



On-Site Composting at the University of Kansas

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Executive Summary

The University of Kansas currently does not have an on-campus composting program. We outsource nearly one million pounds of food waste to Missouri Organic. In order to ensure a sustainable future for our campus, we propose implementing a 2 phase on-campus composting program. To accomplish this task, our group covered many areas of research. Initially it was important to look back upon past Capstone projects as well as comparable composting programs in order to create an educated proposal. After reviewing these sources, it was decided that we should focus on four areas of research vital to the program. These include, required equipment, additional employees, suitable locations for the composting facility, and the funding required for implementation.

We found that the University would require an industrial in-vessel composter produced by EcoValue at a cost of \$100,000. Additional equipment such as ninety six gallon containers and biobags, valued at roughly \$1500 and \$2000 respectively, will also need to be purchased. We recommend current KU recycling student employees retrieve the waste bins by expanding their current routes as well as use the KU Recycling facility as the new home to our composting program. In order to maintain the compost pile and equipment, the Facilities and Operations department should expand the job responsibilities of a current employee at a salary increase of \$5000 per year. Funding can be supplied from numerous sources including, KU Endowment, KU Revolving Green Fund, Memorial Unions, KU Athletics, Student Senate Environmental Advisory Board, and possible grants from either the state of Kansas or the Federal Government.

By implementing our on-campus composting program, the University could see a net savings of nearly \$27,500 over the course of the next ten years. We strongly urge the University to consider this proposal as it paves the way toward a more sustainable future. Our University should set an example for the surrounding community as well as other schools in the area and around the nation.

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Introduction

The University of Kansas currently produces one million pounds of compostable materials for use around campus and surrounding locations. This report delves into the University's, and affiliated entities' on campus, current composting practices towards composting on site, the long term environmental and economic benefits of on-site composting, and recommends a shift in policy towards sustainable composting. To become more sustainable we recommend that KU accommodate the volume of compostable materials with the greatest social benefit to the University. As well as provide its services at a feasible financial expense to that of Missouri Organics. This program incorporates KUs history and future goals based on the current sustainability plan. This report will compare KU to the successes of other Universities of comparable campus size and student body population. In addition we will provide multiple areas of research aimed at implementing this program.

For those uninformed on this subject, composting is the physical and chemical breakdown of organic materials to create a highly nutritious soil called humus. This requires a specific amount both carbon and nitrogen materials, brown and green respectively. Brown matter consists of dried leaves or wood chips and green matter is any green yard trimmings, food waste or manure. Once matured compost can be used to improve the quality of soil or it can be used to grow plants or crops. For proper decomposition compost requires oxygen flow, or turning, for breakdown to occur at an accelerated rate, adding brown matter can increase decay rates (EPA, 2014).

Currently, a variety of different industrial composting equipment is available for large scale use. The most important factor determining a system of choice comes down to space and labor requirements (Cornell 1996). In an industrial setting such as a university or corporation,

space can become quite expensive, while in an agricultural setting, space may be limited by crops or livestock. Systems such as windrows, require extensive turning and additional equipment such as tractors, dedicated turners, and front end loaders. Generally, windrow systems involve long piles of accumulated food waste (green matter) and yard waste (brown matter) (Wilson 2003). Typically this type of system is suitable for composting very large amounts of material. Unfortunately, labor for windrows is quite extensive. The ratio of carbon versus nitrogen matter greatly affects the efficiency of windrows. The piles must be constantly turned, at least once a week. The temperature of such piles also must be closely monitored to achieve the most efficient composting time. Although windrows are the most popular large scale composting system, the area required for a windrow system is also much larger than other systems (Wilson 2003); this prevents or constrains the ability of a university or large corporation to take full advantage. One other problem with windrows is the odor emitted from the piles. In an urban setting, this presents an issue to the surrounding neighborhoods and businesses. But what options are available that use less space while still performing at a high capacity?

In-vessel systems involve composting within a container. On an industrial scale, these containers can be up to 50 feet long (about the size of a shipping container) or larger. Air flow and temperature are regulated inside the unit, in theory, creating the circumstances for a bioreactor (Wojtowicz 2014). The benefit to this system is the control of odors through a biofilter, as well as the ability to remotely control different temperatures and airflow to achieve an optimum compost blend. In-vessel systems also require far less labor in comparison to windrows, but have a lower volume capacity. Equipment such as front loaders will still be required to move compost after it has completed its biocycle through the machine, and there will still be space requirements for the finished compost.

Background of KU Composting

Past Capstone Projects

The benefits of food waste compost, as a nutrient rich soil additive, dates back to the history of early agriculture (Cornell 1996). However, with the mass migration of people from the countryside to urban and suburban areas, it has become commonplace for food waste to be added to the general waste stream. An increasing awareness of the importance of waste stream management has influenced students, such as current and past Capstone groups, to make changes on KU campus. In 2010 and 2012 Environmental Studies students, as part of their Capstone Sustainability Projects, performed waste audits of Wescoe Hall. The 2012 Wescoe Waste Audit & Recycling Attitudes used auditing procedures established in the "2010 Waste Audit of Wescoe, Strong and the Spencer Art Museum". This audit sought to establish a "unified sampling procedure" for future KU audits to enable comparisons"(Burghart 2012). Their report quantified the the amount of recyclable materials by sorting and weighing the waste that had been collected in the trash bins, rather than recycling bins located nearby. According to the 2012 audit, 14% of the waste retrieved from Wescoe was food/compostable (Burghart 2012). Although neither the amounts of recyclable materials, nor of compostable materials for 2010 were included in the report, the report did suggest that the total amount of recycled materials in waste baskets in Wescoe had decreased 246% from 2010. In 2012, the recyclable materials made up 22%, of which 14% were compostable. Although the compostable materials should be utilized for compost on campus, the current solution for the removal of food waste compost is that Memorial Unions and KU Athletics pay Missouri Organics to pick it up and haul it off.

Current Practice of Composting at KU

Composting at the University of Kansas is slowly evolving; right now KU Dining Services has a contract agreement with Missouri Organics, it is three years long; having a one-year renewal. Right now we are in the third year with the renewal agreement coming forth. The University of Kansas as a large entity is connected to many other parties to help run it smoothly. KU Dining Services operates within the Kansas Memorial Unions which is an affiliate of the University of Kansas, so this separation between KU Dining Services and the rest of KU was puzzling to find out.

According to Sheryl Kidwell, L.D. Assistant Director for KU Dining Services, KU Dining services, “has been proactive not reactive, KU Dining feels that our services have been very successful with composting. Examples are: going trayless which has reduced the post consumer by-product” (Kidwell, 2014). KU has a very limited ability to recycle their own compost so the food waste is shipped off by Missouri Organics to their facilities located in Kansas City, Missouri (Reference: Case Study/Relevant Work). Throughout the course of 3-4 years, KU has added four other dining halls to the list for food waste pickup: Oliver Dining, The North College Cafe, The Studio, and Mrs. E’s. From Mrs. E’s alone, there is approximately 1800-2000 pounds of compostable material picked up each week by Missouri Organics. These dining halls are all major contributors to the overall ‘tonnage’ of approximately 1,000,000 pounds processed by Missouri Organics each year from KU Dining Services. (Kidwell, 2014).

The contract that KU Dining Services has with Missouri Organics provides many great services; consistent pickups of compost material from multiple locations, big trash bins used to separate the different compostable material, and great customer service. One of the high dollar items bought for composting are the biodegradable bags. Missouri Organics was willing to provide these bags but the expense was far too exceeding for KU Memorial Unions to agree upon

so the bags were purchased through a different company with cheaper prices. The next most expensive cost for KU is paying for the transportation of the compost that Missouri Organic's picks up by truck two-three times per week. Missouri Organic's is also providing recycling services to other businesses located in Lawrence; Whole Foods, Chipotle Mexican Grill, and Dillon's Grocery Store. Making for a round trip distance of approximately 85-100 miles; three times per week. (Missouri Organics, 2014)

One current composting pile is located at the ECM (Ecumenical Christian Ministries Center), this is the only current composting pile at The University of Kansas. The residencies of the ECM supposedly turn (mix) the composting pile, but from the looks of the current pile and outside source information the pile is rarely to never mixed leaving it value diminished.



It is a very small pile located in the south end corner of the ECM parking lot. It has a wooden framed structure lacking in overall design and is ultimately defective in the proficiency needed to operate a large composting operation. Within this pile, it has a combination of cardboard, leaves, food waste, and garbage. It is a system that is only used for smaller scale composting; it sits in a small location with minimal exposure to the public's eye. KU Dining Services is well aware of the fact that the current composting pile is located in the southwest corner of the ECM parking lot. The response given by Sheryl Kidwell was straight forward saying

there needs to be something done about this in the near future to help improve campus sustainability with compostable materials.

The University of Kansas and KU Memorial Unions will have to combine their expertise to transform/expand the composting program at KU, the current ECM site is less than efficient for composting but it is a baby step to the overall projection that is expected in the coming years for a sustainable KU Composting Program.

One current composting pile is located at the ECM (Ecumenical Christian Ministries Center). It is a very small pile located in the south end corner of the lot. It is rarely 'turned' and is ultimately not sufficient with the future demand of compost at the University of Kansas. There are steps that the University is taking in regards of the waste being produced across the campus, "KU Recycling, KU Athletics, and Missouri Organics recently formed a partnership to increase recycling and composting at all athletics events in the 2013-2014 academic year. This effort will include a complete marketing campaign devoted to educating fans on how to recycle and provide many outreach opportunities to CFS, KU Recycling, and KU Athletics" (Kansas 2014).

Objectives and Goals

Our goal with the KU Composting Sustainability Project is to implement a two phase on-campus program. Our first phase will last two years and the objective is to get an in-vessel composter and relieve Missouri Organics of four dining halls they currently pick up for. The second phase of our plan will be after the initial two years and will expand our composting by slowly incorporating new dining halls at a time. We designed our program by reviewing comparable university composting programs with similar campus sizes and student numbers to that at KU. We also collected data on the current composting practices at KU and decided how they could be expanded and improved. Our next step was to research the necessities on how to

implement a program here at the University of Kansas. Our objective in this paper is to provide the University of Kansas with recommendations on how to implement our suggested two-phase program based off the research we collected.

The Composting at KU Program would be a large step forward for the KU Sustainability Program. All around the nation universities are taking steps to become more sustainable, which is becoming a valuable selling point for prospective students. If the University made such a large sustainability implementation, it would be news likely to be reported on the university website, where all future students could easily see and read about. This composting program will make the University of Kansas a more environmentally-friendly school, attracting environmental interested students from all around the country. Not only will a university in-vessel composter attract students, but in the long run it will save the University the trouble of outsourcing our composting to Missouri Organics. This will also create a source of revenue for KU by selling the compost in the city of Lawrence. The University can benefit in many ways by updating our compost program, attracting new students and monetary profiting through an on campus program.

Comparable Composting Programs and Studies

There are a multitude of other universities that have implemented projects similar to the one our group is proposing. The University of Oregon, the University of Colorado, Boulder and the University of Massachusetts at Amherst are all comparable in size and population to KU, and have made significant advancements in the area of sustainably managing their food waste. Each one has used different measures to resolve the challenges faced when attempting to compost food waste on site.

University of Colorado at Boulder

The University of Colorado in Boulder boasts about their strong commitment to sustainability. The university proudly states that they were the first campus to acquire the "Gold" ranking through the Sustainability Tracking Assessment and Rating System (STARS) (University of Colorado 2014) . The campus originally founded its' recycling program in 1976 to recover resources from the waste stream. Over the past 37 years, the program has continued to gain momentum and currently has a waste diversion rate of 43.7% (University of Colorado 2014). In order to meet its stringent goals of becoming a zero waste campus by 2025 the university has begun implementing the Zero Waste transition partnering with third party consultants to help prioritize its goals, expand on their current composting practices to include compost bins across campus, and rebuild the current recycling facility to handle current and future recycling needs.

In addition to food waste, the bathrooms on campus compost their toilet paper and paper towels, and the university has implemented compostable eating utensils within the dining facilities located on campus, which helps the school remove 418 tons of their compostable items from the waste stream (University of Colorado 2014). However, the school does not actually compost its own waste. Similar to the contract between Memorial Dining and KU Dining services with Missouri Organic, the University of Colorado also pays a third party contractor to haul its compostable waste off campus where it is composted. This university was used as an example of an institution that faces a similar challenge to the one faced at the University of Kansas, but has implemented the use of compostable eating utensils, cups and plates.

University of Oregon

The University of Oregon has taken this process one step further. The University of Oregon recycling program dates back to 1991 and has evolved to include composting in dining

and residence halls (Kaplan 2013). In 2012 the university took an aggressive leap to strive for excellence with the implementation of the Zero Waste Program. This program uses the concept that "Nature has no waste. Waste from one process is food for another" (Zero-Waste Programs 2014). This concept helped the students and faculty implement the use of compostable eating utensils (cups, plates, chopsticks and food waste) within its food services facilities in order to reduce the amount of disposable "one use" items on campus. The University of Oregon also hosts "zero waste events" which provide compostable eating utensils and bins for events held on campus. Five days a week, and following events, pre and post consumer food waste is collected in 35 gallon roll carts and lifted into a van via hoist. The vans dump their waste into a 20 yard dumpster located on the Facilities and Operations (F&O) grounds, waiting to be composted. The university utilizes an Earth Tub composter for on-site composting, but the majority of its compostable waste is hauled off campus by a local commercial composter, Rexius Forest By-Products (Kaplan 2013). Although the implementation of Zero Waste Program has diverted approximately 743 tons of materials from the waste stream and the institution continues to strive for more sustainable practices, the university faces the challenge of managing all its food waste compost on-site (Kaplan 2013).

University of Massachusetts at Amherst

The University of Massachusetts at Amherst also holds a "Gold" ranking in the STARS Program from the Association for the Advancement of Sustainability in Higher Education (AASHE) (Composting UMass 2014). In 1996, UMass's Office of Waste Management joined forces with the Dining services to pilot a three year food waste and yard trimmings composting program. This was funded by a grant from the Massachusetts Department of Environmental Protection. It is important to remember the ratio used in the program was 1:1 (yard trimmings to

food waste). The compost was collected and turned in a Wright Environmental Management in-vessel unit that has the capacity to handle 1500 lbs daily on a 28 day cycle. The university actually runs there compost on an 18-day cycle and then turn the compost in windrows every ten days or so. According to campus officials the composting program has saved over \$15,500 in landfill fees. “Another benefit of composting, which is harder to quantify, is the impact it has on the university's sewer systems and the town's wastewater treatment facilities” (Chaves 1998).

Case Study - Life Cycle Assessment of a Food Waste Composting

In any proposal or presentation, questions will arise over the environmental impacts of implementation, positive and negative. This article aims to discuss the potential global warming effects of food decomposition. According to the article, food waste represents the second largest component of municipal solid waste in the United States. Composting is the process of organic materials decomposed by microorganisms under low moisture, aerobic conditions, resulting in a nutrient rich product that can be used as a replacement for peat, fertilizers and manure in agricultural and horticultural activities. Although composting has positive effects such as reducing fertilizers, increasing carbon capacity in the soil, and improving soil structure it also has negative effects. These include methane (CH_4), nitrous oxide (N_2O), and ammonia (NH_3) emissions from methanogenic and denitrification processes when anaerobic conditions are present during the composting process, resulting in odor and additional greenhouse gas emissions ([Amlinger et al., 2008](#); [Boldrin et al., 2009](#); [Edwards and Williams, 2011](#)). The purpose of this journal was to evaluate the environmental impacts of the food waste composting life cycle using a LCA (Life Cycle Assessment) approach to evaluate all the stages of the food waste composting process, including waste transport, compost production, and its use as a soil conditioner. They found that the benefits of composting far outweigh the costs.

Implementation at KU

In order to implement an on-campus composting program for the University of Kansas, four things need to be established: equipment, personnel, locations, and funding. These are key to establishing the framework of the program. Each section will highlight the requirements needed to install the program and also calculating future costs and benefits.

Required Equipment

Based on the current volume of food waste on campus, and the lack of space for a windrow system, an in-vessel composting system represents the best choice for a composting solution on campus. In order for the University of Kansas to begin on-site composting, multiple pieces of equipment will also need to be purchased. These include but are not limited to.

Front-end Loader/Tractor

Completed compost will have to be moved from the in-vessel composter to a suitable staging/holding area. This will require the use of a front-end loader by a trained equipment operator. According to the Facilities and Operations Department, this piece of equipment will not need to be purchased as the campus already owns three front end loaders (Lang 2014).

Waste Bins and Bags

96 gallon bins will need to be distributed to the buildings on campus that will participate in the composting program in order to provide an appropriate receptacle for food waste. These cost roughly \$150 each, and we will require eight to start the program (US Plastics 2014). The current buildings that participate in composting are Oliver, North College Cafe, Studio, and Ms. Eee's. Currently these bins are rented from Missouri Organics. The purchase of 96 gallon biobags will also be required. These are biodegradable bags that will be required in order to achieve a

clean as well as efficient pickup and removal. Currently the Unions purchase their own bags from BioTurf at a discounted rate at around \$1.50 per bag (Kidwell 2014).

Industrial In-vessel Composter

Outright this is the largest and most important upfront cost to establish this program. Industrial in-vessel composters represent the most cost-effective and space saving solution for the University because of our space and volume requirements. These systems have become extremely high-tech, with the ability to remotely control temperature and airflow to achieve the highest efficiency. Because of the amount of waste generated by this University, roughly one million pounds per year, it will be vital to purchase a system that can handle our current capacity with the ability to be expanded in the future. There are numerous different systems on the market, each with their own benefits and disadvantages. Deciding on such equipment should be based on a cost to capacity ratio. Each of these systems below meet those criteria.

Industrial In-Vessel Composting Systems

In Vessel Unit	Cost	Labor	Capacity	Cost to Capacity Ratio (Cost/Pound)	Energy Usage
Eco Value	\$80,000-\$100,000	Continuous flow, 1-2 week retention time, requires additional curing.	8,400 lbs FS per week.	\$11.90 per pound.	2 2hp Electric Motors
Hot Rot	\$175,000-\$200,000	Continuous flow, 14 day retention time, requires additional curing/compos	35,000 lbs FS/BM per week.	\$5.70 per pound	60-70 kWh per day

		ting.			
Big Hanna	\$48,000	Continuous aeration with auger, 6-8 week retention time. Requires additional curing.	1,100 lbs FS per week.	\$43.63 per pound	2.35 kWh per day
Rocket	\$89,000	Data not yet available.	7,400 gallons FS per week.	\$12.02 per pound	No Data

*FS represents food scraps, while *BM represents bulking material. *KU's food scrap data is based on a nominal value of 8 lbs per gallon. Hence, these values are currently estimates as different food contains different densities, so each gallon could weigh more or less. Also, the average FS per week from KU is calculated from the total per year divided by 52 weeks.

Personnel

The University of Kansas will need to acquire personnel for the management and maintenance of the composting on-campus plan. For the interests of the University, we advise the University of Kansas to hire the following: two KU Dining employees, two KU Recycling employees and one full-time equipment operator employee. We also advise the University to not hire new employees but instead train four already employed workers. Each division will have a designated job in order to make composting on-campus more effective.

To effectively compost, wastes must be separated from compostable and non-compostable as well as green wastes and brown wastes. KU Dining, a branch of Memorial Unions which manages all the different dining establishments on campus, will be tasked with separating waste and leaving the waste in designated pick up spots. Their training would be in the proper way to separate the compostable waste, designating this waste into green waste and brown waste.

Employees will be required to set compost bins in areas for pickup. Specific locations for pickup will be addressed later within the proposal. The bins will need to be in easy access areas and left out at the designated date and time. We aim to make this a adaptable program so we will make pickup dates the same as Missouri Organics which are three times a week.

KU Recycling employees will be tasked with picking up the compost from the different locations and transferring them over to our designated composting spot that will be expanded upon later on. The University should designate compost bins in areas where KU Recycle also picks up the recycling. Making it easier for KU Recycling employees to adjust to the new pickups without having to memorize a new route. The University will forgo new trucks and instead use the KU Recycling front loaders. The front loaders have the capacity to pick up the composting KU Recycling employees will also be required to place the composting into the composting system and doing other procedures required.

The University of Kansas will need to hire a full-time equipment operator. The machine is not sustainable by itself and will require consistent check ups and repairs. They would be paid through Facilities and Operations with a rough estimate of \$33,000 annually (Lang, 2014). The equipment operator will need prior training and a certificate to be eligible for the position. The certification guarantees more effective maintenance. “Either through apprenticeship or private trade schools can a certificate be accessed” (Bureau, 2014).

Our goal is to train already employed workers and add on more tasks to their job. With this new implementation of tasks, wages will increase to match the amount of work employees will input (Lang, 2014). Instead of hiring a full-time equipment operator, it would be more cost-effective to expand the duties of previously trained employees. We recommend raising wages to \$5,000 a year with the new duties (Lang, 2014).

A Potential Location for the Composting Operation

To ensure a successful transition to an on-campus composting system at the University of Kansas, it is vital to pick an efficient and sustainable location. An ideal location for the composting operation would be next to or behind KU's recycling facilities on Westbrooke St. off of Bob Billings Parkway. This location is 1.2 miles away from campus. An aerial view of this location is below.



The proposed location proves efficient as it aims to achieve minimum wastes effort and maximum productivity. Minimum waste efforts are achieved as this area already experiences traffic from both KU recycling and Facilities and Operations. It is important that the location be accessible to KU recycling and Facility and Operations employees as we propose they play a role in collection of wastes. KU recycling employees will collect the food waste for the compost

operation; Facilities and Operations will collect the yard waste for compost operation. Both groups will minimize waste efforts as they can integrate pickups of wastes into their already established routes. Waste efforts are also minimized as KU recycling cannot currently recycle cardboard compromised from pizza grease. Many consumers on KU's campus are unaware that grease stained boxes cannot be re-sold or re-used by KU's recycling facility and continue to place them into recycling bins. KU recycling collects these and immediately discards them to the landfill. The composting operation will take advantage of this cardboard using it as "brown matter" in composting process. It is necessary for "brown matter" to be added to the "green matter" food waste to ensure optimum composting. Chipboard or wood scraps from the design school and construction projects could also be used in the composting process. Placing the composting operation near the recycling facility also reduces the efforts needed to transfer to brown matter any significant distance after it has already been collected on campus.

The location is sustainable as it allows growth for future expansions as the composting operation grows to address additional buildings on campus. The space needs to support the full capacity potential of the University's compost waste (Severin, 2014). This area allows for that growth as there are a lot of unused land in the area. The location will need to be either a permit or to register as Kansas requires composting facilities to depending on the size of their facility. "K.S.A. 65-3402(y) defines a composting facility as being larger than 1/2 acre in size. Sites under 1/2 acre in composting area is required to register and sites that are 1/2 acre and over in composting area must obtain a permit (Kansas Department of Health and Environment, 2014)." Keeping these variables in mind, we suggest to apply for a permit since the beginning stage will only require 1/2 acre in size, but we suggest to set aside a whole acre for expansion even though it may not be utilized for some time.

Funding the Program

Funding complicates an issue for campus projects in general, but when sustainability is an over-arching goal it can quickly increase the initial costs. Sustainable projects typically require a high initial investment because they are a new or innovation technology which allow for a return or savings. As our research shows, on-campus composting is not a new idea at universities, although funding sources vary for each institution and how they were able to afford the initial and ongoing costs for an on-campus composting program. For example, the University of Boulder received a \$55,000 grant from the EPA and \$32,000 from University of Colorado Student Union which is their student government. The remaining costs were covered by a fee that is applied to every student which enables sustainable projects to receive funding. Many universities have a sustainability fee, including the University of Kansas, although they vary dramatically.

A major concern of implementing a composting program on the University of Kansas's campus is deciphering how to allocate the funds that are needed to begin the program through purchasing an industrial composter and also maintain the annual operating costs such as labor, truck repair and gas. The University of Kansas has a sustainability fund that is currently allocated through a fee that every student attending the university has to pay. This fund is directed towards the Center for Sustainability (CFS) and in the past they have been allocated throughout student groups and campus projects to help improve campus. The fund is primarily managed by Student Senate and then mitigated by the Student Environmental Advisory Board (SEAB). Typically the SEAB decides how to allocate the fund throughout different campus organizations as well as the Center for Sustainability who tries to use this fund as a way of beginning new projects, investing into efficient technologies, or continuing on-going projects that require some extra capital in order to get off of the ground.

This fund is created by a \$1 fee is acquired from every student that enrolls in KU classes which equivocates to roughly \$40,000 a year, but in 2015 that fee will increase to \$1.50 thus producing approximately \$60,000. This fund is quite small compared to other universities and was even on the verge of being eliminated this year. According to the SEAB, the Student Senate felt as though the sustainability fund was not being utilized in the proper manner. According to Jeff Severin, the Director of the Center for Sustainability, sole reason Student Senate decided to keep and even increase the fee by 50 cents came from a demand for an on-campus composting program to be in operation by 2015. The issue with this request revolves around funding the program since it will be so expensive for the initial costs and even the recurring costs of labor and maintenance. Jeff Severin estimates that it would take at least \$100,000 or more to begin the process, so they are going to use \$20,000 of the 2014 sustainability fee to roll-over to the following year (Severin, 2014).

Another potential source of funding is through the Green Revolving Fund which was created for, “Capital improvements that reduce campus dependency on non-renewable energy sources and encourage sustainability” (Kansas 2014). This is a \$40,000 fund that was initiated by allocations from Student Senate (\$10,000), Student Success (\$10,000), and the Provost Office (\$20,000). They created a Revolving Green Fund Committee that that is made up of seven board members whom decide which project is eligible to receive the fund. The issue with applying for this source of funding is that it requires the fund to be paid back and since there is not direct return from the composting program, they would have to find another way to repay the loan.

In order to maintain a program that is capable of handling the amount of food waste that the University of Kansas is creating, there will need to be funding from other campus sources or implement more fees to supplement the required funding. In order to prevent the additional fees,

the Dining Services and KU Athletics are going to need to pay KU Recycling to pick up their compostable goods rather than paying Missouri Organics. Additional sources of revenue could come in the form of annual compost sales, as well as possible Federal or State grants.

Discussion and Analysis

Cost/Benefit Analysis

Implementing such a program on campus will be expensive. It will require an initial investment into an industrial in-vessel composter, the purchase 96 gallon containers, biobags, and either new personnel or expand the duties of current personnel. The tables below show a ten year cost to benefit analysis for implementation of an on-campus composting program at KU. Based on the capacity to cost ratio, we would recommend the EcoValue In-Vessel Composter which costs roughly \$100,000 (Wojtowicz 2014). 96 gallon biobags will cost roughly \$1.50 each and we use roughly 1,300, creating a total \$2,000. (Kidwell 2014). The 96 gallon containers will cost roughly \$150 each and we will require eight of them totaling \$1,200 (US Plastics 2014). Labor will require the expansion of a current employee's job description at a raise of \$5,000 per year. Determining maintenance costs involves numerous externalities, and according to the producers of the EcoValue in-vessel composter, costs hover around \$1000 per year (Wojtowicz 2014). We chose to increase these values on a yearly basis to allow for a "cushion" of sorts.

Cost Analysis

Costs (\$)	Year 1	Year 2	Year 3	Year 4	Year 5
Equipment	103,200	2,000	2,000	2,000	2,000
Labor	5,000	5,000	5,000	5,000	5,000
Maintainence	0	1,000	1,500	2,000	2,500
Total:	108,200	8,000	8,500	9,000	9,500

Costs (\$)	Year 6	Year 7	Year 8	Year 9	Year 10
Equipment	2,000	2,000	2,000	2,000	2,000
Labor	5,000	5,000	5,000	5,000	5,000
Maintainence	3,000	3,500	4,000	4,500	5,000
Total:	10,000	10,500	11,000	11,500	12,000

Benefits of this program are expansive. “Currently the Memorial Union and KU Athletics spend on average \$2,000 a month on composting through Missouri Organic” (Severin 2014). By switching to an on-campus composting program we can expect to see savings of around \$14,000 per year. This analysis accounts for a two-year contract period with inflation rates for gasoline. In addition, the landscaping department, which uses roughly one ton of fertilizer on a yearly basis, could on average see a savings of roughly \$320 per year by using the compost as fertilizer (Barbarick 2014) (Lang 2014). The savings continue with the possible donation and sale of our completed compost. On average, we produce roughly one million pounds of food waste per year. This could translate into nearly 500 cubic yards of compost. The City of Lawrence currently sells their compost for \$10 a cubic yard, which if we sold and or donated the compost, could net roughly \$5,000 a year. In addition, as more buildings start to compost, we can start to produce and sell more compost. We recommend donating half of the compost to local farms and selling the rest to members of the community. The analysis accounts for an increase in the volume of compost over ten years.

Benefit Analysis

Benefits (\$)	Year 1	Year 2	Year 3	Year 4	Year 5
Savings from Missouri Organic	14,000	14,000	14,500	14,500	15,000
Charitable Donations	2,500	2,750	3,000	3,250	3,500
Compost Sales	2,500	2,750	3,000	3,250	3,500
Landscaping Savings	320	320	320	320	320
Total:	19,320	19,820	20,820	21,320	22,320

Benefits (\$)	Year 6	Year 7	Year 8	Year 9	Year 10
Savings from Missouri Organic	15,000	15,500	15,500	16,000	16,000
Charitable Donations	3,750	4,000	4,250	4,500	4,750
Compost Sales	3,750	4,000	4,250	4,500	4,750
Landscaping Savings	320	320	320	320	320
Total:	22,820	23,820	24,320	25,320	25,820

Total Costs vs. Benefits

(\$)	Over a 10 Year Period
Total Costs	198,200
Total Benefits	225,700
10 Year Total Savings	27,500

Recommendations

Our recommendation for the University of Kansas is to implement a two-phase composting program. Based on the waste information supplied Sheryl Kidwell and Jeff Severin, we believe that an in-vessel composter, produced by EcoValue, is the best choice in accordance to the amount of compostable waste produced on campus. We suggest the composter be established at the KU Recycling facility located on Bob Billings Parkway. The Bob Billings location is ideal because if KU Recycling picks up the compostable waste from on-campus, it will be cost-efficient to have all the waste going to one place. The first phase of this program will be to take over the current composting obligations from Missouri Organic. This will involve using four buildings: Oliver, North College Cafe, Ms. Ee's, and the Studio. In order to ensure that the program runs smoothly at the beginning without overworking our composter or staff, we will only focus on the four buildings for the first two years. After which, Phase 2 will begin with the addition of a few new locations that will contribute to the composting program.

Because the staff at the dining halls already compost, employees will only have to continue the routine processes. But we suggest expanding the responsibilities of a current facilities employee for equipment maintenance and operations at a salary increase of \$5,000 per year. Along with this, KU recycling and hourly paid students will be in charge of picking up the waste from the dining halls and transporting it to the in-vessel composter location. It is our hope that students from different environmental departments, such as the Soil Geography or Field Ecology courses, will be interested in having projects that aid in maintaining the compost pile every year as well.

While the initial investment will be large for the university, over the course of ten years we can expect to see a savings of nearly \$27,500. These are estimated values and we have

analyzed that the amounts could change based on numerous externalities. These include but are not limited to: student population, inflation, addition of more food waste, maintenance and labor costs. By implementing this program, the University of Kansas will ensure a sustainable future and becoming an example for other schools who want to implement on-campus composting for the future.

Conclusion

Currently the University of Kansas is not implementing a composting program on-campus. We outsource our food waste to Missouri Organic at a cost of \$2000 per month (Kidwell). But it is our belief that the University would benefit from this sustainable program. Not only does this program promote eco-friendly practices by analyzing the effect composting has on the environment, it also promotes economic stability on campus. KU will need to evaluate the required equipment, personnel, location and funding recommended by our group in order to fully implement this program and achieve savings in the future. By following our two-phase program, the University will take a step toward a sustainable future; becoming an example for other demographically similar universities and the surrounding community. Looking towards the future, it would be in the University's favor to continue adding on to the program and increasing sustainability on-campus.

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