ENVIRONMENTAL IMPACT OF RECYCLING IN THE RESIDENCE HALLS AT OKLAHOMA STATE UNIVERSITY

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ENVIRONMENTAL IMPACT OF RECYCLING IN THE RESIDENCE HALLS AT OKLAHOMA STATE UNIVERSITY

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Abstract: Colleges and universities have the ability and the responsibility to provide their students with access to sustainability education and programs (Orr, 1994; Emanuel & Adams, 2011; Pursehouse, 2012; Owens & Halfacre-Hitchcock, 2003). Housing departments have an additional responsibility to provide access to sustainability and recycling programs because of their almost unlimited access to students living on-campus (Pursehouse, 2012). The purpose of this study was to gain a better understanding of recycling at Oklahoma State University-Stillwater by conducting an evaluation of the on-campus recycling program. The evaluation was done by conducting a cost-benefit analysis and by surveying undergraduate students living on-campus on their attitudes, knowledge, and behavior when it comes to recycling. A nine-step cost-benefit analysis was conducted on the move-in recycling program that took place for the first time in August 2013. The cost-benefit analysis was conducted to determine whether or not it was economically feasible for the move-in recycling program to continue. The recycling survey consisted of four questionnaires, one each for attitudes, knowledge, behavior, and demographics. The survey population was undergraduate students living in Single Student Housing at OSU-Stillwater. Students were selected randomly to participate in the study with a response rate of 6.9%. For the global perspective, the cost-benefit analysis resulted in a NPV=-$3,119 and a B/C=0.45, and for the Residential Life perspective a NPV=$1,553 and a B/C=20.41 resulted. The recycling survey indicated an overall favorable attitude towards recycling. Additionally, students scored an average score of *M=5.2* out of 10 on the recycling knowledge questionnaire. Finally, 43.7% (*N*=97) students indicated that they never, very rarely, or rarely recycle, while 34.8% (*N*=72) indicated that they always, very frequently, or frequently recycle. Based on the results of the cost-benefit analysis, it is recommended that recycling continue to occur as a part of move-in waste collection. Additionally, it is recommended that more education on recycling be provided to the residents. This education should include information on what to recycle as well as the location of recycling bins. If these recommendations are followed it is likely that improvements to OSU's recycling program and improved participation in the program will be seen.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

Table Page

LIST OF FIGURES

Figure Page

.

CHAPTER I

INTRODUCTION

Colleges and universities have the ability and the responsibility to raise awareness of sustainability issues as well as provide access to sustainability related programs to their students (Orr, 1994; Emanuel & Adams, 2011; Pursehouse, 2012; Owens & Halfacre-Hitchcock, 2003). Not only do colleges and universities have the responsibility to raise awareness of sustainability to their students academically, but these institutions also have a responsibility to raise awareness of sustainability through their housing departments (Pursehouse, 2012). Housing departments within these institutions have the ability to play an even more substantial role by providing opportunities for university students to make choices to live more sustainably within the Residence Halls (Pursehouse, 2012). By giving students opportunities to make sustainable choices they can begin to incorporate what they are learning into their everyday lives and routines (Pursehouse, 2012). These opportunities can range from conserving resources to recycling (Pursehouse, 2012). Recycling is a common practice that involves taking materials that are at the end of their useful lives, as consumers see it, and using mechanical and chemical processes to turn the old, useless product into something new and useful (EPA, 2013a; Fridgen, 2011, Merriam-

Webster, 1998). Recently, recycling and other sustainability programs have been increasing on a number of college and university campuses throughout the United States (Pike et al., 2003; Emanuel & Adams, 2011). As such, it is important that universities in the state of Oklahoma continue this trend by providing recycling programs and educational opportunities on their campuses that meet the needs of their students (Emanuel, 2011 & Adams, 2011).

In 2010, a total of 250 million tons of municipal solid waste were generated in the United States; of the 250 million tons only 85 million tons (34.1%) were recycled or composted (Environmental Protection Agency [EPA], 2011). Of the 250 million tons generated, container and packaging waste accounted for 30.3% (75.64 million tons) of all waste, by product type, making container and packaging waste the highest category of waste generated in the U.S. in 2010 (EPA, 2011).

Not only is container and packaging waste a problem for the U.S., it is also a problem at Oklahoma State University-Stillwater. Specifically, container and packaging waste becomes problematic in the month of August when students move back into the residence halls on campus. During August 2011, $21,712 was spent on refuse for single student housing (J. Hunt, personal communication, October 24, 2012). This was 14.2% of the total amount spent on refuse by the Department of Housing and Residential Life during the 2011 fiscal year (J. Hunt, personal communication, October 24, 2012). In addition to a large amount of waste being generated when students move back to campus in August, a large amount of recyclable materials are also being thrown away (J. Hunt, personal communication, October 24, 2012; I. Hershey, personal communication, November 28, 2012).

In August 2012, photos were taken to document the waste problem during move-in at OSU-Stillwater. Figure 1 provides an example of one location during move-in 2011 that was overflowing with waste (See Appendix G for more photographs). From the photo one can see that cardboard is the main contributor of the waste problem. Upon further examination, expanded polystyrene also known as foam packaging was also found to be another significant contributor to the move-in waste problem. Additionally, both cardboard and foam packaging have the ability to be recycled which means that this waste is unnecessary. In order to combat this waste problem, a move-in recycling program was developed and implemented in August 2013 in order to divert cardboard and foam packaging generated during move-in from the landfill.

Figure 1. Photograph of Waste Surrounding Stinchomb Hall August 2012. Refuse dumpster surrounded by additional waste located at the northeast corner of Stinchcomb Hall during move-in 2012 when a recycling program was not yet in place.

The second problem related to recycling at OSU-Stillwater is the lack of information on undergraduate students' knowledge, attitudes, and behavior in regards to recycling within the Residence Halls. A similar study has been conducted of OSU-Stillwater faculty, staff, and graduate students' knowledge, attitudes, and behavior on recycling (Brown, 2007). However, this study did not examine the recycling attitudes, behavior, and knowledge of undergraduate students, the largest population of students on campus, nor did this study specifically look at students living on-campus at OSU-Stillwater (College Board, 2013; Brown, 2007). Furthermore, a waste audit was conducted at the OSU-Stillwater campus during the Spring 2013 semester of six buildings across campus (Kandula, 2013). One of the six buildings was the undergraduate Residence Hall Kamm-Peterson-Friend (KPF) (Kandula, 2013). For this building, the results of the waste audit indicate that 49.3% of the material found in the trash is recyclable on-campus and an additional 12.4% of the waste has the potential to be composted (Kandula, 2013; OSU Recycles, 2013b). The results of the waste audit indicate that more could be done when it comes to recycling on-campus at OSU-Stillwater (Kandula, 2013). This includes educating students, faculty, and staff members on recycling practices at OSU-Stillwater in addition to making sure that the OSU community has access to the appropriate recycling programs (Kandula, 2013).

Purpose

In order to gain a better understanding of the recycling problem at OSU-Stillwater, an evaluation of the on-campus recycling program needs to be conducted. Specifically, a cost benefit analysis of the move-in recycling program that took place for the first time in the Fall of 2013 needs to be conducted. In addition to the cost benefit

analysis, information on students' knowledge, attitudes, and practices regarding recycling need to be collected so that the university can better understand how to educate and provide for the residents living on campus at Oklahoma State University-Stillwater. By exploring these two problems the Department of Housing and Residential Life, OSU Recycles, OSU's Office of Sustainability, and the OSU community will be able to better provide for its students and residents when it comes to recycling.

Research Questions

This study is guided by the following five research questions:

1. Is continuation of the Move-in Recycling Program at Oklahoma State University-Stillwater economically feasible?
2. What are the attitudes of students living in Single Student Housing at Oklahoma State University towards recycling?
3. What would help encourage students living in Single Student Housing at Oklahoma State University to recycle more?
4. Do students living on-campus have an accurate knowledge base of recycling within Single Student Housing?
5. Are students living in Single Student Housing at Oklahoma State University participating in recycling?

Chapter Summary

This chapter provided a brief introduction to the literature on recycling within residence halls on college and university campuses. Additionally, this chapter presented the purpose of this research as well as the research questions which will be used to guide the remainder of this paper.

The remaining chapters will include a review of the current literature on sustainability and recycling, the methodology used in this study, the results, and a discussion of the results. The literature will provide the reader with sufficient knowledge to understand the research that was conducted. Furthermore, the methodology by which the research was conducted will be described, followed by the results from both the cost-benefit analysis and the survey of undergraduate students' knowledge, attitudes, and behaviors regarding recycling within the Residence Halls. Finally, the paper will end with a discussion and conclusion section as well as suggestions for future research and improvements on recycling within the residence halls at OSU-Stillwater.

CHAPTER II

LITERATURE REVIEW

The purpose of this literature review is to provide background information to support a better understanding of the research project. This chapter provides information on the history of recycling as well as the current state of recycling within the United States. The chapter then goes on to describe sustainability and sustainable development and where these concepts originated. Following an explanation on the concept of sustainability, information on how college and universities have incorporated sustainability at their respective institutions is discussed. Finally, a description of recycling at Oklahoma State University is provided including the history of the recycling program and research related to recycling and waste that has been conducted at OSU-Stillwater.

Recycling-Overview and History

The word "recycle" was first used in 1926 to describe industrial processes in which materials were simply reused (Barnhart, 1988). However, it was not until the 1960s that the term "recycle" started being used to mean what it is typically thought of today as the process by which materials are converted from something old, usually seen

as waste, into a new, useable product (Barnharat, 1988; Merriam-Webster, 1998). Even though recycling as it is known today did not begin to become popular until the 1960s, recycling was taking place in a variety of different forms long before this (Fridgen, 2011). These different forms of recycling included repairing damaged clothing, feeding leftover food to pigs, and creating goods that were durable and long-lasting (Fridgen, 2011). In order to gain a better understanding of what the recycling process looks like today, the steps of the recycling processes as well as the benefits of recycling will be examined.

In order for recycling to be successful, all three steps that make up the recycling process must occur (EPA, 2013a). The three steps in the recycling process are collection and processing, manufacturing, and purchasing (EPA, 2013a) Together these three steps create a closed-loop system in which recycling thrives (EPA, 2013a). In the first step, materials are collected in a variety of ways, including curbside and drop-off recycling programs (EPA, 2013a). Once materials have been collected they must then be processed (EPA, 2013a). This processing typically occurs in a materials recovery facility (MRF) (EPA, 2013a; Donkin, 2011). At the MRF, materials are separated, either mechanically or by hand, cleaned, and made into usable stock piles of raw materials so that they can be marketed to manufactures (EPA, 2013a). Manufacturers then use the recycled stock piles as they would virgin materials to create new products (EPA, 2013a). The final step in the recycling process requires action from consumers (EPA, 2013a). After products containing recycled materials have been manufactured, they must be purchased by consumers in order to close the recycling loop and create a demand for more products to be made with recycled materials (EPA, 2013a).

Whenever all three steps in the recycling process are followed, recyclables are collected and processed and recycled-content products are manufactured and purchased (EPA, 2013a). As this process continues, the loop is closed, a higher demand for recycled-content products is created, and virgin materials are saved (EPA, 2013a). Furthermore, there are a number of other benefits to recycling in addition to the ones listed above (EPA, 2013a; Fridgen, 2011). Recycling also helps decrease the amount of landfill space being used, creates jobs, reduces pollution, conserves natural resources, and benefits both society and the environment (EPA, 2013a; Fridgen, 2011).

Current recycling trends in the U.S. As recycling became what it is known as today, data began being collected so that a better understanding of waste in America could be acquired (EPA, 2011). The U.S. Environmental Protection Agency (EPA) has data on the characteristics of municipal solid waste (MSW), including refuse and recycling data, dating back to 1960 (EPA, 2011). This data shows the tonnage of waste being generated by Americans annually and also shows the percentage of waste generated that is diverted from the landfill through recycling, composting, and energy conversion (EPA, 2011). The characteristics of the waste are further broken down by product type and material which is beneficial for knowing what areas need the most improvement when it comes to recycling (EPA, 2011).

Between 1960 and 2010 the amount of municipal solid waste (MSW) generated per capita grew from 2.68 to 4.43 pounds per person per day, an increase of 1.75 pounds over a 50 year period (EPA, 2011). In 2010 alone, 4.43 pounds of MSW per person per day was generated, resulting in approximately 250 million tons of MSW being generated over the course of the year (EPA, 2011). When taking into account recycling and

composting, the actual amount of waste that was deposited into landfills in 2010 was reduced from the 4.43 pounds generated to 2.9 pounds per person per day (EPA, 2011). This recovery of waste, prevented approximately 85.1 million tons of the 250 million tons generated from ending up in a landfill (EPA Waste, 2011).

Of the waste that was generated in 2010, container and packaging waste accounted for 75.64 million tons (30.3%) of all waste (EPA, 2011). The container and packaging waste category exceeded the next highest category, nondurable goods, by 9%, an equivalent of 22.5 million tons of waste (EPA, 2011). The largest component of the container and packaging waste category was paper and paperboard, cardboard is included in this category, which accounted for 37.68 million tons of waste (EPA, 2011). Approximately 27 million tons of the 37.68 million tons of paper and paperboard generated through container and packaging waste was recovered, mostly through recycling (EPA, 2011). By recycling these materials instead of throwing them away, benefits such as "cleaner land, air, and water, overall better health, and a more sustainable economy" are created (EPA, 2011, 10).

History of Sustainability and Sustainability Defined

The sustainability movement began to truly emerge as part of the global environmental movement in the late 1980s through the World Commission on Environment and Development (WCED) (Ricketts, 2010; World Commission on Environment and Development [WCED], 1987). The WCED, also known as the Brundtland Commission, resulted in a document entitled *Our Common Future* which focuses on identifying concerns and challenges facing our world, particularly in regards to sustainability and the environment (WCED, 1987). Additionally, the most often cited

definition of sustainable development, a term often used interchangeably with sustainability, also came out of this document (WCED, 1987; Emanuel & Adams, 2010; Kagawa, 2007). The definition of sustainability presented in the Brundtland Commission urges countries and citizens to utilize their resources in a way that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, 43).

The WCED has not been the only international meeting on sustainability and the environment. In 1992, the world reaffirmed its commitment to sustainability and sustainable development at Earth Summit in Rio de Janeiro, Brazil (United Nations, 1992). At Earth Summit, several documents were created and signed by those in attendance, one of which was *Agenda 21* (United Nations, 1992). According to the preamble of Agenda 21, the document "mark[ed] the beginning of a new global partnership for sustainable development" (United Nations, 1992, 15). By signing *Agenda 21*, the heads of governments and other representatives made a pledge to actively begin implementing sustainable practices in their respective countries and by doing so reconfirmed their commitment to sustainability (United Nations, 1992).

Within both of *Agenda 21* and *Our Common Future*, a variety of topics, all dealing with sustainability, are covered (WCED, 1987; United Nations, 1992). Some of these topics include poverty, production and consumption concerns, and the management of ecosystems (WCED, 1987; United Nations, 1992). In addition to the topics outlined above, sustainability can also include "renewable energy sources, conservation, recycling, environmentally friendly land development, water management, and waste disposal" (Emanuel & Adams, 2011, 81).

Incorporating Recycling and Sustainability Programs on Campus

There are a number of different factors that help ensure successful incorporation of sustainability and recycling programs on college campuses (James & Card, 2012; Kurland, 2011). These factors include having students, administration, and faculty as stakeholders; incorporating sustainability into the vision and master plan of the university; and having a facilities manager who focuses on sustainability (James & Card, 2012). Waste reduction and recycling are at the heart of the different programs that can be implemented on college campuses in terms of sustainability (Kurland, 2011; Ching & Gogan, 1992). "Recycling is among the most visible, measurable, and enforceable of the environmentally sound practices that a campus can undertake" (Ching & Gogan, 1992, 125), and whenever students are given the opportunity to recycle, the likelihood that students will participate in these programs and partake in diverting recyclable materials from the landfill is high (Pike et al., 2003). By focusing on recycling and making it a feasible option for students to participate in, colleges and universities can begin to show their students how to responsibly treat the environment (Pursehouse, 2012).

While the majority of recycling programs on university campuses begin as grassroots efforts of a few dedicated students or faculty members, they eventually become incorporated into the university structure through full-time paid positions (Ching & Gogan, 1992). Programs that rely solely on volunteer efforts often encounter problems such as collection sites being missed or improper sorting of the recyclable materials (Ching & Gogan, 1992). By incorporating these volunteer programs into official university sponsored programs, campuses help ensure their success and longevity (James & Card, 2012; Ching & Gogan, 1992).

The Role of Colleges and Universities in Sustainability and Recycling

According to many researchers, it is the right and the responsibility of colleges and universities to begin implementing sustainable practices into their campuses and to encourage these habits in the lives of their students (Orr, 1994; Emanuel & Adams, 2011; Pursehouse, 2012; Owens & Halfacre-Hitchcock, 2003). Since recycling is a component of sustainability, universities should be responsible for integrating recycling and other programs that encourage sustainability on their campuses rather than waiting for the community in which they are located to do so (Ching & Gogan, 1992; Orr, 1994; Emanuel & Adams, 2011). By taking the initiative to implement these programs, college and university administrators give their students an opportunity to learn how to begin living more sustainably, and in some cases exposure and opportunity are all students need to begin making changes to live more sustainably (Emanuel & Adams, 2011; Pike et al., 2003).

The first step in introducing sustainability to students in the college setting is through education (Emanuel & Adams, 2011). Educating students on sustainability allows them to become more comfortable and familiar with a topic which can sometimes be confusing because of the variety of ways the term has been defined and the range of topics it encompasses (Emanuel & Adams, 2011). Fortunately, sustainability education can be done in a variety of ways which leaves room for universities to do what best meets the needs of their own students and campus in order to implement sustainable practices (Kagawa, 2007). Given the freedom that colleges and universities have, the administration should begin working on incorporating sustainability into the curriculum and to begin create ecologically literate students. A person who is ecologically literate

"has the knowledge necessary to comprehend interrelatedness and an attitude of care or stewardship" towards the environment (Orr, 1992, 92). Once a person becomes ecologically literate they can begin incorporating sustainability into the decision making process within both their personal and professional lives regardless of their disciplinary focus (Azapagic, 2004; Orr, 1994; Orr, 1992).

Environmental education should be incorporated into the university's curriculum, so that students, in addition to obtaining their degree of specialty, will also be ecologically literate when they graduate (Orr, 1994). Some universities are already working on incorporating sustainability and sustainable development into the curriculum of programs outside the field of environmental science (Azapagic, 2004). For example, the University of Surrey has incorporated sustainability into their chemical engineering program using a three tiered approach in which lecturers and case studies were utilized before a full integration into the chemical engineering curriculum occurred (Azapagic, 2004). As a result of the program's success, the University of Surrey is now working on incorporating this model into other engineering programs at the university (Azapagic, 2004).

Although it has been argued that education is the best place to start when incorporating sustainability into college and university campuses, it is not the only factor in determining whether or not an individual will be willing to incorporate sustainable practices in their daily lives (Emanuel & Adams, 2011). Students also need access to programs so they can put the sustainability ideals that they are learning into practice (Pike et al., 2003). By giving students access to sustainability initiatives and providing them with resources such as recycling programs, students are more likely to "significantly

reduce their waste stream" (Pike et al., 2003, 222). Because colleges and universities are molding and shaping future leaders, administrators, faculty, and staff should be setting an example for their students by what they choose to do inside, as well as outside, of the classroom to ensure that they are influencing students as intended, particularly in regards to sustainability (Emanuel & Adams, 2011; Orr 1994). "By raising awareness of sustainability and by providing opportunities to participate in it, universities can be powerful change agents with far-reaching impact" (Emanuel & Adams, 2011, 90).

Sustainability and the Role of Housing and Residential Life

Within the higher education system, housing departments play a unique role in the development of college students (Pursehouse, 2012). Students living on campus have a greater chance of being influenced by dining operations and the university's housing and residential life department because these departments, and as a result, the university as a whole, "have nearly exclusive access to many students' daily life in terms of resource use, consumption, and impact" (Pursehouse, 2012, 42). By using this access to students to be an advocate for recycling and other sustainable practices, universities can teach students how to consume less and live more sustainably (Pursehouse, 2012).

Recycling and Previous Research at OSU

Recycling at OSU-Stillwater began in 1991 with the collection of white paper. The program expanded in 2010 to include plastic bottles and aluminum cans (OSU Recycles, 2013a). In March 2013, OSU Physical Plant created an official recycling department which handles the recycling for all of campus (OSU Recycles, 2013a).

At OSU, research has focused on the attitudes, beliefs, and habits of graduate students and faculty in regards to recycling, but no research has looked at the attitudes,

habits, and beliefs of undergraduate students living in the residence halls (Brown, 2007). This population is particularly important because the students living within the residence halls have a greater chance of being influenced by the university's policies because they are considered to be a captive audience (Pursehouse, 2012). When looking at attitudes, beliefs, and practices of faculty, staff, and graduate students at OSU, research found that as education level increases so do pro-recycling attitudes (Brown, 2007).

Current Recycling Program. The current recycling program at OSU-Stillwater is called OSU Recycles (OSU Recycles, 2013a). While recycling at OSU-Stillwater has been around since the early nineties, this program was officially created in 2013 after the formation of the Recycling Department (OSU Recycles, 2013a). The OSU Recycles program's mission is to "cultivate a campus-wide, sustainable recycling system and culture that will increase OSU Stillwater's recycling rate, reduce waste and pollution, and raise resource conservation awareness through education and outreach programs that foster generations of environmental stewards" (OSU Recycles, 2013a). As of June 2014, this program covers all of campus including, office space, classroom buildings, the Student Union, and residence halls (OSU Recycles, 2013b). OSU Recycles accepts a variety of recyclable items such as aluminum cans, #1 plastic bottles, paperboard, cardboard, and a variety of paper products (OSU Recycles, 2013b). Recyclable paper products include white paper, colored paper, and mixed paper such as magazines, envelopes, newspaper, and phone books (OSU Recycles, 2013b). In addition to the above materials, the OSU Recycles program is also responsible for recycling scrap metal and wooden pallets (OSU Recycles, 2013c).

Looking at data beginning with the inception of the OSU Recycles program in March 2013 through June 2014, OSU has recycled approximately 786 pounds of aluminum, 26 tons of plastic bottles, 191 tons of cardboard, 111 tons of mixed paper, and 90 tons of paper (Appendix F). This equates to a total of approximately 418 tons of recyclable materials in just over a year's time (Appendix F). A breakdown of the tonnage of materials recycled can be seen in Table 1.

In addition to the environmental benefits of recycling these materials, revenue is also generated by recycling which adds an economic benefit to recycling for the university. Each of the commodities discussed above, with the exception of aluminum and plastic bottles, is marketed and sold. From March 2013 to June 2014, $31,001.34 was generated through the sale of paper, cardboard, and mixed paper at OSU-Stillwater (Appendix F). Revenue generated from these materials can be seen along with the tonnage of material recycled in Table 1.

Table 1

Recyclable Materials, Tonnage, and Revenue Generated by OSU Recycles Program from March 2013 to June 2014

Material	Tons	Revenue
Cardboard	190.97	$20,182.95
Paper	90.17	$9,293.29
Mixed Paper	111.06	$1,525.10
Plastic Bottles	25.66	N/A
Aluminum Cans	0.39	N/A
Total	418.25	$31,001.34

Waste Audit at OSU-Stillwater

During the spring 2013 semester a waste audit was conducted on the OSU-Stillwater campus (Kandula, 2013). A waste audit investigates the "sources, composition, weight, volume, and destinations" of waste that an organization, business, or group generates (Natural Resources Defense Council [NRDC], 2014). In this case, volunteers at OSU-Stillwater sorted through waste from six different building on the OSU-Stillwater campus in order to evaluate the waste being generated on campus (Kandula, 2013). The six buildings studied in this waste audit were Classroom Building North, Family Graduate Student Housing (FGSH), Agriculture Hall, Student Union, Physical Sciences Building, and Kamm-Peterson-Friend Residence Hall (Kandula, 2013). The waste was divided into 21 different categories including white paper, #1 & #2 plastics, aluminum, food waste, trash, and hazardous materials (Kandula, 2013).

Overall, the waste audit showed that of the 302.48 pounds of waste collected from six different buildings across campus, a sizeable amount had potential to be diverted from the landfill (Kandula, 2013). Through the OSU Recycles program alone, 28.6% (86.55 pounds) of the materials found in the waste audit could have been recycled on campus, not including the behind-the-scenes recycling done by the OSU Recycles Program (Kandula, 2013; OSU Recycles, 2013b). An additional 24.2% (73.24 pounds) of food waste had the potential to be diverted from the landfill through composting (Kandula, 2013). Within the Single Student Housing residence hall of Kamm-Peterson-Friend the percentage of recyclable materials that could have potentially been diverted through the OSU Recycles program was 49.3% (22.48 pounds) (Kandula, 2013).

Environmental Impacts of Waste

On average, Americans throw away 4.43 pounds of waste per person per day (EPA, 2010). While 1.51 pounds of the 4.43 pounds of waste is either composted or recycled that leaves 2.92 pounds of waste that the typical American is sending to the landfill each day (EPA, 2010). Landfills are designed to contain waste materials, protect the environment from contaminants, and protect public health (EPA, 2014b). These landfills are regulated and monitored in order to prevent contamination of groundwater sources and to ensure methane gas emissions are occurring at an appropriate level (EPA, 2014b). Landfills are monitored throughout operation and for up to thirty years after the landfills are no longer in operation (EPA, 2014a; EPA, 2014b). Landfills are designed and regulated to protect public health and the environment by frequently covering layers of garbage with soil, monitoring for levels of methane gas, and monitoring groundwater for contaminates (EPA, 2014b; Bailey, 2015a; Bailey, 2015b). These things are done in order to prevent trash from blowing around and getting out of the landfill, to reduce threats of global warming, and to prevent contamination of groundwater (El-Fadel, Findikakis, & Leckie, 1995; EPA, 2014b). Research has shown that leachate is one of the most significant threats to groundwater (El-Fadel et al., 1995). If leachate is released into the groundwater it has the potential to damage aquifers that are near landfills (El-Fadel et al., 1995). Furthermore, emissions of carbon dioxide and methane gas have been shown to contribute to global warming (El-Fadel et al., 1995). If the levels of methane gas and carbon dioxide from landfills are not kept at an appropriate level, the impact on the environment could be even greater than it currently is (El-Fadel et al., 1995).

Even with proper design, violations of these regulations that help protect both the environment and human health still occur (Bailey, 2015b; EPA, 2014b). Recently, violations at landfills in Oklahoma have occurred (Bailey, 2015b). Some of these violations include blowing litter, methane gas above regulatory limits, and landfill leachate being disposed of into the sewer (Bailey, 2015b). These violations are problematic because blowing litter can pollute surrounding communities, excessive levels of methane gas can cause fires or explosions, and improper disposal of leachate can cause problems with waste water treatment (Bailey, 2015a; Bailey, 2015b). In recent years at the landfill in Tecumseh, Oklahoma, there have been multiple violations of exposed animal carcasses and pools of blood, as well as several fires within the landfill (Bailey, 2015c). As a result of these violations, the landfill has been shut down until it can be operated in compliance with federal regulations (Bailey, 2015c).

Cardboard and Expanded Polystyrene

In 2010, packaging waste was the largest category of waste in the U.S. by product type at 75.64 million tons (30.3%) (EPA, 2011). Within the packaging waste category, the materials that are most present are paper and paperboard (49.8%), and plastics (18.1%) (EPA, 2011). Of the paper and paperboard within the packaging waste category, 26.85 million tons (73.2%) was recycled or composted, leaving 10.83 million tons (29.5%) that was sent to the landfill in 2010 (EPA, 2011). Cardboard, a component of the paper and paperboard category, is made up of mostly paper and glue, and it is estimated manufacturing one ton of cardboard requires 17 trees, 7,000 gallons of water, and 380 gallons of oil (EPA, 2013b). By recycling cardboard instead of sending it to the landfill,

approximately nine cubic feet of landfill space is saved, and the amount of energy needed to create cardboard is reduced by almost 25% (Waste Management, 2015).

Expanded polystyrene (EPS), another component of packaging waste, is composed of a styrene polymer and a blowing agent (NOVA Chemicals, 2005). Pentane is most commonly used as a blowing agent for EPS and is typically 3-8% of that material by weight (NOVA Chemicals, 2005). The most common safety hazard with EPS is its flammable nature due to the use of pentane in its creation (NOVA Chemicals, 2005). Other problems with EPS arise when it comes to disposal. Although EPS is low in weight, it is large in volume and as a result EPS takes up a large amount of space in landfills and can be problematic to marine life when littered (Kelly, 2012).

Chapter Summary

Chapter II provides an overview of the literature relevant to this research. The process of recycling was discussed as well as the various factors needed to ensure successful incorporation of recycling and other sustainability programs. The role that universities and their housing departments play in educating students on sustainability was also discussed. Finally, a review of the current recycling program at OSU-Stillwater was given, including a waste stream analysis that was conducted in the Spring of 2013. Chapter III will discuss the methodologies used to guide this research.

CHAPTER III

METHODOLOGY

This study will be conducted in two parts. The first part of this study consists of a cost-benefit analysis of the Move-in Recycling Program that was conducted for the first time in August 2013 for the Department of Housing and Residential Life at Oklahoma State University-Stillwater to determine to what extent the program is economically feasible. The second phase of this study will be a cross-sectional survey of undergraduate students living in Single Student Housing on Oklahoma State University-Stillwater's campus. The survey will explore resident's attitudes, knowledge, and behavior in regards to recycling within their residence hall. The survey used in this study consists of four questionnaires. One questionnaire each for attitudes, knowledge, and behavior with a forth questionnaire that asks demographic questions. The remainder of this chapter will include a description of the Move-in Recycling Program as well as additional information on how the cost-benefit analysis and the recycling survey were conducted.

Move-in Recycling Program Project Description

In August 2013, Oklahoma State University's Department of Housing and Residential Life, in conjunction with the Office of Sustainability and the OSU Recycling

Department, created the first ever Move-in Recycling Program on OSU-Stillwater's campus. The Move-in Recycling Program took place in Family and Graduate Student Housing (FGSH) as well as Single Student Housing, with the main focus being on Single Student Housing. The program spanned a total of nine days between the two locations, and both cardboard and foam packaging were collected for recycling throughout the entirety of the program. Based on the needs for each of the two student populations, the program varied slightly for each of the two communities. In FGSH, recycling dumpsters were placed at three different locations and left out over the nine day duration of the program. Due to the length of time the dumpsters were in place in the FGSH area, the recycling dumpsters were left unattended but did have signage placed on them so that residents would know how to properly sort their materials between what would eventually be sent to the landfill and what would eventually be recycled.

In Single Student Housing, there were two weekends in which move-in primarily occurred. Early arrivals weekend occurred August 3rd and 4th during which approximately 850 students moved into the 27 residence halls across campus (OSU Department of Housing and Residential Life, n.d.; M. Brown, personal communication, November 13, 2013). The following Sunday, August 11th, was the major move-in weekend where 4,900 students returned to the residence halls (M. Brown, personal communication, November 13, 2013). During the main move-in weekend, over 100 volunteers were stationed at trash dumpster and recycling dumpster locations throughout on-campus housing. These students helped direct and inform parents, students, and other guests on how to properly dispose of their waste and recyclable materials. Volunteers also helped those who were

moving in break down their cardboard boxes and separate the cardboard from foam packaging.

The materials were then collected by the OSU Recycling Department and taken to OSU's Recycling Center located on the north side of campus. The cardboard was then baled and sold, and the foam packaging was sent to Cedar Creek Farms, the local Materials Recovery Facility. Over the course of the program, 16,320 pounds (8.16 tons) of cardboard and 435 pounds (57 cubic yards) of foam packaging were recycled and diverted from the landfill (I. Hershey, personal communication, August 15, 2013).

Cost-Benefit Analysis

A cost-benefit analysis of the Move-in Recycling Program that took place in August 2013 was conducted in order to determine whether or not continuation of this program is economically feasible. The costs and benefits from the 2013 Move-in Recycling Program were compared with what move-in 2013 would have looked like had recycling not taken place. This was done to determine if any financial benefits resulted from diverting waste from the landfill through recycling. The cost-benefit analysis of the 2013 Move-in Recycling Program was conducted using Boardman's Cost Benefit Analysis as a guide (Boardman, Greenberg, Vining, & Weimer, 2010). The cost-benefit analysis shows to what extent the Move-in Recycling Program itself is economically viable. The cost-benefit analysis was conducted using the following nine steps:

1. Specify the set of alternative projects.
2. Decide whose benefits and costs count (standing).
3. Identify the impact categories, catalogue them, and select measurement indicators.

4. Predict the impacts quantitatively over the life of the project.
5. Monetize all impacts.
6. Discount benefits and costs to obtain present values.
7. Compute the net present value of each alternative.
8. Perform a sensitivity analysis.
9. Make a recommendation. (Boardman, Greenberg, Vining, & Weimer, 2010, 6)

Alternative projects. In order to conduct a cost-benefit analysis (CBA), one must define the project for which the analysis is being conducted (Boardman, Greenberg, Vining, & Weimer, 2010). In addition to defining the project being studied, alternative projects must also be identified so that the project under consideration can be adequately compared with reasonable alternatives (Boardman, Greenberg, Vining, & Weimer, 2010). While many alternatives often exist, it is unreasonable to analyze all of the potential alternatives, and typically less than six alternatives are sufficient (Boardman, Greenberg, Vining, & Weimer, 2010). In this case, the project being analyzed is the 2013 Move-in Recycling Program. Therefore, move-in with recycling was compared to move-in without recycling for this analysis. Since the focus of the project is on recycling and waste reduction, only the costs and benefits associated with waste were considered.

Specify whose benefits and costs count (standing). When conducting a CBA, the analyst must determine which costs and which benefits will be included; this is done by determining who has standing (Boardman, Greenberg, Vining, & Weimer, 2010). For this project, two groups were given standing. The analysis was conducted from the point-of-view of the Department of Housing and Residential Life, since they pay for the waste

disposal costs within the residence halls, and from a global perspective where all costs and benefits that occurred during the project were included regardless of who incurred them (Boardman, Greenberg, Vining, & Weimer, 2010). The global perspective includes costs and benefits accrued by those who played a significant role in the development and success of the move-in recycling program: Department of Housing and Residential Life, Office of Sustainability, Recycling Department, and Residential Leadership College.

Identifying the costs and benefits. In this phase of the CBA the individual categories that contribute to the analysis are determined (Boardman, Greenberg, Vining, & Weimer, 2010). In order to include a category in the analysis there has to be "a cause-and-effect relationship between some physical outcome of this project and the utility of human being with standing" (Boardman, Greenberg, Vining, & Weimer, 2010, 8). This means that all the categories that are included as costs and benefits in the analysis must be connected in some way to those who have standing in the project.

Predict the far reaching impacts of the project. The analyst must identify the potential costs and benefits of the project that will occur over an extended period of time (Boardman, Greenberg, Vining, & Weimer, 2010). If creating a recycling program in the present has an impact, either a cost or a benefit, in future years, it needs to be predicted as best as possible (Boardman, Greenberg, Vining, & Weimer, 2010).

Monetizing the impacts. After selecting which impacts, both costs and benefits, will be included in the analysis, they must then be monetized, quantified, and given a dollar value (Boardman, Greenberg, Vining, & Weimer, 2010). While it is sometimes difficult to attach a monetary value to things that are not typically thought of in dollar terms, such as some environmental services or a person's life, these values are often

given based on one's willingness-to-pay for a particular service or previous research that has determined what the statistical value of a person's life is (Boardman, Greenberg, Vining, & Weimer, 2010).

Discount to present value. Oftentimes projects occur over periods of time and as a result the costs and benefits that occur throughout the lifespan of the project must be discounted back to the present, or current, value of the costs and benefits being analyzed (Boardman, Greenberg, Vining, & Weimer, 2010). Because the move-in recycling program and its alternatives occurred during one year, discounting will not occur in this analysis.

Compute the net present value of each alternative. After all of the characteristics have been monetized and discounted back to their present value the net present value (NPV) can then be calculated. Based on the NPV a project is selected for completion (Boardman, Greenberg, Vining, & Weimer, 2010). NPV is calculated by subtracting the present value of costs from the present value of benefits (NPV = PV(Benefits) – PV(Costs)) (Boardman, Greenberg, Vining, & Weimer, 2010). A project is considered viable when NPV is greater than zero (Boardman, Greenberg, Vining, & Weimer, 2010). If more than one project has a positive NPV, the project with the highest NPV is selected (Boardman, Greenberg, Vining, & Weimer, 2010). In addition to the NPV the benefit-cost ratio is another way to determine if the project is financially viable. The benefit-cost ratio is calculated by dividing the present value benefits by the present value costs (B/C=PV(Benefits)/PV(Costs) (Boyer, 2013).

Conduct a sensitivity analysis. A sensitivity analysis helps account for any error that may have occurred while conducting a CBA (Boardman, Greenberg, Vining, &

Weimer, 2010). A sensitivity analysis is typically done by conducting the CBA from multiple points of view, giving different people standing, or by using a different discount rate to change all the cost and benefit values back to the present value (Boardman, Greenberg, Vining, & Weimer, 2010). A sensitivity analysis was not done for this project, because discounting was not done nor were different assumptions able to be made about the project since the project already occurred (Cost Benefit Knowledge Bank, 2015).

Make a recommendation. The final step in a CBA is to make a recommendation based on the project with the highest NPV (Boardman, Greenberg, Vining, & Weimer, 2010). By selecting the project with the highest NPV, the resources, money, will be allocated in the most efficient manner amongst the projects that were analyzed (Boardman, Greenberg, Vining, & Weimer, 2010). This does not, however, guarantee that resources will be distributed in the most efficient manner amongst all possible allocations (Boardman, Greenberg, Vining, & Weimer, 2010).

Survey of Recycling Behavior

In the second half of this study, a survey of students living in Single Student Housing at Oklahoma State University-Stillwater was conducted. The survey examined students' current behaviors, attitudes, and knowledge of recycling on campus. The survey consisted of four questionnaires one each that assessed behavior, attitudes, and knowledge of recycling on campus, and an additional questionnaire that asked demographic questions.

Location. This study took place at Oklahoma State University's (OSU) main campus located in Stillwater, Oklahoma in May 2014. OSU's main campus is comprised

of 25,544 students, 20,130 undergraduates and 5,414 graduates (College Board, 2013). The university employs 9,008 full-time, part-time, and temporary staff, faculty, and students (B. Ganders, personal communication, May 16, 2013).

Population. The population for this study was undergraduate students living in Single Student Housing at Oklahoma State University-Stillwater. Undergraduate students were selected because they are the largest component of OSU Stillwater's student population; approximately 80% of students in the 2013 academic year were undergraduates (OSU Ledger, 2014). The total number of undergraduate students living in Single Student Housing at Oklahoma State University-Stillwater at the time this survey was conducted was 5,174 (M. Brown, personal communication, May 8, 2014).

Sample. Based on a population size between 5,000 and 6,000 undergraduate students living on campus in Single Student Housing, between 351 and 361 responses are needed in order obtain a sample at a 95% confidence level with 5% sampling error (Dillman, 2007). Assuming a response rate of 10-15%, the survey was sent to 3,000 undergraduate students in order to acquire the appropriate number of responses needed. A list of 5,174 undergraduate students living in Single Student Housing was acquired through the Department of Housing and Residential Life following Institutional Review Board approval. This list was used in combination with a random number generator found at randomizer.org in order to randomly select participants. Three thousand numbers were randomly selected using the random number generator, corresponding to 3,000 of the 5,174 students on the population list. The individuals for which the numbers corresponded were then sent e-mails asking them to participate in the survey on recycling within the residence halls.

Research design. The survey portion of this study was conducted using four short questionnaires. In three of the four questionnaires, one each was used to assess the attitudes, knowledge, and behavior of undergraduate students on recycling in the residence halls. The additional fourth questionnaire was used to ask demographic questions of each participant. The overall design of this study was based on Dillman's Tailored Design Method; however, modifications were made due to certain constraints that will be discussed throughout this section (Dillman, 2007). The Tailored Design Method was used to ensure clarity, relevance, and importance of each of the questions as well as the survey as a whole (Dillman, 2007).

The first questionnaire assessed the attitudes of participants living in Single Student Housing at OSU-Stillwater. This questionnaire was based on a similar study that explored the opinions, attitudes, and knowledge of graduate students, faculty, and staff at Oklahoma State University (Brown, 2007). The attitude questionnaire contained eight statements about recycling in the residence halls such as "Recycling bins are easily located in the Residence Halls" and "More information about recycling in the Residence Halls would be useful for me." Participants were asked to indicate to what extent they agreed or disagreed with each of the eight statements. A five-point Likert-type scale (Strongly Agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree) was used for participants to indicate their response.

The second questionnaire asked participants questions about their level of knowledge of the recycling program in the residence halls, known as OSU Recycles. This questionnaire can be broken up into three sections. The first section, asked participants to rate what they believed their knowledge level of the on-campus recycling to be on a five-

point Liker-type scale (Poor, Fair, Average, Good, Excellent). The second section asked participants to identify whether or not 10 different materials were recyclable within the residence halls using a yes or no answer option. There was a question for each material that is currently accepted in the recycling program, as well as questions about materials that are not accepted in the OSU Recycles program. The final section of this questionnaire asked participants if they knew where recycling bins were located within their residence hall.

The third questionnaire was used to assess how frequently, if at all, students participate in recycling within their residence hall. In order to assess for this behavior, only one question was used. This question was based off of Ajzen's Theory of Planned Behavior (TPB), which only uses one question when assessing past behavior (Ajzen, 2010). When using the TPB as a guide, it is crucial to have a well-defined behavior and population for which the question is based on (Ajzen, 2010). For the purposes of this research the behavior of interest is recycling within the residence halls and the population is undergraduate students living in Single Student Housing at Oklahoma State University, as defined above. The behavior question for this questionnaire was based on the example questionnaire given by Ajzen as well as other research that has asked similar questions regarding the study of recycling behavior (Ajzen, 2010; Chu & Chiu, 2003). The behavior questionnaire asked "In the last month, how frequently or infrequently have you recycled in your Residence Hall?" Since response choices for TPB questions are usually given on a "seven-point bipolar adjective scale" (i.e. a Likert-type scale) the response options are given reflect that of the TPB (Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently, Always) (Ajzen, 2010, 2).

The final questionnaire asked participants demographic information. The demographic questionnaire included questions on sex, race, and age. In addition, because this survey involved university students living on campus, questions regarding student classification and number of semesters an individual has lived on-campus at OSU-Stillwater were also asked.

Reliability. Reliability is an essential component for any survey to have. Reliability refers to how consistent a particular question or group of questions is (Nolan & Heinzen, 2012; Creswell, 2012). In order to check for reliability of this survey the coefficient alpha was calculated for responses in which a continuous variable was used, in this case, for the knowledge and attitudes questionnaires (Creswell, 2012). The coefficient alpha, or Cronbach's alpha, assesses whether or not the individual items on a questionnaire are all measuring the same idea (Nolan & Heinzen, 2012). The Cronbach's alpha for the knowledge questionnaire was α=0.79, and the Cronbach's alpha for the attitudes questionnaire was α=0.53. An alpha value greater than .70 is considered acceptable; however, an alpha value of .80 or higher is preferred (UCLA: Statistical Consulting Group, 2015; Nolan & Heinzen, 2012). Cronbach's alpha was not able to be calculated for the behavior questionnaire because it only contained one question.

Survey distribution. After receiving approval from the Internal Review Board (IRB) a request was made to Dr. Matthew Brown, Director of Housing and Residential Life, for the e-mail addresses of students currently living on-campus. After acquiring the e-mail addresses, a random number generator was used to select 3,000 numbers. Each number corresponded with an individual living in Single Student Housing for which the survey would be distributed to via e-mail. The survey was distributed in a way that

mimicked the Tailored Design Method in which multiple contacts are made with the potential participants in order to increase the likelihood that the individuals will complete the survey (Dillman, 2007). Due to e-mail constraints by the university, only two contacts were allowed, instead of the five contacts suggested by the Tailored Design Method (Dillman, 2007; OSU University Research Compliance, 2011). The first e-mail contact included a brief message that explained the importance of the research along with a link to the survey and can be found in Appendix D (Dillman, 2007). The second and final follow-up and thank you e-mail was sent a little over one week later and included an additional link to the survey, as suggested by the Tailored Design Method and can be found in Appendix E (Dillman, 2007).

Handling nonresponse. In order to have a sample with a 95% confidence level and 5% sampling error, between 351 and 361 responses were needed (Dillman, 2007). Since only 207 surveys were returned completed, an additional step must be taken in order to account for nonresponse error. In order to account for nonresponse error, early respondents were compared to late respondents because late respondents have been shown to answer similarly to non-respondents (Miller & Smith, 1983; Clausen & Ford, 1947). For purposes of this survey, early respondents are defined as those who completed the survey prior to the reminder e-mail being sent out, and late respondents are defined as those who completed the survey after the reminder e-mail was sent out. This results in 141 early respondents and 66 late respondents.

Chapter Summary

Chapter III described the methodologies used in order to conduct the cost-benefit analysis of the move-in recycling program and the various aspects of survey design and

distribution. In addition to explaining the nine-step process used to analyze the cost-benefit analysis, a brief overview of the move-in recycling program was also provided. In regards to the recycling survey, the population and sample were described as well as information on research design including how the survey was distributed. Chapter IV will provide the results of the cost-benefit analysis and recycling survey.

CHAPTER IV

RESULTS

This chapter will begin by presenting the results of the cost-benefit analysis which was conducted on the move-in recycling program. The cost-benefit analysis will compare move-in with recycling to move-in without recycling. The results of the cost-benefit analysis will be followed by the results of the recycling survey. The recycling survey was conducted using undergraduate students living in Single Student Housing at Oklahoma State University-Stillwater about their attitudes, behavior, and knowledge of recycling within the residence halls.

Cost benefit-analysis

A cost-benefit analysis (CBA) was conducted using Boardman's nine-step process as described in the previous chapter (Boardman, Greenberg, Vining, & Weimer, 2010). The results of the CBA are broken down into nine sections based on Boardman's nine-step process to conducting a CBA.

Alternative projects. As stated previously, both the project under consideration as well as at least one reasonable alternative project must be defined when conducting a CBA (Boardman, Greenberg, Vining, & Weimer, 2010). The project analyzed in this CBA was the move-in recycling program that occurred in August 2013. This project was

compared to what move-in would have looked like had recycling not taken place in the same year.

Specify whose benefits and costs count (standing). Two different perspectives were taken when conducting the cost-benefit analysis. The first viewpoint is the financial perspective. The financial perspective only takes into account the costs and benefits of a specific entity, in this case, the Department of Housing and Residential Life at Oklahoma State University-Stillwater. The second viewpoint that was taken is the global perspective. The global perspective accounts for all costs and benefits, regardless of who accrued them (Boardman, Greenberg, Vining, & Weimer, 2010).

Identifying the costs and benefits. After standing was established, the individual costs and benefits for move-in with recycling and move-in without recycling were identified. Both projects were further broken down, so that both the financial and the global costs and benefits could be analyzed for each project. For the financial (Department of Housing and Residential Life) perspective, the following were identified as costs for move-in with recycling: refuse cost for August 2013, distribution of move-in information and signage, and cost to recycle foam packaging. Benefits for the Department of Housing and Residential Life from move-in with recycling include: cost avoidance, avoidance of unpleasing aesthetics and complaints, and the creation of permanent recyclers.

From the global perspective, costs for move-in with recycling are: refuse cost for August 2013; magnetic signage and dry erase markers; move-in information and signage; Office of Sustainability employees, both hours spent planning and day of; Recycling Department employees, cost to recycle foam, donated box cutters and gloves, volunteer

workers, and other materials. Benefits from move-in with recycling from the global perspective include: revenue generated from recycling cardboard; cost avoidance, money saved by not throwing away the foam and cardboard; pleasing aesthetics, and permanent recyclers that were created as a result of the program.

If no recycling takes place the costs and benefits change. The following are costs associated with move-in without recycling from the Residential Life perspective: refuse cost for August 2013, move-in information and signage, unpleasing aesthetics and complaints. For move-in without recycling, there are no known benefits with regards to waste and recycling.

Since no additional groups were involved in move-in without recycling, outside of the Department of Housing and Residential Life, the costs and benefits from the financial perspective are the same for that of the global perspective.

Predict the far reaching impacts of the project. The move-in recycling program has long-term impacts that were not accounted for when monetizing costs and benefits. One benefit is that the move-in recycling program allowed students to be exposed to recycling on campus before school even began. Therefore, one potential far-reaching impact is the ability to create life-long recyclers from this program. Move-in recycling also allowed for more pleasing aesthetics around the residence halls during the move-in period as there was less trash surrounding the dumpsters. Additionally, several of the supplies that were either purchased or donated can be used again in future years, thus limiting their cost on the current year for which the program is being analyzed. Furthermore, less time will be needed in the future for organizing this event, thus making it more profitable in the future. Finally, as the program gains popularity and familiarity

with students, the potential to recycle more increases which could greatly benefit the university.

Monetizing the impacts. In order to monetize the costs and benefits research was done to provide the most accurate values possible. Refuse cost for August 2013 totaled $27,473 and is labeled as the "remaining refuse cost" for move-in with and without recycling. Refuse cost for the entire month was used, because the cost of refuse just for move-in were not available. The value of the Recycling Department employees totaled $4,194 and includes labor during move-in as well as the labor involved in baling the cardboard for the move-in program. The value of the Sustainability Office workers including planning the program and labor the day of the program totals $1,125. The total value of the 100 volunteers that were used on the main move-in day was $2,900. The cost of the volunteers was determined by multiplying the minimum wage by the number of volunteers utilized for the project. The costs listed above as well as the cost to recycle foam packaging, bags for collecting foam and other materials, donated gloves, and box cutters can be seen in Table 2. The benefits of the project were also monetized. The money earned from recycling the cardboard was $938. Money was also saved by not throwing the material away. This resulted in a $1,633 savings. The monetary values associated with each of the costs, benefits, and impacts are also displayed in Table 2.

For move-in without recycling only two costs occurred. The costs associated with move-in without recycling is equal to the value of refuse for the month of August2013. The only other cost for move-in without recycling is the cost of signage in order to direct the residents where to take their trash. The cost of the signage is $100. There are no

known benefits for move-in without recycling. The costs and benefits for move-in without recycling can also be seen in Table 2.

Table 2

Costs and Benefits for Move-in with and without Recycling

	Move-in with Recycling		**Move-in without Recycling**		**Difference**	
Costs	Global	ResLife (Financial)	Global	ResLife (Financial)	Global	ResLife (Financial)
Signs and Markers	$90.00	$0.00	$0.00	$0.00	$90.00	$0.00
ResLife Signage	$100.00	$100.00	$100.00	$100.00	$0.00	$0.00
Sustainability Office	$1,125.00	$0.00	$804.00	$0.00	$321.00	$0.00
Recycling Dept	$4,194.00	$0.00	$0.00	$0.00	$4,194.00	$0.00
Cost to recycle foam	$80.00	$80.00	$0.00	$0.00	$80.00	$80.00
Collection Bags	$11.00	$0.00	$0.00	$0.00	$11.00	$0.00
Volunteers (100)	$2,900.00	$0.00	$2,900.00	$0.00	$0.00	$0.00
Donated gloves and box cutters	$191.00	$0.00	$0.00	$0.00	$191.00	$0.00
Remaining Refuse Cost[1]	$27,473.00	$27,473.00	$27,473.00	$27,473.00	$0.00	$0.00
Total Cost	**$36,164.00**	**$27,653.00**	**$31,277.00**	**$27,573.00**	**$4,887.00**	**$80.00**
Benefits						
Cardboard recycling	$938.00	$0.00	$0.00	$0.00	$938.00	$0.00
Cost avoidance	$1,633.00	$1,633.00	$0.00	$0.00	$1,633.00	$1,633.00
Total Benefits	**$2,571.00**	**$1,633.00**	**$0.00**	**$0.00**	**$2,571.00**	**$1,633.00**

[1]The Remaining Refuse Cost value is for the entire month of August because the cost for just move-in was unavailable. All other costs and benefits represent values for just move-in.

Discount to present values. No discounting was done for this project. Discounting was not done because all of the costs and benefits occurred in the same year.

Compute the net present value of each alternative. The net present value (NPV) is calculated by subtracting the present value costs from the present value benefits (NPV = PV(Benefits) – PV(Costs)) (Boardman, Greenberg, Vining, & Weimer, 2010). The NPV calculation for this project from the global perspective for move-in with recycling will be shown as an example of how the net present value is calculated. For this project the NPV is calculated based on the difference between the two projects, $2,571 – $4,887 = -$2,316. The NPV for the Residential Life, or Financial perspective, is $1,553. The benefit-cost ratio was also calculated. The benefit-cost ratio is equal to the sum of the benefit divided by the sum of the costs of the project (Boyer, 2013). The benefit-cost ratio for the project from the global perspective is $2,571/$4,887=0.53. The NPV for the Residential Life (Financial) perspective is 20.41. The results of the NPV and the benefit-cost ratio for the project can be seen in Table 3 for easy comparison of the two perspectives.

Table 3

NPV and B/C

	Global	Residential Life (Financial)
NPV	-2,316	1,553
B/C	0.53	20.41

Conduct a sensitivity analysis. A sensitivity analysis was not conducted for this project because actual cost and benefit values were used in the analysis. Since actual

values were used, no assumptions were made. As a result, no assumptions need to be evaluated by a sensitivity analysis.

Make a recommendation. A recommendation for whether or not the project should continue is based off of the NPV and B/C ratio calculated above (Boardman, Greenberg, Vining, & Weimer, 2010; Boyer 2013). These recommendations will be discussed in Chapter V.

Recycling Survey

The remainder of this chapter will present the results of the recycling survey beginning with the demographic information gathered from those who participated in the survey. Following the demographic information, the results of the remaining three questionnaires will be presented. The recycling portion of this survey was shaped by research questions two through five.

2. What are the attitudes of students living in Single Student Housing at Oklahoma State University towards recycling?
3. What would help encourage students living in Single Student Housing at Oklahoma State University to recycle more?
4. Do students living on-campus have an accurate knowledge base of recycling within Single Student Housing?
5. Are students living in Single Student Housing at Oklahoma State University participating in recycling?

Population. The population of this study consisted of 5,174 undergraduate students living in Single Student Housing at Oklahoma State University-Stillwater at the time the survey was conducted (M. Brown, personal communication, May 8, 2014). A

total of 3,000 surveys were sent out and 207 were completed, resulting in 6.9% response rate. For purposes of this research, a completed survey is defined as one in which all but one or two questions were answered. In cases in which a data point was missing, an arbitrary value of 99 was given in order to be able to run statistical tests.

Participants. Tables 4-8 show the demographic information of the participants in this survey. More women than men participated in the survey. Women made up 63.3% of participants (*N*=131) and men 36.7% of participants (*N*=76). The largest participant group by student classification was sophomores at 43% (*N*=89), followed by juniors at 25.1% (*N*=52), and lastly freshmen and seniors each making up 15.9% of the respondents (*N*=33). The average age of a student participating in this survey was 20, and the most common age was 19. The majority of students, 68.6%, participating in this survey described themselves as White (*N*=142). The next highest group was International students at 8.2% (*N*=17), followed by Asian American at 5.8% (*N*=12). Both Multiracial and American Indian/Native Alaskan were represented by 5.3% (*N*=11) of students that participated. Hispanic; Black, not Hispanic; and Hawaiian Native or Pacific Islander made up the smallest group of participants at 3.9% (*N*=8), 2.4% (*N*=5), and 0.5% (*N*=1), respectively. The average number of semesters that a student had been living on campus was 4.29 semesters while the most common length of time an undergraduate student had lived on campus was 2 semesters.

Table 4

Sex of Participants

Sex	N	Percentage (%)
Female	131	63.3%
Male	76	36.7%
Total	207	100%

Table 5

Race of Participants

Race	N	Percentage (%)
American Indian/Native American	11	5.3%
Asian American	12	5.8%
Black, not Hispanic	5	2.4%
Hawaiian Native or Pacific Islander	1	0.5%
Hispanic	8	3.9%
Multiracial	11	5.3%
White	142	68.6%
International	17	8.2%
Total	207	100%

Table 6

Student Classification of Participants

Student Classification	N	Percentage (%)
Freshmen	33	15.9%
Sophomore	89	43%
Junior	52	25.1%
Senior	33	15.9%
Total	207	99.9%[1]

[1]Total does not equal 100% due to rounding

Table 7

Semesters Living in a Residence Hall

Statistic	Semesters in Residence Hall
Mean	3.36
Median	2.00
Mode	2

Table 8

Age of Participants

Statistic	Age of Students in Residence Hall
Mean	20.01
Median	19.00
Mode	19

Research Questions 2 and 3: Attitudes and improvements. In this section the results pertaining to Research Question 2 and Research Question 3 will be displayed. Research Question 2 asks, "What are the attitudes of students living in Single Student Housing at Oklahoma State University towards recycling?" While Research Question 3 asks, "What would help encourage students living in Single Student Housing at Oklahoma State University to recycle more?" In order to assess the attitudes of students living in Single Student Housing on recycling, students were asked to state whether they agreed or disagreed with several statements such as "Recycling is time consuming" and "More information on recycling would be beneficial for me". These questions also helped assess what improvements would encourage students to participate in recycling. The data from all the questions of the attitudes questionnaire will follow.

Recycle more. Students were first asked if they want to recycle more than they do now. The majority of students either Strongly Agree (N=96, 46.4%) or Agree (N=76, 36.7%) that they want to recycle more than they do now. The responses are broken down into three subcategories of agree, neutral, and disagree in Figure 2. Additionally, a chi-square test of independence was performed to determine the relationship between early and late respondents. The relationship between early and late respondents was not significant, χ^2 (4, N = 207) = 2.26, p = .69. As a result, the null hypothesis fails to be rejected. Furthermore, a cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results for "I want to recycle more than I do now" were not significant for sex or student classification, χ^2 (4, N = 4) = 4.94, p = .30 and χ^2 (12, N = 207) = 14.80, p = .25, respectively.

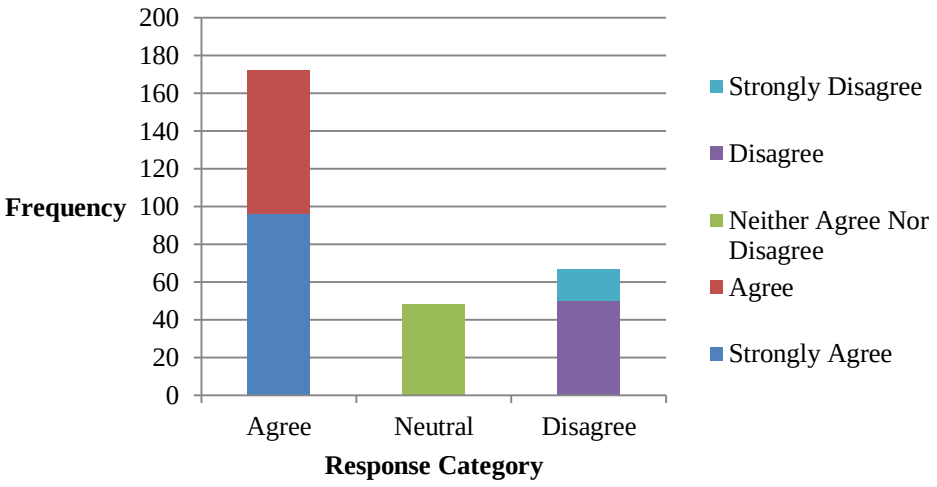

Figure 2. Responses to statement "I want to recycle more than I do now" collapsed into three subcategories.

Recycling bins. Students were also asked if recycling bins were easily located within the residence halls. The majority of students either Disagree (N=77, 37.2%) or Strongly Disagree (*N*=39, 18.8%) that recycling bins are easily located within the

residence halls. The frequency of all the responses can be seen in Figure 3. Additionally, a chi-square test of independence compared early and late respondents, χ^2 (4, N = 207) = 6.89, p = .14. Since p > .05 the null hypothesis fails to be rejected. Furthermore, a cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results for "Recycling bins are easily located within the residence halls" were not significant for sex or student classification, χ^2 (4, N = 207) = 6.82, p = .15 and χ^2 (12, N = 207) = 11.15, p = .52, respectively.

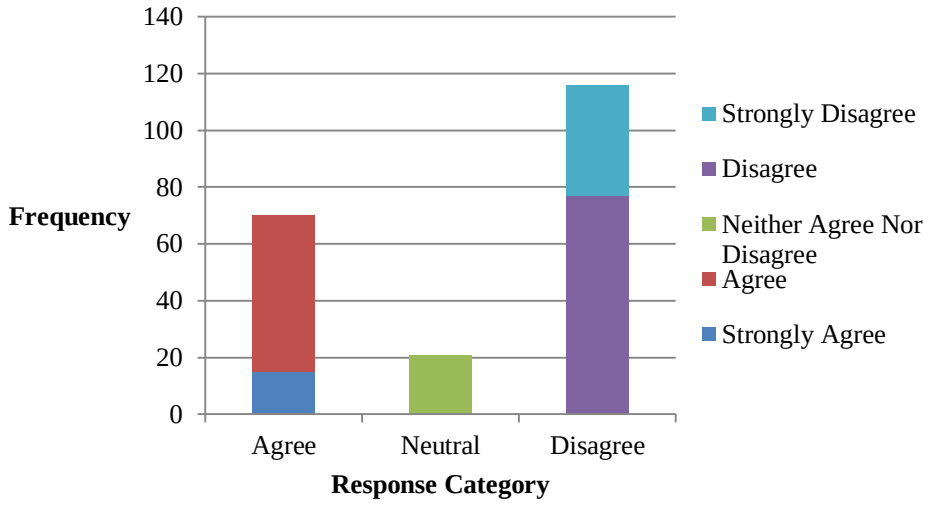

Figure 3. Responses to "Recycling Bins are Easily Located within the Residence Halls" collapsed into three subcategories.

More information. When asked if more information on recycling would be beneficial to the residents living on campus the majority of students either Strongly Agree (N=97, 46.9%) or Agree (N=50, 24.2%) that more information on recycling would be beneficial to them. All the responses for this question are displayed in Figure 4 and are broken down by response type. Additionally, a chi-square test of independence was conducted in order to determine if there is any difference between early and late

respondents. The chi-square results are χ^2 (4, N = 207) = 4.25, p = .37, because p > .05 the null hypothesis fails to be rejected. Furthermore, a cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results for "More information on recycling would be beneficial for me" were not significant for sex χ^2 (4, N = 207) = 1.37, p = .85. However, the results were statistically significant for student classification, χ^2 (12, N = 207) = 35.22, p = .00. Since p < .05 the null hypothesis is rejected. The post-hoc adjusted standardized residuals for student classification showed that fewer freshmen than expected neither agree nor disagree that more information on recycling would be beneficial to them with an adjusted residual score of -2.0, and more freshmen than expected indicated that they disagree with the statement with an adjusted residual score of 3.9. For sophomores, students were less likely to agree or disagree with the statement than expected, with adjusted residual scores of -2.2, and more sophomores than expected responded neutrally, with an adjusted residual score of 3.8. Juniors were more likely to agree (2.8) or respond neutrally (-2.1) to the statement. Finally, seniors responded as expected.

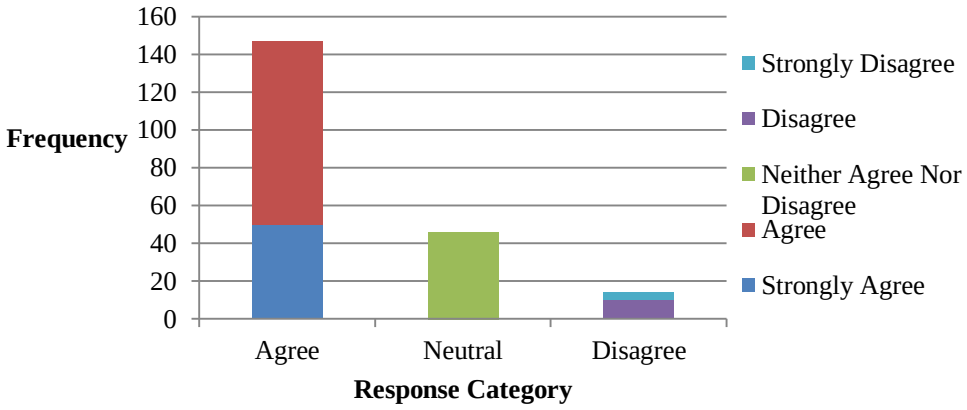

Figure 4. Responses to Statement: "More Information about Recycling Would be Beneficial for me" collapsed into three subcategories.

Properly sort materials. The fourth question pertaining to attitudes of recycling asked participants if they knew how to properly sort recyclable materials. The majority of students either Strongly Agree (N=43, 20.8%) or Agree (N=96, 46.4%) that they knew how to properly sort their recyclable materials. The frequencies of all the responses are displayed in Figure 5. Additionally, a chi-square test of independence was conducted to compare early and late respondents, χ^2 (4, N = 204) = 11.03, p = .03. The results of this test were significant because $p < .05$, as a result the null hypothesis is rejected. Since the chi-square test was significant Cramer's V was calculated in order to determine how strong the association between the two variables is, Cramer's V = .03. Furthermore, a cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results for "I know how to properly sort my recyclable materials" were not significant for sex or student classification, χ^2 (4, N = 204) = 1.10, p = .89 and χ^2 (12, N = 204) = 14.71, p = .26, respectively.

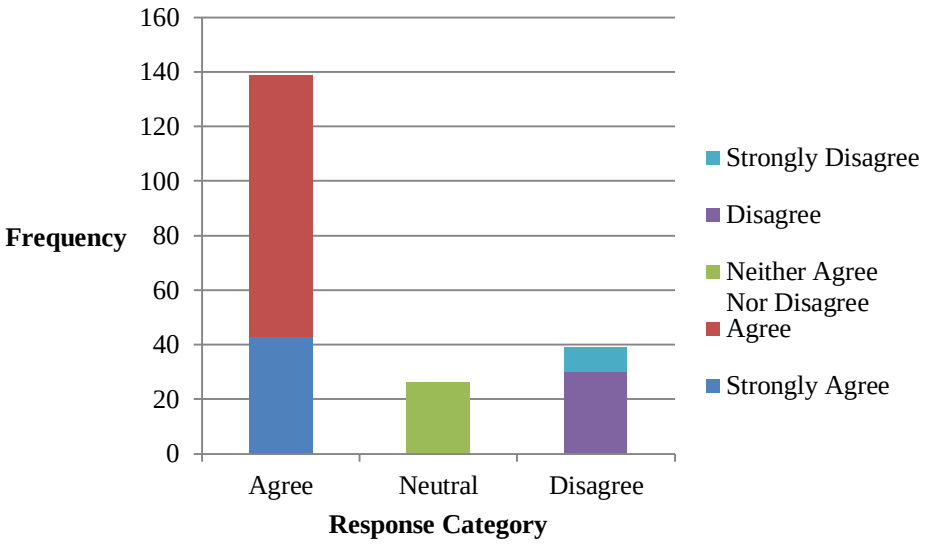

Figure 5. Responses to Statement: "I Know How to Properly Sort my Recyclable Materials" collapsed into three subcategories.

Can it be recycled? The fifth question asked participants if they knew what could be recycled at OSU-Stillwater. Approximately the same number of participants Agree as Disagree with this statement. While 70 participants Agree that they know what materials could be recycled, 66 participants Disagree, indicating they do not have an accurate knowledge base for recycling at OSU-Stillwater. The responses to this statement are displayed in Figure 6 and are broken down into three subcategories. Additionally, a chi-square test of independence was conducted in order to compare early and late respondents, χ^2 (4, N = 206) = 5.10, p = .28. Since, p > .05 the null hypothesis fails to be rejected, indicating that the results for this test were not statistically significant. Furthermore, a cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results for "I know what can be recycled at OSU-Stillwater" were not significant for sex or student classification, χ^2 (4, N = 206) = 8.07, p = .09 and χ^2 (12, N = 206) = 10.80, p = .55, respectively.

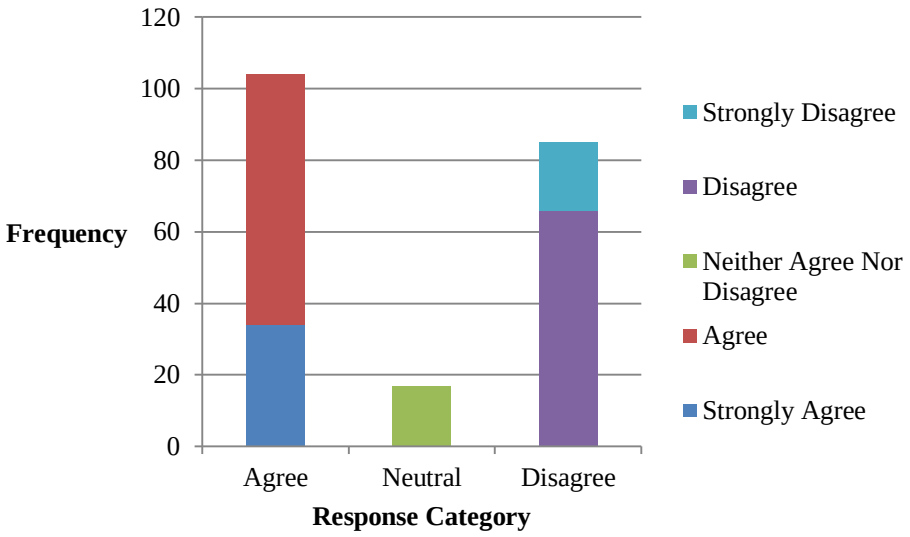

Figure 6. Responses to Statement: "I Know What Can be Recycled at OSU-Stillwater" collapsed into three subcategories.

Recycling is important. The sixth question asked students if they believed recycling was important. The majority of students either Strongly Agree (N=92, 44.4%) or Agree (N=73, 35.3%) that recycling is important to them. The frequencies of all the responses can be seen in Figure 7. Additionally, a chi-square test of independence compared early and late respondents to determine if they are statistically different from one another, χ^2 (4, N = 204) = 7.07, p = .13. Since, $p > .05$ the null hypothesis fails to be rejected, indicating that the results for this test are not statistically significant. Furthermore, a cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results of the cross tabulation for "Recycling is important" were not statistically significant for sex or student classification, χ^2 (4, N = 204) = 1.96, p = .74 and χ^2 (12, N = 204) = 6.48, p = .89, respectively.

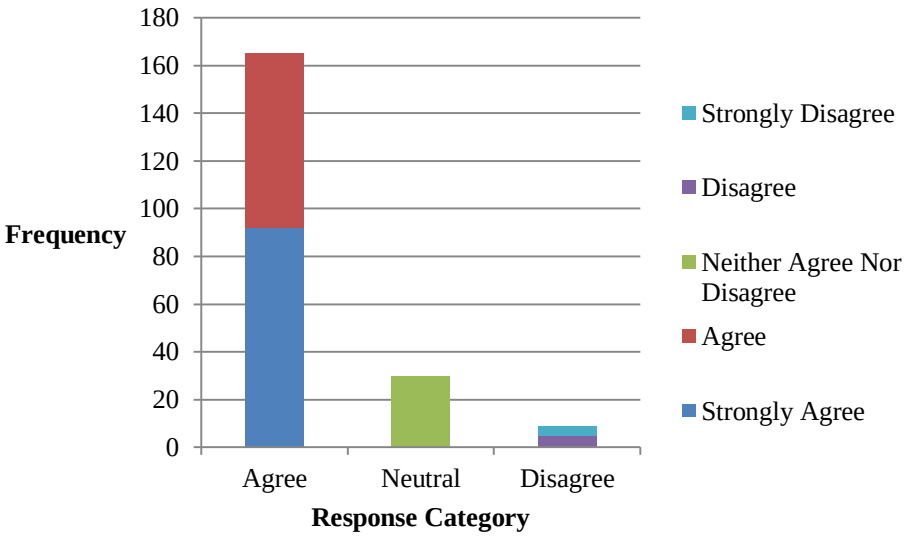

Figure 7. Responses to Statement: "Recycling is Important" collapsed into three subcategories.

Recycling is time consuming. The seventh question asked participants if recycling was time consuming. The majority of students either Disagree (N=65, 31.4%)

or Strongly Disagree (N=42, 20.3%) that recycling is time consuming. All of the responses to this question can be seen in Figure 8 broken down into three subcategories. Additionally, a chi-square test of independence was conducted in order to compare early respondents and late respondents, χ^2 (4, N = 205) = .85, p = .93. Since, $p > .05$ the null hypothesis fails to be rejected, indicating that the results are not statistically significant. Finally, a cross tabulation and chi-square analysis of this question along with sex and student classification was also conducted. The results of the cross tabulation for "Recycling is time consuming" were not statistically significant for sex or student classification, χ^2 (4, N = 205) = 1.96, p = .74 and χ^2 (12, N = 205) = 8.31, p = .76, respectively.

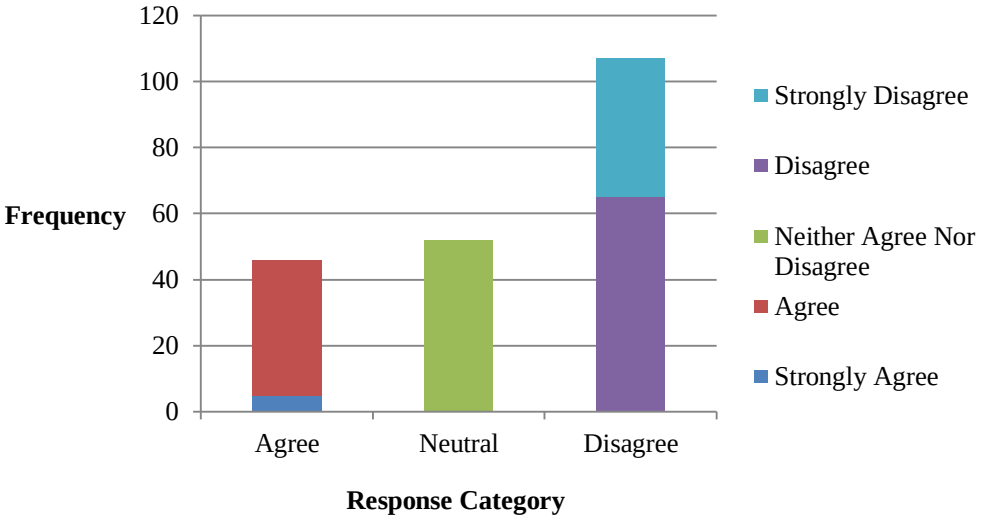

Figure 8. Responses to Statement: "Recycling is Time Consuming" collapsed into three subcategories.

It is easy to recycle at OSU. The final question in this portion of the survey asked participants if they believed it was easy to recycle at OSU. The largest response group of students Agree (N=76, 36.7%) that recycling at OSU is easy. However, 50 (24.2%)

students Disagree that recycling was easy and 48 (23.2%) students Neither Agree Nor Disagree that recycling at OSU is easy. The frequencies of all the responses are displayed in Figure 9. Additionally, a chi-square test of independence was conducted to determine if there is a difference between early and late respondents, χ^2 (4, N = 207) = 7.69, p = .10. Since p > .05 the null hypothesis fails to be rejected. A cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results of the cross tabulation for "It is easy to recycle at OSU" were not significant for sex, χ^2 (4, N = 207) = 4.29, p = .37. However, the results were statistically significant for student classification, χ^2 (12, N = 207) = 25.39, p = .01, and as a result the null hypothesis is rejected. The post-hoc adjusted standardized residuals for student classification showed that more freshmen than expected disagreed with the statement "it is easy to recycle at OSU" with an adjusted residual score of 2.2. Sophomores were more likely to strongly agree (2.7) but less likely to disagree (-2.1) with the statement than expected. Juniors were more likely to disagree (2.4) than expected. Finally, seniors were more likely to disagree (-2.2) with the statement than expected.

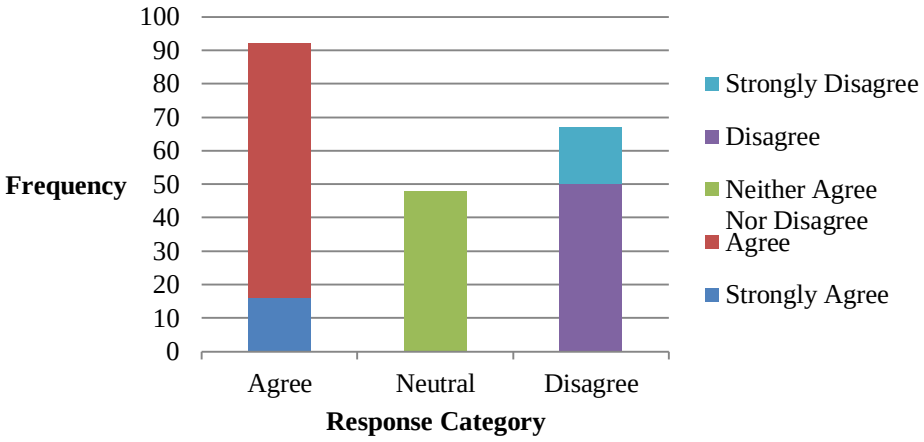

Figure 9. Responses to Statement: "It is Easy to Recycle at OSU" collapsed into three subcategories.

Research Question 4: Knowledge. Research Question 4 looked at the knowledge level of students living in Single Student Housing on the current recycling program within the residence halls. This was done in two ways. First, students were asked to give a self-assessment of what they believed their knowledge of the recycling program at OSU to be. The second tested their actual knowledge by having students indicate whether or not they believed certain materials to be recyclable at OSU-Stillwater.

For the self-assessment, participants were asked to rate themselves on what they believed their current level of recycling knowledge to be within Single Student Housing. Out of the 207 participants, 88 (42.5%) participants believed they possessed an average knowledge of recycling with in the Residence Halls. Fifty-three participants (25.6%) believed they had a good level of knowledge of recycling within the Residence Halls, while 23 (11.1%), 39 (18.8%), and 4 (1.9%) participants believed their level of knowledge of recycling within the Residence Halls to be poor, fair, and excellent, respectively. The frequencies of all responses are displayed in Table 9.

Table 9

Students' Self-Assessed Level of Recycling Knowledge

Response	Frequency	Percentage (%)
Poor	23	11.1
Fair	39	18.8
Average	88	42.5
Good	53	25.6
Excellent	4	1.9

In addition to the self-assessment, a test to better determine the level of knowledge students have of recycling within the residence halls was also given. Scores were calculated based on whether an individual correctly identified whether or not each

of the 10 listed materials was recyclable on campus. Participants received one point for each correct answer, zero points for each incorrect answer, and zero points for each question that was skipped. If participants skipped more than two questions their results were not included in this study. A total of 10 points was possible if a participant correctly identified all materials as either recyclable or not on campus. The average score for all participants was 5.3. The frequency of all responses can be seen in Table 10.

Table 10

Frequency Table of Recycling Knowledge Questionnaire

Score	Frequency	Percentage (%)
0	0	0
1	0	0
2	4	1.9
3	21	10.1
4	49	23.7
5	38	18.4
6	45	21.7
7	36	17.4
8	7	3.4
9	7	3.4
10	0	0

In order to treat for nonresponse error, a comparison between early and late respondents was conducted. A comparison between these two groups was done because late respondents are the closest indicator to non-respondents that the study had access to. An independent samples t-test was conducted to indicate whether or not there was a difference between early and late responders.

H_0: There is no difference in knowledge score of recycling on campus between early and late responders.

The independent samples *t*-test shows that the mean for early responders was 5.28 and the mean for late responders was 5.35, $t(205) = -.274$, $p = .784$. Since $p > .05$ the null hypothesis fails to be rejected, indicating that there is no significant difference between early and late responders regarding their level of recycling knowledge within Single Student Housing. The results of the independent samples *t*-test are displayed in Table 11. A cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results for recycling knowledge were not statistically significant for sex or student classification, $\chi^2 (7, N = 207) = 3.77$, $p = .81$ and $\chi^2 (21, N = 207) = 9.30$, $p = .99$, respectively.

Table 11

Independent Samples t-test (Mean Scores of Recycling Knowledge Test)

Group	N	M	F	*p*
Early Respondents	141	5.28	.133	.715
Late Respondents	66	5.35		
All Participants	207	5.30		

Research Question 5: Behavior. Research Question 5 asked "Are students living in Single Student Housing at Oklahoma State University participating in recycling?" In order to assess behavior and participation of recycling within the Residence Halls a seven point Likert-type scale question was used. This question asked participants "In the past month, how frequently or infrequently have you recycled in your Residence Hall?" During that time frame, 40 (19.3%) students indicated that they never recycle, 35 (16.9%) very rarely recycle, and 23 (11.1%) that they always recycle in their Residence Hall. The responses to this question can be seen in Table 12. A chi-square for independence test was done to determine if early respondents answered differently than late respondents, χ^2

(6, N = 207) = 6.24, p = .40. Since, p > .05 the null hypothesis fails to be rejected. A cross tabulation with chi-square analysis of this question with sex and student classification was also conducted. The results for recycling behavior were not statistically significant for sex or student classification, χ^2 (6, N = 207) = 8.49, p = .21 and χ^2 (18, N = 207) = 3.47, p = .76, respectively.

Table 12

Frequency of Recycling in the Residence Halls at OSU-Stillwater by Residents

Response	Frequency (N)	Percentage (%)
Never	40	19.3%
Very Rarely	35	16.9%
Rarely	22	10.6%
Occasionally	38	18.4%
Frequently	32	15.5%
Very Frequently	17	8.2%
Always	23	11.1%

Chapter Summary

Chapter IV provided the results from the cost-benefit analysis and recycling survey of students living in Single Student Housing at Oklahoma State University-Stillwater. The results of the cost-benefit analysis showed a NPV>0 and a B/C >1 for the Residential Life perspective and a NPV<0 and a B/C<1 for the global perspective. The attitudes questionnaire showed that 83.1% of residents strongly agree or agree that they want to recycle more, 71.1% strongly agree or agree that more information on recycling would be beneficial, and 79.7% of residents agree or strongly agree that recycling is important. Respondents scored an average of M=5.3 out of 10 on the knowledge questionnaire. The behavior questionnaire indicated that 46.8% of participants never,

very rarely, or rarely recycle, and 34.8% of respondents always, very frequently, or frequently recycle. Chapter V will provide further discussion on these results and will give recommendations to improve the recycling program as well as recommendations for future research.

CHAPTER V

DISCUSSION AND CONCLUSION

The purpose of this study was to examine the move-in recycling program created in August 2013 and to conduct a survey of students living in Single Student Housing on their attitudes, knowledge, and behavior in regards to recycling within the residence halls at OSU-Stillwater. This chapter will discuss the findings and limitations of this study. Additionally, recommendations for improvements of the recycling program within the residence halls will be given, as well as recommendations for future research.

Cost-Benefit Analysis

A cost-benefit analysis was conducted in order to address Research Question 1 which asked, "Is continuation of the Move-in Recycling Program at Oklahoma State University-Stillwater economically feasible?" A project is considered feasible when the net present value (NPV) is greater than zero (NPV>0), and the benefit-cost ratio (B/C) is greater than 1 (B/C>1) (Boardman, Greenberg, Vining, & Weimer, 2010; Boyer, 2013). In this analysis, the Residential Life perspective in which move-in recycling occurred met both of these requirements with a NPV of $1,553 and a B/C of 20.41. Based on the NPV and the B/C the project is economically viable for the Department of Housing and Residential Life and should be continued in the future. For the global perspective, the

project is not economically viable. With a NPV = -$2,316 and a B/C = 0.53, the analysis indicates that the project is not viable for the global perspective, and therefore should not be continued. However, not all of the benefits were able to be monetized for the move-in 2013 program. Neither the pleasing aesthetics that were created as a result of the move-in recycling program, nor the value of the creation of permanent recyclers was able to be monetized. If permanent recyclers are created then the project has potential to become economically viable for the global perspective as well.

Limitations of the Cost-Benefit Analysis. The cost-benefit analysis was limited by the inability to monetize the creation of life-long recyclers as a result of exposure to the move-in recycling program. Additionally, the aesthetics that were improved as a result of the move-in recycling program by limiting the amount of waste surrounding dumpsters during move-in were unable to be monetized. If one were able to associate monetary values with the creation of permanent recyclers and pleasing aesthetics, the overall benefits would have increased. Increasing the overall value of the benefits of the program could have resulted in the global perspective also being economically viable.

Present Value of Recycler. In order to determine when the global perspective becomes economically viable, a rough calculation of the value of a person becoming a lifetime recycler as a result of the move-in recycling program was conducted. The present value of the creation of a new recycler over a 50 year period with a discount rate of 4% is $296. Using this value, only eight people would need to be converted into permanent recyclers in order for the global perspective of the CBA to be positive.

Recommendations. Since the waste from move-in must be disposed of, one of these programs, either move-in with recycling or move-in without recycling, must occur.

As such, it is recommended that move-in with recycling continue to take place. The program is economically and financially viable for the Department of Housing and Residential Life and as shown by the cost-benefit analysis, the benefits outweigh the costs. Thus, when looking at Residential Life as the customer, it is economically and financially beneficial for them to continue to offer recycling when students move back to campus each fall.

Additionally, recycling should continue to take place because of the benefit to the environment. Recycling helps decrease the amount of landfill space being used, creates jobs, reduces pollution, conserves natural resources, and benefits both society and the environment (EPA, 2013a; Fridgen, 2011). This is seen within the analysis of the program when looking at the cost avoidance figures. A savings of $1,633 occurred simply by not throwing the waste into the landfill, and as a result also saved space in the landfill.

Furthermore, in the future, fewer resources may be needed to complete the move-in recycling program. If less time is invested and fewer people are involved in planning and carrying out the program, then the overall costs of the program will decrease. If the costs decrease enough, the global perspective for move-in with recycling may become economically viable.

Attitudes and Improvements

Research Questions 2 and 3 asked, "What are the attitudes of students living in Single Student Housing at Oklahoma State University towards recycling?" and "What would help encourage students living in Single Student Housing at Oklahoma State University to recycle more?" The results of the survey indicate that overall, the attitudes

of students living in Single Student Housing at OSU-Stillwater are positive towards recycling. The majority of students desire to recycle more than they currently do, are interested in obtaining more information on recycling at OSU-Stillwater, and believe recycling is important. Students living in Single Student Housing also believe that recycling is not time consuming. This indicates that OSU-Stillwater has a climate that is favorable towards recycling and that those in charge of these efforts should continue to make improvements to the recycling program at OSU in order to encourage those who are not participating in recycling to participate.

According to the results of the chi-square for independence test, students responded to two statements in the attitudes questionnaire differently than expected based on their student classification (freshmen, sophomore, junior, or senior). The two statements "More information about recycling would be beneficial for me" and "It is easy to recycle at OSU" have a statistically significant relationship with student classification. Sophomores and juniors were more likely than freshmen and seniors to respond differently than expected based on the chi-square analysis.

In order to account for nonresponse error in the attitude questionnaire a chi-square test of independence was conducted that compared early and late respondents. This was done to determine whether or not non-respondents are similar to late respondents since late respondents were the closest thing to non-respondents that were available from this survey (Miller & Smith, 1983; Clausen & Ford, 1947). For this section of the survey, only one question was statistically significant, indicating that for seven of the eight questions late respondents are similar to early respondents and therefore, it can be assumed that non-respondents are no different than late respondents (Miller & Smith,

1983; Clausen & Ford, 1947). The one question that was statistically significant was "I Know How to Properly Sort my Recyclable Materials." For this question, early respondents were approximately three times more likely to Agree with the statement than were late respondents. This indicates that those who did not participate in the survey are likely different from those who did participate when it comes to their knowledge, or at least their confidence, in their ability properly sort recyclable materials.

Knowledge

Research Question 4 asked, "Do students living on campus have an accurate knowledge base of recycling within Single Student Housing?" The data indicates that some students do have an accurate knowledge base of recycling, but the majority of students either have an average or below average (N=157, 77.8%) understanding of recycling within Single Student Housing. Additionally, no participant made a perfect score on the recycling knowledge test, indicating there is room for improvement for all students.

Both the perceived knowledge level of participants and the actual knowledge level of students appear to indicate that the majority of students have an average or below average level of recycling knowledge. Although more students indicated that they have a poor level of recycling knowledge than the recycling test indicated, overall, when comparing the self-assessment with the actual knowledge level, students accurately assessed their level of recycling knowledge. While it is not ideal that students have an average or below average level of recycling, it is beneficial that students can somewhat accurately self-assess their level of recycling knowledge.

Since education is the first step in helping sustainability programs gain ground, the university would benefit by focusing on educating students on what can and cannot be recycled within the residence halls (Emanuel & Adams, 2011). Additionally, because the university has greater access to students living in Single Student Housing than those who live off-campus it is important to educate the RAs and other staff members on recycling as well (Pursehouse, 2012).

Behavior

Finally, Research Question 5 asked "Are students living in Single Student Housing at Oklahoma State University participating in recycling?" The results indicate that, yes, some of the students living in Single Student Housing are recycling; however, the majority of students are not. The survey found that 34.8% (*N*=72) of students either recycle frequently, very frequently, or always and that 37.7% (*N*=78) either never recycle or occasionally do so. Pike et al. (2003) showed that when students are given the opportunity to recycle the likelihood that they will participate is high. Since this study shows that the majority of students are not recycling on a regular basis, other barriers may be present that were not present in the Pike et al. study (2003). Barriers such as not knowing what to recycle or not knowing where to take recyclable materials could impact the surveyed students' ability to recycle. Another possible barrier, as seen in this survey, is that recycling bins are not easily located in the residence halls. The majority of students, 56% (*N*=116) Disagree or Strongly Disagree that recycling bins were easily located in their residence hall. Since many students have trouble locating recycling bins within their residence hall, it is possible they are not experiencing the access they need in order to participate in the program (Pike et al., 2003). Additionally, the majority of

students had a score of six or less (*N*=157, 77.8%) on the knowledge portion of the survey. The lack of knowledge could be inhibiting students from recycling. If their level of knowledge were to increase, it would be interesting to see if participation in the recycling program increased as well.

Limitations of the Survey

A few limitations exist in this study. First, only two contact e-mails were allowed to be sent to residents asking them to participate in this survey (OSU University Research Compliance, 2011). Previous studies have shown the benefit of using five contacts, and if more than two contacts would have been allowed to be used in this study, the higher number of contacts with the students could have resulted in a higher response rate and as a result, a better sample to generalize from (Dillman, 2007). Additionally, as a result of only two contacts being allowed, only 207 responses were obtained. This is below the approximately 351 responses needed in order to ensure a 95% confidence level with 5% sampling error (Dillman, 2007). While this was compensated for by comparing early and late respondents, greater accuracy of the survey results could have been obtained with a higher response rate.

Second, these results only apply to undergraduate students living within the residence halls at OSU-Stillwater. Those who live off campus or who are in the graduate college may have responded differently. Thus, these results only apply to undergraduate students living in Single Student Housing and not the university as a whole. In order to have a better understanding of recycling at the university, more research is needed.

Furthermore, since a survey was used, the results are based on the responses of the students. It is possible that students may have guessed or may have lied about what

they believe regarding recycling at OSU-Stillwater. Finally, there are always improvements that can be made to a study and there may be additional limitations that were overlooked.

Recommendations for improving recycling within the Residence Halls

While the survey indicated that overall students have a favorable attitude towards recycling, it also indicated that students were divided on how strongly they believe they know what materials can be recycled. This is further verified by the results from the knowledge survey which indicate that students living in Single Student Housing at OSU-Stillwater only have an average (*M*=5.3 out of 10) level of recycling knowledge. This suggests that information on what can and cannot be recycled would be beneficial for students living within the residence halls.

Based on the results of the recycling survey the university needs to find ways to encourage students to recycle within their residence halls. One way this could be done is through increased education. Of the students surveyed, 147 (71.1%) either strongly agree or agree with the statement that more information about recycling would be beneficial to them, and increasing education is how this information will get to the students. Education is an essential part of encouraging participation in recycling and other sustainability related projects (Emanuel & Adams, 2011) This education can be carried out in whatever way best suits the university and will be most successful if it has the support of administration and other university officials (Kagawa, 2007; Orr 1994).

Additional improvements that could be made to the recycling program at OSU-Stillwater include making recycling bins more easily located. The majority of students (*N*=116; 56%) either disagree or strongly disagree that recycling bins are easily located in

the residence halls. The recycling program could improve by making recycling bins more accessible and/or by providing more information on where to take recyclables.

Recommendations for Future Studies

In the future, it would be beneficial to conduct another cost-benefit analysis and attempt to monetize some of the benefits such as improved aesthetics and the creation of permanent recyclers that were unable to be monetized in this analysis. Additionally, in order to determine if the recommendations for improving the recycling program in the residence halls are effective, it would be necessary to conduct an additional survey after the education has been implemented to see if improvements have been made. Furthermore, now that graduate students and students living in residence halls have both been studied, a next step would be determining the attitudes, knowledge, and behavior of OSU students as a whole (Brown, 2007). Finally, while the survey indicated that students had an overall favorable disposition to recycling, that favorable attitude does not appear to carry over into the actual participation of recycling. It would be beneficial to explore why a favorable attitude towards recycling is experienced while simultaneously seeing an average level of recycling knowledge and low participation in the recycling program in Single Student Housing at OSU-Stillwater.

Concluding Remarks

Students living on campus at OSU-Stillwater have a great opportunity to participate in recycling. When students move to campus each fall and as they live in Stillwater throughout the school year, the exposure they have to recycling has potential to create students who regularly recycle (Pursehouse, 2012; Pike et al., 2003). Based on a waste stream analysis conducted at OSU, there is potential for 49.3% of the waste created

by on-campus residents to be recycled (Kandula, 2013). By using the positive attitudes students already have toward recycling, along with the results of the cost-benefit analysis and recycling survey, steps for improving recycling at OSU-Stillwater can begin taking place. If the administration takes time to educate students on recycling and improving the locations of recycling bins within the residence halls, the potential to increase the on-campus recycling rate is great. By using the improvements recommended in this paper, the residence halls at OSU-Stillwater could potentially achieve a diversion rate of almost 50% and set an example for the university as a whole for what it means to be sustainable (Kandula, 2013).

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APPENDICES

APPENDIX A

COPY OF IRB APPROVAL

Oklahoma State University Institutional Review Board

Date:	Thursday, May 08, 2014
IRB Application No	GU149
Proposal Title:	Recycling in the Residence Halls at Oklahoma State University
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 5/7/2017

Principal Investigator(s):

Robyn Salisbury
700 NE 122nd St Apt 1009
OKC, OK 73114

Arthur Stoecker
312 AG
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

X The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1.Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or fo
2.Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3.Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated ar impact the subjects during the course of the research; and
4.Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about th IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Shelia Kennison, Chair
Institutional Review Board

APPENDIX B

COPY OF CONSENT FORM

PARTICIPANT INFORMATION
OKLAHOMA STATE UNIVERSITY

Title: Recycling in the Residence Halls at Oklahoma State University

Investigator(s): Robyn Salisbury, B.S. Biochemistry, Environmental Science Graduate Program

Purpose: The purpose of the research study is to gain insight into the recycling attitude, knowledge, and behavior of undergraduate students living on campus in Single Student Housing at Oklahoma State University-Stillwater. You must be 18 years of age or older to participate.

What to Expect: This research study is administered online. Participation in this research will involve completion of two short questionnaires. The first questionnaire will ask about your opinions, knowledge, and past behavior regarding recycling within the Residence Halls at Oklahoma State University; the second questionnaire will ask for demographic information. You must complete each question before moving on to the next. You will be expected to complete the questionnaire only once. It should take you about 2-5 minutes to complete the questionnaires.

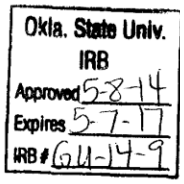
Risks: There are no risks associated with this project which are expected to be greater than those ordinarily encountered in daily life.

Benefits: You may gain an appreciation and understanding of how research is conducted. Additionally, you may gain a better understanding of recycling within the Residence Halls, as well as help identify potential areas of improvement in the recycling program.

Your Rights and Confidentiality: Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time, without penalty.

Confidentiality: All information about you will be kept confidential and will not be released. Research records will be stored securely, and only researchers and individuals responsible for research oversight will have access to the records. You will not be identified individually; we will be looking at the group as a whole. Note that QuestionPro has specific privacy polices of their own. If you have concern you should consult this service directly. QuestionPro's privacy statement is provided at: http://www.questionpro.com/help/1.html.

Contacts: You may contact any of the researchers at the following addresses and phone numbers should you desire to discuss your participation in the study and/or request information about the results of the study: Robyn Salisbury, Principal Investigator, Environmental Science Graduate Program, 405-213-6440, robyn.a.latham@okstate.edu. Arthur Stoecker, Ph.D., 312 Agriculture Hall, Dept. of Agriculture Economics Oklahoma State University, Stillwater, OK 74078, 405-744-6165, art.stoecker@okstate.edu. If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu



If you choose to participate: Please click CONTINUE if you choose to participate. By clicking CONTINUE you are indicating that you freely and voluntarily agree to participate in this study, and you also acknowledge that you are at least 18 years of age. By clicking CONTINUE and completing this survey you are providing consent to allow your responses to be used in this study.

It is recommended that you print a copy of this consent page for your records before you begin the study by clicking "CONTINUE" below.

APPENDIX C

COPY OF RECYCLING SURVEY

Q1.

Please indicate the extent to which you agree or disagree with each of the following statements.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I want to recycle more than I do now.	○	○	○	○	○
Recycling bins are easily located in the Residence Halls.	○	○	○	○	○
More information about recycling in the Residence Halls would be useful for me.	○	○	○	○	○
I know how to properly sort my recyclable items.	○	○	○	○	○
I know what I can recycle in the Residence Halls.	○	○	○	○	○
It is important for me to recycle in the Residence Halls at OSU.	○	○	○	○	○
Recycling is time consuming.	○	○	○	○	○
It is easy to recycle at OSU.	○	○	○	○	○

Q2.

The following questions will assess your knowledge of the current recycling program in the Residence Halls.

How would you describe your current level of knowledge on recycling at OSU?

- ○ Poor ›
- ○ Fair ›
- ○ Average ›
- ○ Good ›
- ○ Excellent ›

Q3.

Please indicate which of the following materials can currently be recycled in your Residence Hall.

	Yes	No
White Paper	○	○
Steel/Tin Cans	○	○
Mixed Paper (Colored Paper, Newspaper, Phone Books, Journal, Manila Folders, Magazines)	○	○
#1 Plastic Bottles	○	○
Cardboard	○	○
#2 Plastic Bottles	○	○
Aluminium Cans	○	○
#3–#7 Plastic Containers	○	○
Glass	○	○
Paperboard/Chipboard (i.e. Cereal Boxes)	○	○

Q4.

Do you know where the recycling bins in your Residence Hall are located?

- ○ Yes ›
- ○ No ›

Q5.

Please complete the following question by selecting the response which best describes your participation in the recycling program in the Residence Halls at Oklahoma State University.

In the past month, how frequently or infrequently have you recycled in your Residence Hall?

- Never
- Very Rarely
- Rarely
- Occasionally
- Frequently
- Very Frequently
- Always

Q6.

The following questions are for generalization purposes only and will help identify trends in recycling in the Residence Halls at Oklahoma State University.

What is your sex?

- Male
- Female

Q7.

How old are you?

(Years)

Q8.

What is your race?

- American Indian/Native Alaskan
- Asian American
- Black, not Hispanic
- Hawaiian Native or Pacific Islander
- Hispanic
- Multiracial
- White
- International

Q9.

What is your current student classification?

- Freshmen
- Sophomore
- Junior
- Senior

Q10.

How many semesters, including the current semester, have you lived in the Residence Halls at Oklahoma State University?

(Number of Semesters)

APPENDIX D

COPY OF FIRST CONTACT E-MAIL

Dear Participant/Participant Name,

My name is Robyn Salisbury, and I am writing you today to ask for your help so that the opinions, knowledge, and behavior of undergraduate students living on campus at Oklahoma State University can be better understood when it comes to recycling.

Your participation in an online survey concerning your opinions and knowledge of recycling in the Residence Halls may help to identify potential areas of improvement in the recycling program. The survey will consist of two short questionnaires that should only require a total of 2 to 5 minutes to complete.

If you would like to participate, please click the QuestionPro link (http://questionpro.com/t/AKzSlZQ5j6); you will be taken to an information page before the survey begins.

Your participation in this research is greatly appreciated; it is only with generous people like you that this research can be successful.

Thank you for your participation.

Sincerely,

Robyn Latham Salisbury
Environmental Sciences Graduate Program
Senior Sustainability Intern
robyn.a.latham@okstate.edu

APPENDIX E

COPY OF SECOND FOLLOW-UP CONTACT E-MAIL

Dear Participant/Participant Name,

About a week ago you received an e-mail asking about your opinions, knowledge, and behavior of recycling within the Residence Halls at Oklahoma State University. If you have already completed the survey, please accept my sincere thanks. If not, please do so today. It is only through your help that this research can be successful.

Your participation in this 2-5 minute online survey concerning your opinions and knowledge of recycling in the Residence Halls may help to identify potential areas of improvement in the recycling program.

If you would like to participate please click the QuestionPro link (http://questionpro.com/t/AKzSlZQ5j6); you will be taken to an information page before the survey begins.

Your participation in this research is greatly appreciated; it is only with generous people like you that this research can be successful.

Thank you for your participation.

Sincerely,

Robyn Latham Salisbury
Environmental Sciences Graduate Program
Senior Sustainability Intern
robyn.a.latham@okstate.edu

APPENDIX F

OSU RECYCLES MASTER RECYCLE TRACKING SHEET

MARCH 2013 TO JUNE 2014

OSU Recycles Master Recycle Tracking Sheet
March 2013-June 2014

Cardboard

Date	Tons	Revenue	Price per Ton
4/11/2013	21.18	$2,329.25	$110.00
6/18/2013	21.38	$2,244.90	$105.00
9/12/2013	22.23	$2,556.45	$115.00
10/22/2013	22.17	$2,549.55	$115.00
11/6/2013	20.73	$2,280.30	$110.00
12/19/2013	21.11	$2,111.00	$100.00
2/21/2014	20.21	$2,021.00	$100.00
4/7/2014	20.86	$2,086.00	$100.00
5/15/2014	21.1	$2,004.50	$95.00
Total	**190.97**	**$20,182.95**	

Paper

Date	Tons	Revenue	Price per Ton
4/11/2013	13.71	$1,782.30	$130.00
6/18/2013	17.54	$2,104.80	$120.00
9/11/2013	15.92	$1,830.80	$115.00
11/5/2013	9.43	$1,036.75	$110.00
11/5/2013	4.29	$321.38	$75.00
12/3/2013	5.92	$444.00	$75.00
12/20/2013	1.56	$101.08	$65.00
1/28/2014	7.02	$526.50	$75.00
2/21/2014	1.92	$153.60	$80.00
4/23/2014	2.18	$85.00	$185.05
5/12/2014	4.89	$415.23	$85.00
5/30/2014	5.79	$491.85	$85.00
Total	**90.17**	**$9,293.29**	

Mix Paper

Date	Tons	Revenue	Price Per Ton
5/20/2013	9.46	$189.24	$20.00
6/7/2013	23.38	$467.50	$20.00
7/13/2013	8.62	$172.40	$20.00
9/10/2013	9.61	$96.10	$10.00
10/30/2013	8.86	$88.60	$10.00
11/26/2013	8.07	$80.74	$10.00
12/20/2013	6.73	$67.34	$10.00
2/21/2014	8.83	$88.25	$10.00
3/26/2014	11.28	$112.82	$10.00
4/23/2014	6.27	$62.68	$10.00
5/12/2014	4.29	$42.85	$10.00
5/30/2014	5.66	$56.58	$10.00
Total	**111.06**	**$1,525.10**	

Plastic Bottles

Date	Total Pounds	Total Units	Tons
3/31/2013	1,914.70	30,635	0.95735
4/30/2013	2,691.94	43,071	1.34597
5/31/2013	2,630.12	42,082	1.31506
6/30/2013	1,528.95	24,463	0.764475
7/31/2013	1,339.70	21,435	0.66985
8/31/2013	1,385.94	22,175	0.69297
9/30/2013	1,524.58	24,393	0.76229
10/31/2013	3,250.00	52,000	1.625
11/30/2013	1,893.76	30,300	0.94688
12/31/2013	1,324.32	21,189	0.66216
1/31/2014	1,108.62	17,738	0.55431
2/28/2014	1,555.50	24,888	0.77775
3/31/2014	23,281.26	4,519	11.64063
4/30/2014	3,842.07	61,473	1.921035
5/31/2014	2,038.58	32,617	1.01929
Total	**51,310.04**	**452,978.00**	**25.66**

Aluminum Cans

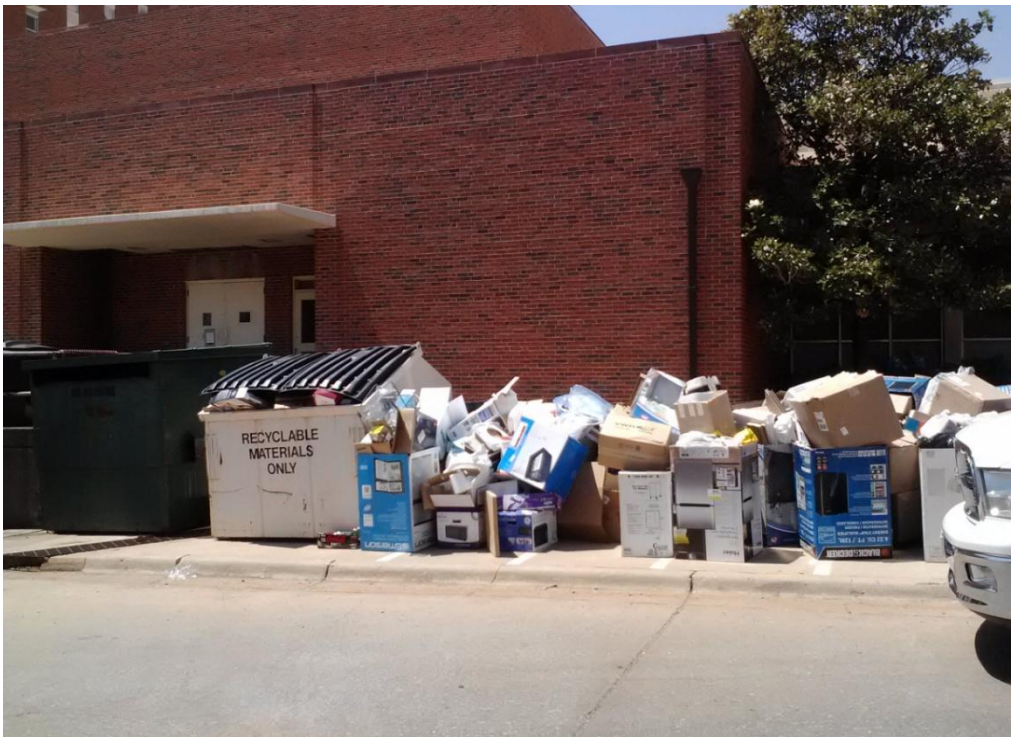
Date	Total Pounds	Total Units	Tons
3/31/2013	54.07	1,622	0.027035
4/30/2013	67.16	2,015	0.03358
5/31/2013	63.23	1,897	0.031615
6/30/2013	38.17	1,145	0.019085
7/31/2013	35.40	1,062	0.0177
8/31/2013	41.54	1,066	0.02077
9/30/2013	44.71	1,314	0.022355
10/31/2013	83.36	2,501	0.04168
11/30/2013	48.56	1,457	0.02428
12/31/2013	34.41	1,032	0.017205
1/31/2014	54.58	1,637	0.02729
2/28/2014	40.04	1,201	0.02002
3/31/2014	41.27	1,238	0.020635
4/30/2014	99.01	2,970	0.049505
5/31/2014	41.16	1,235	0.02058
Total	**786.67**	**23,392.00**	**0.39**

Material	Tons	Revenue
Cardboard	190.97	$20,182.95
Paper	90.17	$9,293.29
Mix Paper	111.06	$1,525.10
Plastic Bot	25.66	N/A
Aluminum	0.39	N/A
Total	418.25	$31,001.34

APPENDIX G

PHOTOGRAPHS DOCUMENTING MOVE-IN 2012: NO RECYCLING PROGRAM

Note: Refuse piled around dumpster East of Kerr Hall in August 2012



Note: Refuse piled around dumpster east of Kerr Hall, view 2.

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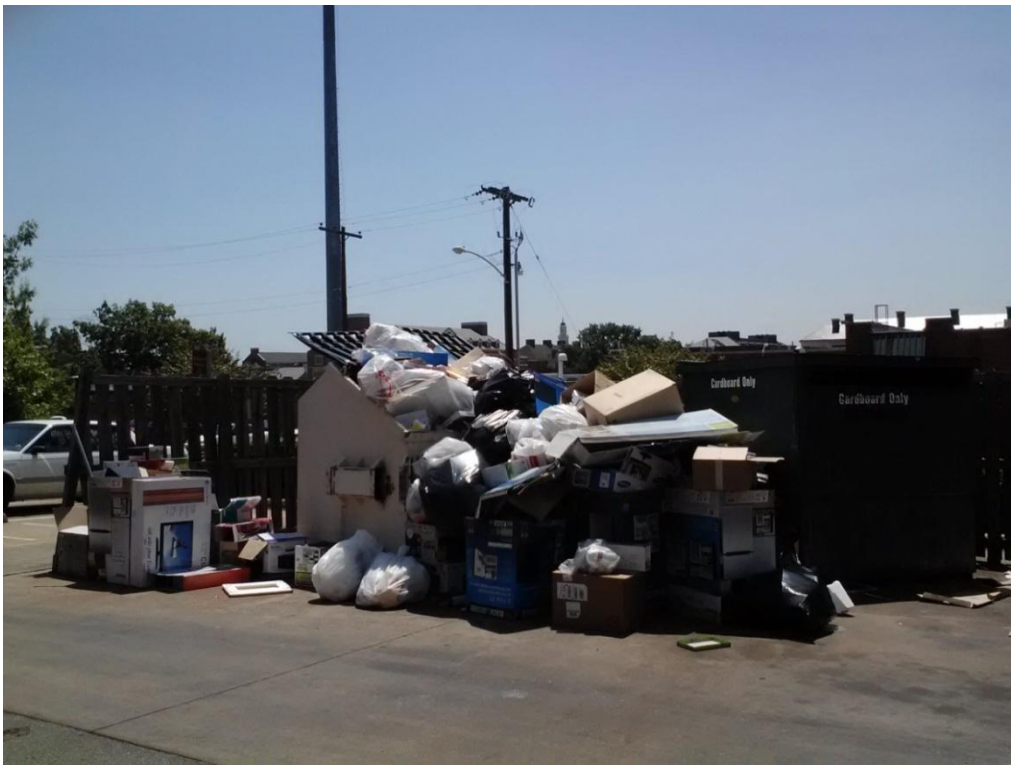
Note: Refuse placed in dumpster and paper retriever east of Drummond Hall.

Note: Pile of Refuse next to dumpster and paper retriever east of Drummond Hall.

Note: Refuse overflowing from dumpster NE of Stinchocmb Hall, view 1.

Note: Refuse overflowing from dumpster NE of Stinchcomb Hall, view 2

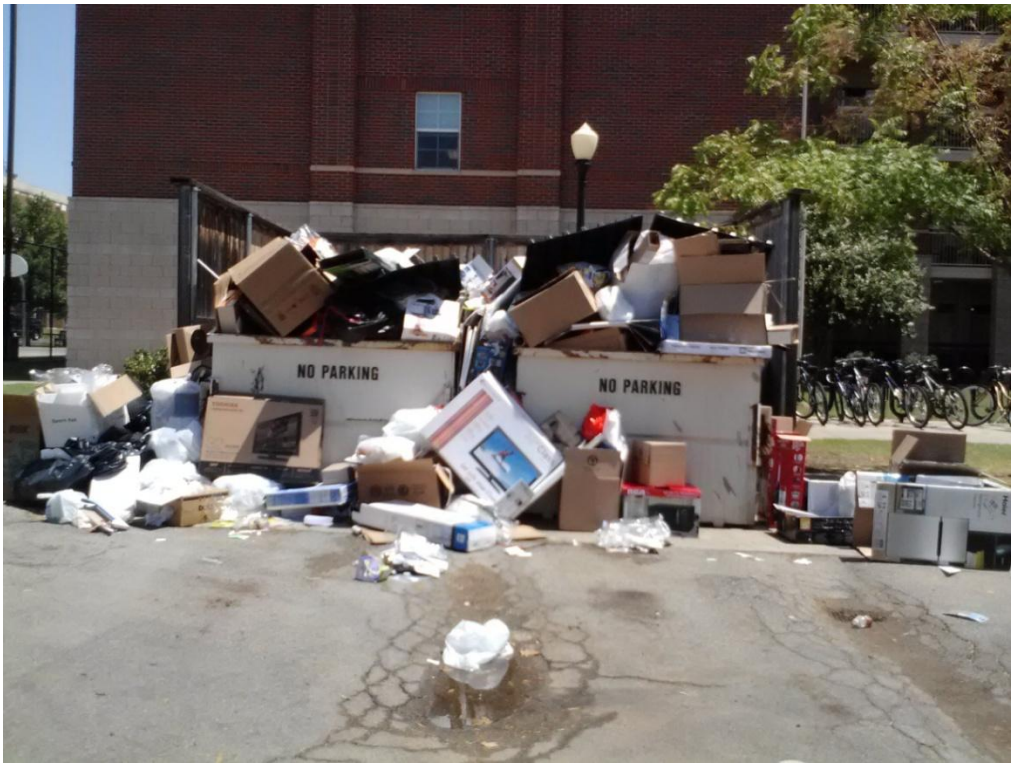


Note: Refuse around dumpsters south of Zink and Allen Hall.

Note: Refuse around dumpsters southwest of Zink Hall.

Note: Refuse surrounding dumpster north of Davis Hall.

Note: Refuse surrounding dumpster north of Village E



Note: Refuse surrounding dumpsters west of Village A.

Final Note: All photos in Appendix G were taken by Ilda Hershey in August 2012 when no move-in recycling program was taking place.

APPENDIX H

PHOTOGRAPHS DOCUMENTING MOVE-IN 2013 WITH THE MOVE-IN RECYCLING PRGORAM IN PLACE

Note: Volunteers collecting cardboard and foam packaging north of Davis Hall during Move-in 2013.

Note: Volunteers breaking down cardboard boxes and placing it in recycling bin between Stinchcomb and Davis Halls.

Note: Recycling dumpster filled with cardboard behind Drummond Hall.

Note: Empty refuse and filled recycling dumpster with bag filled with foam packaging behind Drummond Hall at the end of the day during Move-in 2013.

Note: Empty space behind Drummond Hall in 2013. Used to compare same location in 2012 in which there was a huge pile of cardboard and other materials that did not get recycled.

Final Note: All photographs in Appendix H taken by Robyn Salisbury.

VITA

Robyn Ashley Latham Salisbury

Candidate for the Degree of

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