

NRES Capstone Course

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Kansas State University

Sustainability

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Introduction to Environmental Sustainability

Environmental sustainability is based on making responsible decisions that preserve the viability and functionality of ecological services vital for human survival, and that support human well-being in the present and future. Throughout this report we will explore Kansas State University's sustainability efforts in the areas of retrofitting, internal water resources, external water resources/grounds management, waste management and recycling, and food resources and food waste management. We will also explore what other universities around the United States in their efforts to become more sustainable, as well as which practices they are currently doing that we should try to implement at Kansas State University. The schools we have selected for comparisons are:

- Arizona State University- Tempe, Arizona
- New Mexico State University- Las Cruces, New Mexico
- Guilford College- Greensboro, North Carolina
- Stanford University- Stanford, California
- Colorado State University- Fort Collins, Colorado

We have found that these 5 colleges and universities have stand out programs in one or more of the areas of sustainability that we have selected to study at Kansas State University. Last we will make recommendations to Kansas State University on how they can improve their sustainable practices, as well as what changes we recommend the university makes to the 2025 Sustainability Action Plan.

Retrofitting

The definition of retrofit is to provide (something) with new parts that were not available when it was originally built. When retrofitting an existing building it is often done to make the building more energy efficient and sustainable. Kansas State University is moving towards a more sustainable future. The University has implemented a sustainable strategic action plan that will help our campus achieve this level of sustainability. I have discovered many ways to retrofit existing buildings, what Kansas State University is currently doing to become more sustainable, what other universities have implemented to be sustainable, and I have compiled a list of things that Kansas State University can adapt from the other universities to help be more sustainable.

Ways to Retrofit

A good first step in a retrofit project would be to do an energy audit which can help identify air leaks in the buildings. Gaps could be in walls, roofs, foundations, windows, doors, and even in the attic floor. Energy audits also evaluate the current energy use of the buildings. It helps by figuring out what appliances and fixtures need updating and also if insulation needs added. Professional auditors tend to use thermography which will show infiltrations and lack of insulation through an infrared camera. Reducing air leakage is a high priority when retrofitting. According to the NPS, leakage of air into a building can account for 5 to 40% of space condition costs. Doing the energy audit will help discover where air can enter and leave from. Windows need to be updated, according to the EPA up to 15% of a building's energy is lost through the windows. Storm windows can be added to older buildings to help with insulation and air leaks. Storm windows do not compromise the historic look of older windows. Along with windows general fixtures and appliances need upgraded too. By updating the lighting to compact florescent bulbs, energy usage can be improved by 35%

What is Kansas State University currently doing?

Kansas State University has a 2025 sustainable strategic action plan. The plan calls for designing new buildings with strong energy performance, water management and other environmental attributes. Also retrofit, renovate, or otherwise improve existing buildings to raise levels of energy and environmental performance relative to university climate mitigation commitment and goals for campus-wide energy intensity. If new buildings and old buildings are built and retrofitted correctly they might even become LEED certified. By 2016 to 2020 the university should have “Improved building sustainability performance due to retrofits, with increased workplace satisfaction and more engaging learning environments due to improved sustainability performance”. The plan also states that by 2020 the entire main campus will have an energy management system in place. In order to help reduce carbon emissions K-State will have a climate action plan to reduce carbon intensity and total carbon emissions from university activities by 80% by 2050.

What are Other Universities doing?

Guilford College

Guilford College has completely retrofitted most bathrooms on campus with water efficient fixtures. XCELERATOR Hand Dryers are a paper free way to dry hands and they use 80% less energy than conventional hand dryers. By upgrading all their toilets on campus to dual-flush toilets they are saving about 18,000 gallons of water per toilet per year. Water-free urinals has saved over 40,000 gallons of fresh water. Sink aerators have also been installed on all sink faucets on Guilford’s campus. It helps save 18,000 gallons of fresh water per sink per year by having a low flow of .5 gallons per minute. Guilford has also installed ultra-low flow shower heads in all facilities across campus. The new shower heads have a flow of about 1.5 gallons per

minute. Their usage went from 40 gallons of water used during a 5 minute shower to 7.5 gallons used during a 5 minute shower. These are easy upgrade that K-State can adapt to help with water usage across campus.

New Mexico State University

New Mexico State University has implemented a plan to achieve a LEED certification on all buildings on campus. By being LEED certified it means the building has reached certain levels of sustainability with LEED PLATINUM being the highest level you can achieve. New Mexico State has achieved 8 gold and 5 silver certified buildings. Like Guilford, they have installed low-flow sink, toilets, and shower heads in all new buildings and updated buildings on campus. To achieve the updates in existing buildings New Mexico State tries to use mostly renewable resources when possible. When switching to green materials New Mexico State University reduced overall costs in initial use and replacement costs throughout the lifetime of the buildings. Resources efficiency includes materials that are recycled, harvested from a managed renewable source, durable goods, and locally available resources within 250 miles.

What can Kansas State do to achieve a more sustainable campus?

With the sustainable action plan in place K-State is set up for a more sustainable and successful future. K-State's main focus currently is on building newer buildings in an eco-friendly and sustainable way along with building additions. Really attention needs to be turned towards older buildings and residence halls. Residence halls should be a high priority for KSU because it houses approximately 5,500 students. As a campus we really need to focus on reducing our water and energy usage. By following Guilford's sustainability steps we can dramatically reduce both usages. By putting in the dual-flush toilets, sink aerators, and the low-flow shower heads the dorms would save water and be more water conscious. Switching to

XCELERATOR hand dryers would eliminate paper usage and use 80% less energy than conventional hand dryers. Guilford also has on-campus apartments that are available to students that have an energy allowance. This allowance gives students a monthly usage limit which helps conserve energy. It also shows students how much energy they are using through mini-fridges, TVs, and by just leaving the lights on. K-State should consider using a section of Jardine to test out an energy allowance system to educate students and as a learning experience to see if we can move to an energy allowance in all residence halls on campus. K-State should also consider adopting a thermal energy system. Guilford's thermal energy system uses over 200 solar panels on rooftops across campus. These panels help produce over 9000 gallons of hot water for many buildings across campus including the dorms. This reduces their dependence on natural gas significantly. Kansas State should adapt New Mexico State's green materials selection. Using local materials within 250 miles will help local economy. New Mexico State like Guilford, has also implemented a low-flow sink, toilet and shower head system that Kansas State University should change to. Kansas State University needs to be updating all buildings on campus to maximize sustainability.

Internal Water Resources

In today's society our life revolves around water resources, in fact there are very few things that we can do in today's world that do not use water. It is easy to pick out the obvious things that we do every day such as drinking a glass of water, bathing or flushing a toilet. However, we also use water indirectly through heating and cooling systems as well as items we use as consumers on a day to day basis. We live in a society where our access to water has never been a concern to any of us that live in the first world, all we have to do is walk to the faucet and turn the handle. Never does it cross our mind that we should be working to conserve the amount

of water we use, or even what the impacts may be if we use too much of this life sustaining resource. We are starting to see the effects of not conserving water in the United States today. Take the state of California for example, they are currently in a severe drought due to lack of rainfall and snowfall. This drought has given the citizens of California a great chance to reflect on how much water they actually need in a day versus how much they are accustomed to using.

What is Kansas State University Currently Doing?

Currently Kansas State University is in the very early stages of working to create more sustainable water use throughout campus. A major project is currently underway on campus upgrading our steam heat and cooling system to make it more operationally efficient. This system is responsible for providing both heat and cooling in all of the buildings across campus, without having to be dependent on electricity to heat and cool every building. Problems the university is currently addressing in this system is the old and leaking pipes buried around campus running to all of the buildings (Kansas State University, 2015). By performing these upgrades on the system we can ensure optimum water conservation within the system where we will be able to continue to cycle the same water through the system of pipes over and over, instead of constantly having to replenish the supply like we are currently. These upgrades should not only help save money in water utilities, but also electric utilities as the system will be less vulnerable to breaks and service interruptions.

However, we are still not actively exploring our largest source of water consumption on the university. The bulk of the water that we use every day is actually in the bathroom, between taking a shower, flushing a toilet and washing your hands you end up using hundreds of gallons of water daily. K-State has it planned to install the most sustainable options available with all new construction as well as renovation projects going on around the university. However

we have no plans at this time to retrofit any buildings that are not on that list, losing hundreds of dollars a year to something that would be an easy fix. Other than the plans for new construction and the upgrades to the steam line system and a vague mention of finding a use for the grey water produced in campus buildings, Kansas State University's 2025 Sustainability Plan does not really address internal water usage around campus.

What are other Universities doing?

Guilford College

Guilford has worked hard to establish a solid foundation in managing their internal water resources on their campus. The major area of internal water sustainability for Guilford has been to retrofit restroom facilities around campus to help reduce the amount of water used by occupants. Guilford has been able to effectively implement these sustainable practices by just making upgrades to fixtures in these facilities. They worked to change all of the toilets on campus to a dual flush model, by installing these toilets around campus they are saving on average 18,000 gallons of water per year per toilet. On top of the toilet upgrades, Guilford also replaced all of the urinals in the men's restrooms with a waterless urinal that will not only save 40,000 gallons of water each year per urinal, it also serves as a remind to conserve water throughout the day. The college also worked to switch their low flow showerheads to an ultra low flow model which only uses 1.5 gallons of water per minute without jeopardizing water pressure. The installation on these shower heads knocks the total amount of water used per the average 5 minute shower down to 7.5 gallons from 40. The last part of the restroom upgrades Guilford performed was simply replacing the aerators on all of the sinks to a .5 gallon per minute model, which has saved another 18,000 gallons of fresh water per sink, per year (Guilford 2015).

Arizona State University

Arizona State University has helped pave the way in terms of university sustainability programs by being the first sustainable university. Arizona State much like Guilford saw that the greatest place to reduce the amount of water being used on campus is in restroom facilities across campus. This prompted Arizona State to replace all of their old, conventional fixtures with up to date low flow fixtures, by doing this Arizona State has saved about 30% of the water used by the conventional fixtures (Arizona State University 2015). The university is now starting to make the transition to waterless urinals in the restroom facilities, to help save additional water consumption campus wide.

New Mexico State University

At New Mexico State University, their facilities team has also taken the easy steps to conserve internal water resources by the installation of low flow fixtures across the campus. It is now standard that any new construction on campus be fitted with the most up to date sustainable fixture technology to conserve the most water resources possible. In addition to the low flow fixtures, New Mexico State also uses a water powered heating and cooling system for campus buildings (New Mexico State University 2015). The university has worked to insulate and repair these pipes to ensure the most efficient use of water resources as possible while providing proper comfort to facility occupants.

What should Kansas State University do to Reduce Water Consumption Indoors?

Kansas State University should work to start installing the most up to date low flow technology in all new construction on campus. This technology would include dual flush toilets, waterless urinals, ultra-low flow shower heads and .5 gallon per minute aerators on all sink faucets. While working to make sure that all new construction is up to date with low flow

technology, the university should work to start retrofitting facilities across campus with the same technology that is being installed in the new construction projects. With these improvements alone the university should be able to reduce the amount of water that it is using by 30%, and also save around 30% of the money we currently spend on our water bills every year.

	MAIN				ESARP				VETMED			
	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual
Jul-12	48,000	64,920	\$73,265	\$120,876	6,797	9,332	\$10,360	\$17,377	4,619	5,061	\$6,910	\$9,380
Aug-12	42,621	57,919	\$64,650	\$107,835	6,064	8,238	\$9,203	\$15,339	6,960	6,825	\$10,392	\$12,634
Sep-12	40,366	48,554	\$61,277	\$79,305	5,753	6,915	\$8,736	\$11,249	5,793	4,341	\$8,656	\$8,051
Oct-12	34,857	29,692	\$52,948	\$55,454	4,895	4,127	\$7,441	\$7,710	3,730	2,988	\$5,589	\$5,558
Nov-12	21,441	23,127	\$32,817	\$43,192	2,875	3,287	\$4,410	\$6,137	3,034	4,474	\$4,557	\$8,301
Dec-12	22,852	25,879	\$34,680	\$48,297	3,200	3,720	\$4,859	\$6,941	3,147	1,870	\$4,728	\$3,480
Jan-13	17,934	13,708	\$28,513	\$26,329	2,464	1,943	\$3,925	\$3,731	2,483	4,103	\$3,861	\$7,721
Feb-13	17,281	13,860	\$32,354	\$28,194	2,422	1,972	\$4,534	\$4,010	2,290	2,601	\$4,272	\$5,246
Mar-13	18,919	16,808	\$35,430	\$34,105	2,661	2,378	\$4,983	\$4,823	2,118	2,118	\$3,954	\$4,277
Apr-13	18,011	16,507	\$33,835	\$33,561	2,506	2,282	\$4,710	\$4,640	2,437	2,195	\$4,543	\$4,431
May-13	30,579	23,719	\$57,295	\$48,007	4,338	3,314	\$8,129	\$6,707	2,725	2,185	\$5,072	\$4,411
Jun-13	32,580	22,259	\$60,825	\$45,155	4,564	3,084	\$8,523	\$6,256	4,584	2,039	\$8,504	\$4,118
	345,441	356,952	\$567,890	\$670,310	48,539	50,592	\$79,812	\$94,920	43,920	40,800	\$71,037	\$77,608

	SALINA				LAFENE HEALTH CENTER				TOTAL			
	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual
	2,997	5,911	\$17,180	\$34,479	153	132	\$282	\$277	62,566	85,356	\$107,997	\$182,388
	3,173	3,908	\$18,095	\$22,817	183	223	\$325	\$443	59,001	77,113	\$102,665	\$159,069
	3,303	2,324	\$18,679	\$13,509	164	263	\$297	\$530	55,379	62,397	\$97,646	\$112,644
	773	1,897	\$4,480	\$10,903	114	13	\$211	\$27	44,369	38,717	\$70,670	\$79,652
	158	868	\$824	\$5,006	76	101	\$143	\$212	27,584	31,857	\$42,751	\$62,847
	151	369	\$747	\$2,044	77	60	\$144	\$128	29,427	31,898	\$45,157	\$60,890
	124	145	\$650	\$740	35	52	\$69	\$112	23,040	19,951	\$37,019	\$38,633
	161	172	\$859	\$855	52	48	\$107	\$107	22,206	18,653	\$42,125	\$38,412
	190	184	\$1,004	\$952	104	59	\$221	\$131	23,992	21,547	\$45,593	\$44,287
	170	342	\$980	\$2,042	129	48	\$155	\$109	23,253	21,374	\$44,224	\$44,783
	2,116	169	\$12,314	\$1,044	0	61	\$0	\$136	39,758	29,448	\$82,810	\$60,305
	2,747	311	\$16,114	\$1,990	0	59	\$0	\$131	44,475	27,752	\$93,966	\$57,650
	16,063	16,600	\$91,926	\$96,381	1,087	1,119	\$1,956	\$2,342	455,050	466,063	\$812,622	\$941,561

Table 1. Kansas State University Water Resource Utility Budget vs. Actuals. (Source: Kansas State University Facilities, 30 March 2014, page 19)

By using the numbers provided in the most recently published report by Kansas State University Division of Facilities (Table 1), we would save approximately \$282,400 per fiscal year on our water resource budget across all of the facilities managed by Kansas State University. With this 30% that can be saved on the water budget each year, Kansas State University could establish a fund to keep up to date on the latest sustainable technologies to meet our goal of being a model university in the area of sustainability.

Exterior Water Resources and Grounds Management

“Grounds and water management” is an all-encompassing title for the actions taking to increase the sustainability of the outdoor environment and outdoor water use. It ranges from methods involved in storm water management, such as rain gardens and storm water drains, to habitat restoration and native plant landscaping. A variety of these practices are being utilized by colleges attempting to increase their sustainability.

Kansas State University’s 2025 Sustainability plan shows where it stands currently in sustainability efforts, what its end goal is, and how it intends to achieve those goals (Kansas State University, 2015). For outdoor management, Kansas State University is adopting a policy of native plant landscaping. To meet this goal, they are educating employees to utilize this technique. In addition, they are attempting to educate the public to accept the importance and beauty of prairie landscaping. Additionally they intend to replace current lawns with productive community gardens. A partial implementation of this can be seen in the Jardine Apartments, where residents can obtain small lots of land to garden throughout the summer and fall. To encourage these plans, they intend to support research opportunities in sustainable landscape design for students. Kansas State University also has an Arboretum that is spread all around campus with the trees labeled and clearly marked. Some trees are over a hundred years old.

Kansas State University has also made plans to address storm water management. The university plans to install bio-retention cells in critical storm water flow points to decrease flow rates. Additionally they plan on using permeable concrete in sidewalks and parking lots, which will allow storm water to drain, rather than stagnate trapped on concrete. Designs to reduce

storm water runoff have also been included in new construction plans. Finally, Kansas State University plans on investing in modern irrigation technologies for more controlled management. Evidence for this can be seen in the Jardine Apartments grounds as well, as they have begun placing pipelines down for newer lawn irrigation systems.

Storm Water Management

Storm water management is one of the most important aspects of sustainability. Storm water washes away chemicals and fertilizers and flushes them into drains that can empty into water sources if not carefully treated. These chemicals pollute the water and damage the environment. In some cases, this can cause harmful algal blooms, which have numerous deleterious effects, such as producing toxins that can kill people or other organisms, or by causing dead zones where bacteria use up all of the oxygen in the water and nothing can live there any longer.

Guilford College has installed a rainwater capture system to run their toilet system. They capture water from only half of the roof of one of their halls, where it then flows underground to be filtered (Guilford College 2015). This grey water is then able to be used as toilet water. This not only utilizes water that would otherwise be wasted, but also reduces the use of city water, as well as reducing pollution by preventing storm water runoff. Additionally, Guilford College is able to use lake water to irrigate their land. This is beneficial as this water is not processed and reduces the use on city water resources. While not irrigating lawns would be preferable, using unprocessed water is the best water to use, as it has the least amount of energy and chemicals put into it.

Habitat Restoration

Habitat restoration is a very interesting concept which is growing in popularity on campuses around the United States. It refers to the practice of rebuilding natural areas where native wildlife can live. The restoration can be out in rural areas, or be little pockets of nature on campus. Valley Forge Christian College has a successful habitat restoration project in which they have created a trail through a local park and through their campus along which they planted native trees and plants (Mitton, 2003). Additionally, they placed nest boxes and created clean water sources as well in order to encourage wildlife to live there. In order to maintain the trail, they created a club which cleans and manages the trail, as well as provide tours and educate the public on their efforts and the topic of sustainability in general.

Relating to habitat restoration, several schools are beginning to include arboretums in their campuses. Arizona State University has an arboretum spanning the entirety of their campus. This arboretum has over 900 species of trees, and while not all of them are native, they provide homes to wildlife from the surrounding areas. It is the largest public arboretum in Arizona and serves as an educational tool for the public and exposes them to nature. The fruits of these trees are harvested and used, and all of the organic wastes produced by the entire landscape is collected, composted, and then returned to the campus to fertilize the landscape. Additional used fertilizers are natural, such as fish emulsion.

Native Landscaping

University campuses are continuously striving to make their grounds look as beautiful and professional as they can in order to entice prospective students and faculty members. Often this involves using non-native species which may require excessive amounts or additional fertilizers, pesticides, and excessive irrigation. Additionally, some of these plants may become

uncontrolled and become invasive species. New Mexico State University has taken to utilizing xeriscaping (New Mexico State University 2015). This practice is a landscaping method that is used on arid climates in order to produce landscapes which can be drought tolerant, and ensures water conservation. To this end, they use a very efficient irrigation system, choosing to water at night when plants are most receptive to water, they use native grasses, and use mulch. The process takes a lot of planning, but can be very beneficial to increasing the sustainability of a campus.

How Kansas State University can Improve

Kansas State University has shown a lot of promise in sustainability, which is outlined in the 2025 Sustainable Action Plan. However, there are several areas in which they could improve. Kansas State University's storm water management could be improved by utilizing the water in a rainwater capture system. This water could be used as greywater for toilets, or left untreated, used to irrigate the landscape. Kansas State University could also utilize rain gardens that would help utilize some of the runoff storm water. Placed in low lying areas where storm water tends to accumulate, these gardens would turn a previously boggy area into a picturesque garden. Additionally, Kansas State University could attempt to water more of its landscapes at night, to reduce the amount of water needed, by watering during peak absorption times.

Kansas State University could also stand to increase their native landscaping. While their landscapes look beautiful, some of the flowers and plants they choose require vast quantities of water and maintenance. Were they to choose more native plants, they would save water, time, and they wouldn't have to use as many chemical fertilizers and pesticides, as the plants would be adapted to this environment and would have natural resistances to pests. Additionally, Kansas State University could begin a landscaping method similar to the xeriscaping practice of Arizona

State University. However, instead of simulating a desert landscape, they could utilize the natural environment of the Flint Hills and Manhattan area to create their landscape in the form of a prairie. This would also reduce lawn care requirements, water and nutrient requirements and would even support local wildlife.

Waste Management and Recycling

What is Kansas State University currently doing to better manage waste?

It is important to reduce waste because our resources are finite. What we have on this planet is it, nothing new is added, we have to conserve the resources and not waste them. Kansas State University, according to the University's website, has had a recycling program since 1989 through the Division of Facilities. With help from grants by the Kansas Department of Health and Environment (KDHE), sponsors and City/University funds, Kansas State University used the money to purchase recycling equipment, such as trailers, a side-load collection truck, collection bins, carts, and bailers to process the material. In 1998 The Kansas State University Recycling Committee was formed, comprised of faculty, staff, student and Division of Facilities representatives. The committee's goal is to help expand recycling efforts across the campus and by doing so, create a more environmentally friendly campus, minimize the waste stream and decrease waste management costs. It is dedicated to promoting action and education to enhance recycling. Many recycling ideas and activities are a direct result of the Recycling Committee

Kansas State University is implemented a single-stream recycling system in 2013 to facilitate recycling on campus. This resulted in a huge improvement of the recycling rate on campus as people do not have to sort their recyclables into various bins anymore (Kansas State University 2015). The bulk of recyclable materials generated at Kansas State University are mixed paper, cardboard, newspapers, and magazines and many other materials. Kansas State

University's 2025 Sustainability Strategic Action Plan lays out the goals for waste reduction. The short term goal is to have a waste diversion rate of 30% by 2016. The intermediate and long term goals are 50% (2020) and 75% by 2025.

The SEA (Students for Environmental Action) is the student group on campus focusing on aspects of sustainability, environmentalism, recycling, outdoor adventures, and public outreach and education. They host events to help reduce waste on campus like Game Day Recycling and Fake Patty's Day Recycling. Also Kansas State University has a recycling committee composed of staff, faculty and students. (Kansas State University 2015).

What are other Universities doing in Waste Management and Recycling?

New Mexico State University

New Mexico State University encourages everyone to bring their own drinking cups and water bottles to lower waste in the landfills. Facilities and Services Plumbing Shop is making it easier to refill those bottles with cool filtered water from refill stations located throughout campus. Also the college promotes on-the-go cloth towels as an alternative to the conventional paper towel. New Mexico State University has implemented source reduction strategies to reduce total waste generation (garbage, recycling, and compost) per weighted campus user compared to a 2005 baseline (New Mexico State University 2015).

Arizona State University

The goal of Arizona State University is to achieve zero solid waste across all campus locations by 2015. The university plans to reduce its landfill waste by 90 percent, averting some waste through reduced consumption and diverting the rest through recycling, composting, and reusing or repurposing. Recycling efforts across Arizona State University's four campuses have

two main goals: to increase recycling participation and to reduce contamination that can relegate an entire bin of recyclables to the landfill. Arizona State University Mail Services has partnered with Ecological Mail Coalition to help reduce each department's junk mail, including catalogs, magazines, and other advertising mail for employees who are no longer in a department (Arizona State University 2015).

Stanford University

Stanford University is continually improving collection activities, identifying new markets for waste materials and recyclables, and raising awareness. The Procurement Department and the associated Sustainability Working Team developed Sustainable Purchasing Guidelines. The purpose of these guidelines is to support and facilitate the purchase of products, services and materials that minimize the harmful effects to the environment from their production, transportation, use and disposition. Stanford's goal is to increase its rate of waste diverted from landfill to 75 percent by 2020(Stanford University 2015).

Colorado State University

Colorado State adopted a single stream recycling system in 2008, facilitating recycling on campus. Surplus Property at Colorado State handles, disposes, and redistributes all property that the University no longer needs. The main objective is to provide an opportunity for the reallocation of still-usable items from one area of the University to other areas that have a need for them. In addition, items no longer needed by the University are offered to the public through weekly walk-in sales, quarterly public auctions, or recycling of items that no longer have a market value. This both maximizes the value of taxpayer investment in university property and helps prevent these items winding up in the landfill. Each year that new students move into the halls means a lot of empty cardboard boxes. In the most recent residence hall move-in, due to the

set-up of "cardboard corrals" throughout campus, 22.8 tons of cardboard were recycled in just a five-day period (Colorado State University 2015).

Guilford College

Guilford College in Greensboro, NC, provides recycling stations in dorms and most academic buildings that include receptacles for commingled recycling, landfill waste, battery recycling, electronic waste and compost. Guilford offers a Green Office program that certifies faculty and staff office suites based on things like energy use, waste reduction, campus participation and purchasing decisions.

How are Other Universities Recycling Programs Performing?

Recycle Mania

K-State and the other five universities all participate in the national Recycle Mania competition. Recycle Mania is a friendly competition and benchmarking tool for college and university recycling programs to promote waste reduction activities to their campus communities. Over an 8-week period each spring, colleges across the United States and Canada report the amount of recycling and trash collected each week and are in turn ranked in various categories based on who recycles the most on a per capita basis, as well as which schools have the best recycling rate as a percentage of total waste and which schools generate the least amount of combined trash and recycling. This provides a good opportunity to compare the performance the 6 colleges with up to date data as of week 8 in the spring 2015 competition.

University	Week 8 2015 recycling rate %	Recycle Mania ranking as of week 8 2015
New Mexico State	82.96%	3 of 233
Guilford	63.46%	14 of 233
Colorado State	54.71%	27 of 233
Stanford	38.57%	78 of 233
Kansas State	36.07%	93 of 233
Arizona State	35.13%	102 of 233

Table 2. Recycle Mania Results for Week 8. (Source: Recyclemaniacs, 01 May 2015)

What practices can K-State adopt to become more sustainable in this area?

1. Increase the number of recycling bins on campus
2. Adopt New Mexico State University refill stations located throughout campus.
3. Develop a junk mail reduction program
4. Increase funding for recycling program
5. Develop sustainable Purchasing guidelines
6. Promote a more successful Green Office program

The bottom line is that Kansas State University has many waste reduction programs and groups. In addition of the above suggestions, they just need to make existing programs better. The must always keep improving efforts of reaching the goals of sustainability and setting an example.

Food Resources and Food Waste Management

Food resources and the systems by which we produce and distribute them are an important concern in our world today. Emissions that contribute to global warming are produced along the food chain, increasing world population causes strain on existing infrastructure, and uneven distribution of food leads to large magnitudes of waste in some regions while in others people struggle to obtain enough for daily survival. Implementing effective sustainability practices can reduce negative environmental impacts and narrow disparity in food availability by reducing waste produced and the demand on land used in food production. Dining Services at Kansas State University have made some progress towards implementing sustainable food practices, especially with respect to composting. However, a comparison to past research and current efforts at other universities identifies some areas in which the Kansas State University may improve efforts toward food sustainability in coming years.

Current Food Sustainability at Kansas State University

Dining services at Kansas State University do incorporate some local foods in campus facilities. Foods produced close to where they are consumed support the local economy and reduce greenhouse gas emissions from transport. The meat and dairy programs, based in Weber and Call Halls respectively, supply a majority of the meat and dairy products served in campus dining centers. Additionally flour and cereal products come from McPherson, Kansas. Other food products come mainly from vendors in Kansas City or Wichita. Working directly with food producers improves communication along the food chain, allowing for more accurate

expectations between the amount of food produced and what is consumed, which leads to a reduction in food waste. Despite Kansas State University being located near agricultural areas, Jennifer Kennedy, a manager at Kramer Dining Center, does not believe it does a better job of including local foods than other universities.

Kramer Dining Center features a “green box” program that allows students to participate for only five dollars. The traditional “dashers” program allows students to take food from the dining centers in a Styrofoam box for on-the-go eating. The green box program replaces the Styrofoam boxes for plastic containers that can be washed and reused. Ms. Kennedy is in charge of this program. Originally, it was planned to give each student a green box, however many students don’t take dashers and boxes could get lost or destroyed. Allowing students to participate voluntarily reduces the overall cost and waste of the program.

Currently, no official management structure exists for promoting sustainability through Kansas State University’s dining centers. However, one manager at each building typically takes on tasks related to food sustainability. Ms. Kennedy currently serves this role at Kramer Dining Center. Upon leaving next year, a new manager will take up her responsibilities. Ms. Kennedy worked in the past with Ben Champion to promote sustainability beyond the dining centers, however upon his departure last year such efforts have largely been discontinued.

Part of Ms. Kennedy’s responsibilities at Kramer include ensuring that all staff is aware of the impacts of food waste and the importance of its prevention. As a land grant college, reducing food waste is also a part of the university’s mission. Doing so leads to increases in funding and avoidance of penalties. As such, very little avoidable food waste is produced in dining center kitchens. The majority of food waste is generated by students and recovered in the

dish room. Most food waste generated through Kansas State University's dining services is composted through a collaborative university effort. The composting program began several years ago in Kramer Dining Center and spread to other facilities across campus. In 2013 this program earned a Food Recovery Challenge Award from the EPA (Housing and Dining Services 2013).

The new dining center, to be constructed alongside Wefald Hall, Kansas State University's new residence hall, is expected to open in fall of 2016. It will not be a LEED certified building, however it will include newer, more efficient appliances. One of these will be a new dish cleaning machine that recycles water and steam, and includes a pulping function to enhance food recovery by composting. The dining center will also be designed with composting and recycling in mind creating a more efficient and natural flow for these activities to take place. A designated "to-go" station will be included. Ms. Kennedy believes that instead of using green or Styrofoam to-go boxes, prepared meals will be distributed in paper sacks. Greener options might be implemented in future operations.

Food Sustainability at other Universities

Arizona State University

Dining services at Arizona State University offer multiple programs to enhance food sustainability. Local foods are provided through fourteen distributors to date (Arizona State University 2015). A monthly on-campus farmer's market allows students and faculty to purchase from and connect with local growers and producers. The Campus Harvest Program lets students to work alongside the Grounds Department to harvest edible herbs and produce to be used in dining centers, and chefs use a seasonal produce calendar for planning menus and ordering food

(Arizona State University 2015). This reduces the need to ship tropical produce from distant regions.

The Engrained Café, located in the Memorial Union Building of Arizona State University's campus also features locally grown and harvested food. A thread runs throughout the restaurant with tips to educate patrons about steps they can take toward improving sustainability in their lives (Aramark 2009). Aside from local foods, campus dining offers other eco-friendly food choices including Fair Trade coffees, seafood products following the Monterey Bay Aquarium's Seafood Watch guidelines, and cage-free eggs (Arizona State University 2015). Vegetarian meal options, which have a lower impact on the environment, are available to students.

Stanford University

At Stanford, nearly forty percent of produce offered on campus comes from thirty small farms in the area. Stanford Dining defines local foods as those produced within 250 miles of where it is consumed (Stanford University 2015). A one-acre community farm creates additional produce to be sold weekly at a student run produce stand. This gives students a chance to learn about organic farming in a hands-on environment. Composting from dining halls is used as fertilizer at the farm. In 2007, over 1,300 tons of campus food waste was converted to compost (Stanford University 2015).

The "Love Food, Hate Waste" campaign uses compostable to-go service ware and reusable beverage containers for all students to enhance recycling and reduce waste (Stanford University 2015). Other programs such as a food waste competition, Sustainable Seafood Week, trips to local farms, and visits by experts in sustainability increase student awareness of food

sustainability issues (Stanford University 2015). Collaboration is particularly evident in Stanford's efforts. A designated Sustainable Food Coordinator works with the Farm Educator in Stanford's School of Earth Sciences to create a synthesis between campus sustainability efforts and educational programs (Stanford University 2015).

Colorado State University

At Colorado State University, local foods make up about twenty percent of food provided in dining centers. A tray-less dining program, started in 2008 lead to an overall reduction in food waste by nearly forty percent (Colorado State University Housing & Dining Services 2013). Unserved food from the dining centers is given to the Larimer County Food Bank. About 65,000 pounds of food was donated in 2013, along with additional non-perishable food items collected from students moving home at the end of the year (Colorado State University Housing & Dining Services 2013).

Composting also plays a large role at Colorado State dining centers. Pulpers collect food and paper waste, and about 3,000 pounds per day of this material is taken to the city wastewater treatment plant (Colorado State University Housing & Dining Services 2013). Here it is used as input to the experimental food-waste to clean-energy program. All campus dining centers appoint a staff member to serve on the Green Guard, a group intended to help staff members practice sustainable behavior in their daily work while lowering the carbon footprint of Dining Services (Colorado State University Housing & Dining Services 2013). They also work with other sustainability efforts across campus, showing collaboration toward overall sustainability on campus.

Guilford College

A three-acre farm at Guilford College produces over 10,000 pounds of food each year, enough to supply university dining services, a student farmer's market, two local grocers, and even a few restaurants (Guilford College 2015). In 2008 Guilford began efforts to substantially reduce food waste from campus. A remodeled dining center features an efficient dishwashing machine and organic-waste capture system. Dining waste is churned via two commercial-grade Earth Tubs to produce a rich "compost tea" that is used as fertilizer at the university farm (Guilford College 2015). This replaces petroleum-based fertilizers and creates a cyclical process of reusing beneficial nutrients. An estimated 800 to 1,200 pounds of food waste is diverted from landfills every week by using this process (Guilford College 2015).

New Mexico State University

Sodexo is the main food provider on the New Mexico State University campus. The company has many broad sustainability initiatives, but has implemented some programs specific to New Mexico State. Again, local foods play a role. Incorporation of fresh, seasonal fruits and vegetables into dining center menus supports local farms. The New Mexico Pecan Company and Price's Dairy are two local business that benefit (NM State University Dining Services 2015).

An effort specific to New Mexico State University, the Oxford Hunger Banquet, was held as a way to raise awareness about global hunger. Among the students, faculty, and staff who participated, some were randomly selected to receive a typical American meal while the majority of others received only rice and beans or a small helping of rice. (New Mexico State University 2014). Additional research at the university is looking for ways to increase the value of cotton crops by using the seeds for economically important purposes. One way to use these seeds is as

cottonseed oil in the fryers in campus dining centers (New Mexico State University 2014). Once the oils are ready for disposal, they can be used to produce biofuels.

Areas of Improvement for Kansas State University

Overall, Kansas State University appears to perform better with respect to food sustainability when compared to other elements of sustainability around campus. Composting is a major factor in successful efforts. However, throughout this investigation some weak points were identified as well. Some of the biggest include lack of a formal organizational structure for promoting and implementing sustainability efforts, and a lack of motivation and involvement from the student body. A few key changes could greatly increase the university's success in relation to food sustainability in the future.

As mentioned before, composting is a primary component of efforts toward improving food sustainability at Kansas State University. While this program has been quite effective, and even gained recognition by the Environmental Protection Agency in 2013, preventing this waste in the first place would ultimately be more beneficial. Producing less food waste as compost would allow the dining centers to purchase less, thus saving money and reducing costs of meal plans to students. As the university reduces the quantity of food ordered, vendors would require less from producers thereby placing less strain on natural systems.

Student involvement in food sustainability is a major area where Kansas State University lacks when compared to other universities. According to Ms. Kennedy, the dining centers might be able to incorporate more local produce into dining center menus if student demand was sufficient enough to justify paying the higher prices. Most students are also unaware of the effects on the environment associated with eating diets of a higher meat content, or are unwilling

to change their diet. Additionally, most waste generated in the dining centers comes from the dish belt when students throw away food they took but did not end up eating. Dining centers at Kansas State University could hold an event much like New Mexico State University's hunger banquet as a way to increase students' awareness of hunger in other parts of the world.

Policies, an element of the Community Engagement model (fig. 3) as proposed by Too and Bajracharya in 2015, is a key variable related to sustainability that is missing at Kansas State University. Without a formal sustainability organization to synthesize efforts across campus, it is more difficult to initiate and implement policies that promote sustainable actions. Colorado State University's Green Guard program provides a good example of designating sustainability-related responsibilities to specific staff members, and shows how a well-organized management structure can bring together different aspects of sustainability across campus, both through practice and academia.

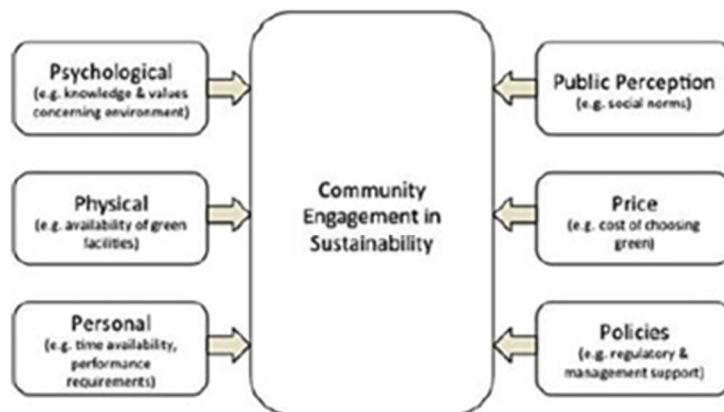


Figure 3 - The 6P framework for community engagement (Too & Bajracharya 2015)

The informal chain of command currently in place to handle sustainability-related issues has proven sufficient within Kansas State University's dining services. However, a formal

university-wide organization could more effectively bring together sustainability efforts across campus to accomplish commonly set goals. Creation of a campus produce farm could allow students from various majors to learn about sustainable agriculture in a hands-on environment while producing food for use in the dining centers or at a campus farmers market, much like Arizona State University or Guilford College. A formal sustainability organization could devote more time and resources to such an ambitious program.

Even though K-State's dining services have accomplished substantial progress toward improving campus food sustainability, a comparison to other colleges show there is much room for improvement. The new dining center, expected to open in fall of 2016, will provide new opportunities for increased sustainability efforts. Not only will the building include a pulping system to improve current composting practices, but new appliances will lower water and energy usage decreasing its environmental footprint overall. New facilities such as this, coupled with an ever younger generation of students will drive demand for improved sustainability efforts and the governance structure needed to supply them. Nonetheless, we must continue efforts to increase awareness of our effects on environmental systems if we want to hasten progress in our ever changing world.

Summary of Findings

By following the practices of the universities that we have selected as examples of leaders in sustainability, we believe that Kansas State University can reach its goal of becoming a leader in the sustainability movement. We feel that it is important for the university to start putting the 2025 Sustainability Action Plan into motion as soon as possible to catch up to other state universities that have got a head start on their sustainable practices. We also feel that it is important to continually update this plan to make sure it accurately reflects the most up to date

sustainable practices. Lastly we firmly believe that the recommendations outlined in the paper above in each category, will make a huge step in the right direction in terms of putting Kansas State University on the map as being a model sustainable university.

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