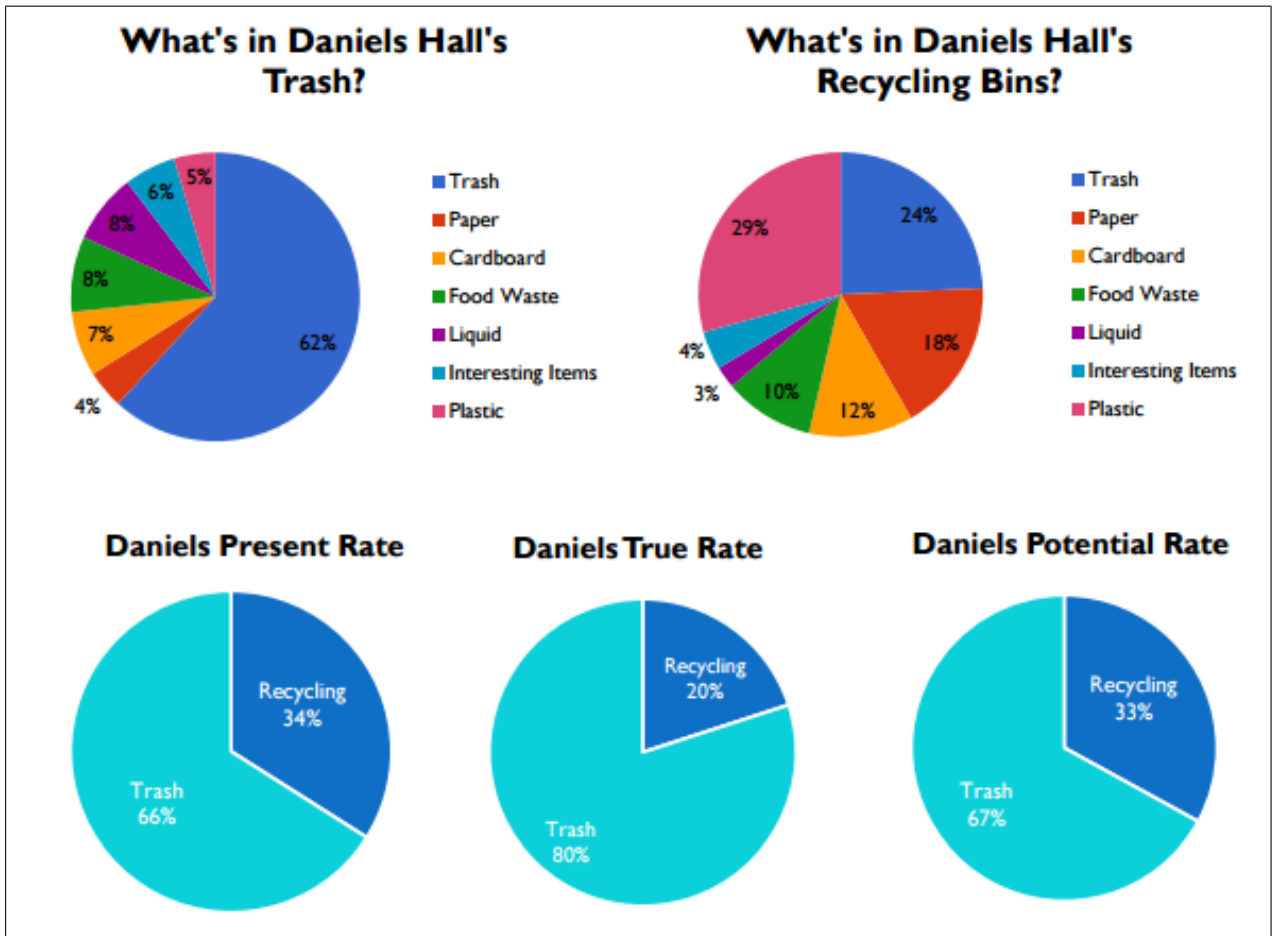


Figure 21: pie charts showing what constitutes waste and trash in Daniels Hall [24]

C Interview Summaries

Professor and Director of Sustainability, John Orr

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: Mar 23, 2017. 10:00 AM

Goal: To learn more about the current plastics recycling status quo on WPI campus.

Q1. What green initiatives are currently underway at WPI in terms of dealing with recyclable plastics?

A.1 John explained to us that single stream recycling began on campus about 2 years ago and since then, there have been a couple of initiatives specifically related to recycling. One of the major initiatives was the installation of recycling bins were placed in individual student dormitories in Daniel's Hall this academic year. This was a trial to see if installing individual recycling bins would increase recycling rates. It seems to John that recycling rates of that building have increased based on meeting with the custodians there. However, there is no person right now responsible for collecting that data.

Q2. Do you know when the data (regarding the Daniel's Hall program) will be available?

A.2 John was uncertain about where the information was and suggested that our IQP may be a good opportunity to track that data down. He mentioned that Liz (Elizabeth) Tomaszewski may or may not have more information on that and we should mention that to her in our future interview. In addition, John suggested that interviewing students living in Daniel's Hall may provide insight related to that program.

Q1. (Continued)

Another ongoing program is to make sure that there are enough recycling containers on campus so that there is always a trash and recycling container next to each-other. John has observed that neither one of the containers is used properly. He says that recyclables are put in the trash and trash is put in the recycling containers. This has bad impacts for example, placing a half-full container of soda in the recycling bin contaminates all of the recyclables in the bin and it has to be moved to the trash. Another initiative is having signs which tell people what is recyclable and what is not. Yesterday (Mar 22, 2017) John said there was a new orientation program staff where sustainability and recycling was discussed.

Q3. Do you feel that recycling practices on campus are effective?

A.3 John feels that the recycling practices on campus are a lot better than nothing. He says that the reported recycling percentages are not bad but clearly we could be doing a lot better.

Q4. What do you think has been successful and not successful in past and current sustainability initiatives (for recycling)?

A.4 John says that the department has not seen and major improvements from and specific

initiative. He mentions that despite all the programs started and all of the audits and measurements taken, the rates have not changed much. John doesn't think that all this effort has not been worthwhile because it is difficult to tell if recycling rates would have gone down without these programs in place.

Q5. What is your opinion on a redemption center or a bulk scrap plastics recycling center for WPI?

A.5 John says it's an interesting idea that hasn't been discussed at all in the sustainability department. He thinks it's separate from recycling but may be relevant as there could be redeemable containers in the trash and recycling. Regarding scrap plastics, John is unsure about what to say about it. There are inefficiencies when recycling is divided into many different ways. John was unsure about whether a scrap plastics recycling program is different from normal recycling when observed from a student's or staff's point of view. He thinks that programs that attempt to change the culture regarding recycling could work.

Q6. We have plans to reach out to a scrap plastic recycling facility in Milbury. If they were interested in working with the school, would you be interested in working with them to collect plastics refuse from WPI?

A.6 John is interested in working with them; however, there is a contract that WPI has with Waste Management for both waste and recycling. He is concerned about the contract prohibiting another company taking our waste.

Q7. Are you aware of any research being conducted on campus in regards to plastics breakdown?

A.7 John is unaware of research in this area on campus. He suggests to us that a good idea to pursue this avenue would be to talk with someone in the materials science department. John mentions to us that a lot of research in that area is extracting high value materials from items such as gold from circuit boards and research is not usually in the direction of plastics breakdown.

Q8. Is there a question that we haven't asked whose answer you think would be beneficial for us to know?

A.8 As John mentioned earlier, now knowing what is recyclable on campus is a problem that the signs on campus attempt to address. He asks himself "Why does it seem so much harder here than at home?" To some extent, it is a matter of what the recycling company will accept. He notes that the recycling rules are more restrictive here (on campus) than it is at his home. He says that on campus there are certain items with the recycling triangle on the bottom (the Resin Identification Code) that are recyclable in most places but not on WPI campus. A question John asks regarding acceptable recycling practice is "How clean does a recyclable have to be before it's trash?" He wonders how to educate people on those two aspects. John says that having signs with exact depictions of items found on campus, such as the Dunkin' Donuts cups, could help.

Facilities Systems Manager, Assoc. Director of Sustainability: Elizabeth (Liz) Tomaszewski
Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth
Date: Mar 24, 2017. 1:15 PM
Goal: To learn more about the current recycling status quo on WPI campus.

Q1. (Statement of our IQP goal) The goal of our IQP is to determine if an incentive recycling program on campus will increase recycling rates.

A.1 Liz said that people on campus generally don't participate in these kinds of efforts unless there is some benefit to themselves. She believed that it may not necessarily be a lack of knowledge regarding recycling based on limited observation of the program.

Q2. What green initiatives are currently underway at WPI in terms of dealing with recyclable plastics?

A.2 Liz mentioned that an initiative was launched in August to put waste and recycling bins in each Daniel's Hall dorm room. She said that there has been some frustration related to that program as students are having difficulty bagging their recyclables and trash appropriately. As a result, this attracts unwanted pests such as fruit flies into the dorm. Every year, there is a waste audit intended to inform everyone about what is really being thrown away and recycled in various buildings here on campus. Last fall, students ran an effective campaign (Project Clean Plate) in Morgan Dining hall intended on reducing food waste. Liz also mentioned that there are Eco-Reps on campus whose focus is to minimize waste. She said that these programs are not only focused on increasing recycling, they are also attempting to decrease waste.

Q3. Do you feel that recycling practices on campus are effective? If not, can you explain why?

A.3 According to Liz, the program in Daniel's hall has not been effective based on her observations and feedback from custodians working in that building. She said that the recycling rate may have been increased; however, the program is not working or being utilized in the way it was intended to be. Each year the institution does a waste audit on campus buildings with one of them always being Daniel's Hall. The recycling rate of Daniel's hall has always been low. This program was an attempt to increase recycling in that building specifically. The next waste audit will provide better insight on how effective that initiative was.

Q4. Why do you think these initiatives have been unsuccessful?

A.4 Liz was uncertain as to the reasons why recycling initiatives on campus were not met with as much success as they had anticipated. She speculated that the reason may partially be that community members are misinformed on what kinds of plastics are recyclable on campus. An example of this is plastics with the Resin Identification Code of 6, such as plastic disposable utensils and clam-shell containers for food. She said that this is a difficult

issue to solve and past attempts, such as the recycling posters, Eco-Reps, and Residence Hall Council training, have not been effective.

Q5. What is your opinion on a redemption center or bulk scrap plastics recycling center on campus?

A.5 Liz said that she is open to any groups and any projects brought up attempting to increase recycling and improve recycling behavior on campus.

Q6. Are there any contractual obligations that WPI has that may prevent such a project?

A.6 Liz did not think that Waste Management would get in the way. In the past, she mentions that accommodations were made that allow individuals to take cans and bottles out of our waste stream for redemption.

Q7. Does WPI pay Waste Management to take away waste by weight or for the service?

A.7 Liz answers that WPI pays a tipping fee and a weight fee for waste disposal. She said that any diversion of WPI's waste stream would reduce their expenses.

Q8. Has anyone ever tried to implement either of these options before?

A.8 Liz was unaware of previous attempts to bring these programs to the campus.

Q9. (Optional) Are you aware of any current research being conducted in regards to plastic breakdown?

A.9 Liz mentioned that she may have heard of a group of student on campus attempting to recycling plastics into usable products; however, she was unaware of the details.

Q10. Besides incentive programs, what are some other programs that you think WPI could implement to improve recycling behavior?

A.10 Liz said that nearly every program that was thought of was tried in some way or form.

Former WPI Green Team President, Ryan Cooney

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: Mar 26, 2017. 8:45 PM

Goal: To learn more about what makes sustainability initiatives successful or unsuccessful on campus.

We received written responses to interview questions from Ryan Cooney, the former president of WPI's Green Team, via email. Unfortunately, we were unable to meet for a physical interview as Ryan was in India for his own IQP project at the time. Our primary goal was to learn how to effectively engage campus community members in recycling endeavors, both by learning from past initiatives and requesting feedback from Ryan regarding our preliminary suggestions. Below are the verbatim answers that we received from Ryan via email.

Q1. What do you think has contributed to the success of past Green Team initiatives and programs?

A.1

- a. Dedication to sustainability of our members. There's a pretty passionate and well connected sustainability community in the Green Team and at WPI and that helps keep morale high and helps us have creative ideas.
- b. Our most successful initiatives (especially bike share) are those that involved other groups outside of the green team, so connections with other groups.
- c. Funding is useful and makes pulling off bigger events easier.
- d. Good leadership. One or two good leaders make all the difference in pulling off big events
- e. Keeping events and initiatives fun for our members.

Q2. Has there ever been, to your knowledge, any attempts to implement an incentive program to increase recycling? If so, can you please detail the program(s).

A.2 Has there ever been, to your knowledge, any attempts to implement an incentive program to increase recycling? If so, can you please detail the program(s).

Q3. If not, what are your opinions on the possibility of implementing a recycling incentive program?

A.3

- a. I'd love to see it happen. I think that using rewards and positive reinforcement are probably one of the simpler ways to get people to pay attention to information about recycling and start making behavioral changes. Definitely better than just giving people information – everyone on campus is so overloaded with ads that it's unreasonable to expect them to listen to anything you say about something that doesn't directly affect their lives (i.e. recycling) unless there's something in it for them.

b. That said, my experience is that people at WPI aren't necessarily against sustainability, but fairly indifferent, and to be honest, recycling isn't "cool" or exciting the way newer sustainability tech is, so it's hard to make it appealing or interesting to recycle. There'd have to be a very direct and meaningful incentive (probably monetary) to recycle. I think students have had enough free food, giveaways, pizza parties, etc.

Q4. Do you have any advice for our team on effectively engaging campus members in recycling endeavors?

A.4 Make it fit well with WPI culture – focus on tech instead of activism; have it be very minimal on time, as most WPI students are really busy (or at least are stressed enough to think they are); have creative means of communication (if you can think of something other than emails, table-sitting, and posters, that might make a big difference); have recycling guidelines be extremely clear (they definitely aren't right now); this probably makes me sound super jaded haha but (I feel like) I've noticed this culture at WPI where it's "cute" to be lazy ("I was supposed to be doing my homework but I decided to watch Netflix and drink Dunkin' instead", "I used SNAP to go from the library to East because stairs are hard") that is definitely detrimental to sustainability efforts, people will smile and tell you recycling is too hard if you don't have the right way of getting past this – I might be completely wrong and just angry at people after 3 years of working on this stuff haha but it may be something to keep in mind. Fun fact – my experience working on reducing food waste in India is showing that people here always jump to the idea of using shame and punishment to change behavior instead of jumping to using rewards the way we do. I think (check out psych research though) there's a happy medium that involves both gentle dis-incentives of bad behavior and small rewards for good behavior, but mostly focuses on systematic change to make recycling simple and practical so that people don't have to think about it. There's been this guy from this thing called Save Ohno or something like that who emailed us and wants to get his software platform set up at WPI – it uses on-line competitions between groups of students to incentivize pro-environmental behavior, might be something interesting for you. If you want more info I can get you in touch with him.

LEED GA, Sustainability Consultant (WM), Total Recycling Program Manager (WM):
Michelle Lee Guiney

Participants: (Via Teleconference) Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: Mar 29, 2017. 1:00 PM

Goal: To learn about the life-cycle of recyclable materials from WPI. Waste Management is currently contracted by the school to remove and dispose of both trash and single-stream recycling.

The interview began with us explaining our past thoughts on incentive recycling through a bottle redemption center.

Michelle mentioned placement, staff, and cleanliness as primary issues with a recycling center of any kind on campus. We would need to have in depth discussions with facilities before we could consider such an option viable. Further, she went on to describe the broader context, pointing out that in Massachusetts the number of active redemption centers dropped from about 1000 to about 100 due to difficulties in running them. She suggested we bring these points up in our interview with Bill Spratt of facilities.

Q1. What kinds of measurements are done on waste and recycling collected from our campus?

A.1 Michelle said that while she did not have statistics on hand, there was some data she could send us through email. When asked about other campuses, we were told such information was private. She suggested looking at Recyclemania, say it is the only good public source of information on college's recycling.

Q2. Are there situations where items collected in the recycling stream are moved to the trash?

A.2 Common items found in recycling that Waste Management cannot deal with include film, bags, stretchy plastics, multilayer containers, juice pouches, and polylaminate layer on aluminium foil. These items all have to be removed. Further, any recyclables contaminated with food need to be removed.

Q3. Where does recycled plastic end up?

A.3 The recycling from WPI specifically isn't tracked. All recyclables from all contracts are sent to waste management facilities first. At the facility they are processed, sorted, and then sold on the open market as a commodity.

Q4. We brought up our idea of updating the recycling posters around WPI.

A.4 Michelle began with bringing up the previous IQP that designed the recycling posters. She believed the signs to be imperfect, but sufficient. She pressed us to note that while you could continually change the signs to be better and better, it is questionable if that will have much effect, and more importantly it would not be the best use of time. She strongly

believed it makes more sense for our IQP to focus on other solutions. She pointed to the redemption center as a more concrete and larger project.

Michelle talked to us about an example she likes of the importance of correctly motivating your target group. She told us there was a recycling program started in hotels that asked housekeepers to remove recyclables from the trash. The program initially failed, as across the board the housekeepers all claimed they did not have the time to stop and do that for every room, did not have the space on their carts to keep them, and other logistical concerns. However, once the housekeepers were made aware that the proceeds of the program would be going to a charity doing work in Haiti, program participation went from nonexistent to nearly 100% participation. The logistical complaints even disappeared, showing that people who claim to not have time for something might change their tune when they have a personal reason to care.

Q5. In a previous interview with Ryan Cooney, he impressed on us the importance of a program being ingrained in the culture at WPI if it is to be successful. What are your thoughts on that?

A.5 Michelle asked us if we had thought of other incentives beyond a redemption center. We explained our intentions to look into bulk plastic recycling to her, but she focused on student incentives, wondering if we had asked students, “What are they interested in?” She then discussed with us how non-monetary incentives could lead to be more powerful motivators, and that we needed to understand what would lead WPI students to cooperate. Michelle expressed the opinion that the number one factor in behavior change is understanding the interests of your audience.

Q6. Would you be open to scheduling a tour of the Waste Management facilities with us?

A.6 Michelle said that while it would be possible, it could be hard for us to schedule depending on how busy we are. She said she would send us some videos as well that would serve a similar purpose.

Q7. Does Waste Management deal with anything in regards to food waste or composting? (question was asked for the benefit of the food waste group)

A.7 Michelle said outlets are limited, and they might want to look into something on site. She also mentioned ‘WeCare’ as a nearby organization.

Student Green Team Member and Sustainability Intern: Meghan Trahan

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: Mar 30, 2017. 3:00 PM

Goal: To learn more about current student recycling initiatives and what contributes to the success of these programs. We also aim to receive feedback on potential recommendations to increase on campus recycling.

Q1. What do you think has contributed to the success of past Green Team initiatives and programs?

A.1 Meghan said that when students get excited about a certain initiative, the program will snowball and spread about campus. However, finding a way to foster excitement can be difficult. An example would be Project Clean Plate. In this program, Green Team representatives would stand at the waste disposal bins in the cafeteria and encourage students to dispose of their waste properly. At the start of the program, student behavior changed for 1 to 2 months. As time elapses, interest fades and the students revert to their original behavior. Meghan suggested that if we want to make a change in student behavior, we would need a passionate group to organize the program and enough students excited about the topic to participate. If we want a larger scale change, such as something on the administrative level, we need to be able to show that the program will either save or make money for the school on a long term. It is also best if we can develop a program that is self-hosting. Self-hosting refers to a program that generates a higher amount of revenue than the budget and labor burden it imposes on the institution.

Q2. Has there ever been, to your knowledge, any attempts to implement an incentive program to increase recycling? If so, can you please detail the programs. If not, what are your opinions on the possibility of implementing a recycling incentive program?

A.2 The first thing that came to Meghan's mind is Project Clean Plate. If the students disposed of their waste properly before leaving the Morgan Dining Hall, Green Team representatives would reward them with a piece of candy. However, the program's success was short lived because the incentive was not great and it required continuous stream of student volunteers. Furthermore, Meghan stated that both Dunkin' Donuts and the Campus Center sell reusable mugs that earn you a discount on your coffee purchases; however, she is unsure of the details of the discount.

Q3. How is the Bike Share a self-hosting program?

A.3 All of the bicycles are taken care of by volunteers and requires no involvement from facilities. Originally, the program had a relatively small upfront cost for the school. Administration paid for the cost due to sufficient student interest for the program. The program also makes our institution appear more sustainability minded to external review, such as

AASHE STARS, a rating used nationwide to rank schools in their sustainability or green minded efforts.

Q4. Have there been unforeseen issues with initiatives, such as the Bike Share program, that we should be careful to avoid?

A.4 Meghan said that people will often incorrectly utilize any program regardless of how simple the requirements may be. Regarding the Bike Share, program people stole the lights and even seats off of some bicycles.

Q5. Do you have any advice for our team on effectively engaging campus members in recycling endeavors?

A.5 Again, Meghan reiterated that we need an excited group of students and real campus interest for any program to be successful. Additionally, a dedicated leader, such as a passionate Green Team representative, makes a significant difference because they are often willing to put a lot of their time into ensuring the execution of these programs. She said that it requires more work to make a change on the administrative level. A program needs to show that it will either save or make money for the school and also require minimal involvement from facilities .

Q6. Do you feel the signs explaining WPI's recycling program are effective? Would updating them be an effective use of time?

A.6 Meghan feels that the signs were okay for dual stream; however, the information is no longer relevant for single stream recycling and could be updated. The Green Team had been working on developing new signs for campus but stopped in the process. Members of the Green Team could not agree on what was and what was not recyclable under single stream. The new sign project was lead under former president Ryan Cooney. When the seats changed after this year's Green Team elections, the signs became a forgotten effort.

Q7. Our team was exploring the idea of creating different signs for specific locations on campus. These signs would include items sold or commonly found at those locations. What are your thoughts on signs specifically made for certain locations on campus?

A.7 Meghan would love to see someone finish updating the signs. She recommends that these kinds of posters should stand out from the rest to gain more exposure. Despite the difficulty of gaging the effectiveness of these posters, Meghan feels that updating the current posters is an effective use of time because many people are unsure of what is recyclable under single stream.

Q8. What efforts do you know of to reduce non-recyclable products on campus?

A.8 Meghan was unaware of any initiatives that aimed at keeping non recyclable materials off of WPI's campus. She informed us the WPI does have a contract with Coca-Cola that requires us to use their cups. Unless sales for the Coke products drop below a certain limit,

WPI cannot change the contract.

Q9. We were looking into the possibility of an on campus redemption center where students could a deposit for redeeming cans and bottles. What are your thought on such a program?

A.9 Meghan expressed that the 5 cent deposit will most likely be too little compensation for many students to use it since they would need to collect large bags of redeemable containers to make it worth their time. She informed us that APO, the community service fraternity on campus, conducted a bottle and can drive hoping to raise some money. Meghan noted that the program lasted several months and as a result, the fraternity was only able to raise 5 to 10 dollars.

Q10. Our group is also exploring the idea of organizing the collection of bulk scrap plastic on campus for sale to third party purchasers. Do you have any thoughts or concerns with this idea?

A.10 Meghan advised us to look into bulk scrap plastics redemption from the view point of the institution rather than as an option for individual students. Again, we need to show that such a program would financially benefit the institution in addition to being a green minded program.

WPI Director of Facilities Operations: William (Bill) Spratt

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: Mar 29, 2017. 3:00 PM

Goal: To collect information from facilities regarding overall campus recycling.

Q1. What does your job as the director of facilities operations entail on a day to day basis? How much time do you spend on sustainability? How much time of that is spent on recycling programs specifically?

A.1 Bill supervises all custodial operations, trade services, power plant operation, grounds crews, and events office at WPI. Most of his work is in the energy sector. He has overseen a 15% energy usage decrease over the past 5 years. He has not done much work on recycling in recent years.

Bill told us about the former post-consumer cardboard recycling program. Due to a decrease in revenue, the program became unable to sustain its labor costs and was eventually cut.

Q2. Can you tell us what happens to waste and recyclables after they are placed in bins and before they are sent to waste management? What happens during and after collection? Is there any inspection or sorting that occurs before it is sent out?

A.2 Bill explained that facilities employees do not inspect or sort any collected waste stream materials. While there have been instances of employees removing redeemable containers from the waste stream, this practice is not facilitated by the department. He also explained that WPI employees do divert any contamination in the recycling streams. Waste Management will sort and inspect recycling for contamination after it is received from WPI.

He informed us that there are currently two full-time employees that are solely responsible for waste collection on-campus. Waste Management will move contaminated recycling to trash in their facilities. Currently, WPI pays \$130 per ton of trash and \$35 per ton of recycling. If the waste stream has too many recyclable items in it, Waste Management will issue a warning to the school. The problem reoccurs after a warning is issued, Waste Management will report WPI to the MassDEP for waste stream violations.

Q3. Would adding bins for redeemable items alongside the recyclable and waste bins be a feasible option?

A.3 Bill does not think people are throwing cans in trash; therefore, it would not divert trash into a recycling stream. There would be no incentive for students to take an extra step in their personal recycling behavior. Before the school switched to single stream recycling, there were three bins at each refuse location. The three bins were for trash, paper recycling, and other recycling.

Q4. Do you think it is a good approach to think about the design of recycling

bins themselves? Would larger bins help? Would a different design for their opening help? Would better signs help?

A.4 Bill suggested the idea of preventative actions to reduce waste streams. It seems that there is a disparity between what is allowed in our single stream by Waste Management and what sorts of plastic items are distributed in dining locations on campus. He supports the idea of adding unique signs to recycling near vendors on campus detailing what items sold at that location are recyclable. For example, the plastic cups at Dunkin' Donuts in the Campus Center are recyclable; however, their straws are not. He stressed that relevant and correct messaging on recycling bins across campus can contribute to the success of a recycling program. He suggested we check with other college campuses to determine the good practice that may be relevant to WPI's sustainability and recycling.

Q5. Initially, our goal was to explore the effectiveness and feasibility of incentive recycling programs on campus. For example, bringing a bottle redemption center or a bulk scrap plastic recycling center on campus. Do you think that these programs would help significantly? What problems can you foresee regarding these types of programs? Would facilities have the budget, space, and labor required to operate and maintain a facility like this?

A.5 When asked about an on-campus redemption center Bill brought up the following stipulations. The program should not require the school to hire a new employee, nor should it stretch the current staff. Finding space for both the facility and storage will be difficult. Finally, the space must stay mess and odor free to avoid attracting pests. Bill explained the labor process of collecting and storing waste.

Regarding bulk scrap plastic recycling, he said that he would like more information regarding the feasibility for WPI to open an account with a recycling facility.

Q6. What caused past recycling initiatives to succeed or fail?

A.6 Bill spoke about the cardboard recycling program. The program produced revenue for the school per unit weight of loose cardboard. It ultimately failed because of the crash in prices for post-consumer cardboard. He spoke about a current program at Clark University where the cardboard is pressed, baled, and sold as scrap material. It is entirely run by student volunteers.

Bill mentioned that the school removed trash bins that used to line Institute Road. People would overuse the bins and bring trash from their home to dispose in these bins. This imposed an unnecessary cost to the school.

Bill also stated that the addition of new signs to recycling bins may have helped a little. However, the signs were inconsistently distributed across campus and ineffective at routing attention. He said that two of the most important factors in a successful recycling initiative were to reduce the ease of proper recycling behavior and to have convenient recycling locations.

He expressed concern that there are items sold on campus that are ordinarily recyclable; however, not accepted in recycling containers on campus. This causes confusion and improper recycling behavior as information regarding the proper disposal of those items is miscommunicated.

Q7. Do you have any final suggestions or opinions for our team?

A.7 Bill suggested to us that we should explore preventative actions to improve recycling rates on campus He gave us a few suggestions for potential avenues of preventative solutions.

One was making sure that all plastic items sold or used on campus are recyclable or reusable. Bill suggested meeting with Joe Kraskouskas. Joe is the Director of Dining Services on campus and is responsible for ordering all plastic dining supplies.

Bill also noted that the information on recycling signs is inconsistent across campus. He posited that better awareness and clarification of what is and is not recyclable in our waste stream would help to increase recycling rates.

WPI Associate Director of Buildings and Events: Terrence (Terry) Pellerin

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: Apr 5, 2017. 1:30 PM

Goal: To obtain information on operations of sustainability programs on campus

Q1. What does your job entail? How much of your time is dedicated to sustainability? How much of that time is specifically related to recycling?

A.1 Terry is in charge of overseeing custodial services, recycling, and trash removal on campus as well event support. Approximately 10% of his time is dedicated to sustainability efforts. The entirety of Terry's sustainability efforts are related to recycling.

Q2. Are there any apparent problems or misuse regarding recycling on campus?

A.2 Terry observed improper recycling practices in both in academic buildings and residential halls on campus. He noted that people sometimes do not put recycling in the proper container and they also put food waste and other contaminants in the recycling containers. This problem is more pronounced in residential halls. If students in their dorm have to walk further to find a recycling bin, they will put recycling in the trash bin. Terry said that the number 1 problem related to misuse of recycling is contamination.

Q3. Are there differences between recycling in different dormitories?

A.3 Terry told us that East Hall and Faraday Hall, upperclassmen housing, have both trash and recycling containers in the bedrooms and suite areas. It makes the program much more successful in those two locations than in older buildings used for underclassmen housing. Terry speculated that the proper recycling behavior practiced in these buildings may be attributed to the students bring upperclassmen or because the program is laid out well and easy to follow.

Q4. What can you say about the initiative to put recycling containers in individual dorms in Daniel's hall?

A.4 Terry said the program was based on the success of the recycling in East and Faraday Halls. The program provided each room in Daniel's hall with recycling and trash bins with bags for each bin. The intent was for students to have recycling and trash in a more accessible area. Students were supposed to bag their waste and place the bags in larger central collection areas.

Terry said that program has been 75-80% successful. He said there are still issues with students throwing "loose" items in the large containers like food waste and other contaminants. Further, he explained that there was a huge problem with fruit flies. That problem has somewhat been resolved because the students noticed and improved their behavior after being affected by the presence of fruit flies.

Q5. Are there any other initiatives currently underway?

A.5 Terry told us that Liz Tomaszewski works with the Eco-Reps and the Student Green Team. He is not usually involved in student activities. Terry would like to see the Daniel's Hall program expanded to other residential halls. He explained to us that, as with any program initiated on campus, there are costs associated. However, he thinks that investing in recycling is the right thing to do and benefits everyone in the long term.

Q6. Do these programs save money over time?

A.6 Terry told us about the rates that WPI pays for waste. He told us the following figures may not be exact or updated. WPI pays Waste Management 85 to 90 dollars per ton of trash. The cost for recycling varies depending on the market. Recycling can cost 15 to 30 dollars per ton. When the campus used to have bulk cardboard recycling, WPI received 60 dollars per ton of cardboard depending on the market.

Q7. What is your opinion on incentive recycling programs? Specifically an incentive that would make students recycle more on campus.

A.7 Terry told us there has been talk about putting a program like that on campus. He is unsure how or who would service or maintain the program's infrastructure. Terry has used grocery store redemption centers; however, he is unsure of the operational requirements of those centers.

Q8. We have also explored three new potential avenues that could improve recycling habits on campus. The first is improving recycling education. What is your opinion on the current state of recycling knowledge and awareness on campus?

A.8 Terry notes the signs that were put up recently as a result of the Green Team. He thinks that if you are unsure of whether an item is recyclable or not, you should put it in the recycling. His understanding is that the recycling will be sorted by Waste Management at their facility.

Q9. Does waste management charge more for contaminated recycling?

A.9 Terry explained to us that if an entire load of recycling is too contaminated, it gets moved to trash. Waste Management will allow a 10-15% contamination rate. Contamination of that degree is rare occurrence.

Q10. What is your opinion of industrial bulk plastics recycling? This is bulk recycling for dining services, facilities, and academic departments.

A.10 Terry told us that all plastic jugs or tin cans from shipments are recycled. Until recently, staff would place the recycling in a domed container in the parking lot. The Rubin Campus Center now has a recycling compactor. A trash and recycling compactor was installed in the building no more than a month ago. The compactor is very effective. WPI produces enough material that there is a weekly pickup for recycling.

Terry told us that city and state inspectors have notified WPI in the past that there is too many recyclable items in the trash. Specifically Morgan Dining Hall and the Rubin Campus

Center have encountered this problem. It was a result of the food services producing too much recyclables and being forced to place it in the trash once the recycling container was full. Terry is currently working with Morgan Hall to implement the same compactors that the Rubin Campus Center has. He is shocked at how effective and how quickly the recycling containers fill up.

Q11. Are there any other location on campus that could use a compactor?

A.11 The next place Terry thinks it would be effective would be Founder's Hall, where the Goat's Head restaurant is located. The compactors have resulted in large labor savings for staff to not have to move all the materials produced by these buildings. It saves employees 2 hours per day.

Q12. Are there any other places on campus that generate a lot of large waste?

A.12 Terry told us that Washburn Labs generates a lot of miscellaneous items like wooden palettes and metal objects from equipment. The laboratories receive shipments containing machinery, cabinets, and other heavy metal items frequently. He told us that a vendor, Superior Waste, comes here to recycling those items. Another location that receives bulk shipments often is Gateway Park.

Q13. Is there a strict set of guidelines provided from waste management detailing exactly what is recyclable?

A.13 Terry mentioned that there is paperwork provided by Michelle Lee Guiney from waste management. He believes Liz Tomaszewski has the paperwork.

Q14. Would that be a good avenue to explore for improving on-campus recycling and reducing waste?

A.14 Terry suggested that we work with food services. He has worked with the dining services in the past. Facilities purchased 900 reusable mugs and food services would allow students receive a discount on fountain drinks if they used these mugs. He suggested that we see if we can ask dining vendors on campus to provide a discount for using refillable beverage containers. Each year WPI installs 3 or 4 refillable filtered water stations. Older water fountains are replaced across campus; however, it is a costly endeavor.

Another large problem that Terry has with waste generation is trash coming onto campus that is not WPI generated. Non WPI community members will see a container on campus and they come here with their trash to dispose of it. Terry monitored the east hall compactor where people would put things like construction debris and piping. Despite the monitoring, people still inappropriately disposed their waste in the compactor. He resolved the issue with a padlock.

Q15. Is there any information we have not asked for that we should know?

A.15 Terry believes a more aggressive initiative in the Fuller and Ellsworth apartments could improve recycling. He also suggests similar measures in other areas like the Salisbury estates. He does not know who manages the waste in that area. He thinks it would a great

initiative to start a program there if there is not one already.

Sr. Assoc. Director of Residential Operations, Res Services: Amy Beth Laythe

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: Apr 10, 2017. 3:00 PM

Goal: To obtain information regarding operations of sustainability programs and initiatives targeting residential halls

Q1. As Senior Associate Director of Residential Operations, what does your job entail on a daily basis? Are you actively involved with any sustainability efforts?

A.1 Amy is the facilities contact for residential services. She is responsible for work orders, supervising complex coordinators, and conducting walk-throughs with facility supervisors. She has served on sustainability committee and the past and now continues to work with recycling program.

Q2. Is Salisbury Estates one of the housing locations that you oversee or is it its own separate community? What is the current recycling situation at salisbury estates?

A.2 Amy told us that at salisbury estates, WPI owns between 40 and 50 apartments for both undergraduate and graduate students. The remaining apartments in the complex can be rented by the general public. She told us that a management company manages the non-WPI owned apartments. Amy also informed us that there is no recycling at the Salisbury estates. There are only dumpsters for waste disposal and it is unclear on who is managing the waste stream.

Q3. Moving away from the topic of Salisbury Estates, from your observations, are there any apparent problems or misuse regarding recycling on campus?

A.3 Amy has observed misuse of the trash and recycling containers on campus. She has noticed trash in recycling bins, uncleanly waste containers, and loose items in the large recycling containers in dorms. She has stated a need on additional education focused on recycling; however, she is unsure on whose role sustainability education falls under. She mentioned the success of a pilot study in Daniels Hall to place both trash and recycling containers in individual dorms. Lastly, residential services includes in every room a sign explaining what is and is not recyclable. Despite this, Amy still notes confusion regarding recycling practice in dorms.

Q4. Do you see the Daniels initiative expanding in the future?

A.4 Amy would like to expand the initiative in Daniel's Hall to other residential halls. A limitation to this was that residential advisors were unprepared for spreading information regarding the program. If the initiative were to occur in other buildings, it would have to be incorporated with moving into and living in the building. Amy also mentions that the Student Green Team's role in residential programs is unclear as they are advised by Liz, who

works in Facilities.

Q5. What would be the restrictions for posting new recycling signs in residential halls? What areas do you think could use improved or targeted signs?

A.5 Amy motioned that it would not be complicated to improve signs in residential halls. She said that we would work with facilities to post signs around waste receptacles. In addition, the signs would need to come through the residential services office to produce approximately 50 signs for each residential advisor. She noted that laundry rooms, The Goat's Head, and Outtakes could use specific recycling signs. For generic recycling signs, she noted that they could be placed near recycling stations in dorms. In addition, signs can be placed in each room before the school year starts.

Q6. Is there any information that you think we should know that we have not asked about yet?

A.6 Amy mentioned that the transition from dual stream to single stream recycling took a long time to make sure that all of the waste containers were the way they should be. There is a need to make sure every trash area has the same receptacles. Regarding waste compactors, she mentioned that residential halls and dining halls make very effective use of the compactors.

Director of Dining Services, Joe Kraskouskas

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: April 14, 2017. 2:00 PM

Goal: To explore preventative options for keeping non recyclable plastics off campus.

Q1. As Director of Dining Services, what does your job entail on a daily basis? Are you actively involved with any sustainability efforts?

A.1 Joe explained that the overarching purpose of his job is to feed everyone at WPI. He is actively involved in several green initiatives with Dining Services including Project Clean Plate, Trim Trax, and the promotion of reusable food containers.

Q2. How much non-recyclable plastic is being used on campus? Average monthly usage rates? Where specifically is it going?

A.2 Joe was able to provide us with actual weekly and monthly usage rates of non recyclable plastics on campus. According to his data WPI Dining Services uses 108 cases of non recyclable plastics monthly. The 108 cases translates to 2,180 pounds of non recyclable material on campus monthly. The usage data for non recyclables accounts for the material at the Campus Center, Library Cafe, and the Outtakes shop which only uses a very small amount of non recyclables when compared to the other two locations.

Q3. Why does Goat's Head have compostable to-go containers, and the Campus Center has non-recyclable containers?

A.3 Joe explained that the clear plastic containers are used in the campus center for presentation purposes so that students can see what they are buying. He said that it makes sense for students to be able to see inside a fruit cup before they buy it whereas they would not need to see inside a to go box that they would be taking from the goats head. However, when we brought up the clear plastic clamshells used at the Campus Center salad bar Joe had a different opinion. He said that they would be willing to change those containers to a compostable option since students are building their own salads so they do not need to see through the container before they purchase a salad.

Q4. For the Campus Center salad bar, can someone bring in their own reusable container?

A.4 Joe told us that students can use their own reusable containers for the salad bar if they would like to. He also explained that he has reached out to the provider of the clear clamshells that are currently used at the salad bar to see if there are compostable options that they could purchase instead.

Q5. Can you detail the source and usage rates for each non-recyclable item coming onto campus?

A.5 Joe explained that all the non recyclable plastics come from Sysco except for the plastic bowls used by the Chick N Grill in the Campus Center. He then gave us detailed data on

how much of each specific non recyclable item we use per month.

- a. Plastic straws- 6 cases of 300 straws per month which equates to 40 pounds of non recyclable material.
- b. Plastic clamshells- 3 cases of 200 Large containers per week plus 1 case of 400 smaller plastic clamshells per week. This equates to 400 pounds of non recyclable material per month.
- c. Plastic lids for hot beverages- 1 case of 1200 lids per week which is equates to 60 pounds of non recyclable material per month.
- d. Plastic bowl and lids for Chick N Grill- 9 cases of 250 bowls per week plus 9 cases of 250 lids per week. This combination of bowls and lids accounts for 1440 pounds of non recyclable material per month.
- e. Plastic fruit and smoothie cups- 3 cases of 500 lids and cups accounts for 240 pounds of non recyclable material per month.

Q6. What happens to plastics coming with the shipments, like the pallets and plastic wrap?

A.6 Joe told us that the schools receives about 3 pallets of food per day and that there is roughly 1 pound of plastic wrap used per pallet. The plastic is either taken back by the vendor or disposed of in the WPI dumpsters.

Q7. Why do we continue to order non-recyclable plastics and can we change this?

A.7 Joe explained that he will reach out to the contracting company to find what alternatives for the non recyclable products are available. He thinks that changing the salad bar clamshells to a compostable option could actually have a significant impact but changing straws to be compostable most likely is not worth it. During this discussion Joe wanted to note two of the green initiatives Dining Services is currently participating. These two initiatives are the reusable containers and the use of actual silverware in the Campus Center. He estimated that about 90 to 100 people are using the reusable silverware and china per day in the Campus Center. He recalls that about 200 reusable containers were initially sold but sales of the containers has dropped. When the program started the Campus center staff filled roughly 50 reusable containers per day but now they only see around 10 per day. Joe then reiterated that he felt switching to a compostable container for the Campus Center salad bar is a good idea and that he will try to get a better idea of how many plastic clamshells could be kept off campus by making the switch.

Q8. Have you thought about implementing compostable utensils?

A.8 Joe told us that the catering department actually has compostable utensils but they are not used through out campus because they are not compatible with the current utensil dispensers. Dining Services did look into making the switch about 6 months ago but the compostable utensils were not offered in th cartridge style packaging that the current

dispensers on campus require. He felt that if there were more space in dining areas then they could potentially offer both plastic utensils and compostable utensils. However, he did express some concern with compostable utensils and said that they can act a little "funky" with hot foods.

Q9. We would like to reduce the number of disposable cups used on campus. What would it take to get a discount for using your own cup at places like Dunkin' Donuts or the Rubin Campus Center food court?

A.9 Dunkin' Donuts informed Joe that they will offer a drink upsize if the customer has a reusable cup. This means that if a customer using a reusable cup orders a large coffee they will only be charged for a medium sized coffee. However, Joe said that he was unsure of how much this is actually happening on dunkin' Donuts' end. He also explained that all coffees are 99 cents at the Campus Center so using a reusable cup would not offer any additional discount.

D Facility Visit Summaries

Waste Management (Tom J Henry, Major Account Manager)

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: April 7, 2017. 10:00 AM

Goal: To learn about what happens to our waste after it leaves campus.

Q1. Which numbers of plastics are recyclable at you facility?

A.1 Tom explained that number six and seven plastics are not recyclable at the Avon Waste Management facility. It is not that the plastics themselves are not recyclable it is just that they are not profitable for the facility so they do not recycle them. According to Tom plastic numbers one, two, and five are the current most profitable plastics for the facility.

Q2. what happens to the number six plastics if they are not recyclable? Specifically, WPI uses number six plastic utensils and we were exploring the idea of changing to number 5 utensils.

A.2 Tom explained that Number six and seven plastics are treated as trash. In addition, most plastic eating utensils end up being processed as trash because they are so small and are able to fall through the rollers during the initial phase of sorting.

Q3. Would the utensils be recyclable if we put them in a larger plastic container made of the same type of plastic before being sent to Waste Management?

A.3 Tom said that whatever was contained in the larger container such as a cleaned and resealed mayonnaise jar would most likely make it through the entire sorting process and treated like as whatever material the container was made of. While he found this strategy for dealing with smaller plastic items very interesting He was unsure of how practical it really was since it would require another step of sorting on the consumers end before sending to the Waste Management facility.

Q4. What happens to plastic bags and straws at the Facility?

A.4 Tom said that employees are trained to pull all the plastic bags that they see off of the feeding conveyor belt before they reach the initial sorting phase. Tom explained that the bags, no matter what number they are, get wrapped around the rollers of the sorting machine and cause it to malfunction. All of the bags they receive are treated as trash since they do not have the proper machinery to compress the bags into bricks for reselling. Tom said that the plastic straws usually end up with the recycled glass because they are too small for the sorting machine. Further, it is nearly impossible for employees to remove them as they pass by in the conveyor belt.

Q5. What do you suggest we do with the plastic bags and straws if they are treated as trash in the Waste Management facility?

A.5 Tom recommended that people return the plastic bags to the grocery stores because the grocery stores actually have the capability of recycling them. Additionally, he suggested

that eliminating all plastic bags on campus would be the most effective way of dealing with them. As for straws, there is currently no real way for the Waste Management plant to recycle them properly for the same reasons that there is no practical or economic reason to recycle plastic utensils.

Q6. How is Styrofoam dealt with in the Facility?

A.6 Tom said that Styrofoam alone is recyclable but it treated as trash at their facility. He told us that it is simply to light to be economically viable for the facility to process

Q7. How large of an issue is contamination at your facility?

A.7 Tom explained that contamination is a problem at every recycling facility. He used a peanut butter jar as an example to explain it to us. He said that if you use all of the peanut butter that you can in a jar and leave the residue on the walls of it then that jar should be fine for processing at the plant although they do prefer that the jar is rinsed out. However, if you left half of the peanut butter in the jar it would be too heavy causing it to be incorrectly sorted by the phase of machines that use air knives to identify the different plastics. Tom told us that they experience approximately a 9.4% contamination rate at their plant.

Warehouse Plastics (Henry Coz, salesperson)

Participants: Ray DiMestico, Elisha Musgraves, Lambert Wang, Tim Whitworth

Date: April 11, 2017. 10:00 AM

Goal: To explore the viability of industrial bulk plastics recycling for WPI.

Q1. What does your job entail on a day to day basis?

A.1 Henry informed us that he acts as a salesman for warehouse plastics. The company has stockpiles of old recycled plastic materials that are ready to ship and it is Henry's job to find the buyer and make the sales. He has been working at Warehouse Plastics for 15 years and as a result was extremely knowledgeable about the entire process that the plastics undergo at the company's facility.

Q2. What types of plastics do you handle?

A.2 Henry explained that the company will accept mixed plastics as long as there is a market for those plastics at that specific time. However, if they accept a mixed batch of plastics they prefer the individual parts to be rather large such as the size of a food tray since smaller mixed parts are very difficult for the facility to sort. Henry also said that Warehouse Plastics handles very little post consumer plastics and that the company will not accept Styrofoam and other low density plastics since they require a specific type of compressor for bailing and an optical sorter which Warehouse Plastics does not have. Further, the company typically does not accept film from food packaging since it is very difficult for the facility to process. Lastly, no metals or woods are processed at Warehouse Plastics because the facility is only meant to process plastics.

Q3. What services does Warehouse Plastics provide?

A.3 Henry said that Warehouse Plastics takes shipments of bulk plastics, processes them into ground up pellets of the sorted materials, and then sells them to other companies for the creation of recycled plastic based items.

Q4. What is the general market price of the plastic you handle?

A.4 Henry said that generally the more common plastics they work with are worth approximately 20 cents a pound which amounts to 200 dollars per ton. However, he also explained that the market for recycled plastic is constantly changing and that sometimes the average value per ton can drop as low as 80 dollars. Further in the discussion Henry said that acrylic costs about 2 dollars per pound for virgin material while it only costs around 50 cents per pound if you buy recycled material.

Q5. What are the most valuable plastics that your company processes?

A.5 Henry told us that polycarbonate and Teflon are the most valuable materials that Warehouse Plastics deals with. Polycarbonate are worth upwards of 30 dollars per pound depending on the market and Teflon (PTFE) can be similar amounts at times.

Q6. What is the smallest amount of plastics you are willing to accept?

A.6 Henry said that the minimum size of shipment they would accept is two gaylords, large cardboard boxes usually around 48" x 40" x 36" in size. He also explained that for shipments that small it is much more convenient if the plastic is brought to the facility rather than Warehouse Plastics having to pick up the material.

Q7. How much contamination, food or liquid waste, is acceptable for you to

take?

A.7 Warehouse Plastics does not deal with plastics that have food contamination. They will remove metal wire pieces from some plastic parts such as tote boxes so that they can process the plastics. Henry also said that that paper contamination such as stickers on the plastics are acceptable because they will eventually be screened out by the companies that Warehouse Plastics sells to.

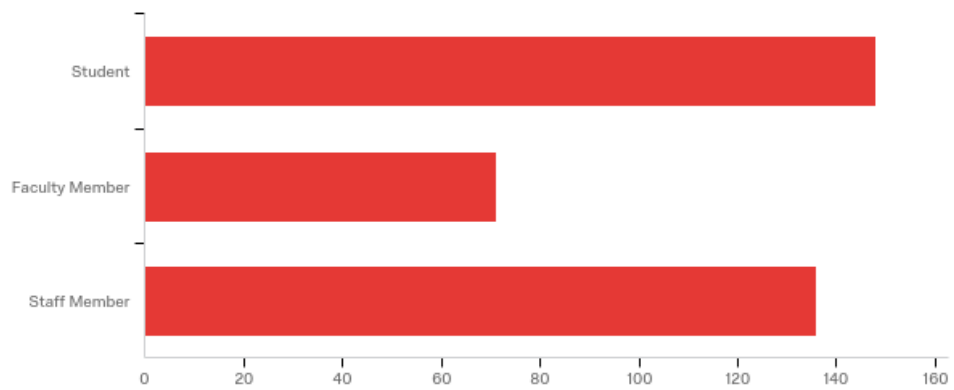
E Community Survey Responses

Default Report

Campus Recycling Habits

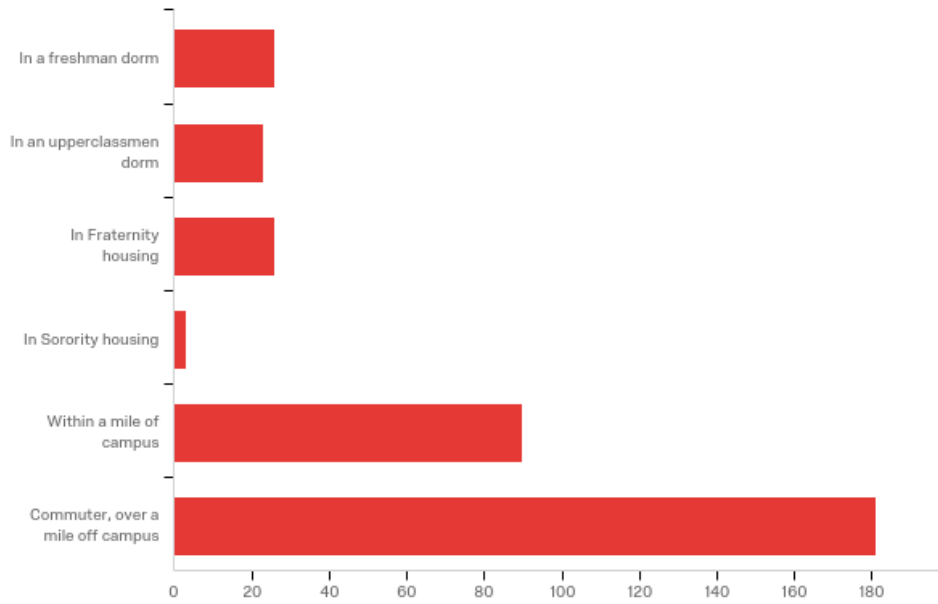
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Q13 - I am a:



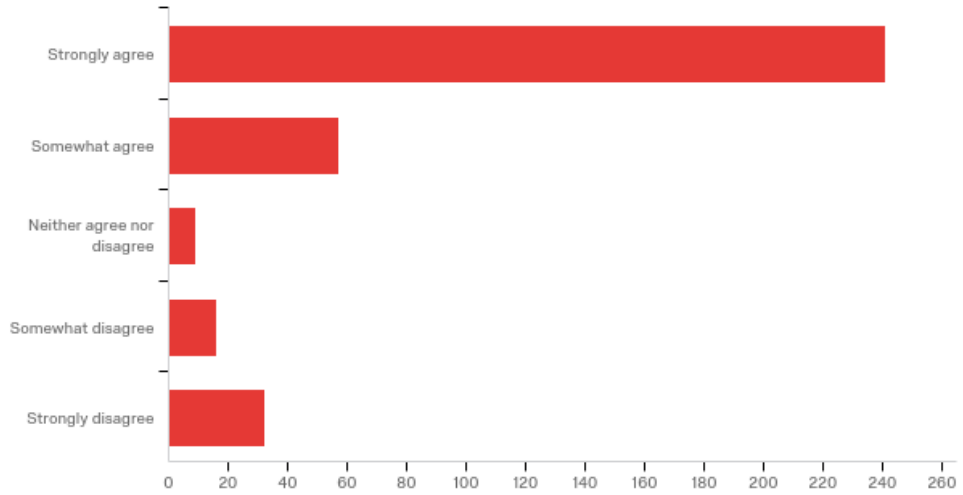
#	Answer	%	Count
1	Student	41.69%	148
2	Faculty Member	20.00%	71
3	Staff Member	38.31%	136
	Total	100%	355

Q14 - I live:



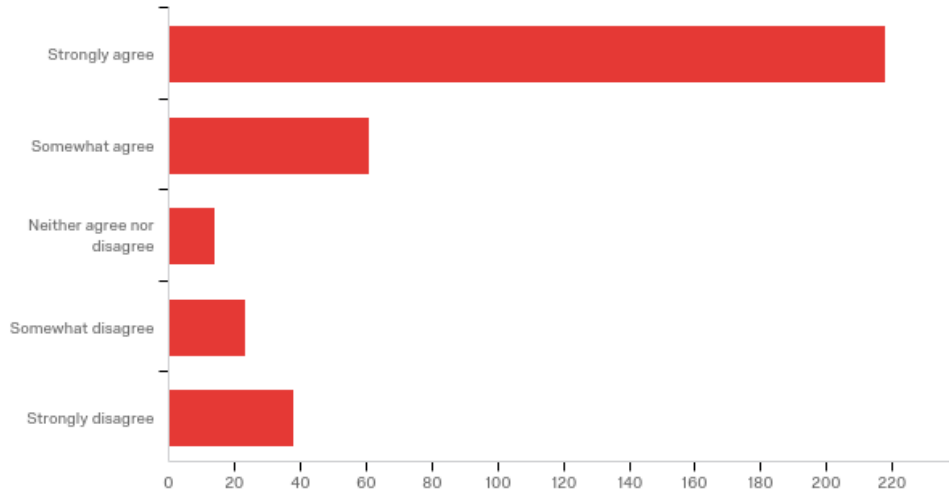
#	Answer	%	Count
1	In a freshman dorm	7.45%	26
2	In an upperclassmen dorm	6.59%	23
3	In Fraternity housing	7.45%	26
4	In Sorority housing	0.86%	3
5	Within a mile of campus	25.79%	90
6	Commuter, over a mile off campus	51.86%	181
	Total	100%	349

Q1 - 1) I regularly separate redeemable bottles from my trash and recycle or redeem them



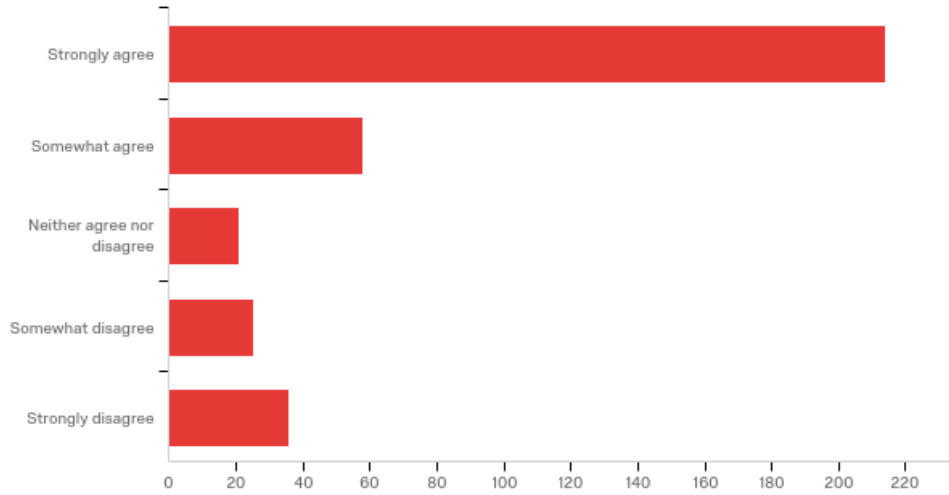
#	Answer	%	Count
1	Strongly agree	67.89%	241
2	Somewhat agree	16.06%	57
3	Neither agree nor disagree	2.54%	9
4	Somewhat disagree	4.51%	16
5	Strongly disagree	9.01%	32
	Total	100%	355

Q2 - 2) I regularly separate redeemable aluminum containers from my trash and recycle or redeem them



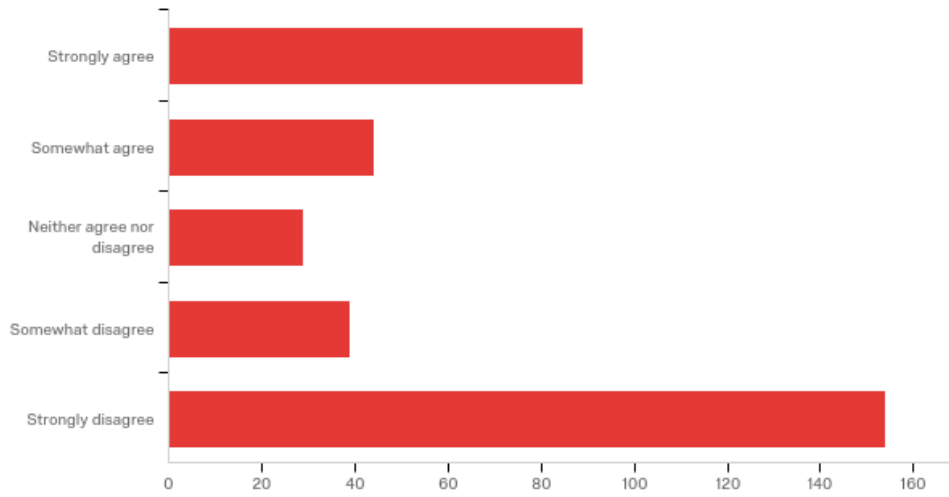
#	Answer	%	Count
1	Strongly agree	61.58%	218
2	Somewhat agree	17.23%	61
3	Neither agree nor disagree	3.95%	14
4	Somewhat disagree	6.50%	23
5	Strongly disagree	10.73%	38
	Total	100%	354

Q3 - 3) I regularly separate non-redeemable plastics from my trash and recycle or redeem them



#	Answer	%	Count
1	Strongly agree	60.45%	214
2	Somewhat agree	16.38%	58
3	Neither agree nor disagree	5.93%	21
4	Somewhat disagree	7.06%	25
5	Strongly disagree	10.17%	36
	Total	100%	354

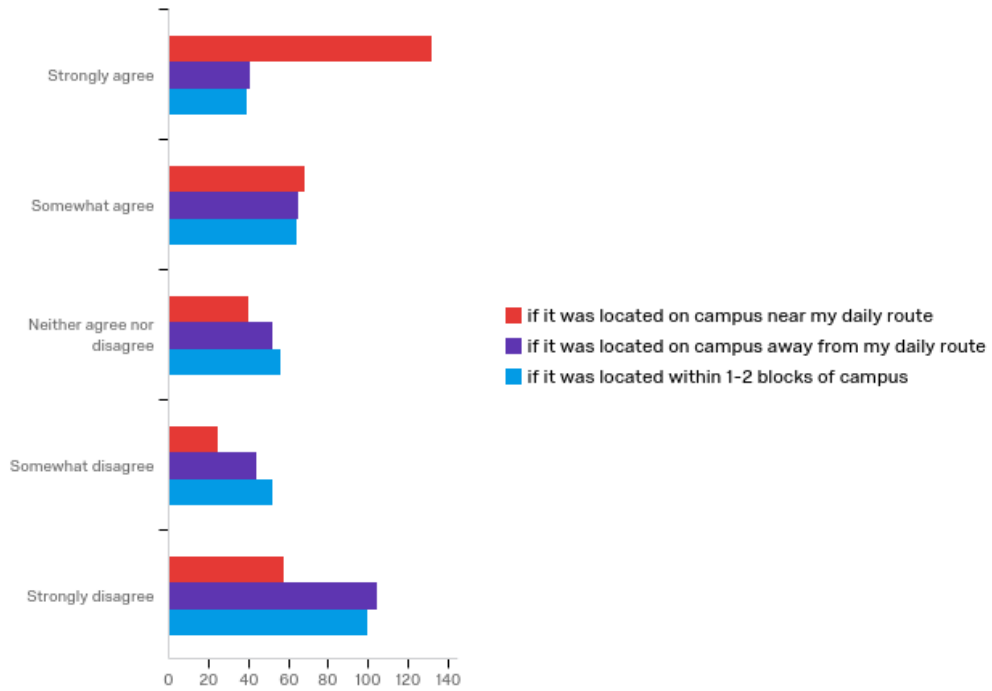
Q4 - 4) I regularly utilize a deposit redemption center



#	Answer	%	Count
1	Strongly agree	25.07%	89
2	Somewhat agree	12.39%	44
3	Neither agree nor disagree	8.17%	29
4	Somewhat disagree	10.99%	39
5	Strongly disagree	43.38%	154
	Total	100%	355

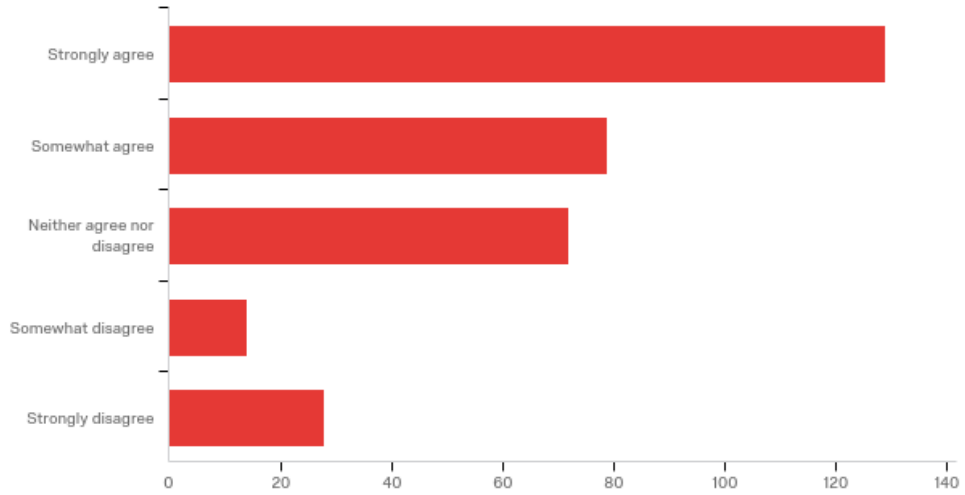
Q5 - 5) I would be likely to use a deposit redemption center:

I would be likely to use a deposit redemption center: if it was on campus near my daily route.



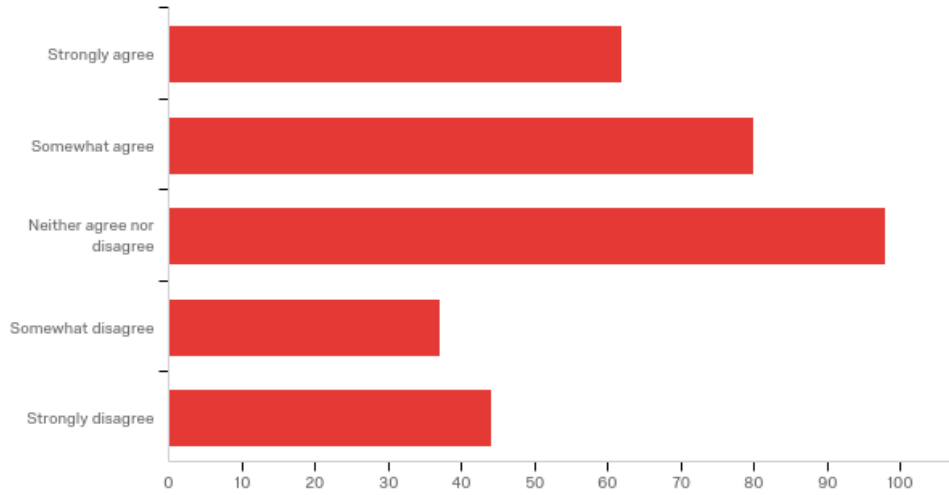
#	Question	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Total
1	if it was located on campus near my daily route	40.87% 132	21.05% 68	12.38% 40	7.74% 25	17.96% 58	323
2	if it was located on campus away from my daily route	13.36% 41	21.17% 65	16.94% 52	14.33% 44	34.20% 105	307
3	if it was located within 1-2 blocks of campus	12.54% 39	20.58% 64	18.01% 56	16.72% 52	32.15% 100	311

Q6 - 6) I would be likely to recycle more without monetary compensation if it was more convenient



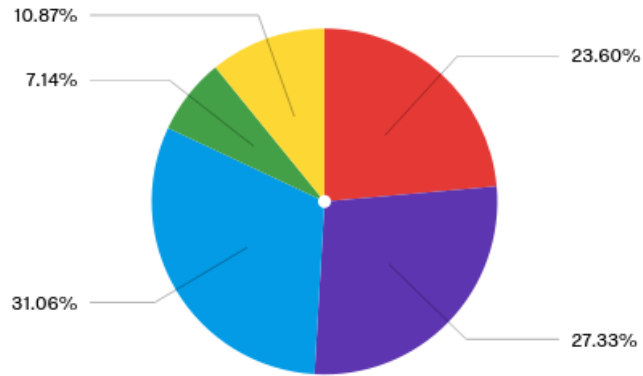
#	Answer	%	Count
1	Strongly agree	40.06%	129
2	Somewhat agree	24.53%	79
3	Neither agree nor disagree	22.36%	72
4	Somewhat disagree	4.35%	14
5	Strongly disagree	8.70%	28
	Total	100%	322

Q7 - 7) I would be likely to recycle more without monetary compensation if I was reminded



#	Answer	%	Count
1	Strongly agree	19.31%	62
2	Somewhat agree	24.92%	80
3	Neither agree nor disagree	30.53%	98
4	Somewhat disagree	11.53%	37
5	Strongly disagree	13.71%	44
	Total	100%	321

Q8 - 8) I would be likely to recycle more without monetary compensation if I was better informed about recycling practices at WPI



■ Strongly agree
 ■ Somewhat agree
 ■ Neither agree nor disagree
 ■ Somewhat disagree
■ Strongly disagree

#	Answer	%	Count
1	Strongly agree	23.60%	76
2	Somewhat agree	27.33%	88
3	Neither agree nor disagree	31.06%	100
4	Somewhat disagree	7.14%	23
5	Strongly disagree	10.87%	35
	Total	100%	322

Q9 - 9) I would be likely to recycle more WITHOUT monetary compensation if

I would be likely to recycle more WITHOUT compensation if

I already recycle everything recyclable.

I knew what was recyclable/not recyclable at point of collection.

I already recycle as much as I can! If it was super convenient, and people had a really good understanding of what you can and cannot recycle, because I think that's the hardest thing.

I already do.

There were more recycling bins on campus or in my fraternity house. Convenience is the most important factor.

It was on campus

It's convenient and I know that the money that is redeemed is going to a good cause (not the school)

N/A. I already recycle.

My family and I live in Holden where they have curbside recycling pickup once every two weeks. We are avid recyclers and recycle everything we can. We always return our bottles and cans at either the beer and wine store where we buy most of our bottles and cans or the redemption center at the BigY (our grocery store in Holden).

Worcester had a better trash/recycling system: perhaps better bins you could better leave outside that have lids

there wasn't so much trash from the 12 people living in my house.

I knew more about WPI's recycling practices and if they were in my daily route.

- does not apply. I already recycle everything that is recyclable.

Yes

Worcester allowed large rolling bins, instead of many small recycling containers.

It was Convenient to do and easily accessible.

If it were more convenient. I already separate cans and bottles but it is easy to leave them outside of my apartment for the recycling company to come and pick them up.

I got monetary compensation

I was able to convince a group of friends to go do it with me

I already recycle as much as I can

If it was more clear what can and cannot be recycled

I understood what I can and cannot recycle at WPI

Its convenient

It were more convenient

I know the proper way to recycle.

I was more educated about what can and can't be recycled

receptacles were provided (which they mostly are)

It was more clear which materials can be recycled and which cannot

My office had a kitchen sink so I could regularly clean out my containers. Or a place to bring dirty containers where they could be cleaned and recycled.

Convenience is everything - but it would have to be through my waste management company and be at home (just walk to container in my garage).

It was easily accessible and user friendly.

I already recycle as much as I can. I never redeem for monetary compensation because it's so little it's not worth the effort to travel to a redemption center. I just throw my recyclables in the recycle box and set it on the curb to be collected.

The recycling practices were explained and there were more recycling bins around campus

N/A - We recycle at home even if we aren't returning for deposit.

I the machine dispensed doughnut holes

I had more recyclables to recycle.

bins were conveniently located for me to use.

I believed the recycle bins were not mixed with trash in the end and thrown out

I recycle everything possible, regardless of whether I have to take an empty container with me a ways to find a recycling bin-and I don't think I need to be paid to recycle. I lived in NYC for many years where you had to sort your trash from recyclables. If you had cans kicking around in your regular trash, you could be fined.

i regularly recycle

it was made easily available

It was easier to remember what goes where

access was convenient and information about what is recyclable was more readily available.

More convenient

I was rewarded in another way

the recycling center was in a convenient location and the negative effects of not recycling were advertised.

It was simple and I was certain on the rules and regulations to recycle.

I would be likely to recycle more without monetary compensation if the infrastructure were in place in convenient locations. For example, every trash can should have a recycling bin directly adjacent to it.

It's was easy

there was a more convenient way to do so.

Just make it easier to recycle

There was regular reminders to.

it was within walking distance

I recycle everything I can

the design of the bins should be improved. office and lab space is limited, and these flimsy plastic bins are unsightly and take up a lot of space.

recycling was in more convenient locations

I didn't have to put any effort into it

There was a different compensation for example a raffle entry.

it was more efficient and reminded more

it was convenient to my daily route around campus

There were more recycling receptacles around campus

If there was more information on campus about what is recycled and what is not, and it was more integrated into the culture on campus.

I knew how much it helped WPI

it was more convenient

It is convenient. Clearly marked containers, ergonomically designed, convenient locations.

I generated more recyclable waste! - I try to reduce instead of just recycling. You gotta do all three of the R's, you know? I would recycle even more if it were clearer what was recyclable at WPI.

it was convenient

tbh if it was close and not hidden away

I recycle almost everything that can be.

It was more convenient

someone had a place on campus to put it

More products on campus were actually recyclable! There are a lot of items: plastic bags, food containers, cups, receipts... that can't be recycled. In addition, some items that have a recycling symbol on the bottom can't be recycled in single stream if they are too flimsy.. This makes everything very confusing.

There was a center in every upperclassmen dorm.

I didn't pay a deposit, but could just include redeemable bottles with my weekly recycling pickup.

there were specific recycle containers in every location that there is a garbage can

i already do - waste management picks up all recyclables

Accessible and easy to deposit.

I had more convenient storage in my home

it was easier

it was easier and less time consuming

I could see my impact

Irrelevant --- I "automatically" recycle as much as I can, not paying attention to redemption possibilities.

WPI had more containers that allowed recycling of more of the things I use on campus.

Not applicable - I already do it

I already recycle

There was another incentive

I knew more about what happens to my garbage after I recycle it.

there were more signs posted or information about where I could recycle things like batteries, electronics, etc. I already think I do a pretty good job of paper and everyday plastics, on campus and at home.

I already recycle most of my paper & plastic. I don't recycle for the money, so that's not a factor. Having very clearly marked bins (different colors, big pictures/instructions) in more places on campus would really encourage more recycling.

It does not matter, I recycle as often as I can.

it was clearer what is and is not acceptable to put into WPI's single stream recycling system

I knew exactly what was recyclable.

recycling collection containers were more available

I would be likely to recycle more WITHOUT monetary compensation if it was more convenient to do so. Convenience is an important motivator in recycling. Education is also important - the WPI recycling rules are not very clear.

I had a better idea of what plastics and papers are recyclable

I remind myself that the stuff I recycle is not going in the landfill

I think I recycle everything I can now as far as cans and bottles. Larger items are more difficult to recycle and it is a pain to take them to the city. I appreciate that WPI has the electrical recycling day in the spring

Containers were more available

lists of items that could be put in particular recycle bins were listed

if it would be easier, some deposit redemption center only take few brands and I do not want to not recycle the rest

I knew what it cost WPI to dispose of garbage each year

The garbage collection personnel in Worcester wouldn't make such a mess while picking up the green recycling containers. Check the streets near campus on Tuesdays to see how there are recyclable items scattered all over the place. This discourages recycling since half of the items are left at your doorstep.

If there was a cause connected. I usually hoard my bottles and cans and when the boy scouts do a can drive I bring them my bags. In Sterling, MA - where I live there is a disabled gentleman who requests people drop off their cans to him so he can redeem them to help support himself.

I recycle everything I can but convenience always makes it easier.

it were more convenient.

Drive thru.

I already do on campus and at home. So more is not an option.

the recycling was near me

I don't need monetary compensation to recycle I just need a convenient way to recycle without having to pay to recycle, as is required at the household cleanup days, etc.

I had a home recycling station that could literally make me something from recycled products. Then it becomes a novelty which is its own reward worth more than 5 cents, and it becomes a more concrete process so I don't have to use my trust and imagination.

easily accessible on campus or within a few blocks

if its convenient

it was convenient (e.g., curbside) and predictable

I already am a recycling tyrant. :-)

I live off campus. My town recycling center is very convenient for me. A recycling centre on or near campus would not be relevant for me, regardless of monetary compensation.

There were sinks and supplies in the hallways next to recycling bins that allowed me to rinse food containers or dump drink containers.

The recycling were conveniently located and I didn't have to separate the recycled materials. But no matter what, I will always recycle--it's a priority to me!

I already recycle paper/plastic significantly. However I do not do well at recycling metals/batteries/etc because I am so unclear on what is recyclable, where to go, and how convenient it is to go there.

Honestly, I recycle a lot already. The only times I throw recyclables in the trash are when there isn't a recycling container within a reasonable distance, and WPI is fairly good about distributing bins around campus.

I knew where to put everything with consistency from building to building

I currently take all my recyclables to the Leicester recycling center. I give them the redeemables to help support the volunteer recycling center. I give them crushed aluminum to recycle as well; they get some pennies per pound for that.

n/a I already recycle pretty much everything I can recycle and for which there are containers. I still would like to see plastic bags being recycled.

I will always recycle regardless of I have any offers or reminders.

I know I am helping the planet

I accumulate recyclables at home and redeem them when a large enough volume of stuff collects. I live in a town with curbside recycling of glass/plastics and paper products, so I don't need to bring my recyclables to campus as a part of commuting. It is a neat idea but for me, it does not make recycling more convenient than it already is. For that reason, having recycling on campus will not make it more likely that I will recycle (I already do it anyway). I recycle all recyclable materials already.

I didn't see my recyclable trash basket mixed with my normal trash basket.

conveniently located

I already recycle almost everything that is recyclable.

if industry / state did not collect the deposit at checkout when purchased. I am very busy and do not have time to collect a monetary refund, that was charged. I do recycle at home/work and follow rules for recycling.

it was easily accessible

Reminded

The money is not a driver for my recycling habits. They are more a matter of being aware of and using recycling bins. My town picks up materials for recycling biweekly.

It is already being done in my town and surrounding areas.

it was convenient to where I am.

I already recycle

I already try to recycle what I know is recyclable

I just always recycle even though I have to pay for an extra barrel at my house.

Doesn't matter, I recycle most things that are allowed

it was easily accessible

False

All about convenience!! Should have paper recycling by every mailbox, can/bottle recycling scatter around, ideally recycling next to every trash can.

We recycle everything with a paid (private) curbside pick-up.

i already do this

I knew if you can throw dirty recyclable containers into the recycle bins

I already find it important to recycle so there's nothing I can think of that would make me recycle more

At home, I recycle fairly consistently. Single-stream recycling was the most significant factor towards that. At work, I do not recycle anywhere near as much as I should, mostly because it's not convenient (no recycling bin in my office).

I could redeem all cans/bottles at one deposit center

If it were easier and more convenient.

I recycle everything I can through the city collection. I know that people come and pick the redeemable materials out of my bins at night. Frankly, taking all my beer bottles to a redemption center is too much work for a mere \$80 per week. I let the can people or the city take care of it.

I recycle plastics/glass/aluminum regularly at home regardless of compensation.

Convenience and accessibility of recycling bins is the most important factor for me. I recycle as long as I have a way to do so.

I do not expect or think it appropriate to compensate people for recycling. It should be easy to do and cover as many materials if possible.

I already recycle as much as possible without compensation. We even collect Styrofoam and drive out to Leominster once a year to a Styrofoam recycling plant.

it was more convenient

It was more convenient to do so.

I recycle regardless.

If I didn't see the recycling being thrown in with the trash when it is picked up.

I already recycle everything per City of Worcester instructions.

there were fewer restrictions on what is accepted, for example, my wife spends more on hot water washing out a peanut butter container to recycle it "clean" than the plastic is worth in a global sense. Recycling and waste streams in general must become part of the American culture. People in England throw away very little "trash" - they even recycle all food waste into compost.

More of an effort was made school wide to recycle

It was clear on what is recyclable

there were recycling bins in all classrooms and they were routinely emptied. Often they are missing or overflowing. Perhaps larger volume recycling bins in clearly evident locations in every building, perhaps even on every floor or floors with high traffic volume.

it is more convenient to do so or have more recycling places

my town does curb-side pick-up every other week. on occasion I wish I had access to recycling services. This weekend I ended up with a huge garbage bag of Styrofoam, and have no way to recycle it. I would travel somewhere if they would just take it.

someone came around and picked them up

Convenient

It was convenient

there were more recycle containers available

it was as convenient or more convenient than throwing it in the trash.

it was more clear what should be recycled and what shouldn't be recycled.

I already do

I already recycle as much as possible without monetary compensation, so this question is irrelevant.

there was recycling for things like old sneakers and other consumables

More options like recycling Styrofoam!

There was some way to wash food containers easily on campus at WPI. Some bathrooms don't have paper towels...cannot drag around dripping items. ALSO if the recycle collection bin was in the public restroom I'd likely recycle food and drink containers much more.

If the system was easy to use AND I would be sure that recycled material was properly used and the process accounts effectively to a reduction of pollution (including all additional downsides from establishing and maintaining the system)

(if) I actually bought items on campus in recyclable packaging, which I almost never do...

I recycle as often as possible

Always do.

It would be hard for me to recycle more, as I am very diligent about it. Where I used to live there was a \$500 fine if recyclables were found in your trash. Recycling is picked up at my home every two weeks.

more locations to recycle,

it was convenient and well advertised

i recycle all things that are disposed of

it was readily available.

I have to pay my garbage company to take my recycling... so not only do I not get money back, I am actually willing to pay to have it recycled.

I didn't have to pay for the pick-up. This is picked up with our weekly trash pickup that we pay for.

I had confidence that the items placed in the bins were being properly recycled (janitorial issues). Recycling bins

were ALWAYS near trash bins (on campus, there are some spots where there are no recycling bins, or where there are ONLY recycling bins and these are often filled with trash).

there was a place for #6/Styrofoam recycling. I'm pretty obsessed with recycling everything that I can.

I do recycle without monetary compensation.

I recycle everything that I can, both at home and at work.

It was more convenient. Here at WPI we have comingled recyclables. If we could bring our home comingled recyclables it would be easier for me to bring the stuff in AND it would help boost WPI's recycling numbers/pounds.

I was informed of all my options and it was relatively convenient

I am not sure monetary compensation would factor into whether I recycle or not. It would more be the ease of recycling; I am glad to recycle if there is the opportunity to do it. If I am very busy and I cannot locate an area to recycle, I would be more likely to throw something away than searching for the recycling location.

I already do

I don't know how clean paper/plastic/glass needs to be for recycling. Do I need to wash everything?

The system is easily recognizable.....abc.....123.....green, yellow, blue.....square, triangle, circle.

receptacles were close by (and they ARE in our department)

I'd like Massachusetts to eliminate the refundable deposit on bottles, etc. I already recycle non-deposit materials as much as possible in my household stream. (We have recycling at the curb.) I'd prefer to recycle everything at the curbside.

It was closer to my location.

it was convenient. i.e. barrels are in every building

I already do this.

I will re-cycle anyway

Your questions don't allow this possibility: that I already recycle all recyclables, without compensation. My "strongly disagree" responses might be misread to mean I don't care about recycling, when in fact I do, and I recycle all the time. I separate out my redeemables and place them by my recycling bins so that people who visit my neighborhood to collect these things have an easy time getting them-- and then they bring them to redemption sites.

Truthfully I just can't stand saving the gross cans. I usually put them in the recycle bin at home. I never bring them back to the store because it is too messy for me.

I already recycle everything at home.

it was easy

I knew where to go and what to bring, and I was reminded to go. Place was convenient (i.e. on campus or close to campus).

The option was conveniently available

not really applicable, since I live 10 miles from campus, I can easily go on a weekend to a redemption center and receive my deposits back

Q10 - 10) I would be likely to recycle more WITH monetary compensation if

I would be likely to recycle more WITH compensation if

It cost more to dispose of trash.

I knew it existed!

It was within walking distance, the nearest collection center is too far.

The compensation was higher. It isn't worth the effort for a few cents per can/bottle

It was nearby or on campus

It was more conveniently available near school

N/A.

It was on campus

recycling companies paid us to pick up our recycling

Same as #9.

someone collected and redeemed recyclables for me.

Yes

the monetary incentive actually kept pace with inflation.

There was a closer place and it was easier to access it

centers were located more conveniently

Again if it was more convenient. I know there is a recycling center at price chopper and shaws, but dragging along a bag of cans is not the most convenient thing for me.

I remembered it existed nearby

The monetary compensation was higher

I could put out my recycling the same way I do now and someone came to collect it

I drank things from redeemable containers

it's convenient

The monetary compensation was greater than my deposit

I know the proper way to recycle and the recycling center was at a more convenient location.

It was available on or near campus

it didn't take 4 tons of material to get more than pocket change out of it. It's generally not worth taking up space in my garage to save up enough items to make feeding 300 cans into a dirty machine worth my time. It all just goes into my recycling bin for pick up.

Money isn't a motivating factor for my recycling: I care about the environment

This exists on campus at places like Dunkin Donuts. You pay less if you bring your own container. I wish this was

advertised more - so many cups are used their daily. Even a program by the Dunkin Donuts to sell reusable containers and maybe a flyer showing how much money you would save over the year with a reusable container.

5c a bottle certainly isn't enough - I just put it in the recycling out of convenience. Maybe 15 c would be a tipping point.

It the monetary compensation was immediate.

I wouldn't. It's a waste of time and effort for so little money for me personally. A better incentive would be to charge per trash bag of waste (like worcester does) in order to incentivize me to recycle more.

there was an opportunity to do so on campus

N/A - We recycle all our bottles/cans regardless of deposit.

The machine was located near campus.

I can not recycle more.

bins were conveniently located for me to use.

the location was convenient and fast

na

I recycle everything possible, regardless of whether I have to take an empty container with me a ways to find a recycling bin-and I don't think I need to be paid to recycle. I lived in NYC for many years where you had to sort your trash from recyclables. If you had cans kicking around in your regular trash, you could be fined.

I move to a bigger apartment/house that can accommodate all these items

it was accessible

it was easy to get the compensation. But I usually leave my returnables out for the homeless, so....it wouldn't really effect me

access was convenient.

it were more convenient to get to

I got money (relevant)

more \$\$

it was in a convenient location and clearly advertised.

It was open convenient hours.

I would be more likely to recycle more with monetary compensation if I purchased more redeemable recyclables or if more recyclables were redeemable in this state. Currently I do not regularly purchase recyclables that are redeemable in Massachusetts.

It was good pay

It was near campus

there was a more convenient way to do so.

Just make it easier to recycle

if they reminded me that i could

same as above

I recycle everything I can

n/a -- the cost/benefit of moving stuff around is rarely worth it

recycling each container/bottle/can had a larger monetary compensation

The amount of compensation was appropriate for the amount of effort required to recycle.

It was more accessible.

reminded more

it was convenient to my daily route around campus

i knew there was monetary compensation:-)

There was a closer place I could do this at.

It was convenient enough

it was convenient, quick and easy

The monetary compensation were greater!

There were depositories on campus.

it was convinient

i would just recycle i dot really care about the money part

There was an accessible location for it.

It was more convenient

Located nearby

The compensation was significant. Currently, it's usually about 5 cents a bottle.... That means I would need 20 bottles just to get 1 dollar. Also, encouraging the use of disposable plastics for compensation takes away from the better alternative of using reusable cups, bags, and other items. Buying more plastic bottles because you know you will get paid for them means you may be less likely to use reusable products, which are much better for the environment.

There was a center in every upperclassmen dorm.

Stores maintained their machines better (they're often full) or had a better mechanism for accepting bottles.

it was located close to me

Don't need

Accesible or on campus.

It was integrated with my trash pickup contractor (ie - I put out a separate bin of redeemables and receive a portion of the proceeds)

it was easier

it was easier and less time consuming and i got money

It was really convenient

See supra.

Not applicable - I already do it

It was easier to bring to somewhere with compensation

The compensation doubled

I could use the compensation as Goat Bucks.

I already recycle most of my paper & plastic. Compensation doesn't affect my recycling behavior.

It does not matter, I recycle as often as I can.

The deposit redemption was close to campus

the monetary compensation offset the cost of obtaining it

I would be likely to recycle more WITH monetary compensation if I did not have curbside pick-up of recycling. My previous apartment did not have curbside recycling pickup, and I used to bring redeemable bottles to Price Chopper to recycle them. The money was not a motivator - I was motivated by a desire to recycle. Now that I have curbside recycling pickup, I no longer need to bring redeemable bottles to Price Chopper - it is more convenient to just put them in my recycling, which is picked up once a week by the city.

Monetary compensation could be accumulated and then redeemed without me having to bring a giant bag of bottles up the hill to get more than a nickel at a time

I know that I am benefiting as well I am caring for the lecture

I don't really care about monetary compensation. I just want to dispose of things responsibly

Grinding machines were available in certain academic buildings.

items are 'big ticket items' that carry a value of say \$4 or more (like ink cartridges at Staples)

again, if it would be easier

personal \$\$\$ savings is not a big influence

If I could donate the funds quickly and easily.

I recycle everything I can but convenience always makes it easier.

it were more convenient.

It was some place with convenient parking, and easy access in and out.

Na. Don't need compensation or reminding.

it was located on my route

I don't understand this question

it was CONSIDERABLY more of a payout.

More money

easily accessible on campus or within a few blocks

thats always good

it was close to my home

I already am a recycling tyrant. :-)

I live off campus. My town recycling center is very convenient for me. A recycling centre on or near campus would not be relevant for me, regardless of monetary compensation.

I entered a competition where my building or floor or department won a meal for least amount of recycling in trash.

The recycling center was conveniently located and open on the weekends.

I knew where the redemption center was, if it was easy to get to (5 cents per bottle is not exactly a major motivator), and if there was a separate bin provided to keep the redemption containers separate from general recycling

Getting monetary compensation for recycling is generally more effort than its worth.

there were conveniently located machines

I give my redeemables to the recycling center.

n/a

No necessary. I will always recycle

The system I use for recycling redeemable items (glass & aluminum) is to accumulate those items in a box or bag, which is then brought to a redemption center when I have enough material to either get in the way or look worthwhile to recycle. There are plenty of places within a short distance of campus already and running a redemption ctr on campus would be pretty expensive, I think, unless we simply accumulated stuff here and DROVE it to another nearby redemption center.

I could donate the proceeds

I already recycle almost everything that is recyclable.

it was easily accessible

Facilities available close to Wpi or home

Recycling center was convenient. Currently I use a supermarket at which I must insert the redeemable bottles and cans into a machine. The machines are often full because they are not highly maintained by store workers.

From a town / municipal point of view if it would in some way benefit me . An example would be a reduced tax on my property.

t was convenient to where I am.

Cleaning and storing containers is the problem. Too much of a hassle for only maybe \$1.50

(see above)

More items had monetary compensation

It was easier

I take my recyclables home

This doesnt make much difference to me

it was easier & if i drank more soda

I don't think monetary compensation is necessary

Unlikely would change much. We have lots of redeemable cans at home but it just isn't worth separating them.

I could redeem all cans/bottles at one deposit center

I recycle plastics/glass/aluminum regularly at home, but I do not purchase much in plastics or glass to make redeeming it worthwhile.

Monetary compensation is not the driver for me to recycle.

I already recycle as much as possible for monetary compensation, but it's mostly my husbands occasional Mike's bottles and soda bottles, so I would not bring them to campus.

if was more convenient

I recycle regardless.

If they took it at my grocery store, which is where I redeem everything.

Same as above.

n/a

A location was on campus

Nothing. Money is not my motivation for recycling.

n/a

it paid a lot

Don't care/convenience

It was convenient

There was a recycle center close to WPI

it were not much more inconvenient than throwing it in the trash.

it was more clear what should be recycled and what shouldn't be recycled.

I always recycle. It is inconvenient for me to take things to places where I can redeem them for money (I would have to drive to get there), so I just put them into my recycling which is conveniently picked up at the curb every week.

I already recycle what I can with monetary compensation, so this question is irrelevant.

Not an issue.

All the redeemable bottles and cans could be dropped off easily at one location, from my car--with free parking, very little waiting time in redeeming them, and not having too far to walk.

It would be easy to return bottles etc. (e.g., in some parts of Europe supermarkets have just automated machines, that scan bottles and turn out a coupon to be redeemed at the cashier)

(if) convenient.

Same amount, but it would be a nice extra!

always recycle without monetary compensation.

I recycle consistently at a local store for any redeemable items.

more locations to recycle,

as above

it was a convenient location

it would reduce my trash pick up fee.

It was convenient. Redemption centers are a hassle for the amount of money you receive back. I would prefer to turn my office recycling in to a location where someone else processed it and the money went to a charity. A social cause would be more of a motivator to me than getting nickles and dimes back to myself.

it is close to home and clean...The way I am doing it now is totally clean and not smelly.

No, I recycle all with monetary compensation.

n/a I will recycle regardless

it were an option. Icing on the cake.

I do not care about monetary compensation for recycling. It is not worth the money to lug a bunch of cans and bottles to a redemption center. However, if I knew the money would go to a charitable cause, that would be worth it to me.

I don't think of recycling as something for which I should be paid . I do it because it is good for the environment and the future of our planet.

N/A. I'd do it all for free as long as it was convenient!

As above.

There was a redemption processing machine in my apartment complex - I live a few miles from campus. I just place all my redeemable recyclables in with my non-redeemable recyclables now for ease.

Please see above.

N/A

The value of deposit is not high enough, it doesn't really feel worth doing for 5c a can.

It helps the community

I knew of a place close by

Either closer or the monetary compensation is worth the distance (I never used recycled places with this and only see on TV shows how small amount the money you receive is)

There were local kiosks that dispensed cash or a credit card once recyclable are deposited.

I will re-cycle anyway

Truthfully I just can't stand saving the gross cans. I usually put them in the recycle bin at home. I never bring them back to the store because it is too messy for me.

I could redeem my coins on campus or directly through the city of Worcester.

it's money what is more motivating than that?

I knew where to go and what to bring, and I was reminded to go. Place was convenient (i.e. on campus or close to campus).

Same as above

there was on easily and readily accessible on campus