CLARK UNIVERSITY
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The Sustainable University: Sustainability & the Role of Higher Education

Final Course Report Fall 2011

EN 103 The Sustainable University
IDCE 30185 Sustainability and the Role of Higher Education
Clark University, Worcester, MA

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Introduction

Jennie C. Stephens

This final report is a collaborative effort detailing the team projects of 14 undergraduate students enrolled in EN 103: The Sustainable University and 5 graduate students enrolled in IDCE 30185 Sustainability and the Role of Higher Education (the graduate-level section of this course) during the fall 2011 semester at Clark University. In addition to reading and writing about the challenges of sustainability and the role of the university in promoting sustainable practices in society, in this course students engage directly with the challenges associated with promoting sustainable behavior and fostering institutional and social change through semester-long team projects focused on specific sustainability initiatives within the Clark community. These projects have been an integral part of this course, and this final course report includes culminating details on the five different semester-long team projects that these students developed in the fall of 2011.

Throughout the semester, students in the course benefited greatly from engagement and interactions with multiple individuals within and outside the Clark community. We extend appreciation to all of these people who have contributed to the success of this course and the students' efforts. Special thanks go to Jenny Isler, Clark's Sustainability Coordinator, who was an integral part of each of the student team projects. She was also an active and engaged member of the course, contributing throughout the semester in multiple invaluable ways. Thanks to Jenny for her effectiveness, dedication, and efficiency in communicating, responding and helping with so many aspects of the course. In addition we all benefited greatly from the valuable dedication, coordination, and contributions of the course Peer Learning Assistant Katy Cleminson (IDSC '12) who took the course as a student during the fall 2010 semester. Thanks to Katie for participating in this leadership role! Thanks also goes out to all the members of Clark University's Environmental Sustainability Task Force for their engagement with the course. I would like to express appreciation also to all the other individuals on campus who contributed to these students' work and to all of those who came to the students' final culminating public presentation on December 9, 2011.

During the semester, students in this class have read quite extensively the work of David Orr and others who have expanded on the notion that the impact of learning at institutes of higher education does not only occur in classrooms but throughout the campus community and space. Students have been exposed to and engaged with ideas about university policies and community priorities, as well as buildings and campus operations, and how these multiple dimensions all play a role in the education of students, and have a broad impact on society. We have explored how institutions of higher education have unique potential to catalyze and/or accelerate the transition to sustainability. The focus on the university provided a lens for students to examine how decisions with environmental consequences are made at institutions with complex structures. This situated students in a context for considering the broad role of education in sustainable development. And the course provided students with personal, direct connections and experiences facilitating learning about the challenges of promoting sustainability.

This semester has definitely been a learning experience for all of us. I recognize that many of the teams had initial hopes of accomplishing more within this semester than they have ultimately been able to complete, but I also hope that they have learned how common that is in many "real-world" experiences. The complexities of engaging with and contributing to these projects turned out to be greater than many were initially anticipated. But I am confident that the learning associated with these projects will exceed expectations in surprising ways.

Working with these students throughout the semester has been a pleasure. These students have worked hard and accomplished a great deal as they struggled with the challenges of promoting environmental sustainability at the individual, institutional, and community levels. While this report details the work done during the fall 2011 semester, several of these initiatives will continue to be developed and implemented by these students and others on campus beyond this semester. For up-to-date information about any of these initiatives please get in touch with me or with any of the students.

Thank you for your interest in these student projects and in the sustainability initiatives at Clark University!

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Transportation within Clark's Climate Action Plan

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Abstract

Anthropogenic-induced climate change from activities such as transportation, fossil fuel combustion, and agriculture has accelerated greatly in the past decade, and is consequently degrading the Earth's current ecosystems. In attempts to mitigate harmful greenhouse gas emissions that are perpetuating the cycle of global climate change, Clark University has signed on to the American College & University Presidents' Climate Commitment. As a result of this commitment, Clark released a climate action plan in 2009. Within the plan, estimations for greenhouse gas emissions associated with transportation are the weakest. This project contributes to investigating more closely the climate impact of transportation at Clark. By developing and sending out a survey that inquired about staff and faculty commuting habits, we were able to come up with an approximation of the 150 (20% of all faculty and staff) respondents' carbon dioxide emissions from commuting. After conducting our survey, we found that the total amount of carbon dioxide emitted from the miles traveled by the respondents was 771.4 $MTCO_2$. With an ultimate goal of carbon neutrality by 2030, we hope that this project helped inform the university's climate action planning process, and that our survey will be modified and sent out in years to come to better monitor Clark's greenhouse gas emissions.

Introduction

As top members of the food chain, humans often do not stop to think about how their actions will affect other living species that coexist in the world with them—how often do we think twice about getting into our cars to go to work? The reality is, however, that everything we do has consequences, unintended or not, on processes that maintain the Earth's systems. There is much evidence that anthropogenic greenhouse gases (GHGs) from activities such as fossil fuel combustion for electricity, transportation, and agriculture processes are the main drivers for global climate change (Worldwatch Institute, 2009). Carbon dioxide (CO_2) is a GHG that is of major concern because of its long residence time (50-200 years) in the atmosphere and because of its extremely high concentration level, now reaching approximately 390 parts per million (ppm) (NOAA, 2011). Other harmful GHGs include methane, nitrous oxide, and hydroflurocarbons (Worldwatch Institute, 2009). Anthropogenic emissions of greenhouse gases have such a strong effect on the environment and are currently overriding our planet's natural forcings because of their ability to absorb heat, which is then trapped in the atmosphere as long-wavelength radiation and acts as an insulating blanket that warms the Earth (Hansen, 2004; IPCC, 2007).

As the Earth's temperature rises, ecosystems as we know them are suffering greatly (Hansen, 2004). For instance, conditions that are associated with global climate change include increased flooding, sea level rise, more intense storms, severe wildfires, intense heat waves, and other more frequent extreme weather events (IPCC, 2007). In addition, extreme temperature fluctuations can move out of certain species' ranges of tolerance, thus killing them off either partially or completely. Climate change is such a difficult and overwhelming issue because it affects the entire world, including the

livelihood of a plethora of species, humans, and ecosystems. Despite its very real and harmful effects, however, some people do not feel a sense of urgency around the topic and many even deny that it is occurring (Lindzen, 2009). For those who have started to think ahead, however, there seem to be two different strategies regarding how to combat climate change. For instance, mitigation strategies include actively reducing greenhouse gas emissions or enhancing sinks for capturing GHGs. Adaptation strategies, on the other hand, aim more at making adjustments to reduce the vulnerability of ecosystems and communities to the impacts of climate change (Worldwatch Institute, 2009).

Looking more closely at some of the anthropogenic drivers of climate change, various modes of transportation certainly account for a large percentage of carbon dioxide emissions. For instance, in 2007, mobile sources of transportation contributed to 31 percent of total U.S. GHG emissions, and have been the fastest-growing source of U.S. GHG emissions since 1990 (EPA, 2011). Many Americans are unaware of the environmental impacts of their driving patterns because they are often not conscious that they are "locked-in" to certain practices and the use of particular technologies because of a path dependent trajectory that is difficult to change (Jackson, 2005). For instance, living in a rural or suburban area makes it difficult to get to more central places without owning a car (or two or three), especially with a family. People residing in urban areas often have the luxury of public transportation infrastructure, such as a bus or train system. In addition to an oftentimes lack of access to public transportation, the U.S. is spread out because of the Interstate Highway System, and people are particularly attached to their personal vehicles (DeCicco & Fung, 2006). Commuting is part of our everyday lives, whether it be via car or airplane, and the increasing amount carbon dioxide emissions in the atmosphere are there to prove it.

While a lack of a sense of urgency might just be one of many barriers that slow down the process of legislation, there are also many segments of the population that are starting to be proactive about implementing mitigation strategies. For instance, 674 schools have now signed onto the American College and University Presidents' Climate Commitment (ACUPCC, 2011), of which Clark is a signatory. As part of this commitment, colleges and universities have realized the critical leadership role they play, and recognize that they can act as models for the larger society (ACUPCC, 2011). Stephens et al. (2008) discuss this idea of colleges and universities being "models" for society explicitly in their article about higher education institutions acting as agents of change. Under the commitment, schools are required to come up with a plan for sustainability initiatives in order to mitigate climate change. Thus, in 2009, Clark University produced a climate action plan to be launched in two phases, the first of which is targeted at achieving an interim emissions target of cutting 2010s emissions by 15% by 2015 (2010-2015), with the second aimed at accomplishing climate neutrality by 2030 through a transformation of Clark's energy systems (Clark Climate Action Plan, 2009). Our project looks into the various mitigation strategies outlined in the climate action plan. It then further investigates information regarding transportation and commuting habits at Clark University.

Background

Clark's climate action plan (CAP) is comprehensive, and includes many goals under various sectors of the university. The first one is building and energy systems,

which includes heating and cooling, space usage, and the efficiency of the co-generation power plant. There is also the footprint management sector, which is more about delivering the same education and research experience with a more efficient use of space. The information technology sector deals with power management and buying energy efficient appliances. Lastly, the air travel and commuting sector, which is the focus of our project, relates to faculty air travel as well as methods for commuting, and maximizing the use of public transportation and carpooling (CAP, 2009). Automobiles are certainly a critical part of the transportation sector, especially in the United States. For instance, although the U.S. has approximately 5 percent of the world's population, around 45 percent of the world's automotive carbon dioxide emissions come from the U.S. (DeCicco & Fung, 2006). This is partially because of how many Sports Utility Vehicles (SUVs) and trucks occupy American roads.

With an increasing number of students each year, getting closer to climate neutrality will certainly have its challenges, especially with commuting students, staff, and faculty. For instance, in 2008, commuting and faculty air travel combined accounted for approximately 26 percent of Clark's total carbon dioxide emissions (CAP, 2009). As the university grows, and we come closer to the year in which our goal is climate neutrality, commuting behaviors of faculty, staff, and students needs to be closely monitored, a task which our project attempts to do.

As transportation accounts for a major chunk of the total CO_2 emissions, the ultimate goal of this project was to investigate more closely the commuting habits of Clark staff and faculty. Additionally, because Clark's climate action plan includes so many different aspects, and universities sometimes lose sight of longer-term sustainability goals (Breen, 2010), we also wanted to assess the status of the various mitigation strategies within Clark's climate action plan. With the results of the survey that we created to inquire about transportation patterns, this project will contribute valuable data to inform Clark's climate action plan, and hopefully aid the university in monitoring and reducing total GHG emissions.

Process

Over the course of the semester, our project involved many different stages. Our team met regularly once a week to discuss our evolving plans and what we needed to complete. Bearing in mind Clark's goals for mitigating climate change and achieving climate neutrality by 2030, our team began to tackle the task of assessing all of the various mitigation strategies outlined in Clark's climate action plan. We looked at specific mitigation strategies that were separated under broader categories. The categories include Building and Energy Systems, IT and Equipment Purchasing, Commuting and Air Travel, and Education. We evaluated what measures had been taken so far within each category. We identified the strategies as being completed, not completed, ongoing, to be investigated, or completely aborted. We compiled these mitigation strategies and their status into an excel spreadsheet, which allowed everything to be summarized in one place. Figure 1 is a sample of this spreadsheet—a complete copy can be found online by contacting the Sustainability Office.

	A	B	C	D
1	**Building and Energy Systems**		**IT and Equipment Purchasing**	
2				
3	**Mitigation Strategy**	**Status (C/N/A/O)**	**Mitigation Strategy**	**Status (I/C/N/A/O)**
4	Energy Audit (Lighting/H/C)	C	Migrate computers to Windows Vista to turn computers off at night	I - Justin Brooks
5	Replacement of Steam Boilers with Hot Water Boilers	N	Investigate other computer monitoring/power management programs for the computers	C
6	Switch to Natural Gas with #2 Oil	C	Better educate Clark about turning off monitors	?
7	Switch to Biofuel	N	Use cycles/watts criterion for purchasing equipment	C
8	Central Heating Distribution Change from Steam to Hot Water	N	Train ITS staff in "green computing" best practices	I - Justin Brooks
9	Replacement of inefficient rooftop cooling units	C	Investigate participation in the Google/Intel Climate Savers Initiative	I - Justin Brooks
10	Use of renewable energy	N	Expand the virtual server environment for consolidation of departmental servers	I - Justin Brooks
11	Retrofit lighting--LEDs	N	Use more video conferencing tools for routine meetings	O
12	Heating Policy	I - draft policy		
13	Cooling Policy	I - draft policy		
14	Office Plug Load Management	I - ?	I=Investigate	
15			C=Complete	
16			N=Not Complete	
17			A=Aborted	
18			O=Ongoing	
19				

Figure 1: Sample of the Mitigation Strategies Spreadsheet

This process helped us to really break down the tactics and see what has, and has not, been accomplished since the plan was written; it is important to help Clark stay "on track" with their goals. Some schools, intentionally or not, tend to glorify past sustainability initiatives and thus sometimes lose sight of implementing longer-term objectives (Breen, 2010).

After completing the spreadsheet of mitigation strategies, we met with Paul Wykes, Clark's Business Manager, and Jenny Isler, the Sustainability Coordinator at Clark, to talk about what we had come up with. With plenty of feedback and advice, they were able to assist us in assessing what sections of the climate action plan needed to be investigated more closely. They suggested that we look more into the transportation sector of the climate action plan—although the approximate contributions for air travel and commuting were in the report, those areas were still relatively "shady," and more updated information was needed (Isler, 2011). They also suggested that, time permitting,

we evaluate the university-wide heating and cooling plan and potentially draft a new one that would save more energy.

Improving Data on University Travel Habits

We decided to focus our research on faculty and staff, as information about commuting students had recently been collected through a commuting survey conducted by Ya'ara Persing and Brittney Pietro (Clark students). We decided to create a similar survey to send to faculty and staff members. To begin this process, we began drafting sample survey questions that would help us gather information about commuting methods, how far people were driving, and about what cars people were driving. In order to officially send out our survey, the questions needed to be approved by the Institutional Review Board (IRB). The IRB makes suggestions for improvement, as well as makes sure that answers to the questions do not reveal people's identities—to achieve approval, the survey must be completely anonymous. It is also required that the survey be sent out via the official Clark University survey database. Once we were set up in the database, the survey approval process began, which ended up taking much longer than initially anticipated.

In the meantime, Jennie Stephens suggested that we also look into amending the form that faculty and staff fill out when they participate in university sponsored travel. We thought that it might encourage faculty and staff to become more environmentally conscious by adding a question asking whether or not they offset their trip, meaning whether or not they used an air travel carbon offsetting website. We consulted with Deb Brenner in the Provost's office about possible changes to the form.

After around three weeks of corresponding with the IRB and Information Technology Services (ITS), our survey was finally approved and ready to be sent out (see Figure 2).

1) In what City/State do you reside
2) What is the length of your commute (miles)?
3) How often do you make this trip per week?
    Trip from home to work and trip from work to home=2 trips
4) How often do you make this commute?
    -Full Time
    -Academic Year
5) What is your method of transportation?
    -Bus/Commuter Rail
    -Walk
    -Bike
    -Carpool/Van
    -Drive own vehicle
6) If you chose "Drive own vehicle", please check the box that best describes the vehicle you use to commute.
    -Compact Car (Sedan)
    -Mid size Car
    -SUV

-Pickup Truck
-Mini Van

7) If you chose "Drive own vehicle", what is the model year of the vehicle you use to commute?

-1980-1985
-1986-1990
-1991-1995
-1996-2000
-2001-2005
-2006-2010
-2011-

Figure 2: Faculty and Staff Commuting Survey

The survey was open for responses for a total of nine days (11/29/11-12/8/11). After the survey closed, we exported the data into an excel document for analysis. We were also able to create summary graphs and tables using the survey database.

Survey Limitations

When we initially designed the survey, we had not anticipated how complicated some people's commuting situations would be. When the survey was first sent out, Jenny Isler and others immediately notified us that faculty and staff members did not have any place on the survey to explain their situations. For instance, some people use both their own vehicles and public transportation as a means for their commuting. Other people had complex situations with regards to residential areas because they had different apartments in different areas, which results in the different distances of their daily or weekly commuting. People also could have owned vehicles that were not an option within the survey answers. By the time we were able to amend the survey to add a text box, we had received most of the responses already. We recognize this as a major limitation, and discuss this further in the results section.

Changing Objectives throughout the Semester

When we originally had meetings with the Climate Action Plan sub-committee, we thought that we would perhaps be able to investigate a few aspects of the climate action plan, such as transportation and a new heating/cooling policy. After the first few weeks of working on this project, however, it became clear that it was more realistic to focus solely on transportation. With regards to university-sponsored travel, we were also able to draft some recommendations to add to the travel form. We were interested in adding a question about the approximate miles traveled throughout the course of trip, as well as in suggesting a few carbon offsetting websites (www.terrapass.com and www.climatepath.org). By the time our survey closed, however, our focus was mainly on analyzing the results, so our draft of amendments was never actually added to the form.

Results

Our survey generated a high response rate (approximately 36%)—we received 278 total responses. There are approximately 783 total staff and faculty (Olson, 2011). While we received a total of 278 responses, the number of answers for each individual question varied slightly, depending on the person's commuting situation. Figure 3 below shows the various modes of transportation used by faculty and staff members.

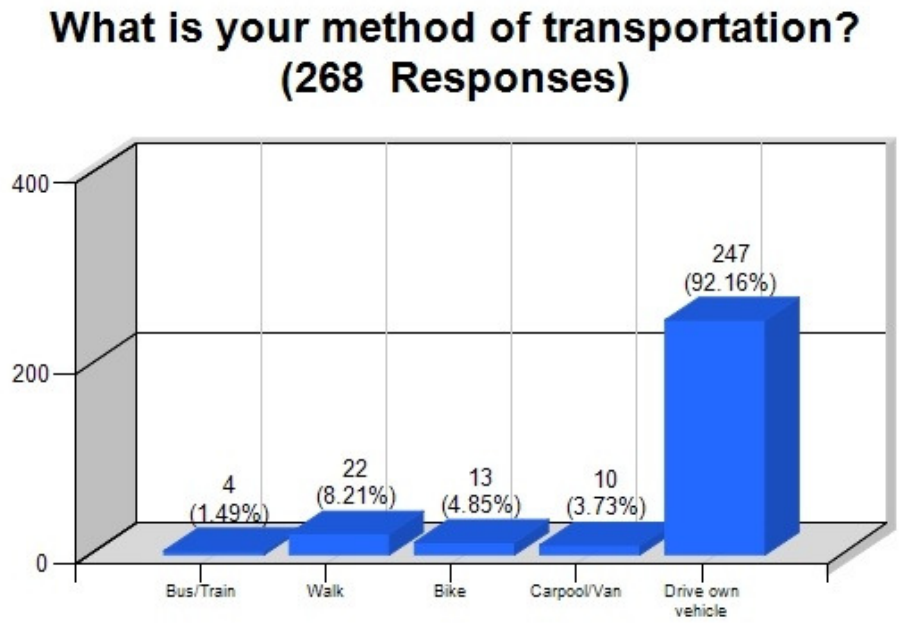

Figure 3: Survey Results—Modes of Transportation

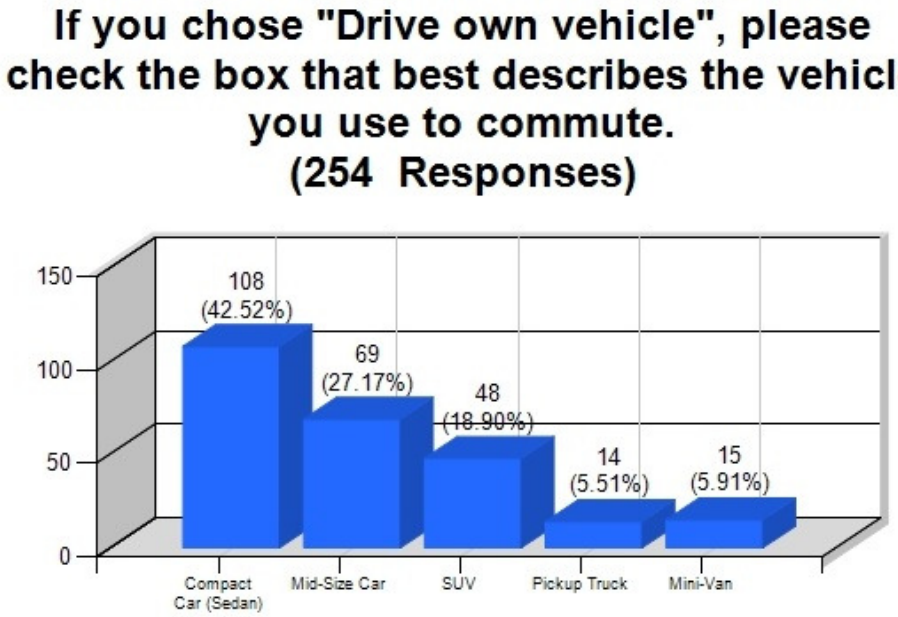

Figure 4: Survey Results—Classes of Cars

Figure 4 demonstrates the types of cars people drive. Based on these car classifications, we researched information regarding fuel economy and corresponding carbon dioxide emissions from gasoline. In a comprehensive review of automobile transportation in the U.S., DeCicco and Fung (2006) indicate the amount of gasoline consumed by different cars, illustrated in Figure 5 below:

TABLE 2
Light vehicle stock, fuel consumption, and carbon emissions by vehicle class, 2004

	ROLLING STOCK AS OF 2004 (ALL VEHICLES NEW AND USED)						MY2004 (NEW FLEET ONLY)		
Vehicle class	Vehicle population (millions)	On-road fuel economy (mpg)	Fuel consumption (Mbd)	Carbon emissions (MMTc)	Vehicle population share	Carbon emissions share	On-road fuel economy (mpg)	Market share	Carbon burden share
Small cars	65.1	24.3	2.10	77.2	32.0%	25%	24.6	23%	18%
Midsize cars	38.5	21.4	1.46	53.7	18.9%	17%	23.2	17%	17%
Large cars	17.6	19.7	0.72	26.5	8.6%	8%	20.8	7%	8%
Pickups	32.2	16.3	1.63	59.9	15.8%	19%	15.6	16%	15%
Vans	17.3	17.9	0.80	29.5	8.5%	9%	19.1	5%	7%
SUVs	33.1	16.3	1.83	67.5	16.2%	21%	16.9	31%	34%
Cars	121.2	22.6	4.27	157.3	59.5%	50%	23.4	47%	43%
Light trucks	82.5	16.6	4.26	156.9	40.5%	50%	16.7	53%	57%
Overall	**203.7**	**19.6**	**8.53**	**314.2**	**100.0%**	**100%**	**19.3**	**100%**	**100%**

Figure 5: Vehicle Classifications Source: DeCicco and Fung (2006)

Survey responses regarding the number of miles traveled by each faculty and staff member helped us to calculate the total amount of carbon dioxide emissions for those who use their own vehicle. While we were not able to find the latest information regarding the efficiency of the vehicle based on the year it was made, we were still able to gather this information from our survey. Figure 6 below indicates that the majority of survey respondents drive cars that have been manufactured relatively recently (within the past decade):

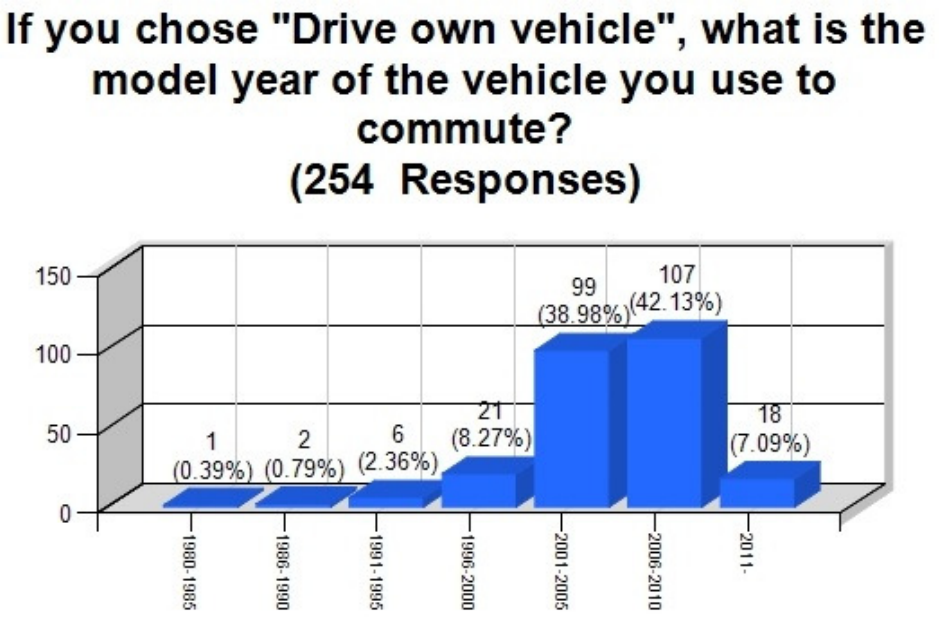

Figure 6: Survey Results—Model Year of Cars

DeCicco and Fung (2006) indicate that the average amount of carbon in each gallon of fossil fuel is 5.3 pounds. Based on the weight of carbon dioxide molecular, we can calculate the amount of carbon dioxide from one gallon of fossil fuels. Masters and Ela (2008) indicate that the average amount of carbon dioxide from one gallon of fossil fuels is about 19.2 pounds. Based on the number of miles traveled by staff and faculty and information about classes of cars, we were able to use Excel to estimate carbon dioxide emissions from the respondents, using the following formulas:

M(CO2) = (Length of one way trip/the average miles per one gallon of gasoline) * (2 ways/day) * (Number of trips/week) * (Number of week per year) (gallons)

MTCO2 = M(CO2) (gallons)*19.2 pounds/gallon*454 g/pound/1000000g/ton

As indicated, we took into account how often each individual makes the trip, demonstrated by Figure 7. The Academic Year is 39 weeks, with the full year being 53 weeks.

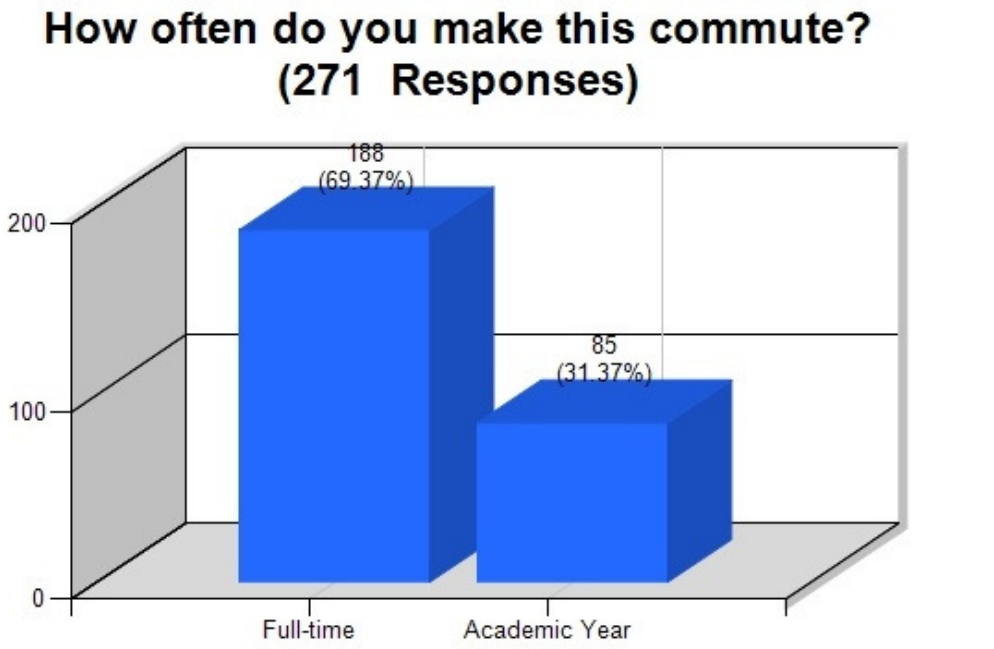

Figure 7: Survey Results—Full-time or Academic Year

Based on the above information, the total amount of emitted carbon dioxide from the respondents of the survey was calculated to be 771.4 MTCO2/year. This number is based only on the survey responses (around 36% of the total staff and faculty).

Conclusions

After a semester of work, we were able to assess the status of various mitigation strategies within Clark's climate action plan, draft recommendations for modifying the faculty travel form, develop and send out a survey for commuting staff and faculty members, and estimate the approximate contribution of carbon dioxide emissions from the survey responses. Although our objectives changed throughout the course of the semester, it is our ultimate hope that the data we collected will help the university better monitor and understand the contribution of transportation to the institution's total greenhouse gas emissions.

Our survey generated a relatively high response rate, which could indicate a high interest of the respondents for implementing sustainability initiatives, especially with regards to the university's climate action plan. While one major limitation of our survey involved not having adequate space to explain complex driving situations, a similar survey in the future could be modified and used to further document driving patterns of staff and faculty.

After conducting our survey, we found that the total amount of carbon dioxide emitted from the miles traveled by the respondents was 771.4 MTCO2, which is around 4.4% of the total CO_2 emissions from Clark in 2008. This is an approximation, as we used information regarding fuel economy for classes of automobiles manufactured around 2004 (DeCicco & Fung, 2006). To further improve this estimation, we recommend taking into account the year each car was made, to get a better idea of the exact amount of gasoline used. Also, this number is only representative of those who

responded to the survey. Further sophisticated extrapolation is recommended in order to get a better idea of the total contributions from transportation.

Moving forward, we hope that our survey can be modified and used by the Sustainability Task Force and the Climate Action Plan sub-committee to continue monitoring staff and faculty commuting patterns. This will be essential for keeping up with the climate action plan's emissions targets. Keeping this information accurate and up-to-date is necessary to further educate about potential carpooling arrangements for staff and faculty who live in the same area, thus potentially reducing Clark's carbon footprint and helping the university achieve carbon neutrality by 2030.

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Rain Garden Initiative

Sam Boyle, Kerry Burke, Will Maxwell, Sam Sandella

Abstract

Stormwater runoff affects the quality of water used for drinking as well as for recreational purposes. As rain and snow melting occurs, the runoff collects and carries various impurities including bacteria, viruses, and hazardous waste into water supplies. This contamination can make the water unhealthy to consume, and can have multiple negative environmental impacts. While water runoff is an issue worldwide, our team developed a local stormwater runoff project focused on implementing a rain garden at Clark University. We call ourselves The Rain Garden Initiative; we have been working all semester toward planting a rain garden outside of Clark University's Admissions building to reduce the amount of water runoff. We have also designed a sign for the garden to educate the Clark and Worcester community on the impacts of stormwater runoff and the potential of a rain garden to reduce these impacts. The rain garden will also serve as one of the first rain gardens in Worcester contributing toward a goal of twenty-five rain gardens that Mayor Joe O'Brien has proposed to implement in the city of Worcester. Although our rain garden has not yet been planted (December 2011), our team has completed the physical tests necessary to plan the garden, obtained funding from supportive student clubs, designed an educational sign and begun to plan an opening ceremony for when the garden is planted. We have worked closely with Clark's Sustainability Coordinator Jenny Isler, who has purchased the plants that are ready for planting. With the help of Physical Plant, we intend to construct Clark's first rain garden in the spring of 2012.

Introduction

Managing stormwater runoff is a critical environmental challenge in many regions of the world. Runoff happens when there is heavy rain flow or the melting of ice or snow does not get absorbed into the ground and instead goes into streets and waterways (NYDEC, 2011). As water flows into the streets it picks up debris and contaminants from the surrounding land-surface. Many factors contribute to a change in the quality of water runoff such as, geography, the season, and local meteorology (NYDEC, 2011). Professor Michael Dietz of University of Connecticut has been studying the effects of stormwater runoff and stated, "Urban areas further contribute pollutants to stormwater such as sediment, nitrogen, phosphorus and heavy metals, impairing downstream habitat and water quality" (Dietz, 2004). Nutrients such as phosphorus and nitrogen can cause algae blooms that result from the associated depletion of oxygen in the water (EPA, 2003). The algae blooms and the oxygen depletion can negatively affect aquatic wildlife. Bacteria and household waste (such as cleaning fluids, oil, etc) get into natural bodies of water that are used for recreational purposes. Furthermore, they can sicken wildlife, as well as affect the health of humans (EPA, 2003).

Stormwater runoff is an issue worldwide. In September of 2010, Stockholm held their annual conference about water pollution and quality. The Stockholm International Water Institute stated that approximately everyday about two million tons of human waste is poured into rivers, lakes, seas, and all bodies of water used in our daily

lives. In various developing countries around the world, 70 percent of industrial waste is poured into waters without being treated (AFP, 2010). The United Nation's Food and Agriculture Organization (FAO) estimates that within the next 15 years, approximately 1.8 billion people will be living in countries with scarce amounts of healthy water available (FAO, 2007). The Washington Department of Ecology gauges that about one-third of the polluted waters in the state of Washington are polluted primarily due to stormwater runoff. This heavy amount of water runoff has been conducive to the closing of thousands of acres of productive shellfish growing beaches (King County, 2011).

The Natural Resources Defense Council and Waterkeeper Alliance previously sued The U.S. Environmental Protection Agency claiming that they failed to follow the Clean Water Act and the Administrative Procedure Act. This was due to the fact that they were not promoting the correct regulations for stormwater pollution that is caused by the construction and development industry (Lewis & Clark Law School, 2008). The EPA is now getting ready to enforce more strongly the federal stormwater rules after being pummeled by various environmental groups (Coefield, 2010). There are many ways to reduce the amount of water runoff getting into waterways and affecting the environment and public health. Some options are reducing the amount of driving CO2 emitting vehicles, being more aware of oil use, and recycling oil. Cutting down on fertilizers and pesticides, and preserving trees as well as planting new ones are also helpful as these help soak in water runoff (King County, 2011).

Another option for reducing the impact of stormwater runoff is to plant a rain garden. Here at Clark University, the Admissions building has had a problem with stormwater runoff because, when it rains heavily, water has been leaking into the basement. We, as the Rain Garden Initiative of the Sustainable University class, decided to build a rain garden in front of the Admissions building not only to help with the flooding, but to help filter water runoff from going into the streets and into the waterways of Worcester. We hope that by doing this, we will not only be contributing to an effort to become more environmentally friendly, but we will also be creating an educational tool to show Clark and surrounding Worcester community an example of a simple change that can enhance the sustainability of the community.

Campus-Community involvement is an important way to reach out of campus boundaries and to try to help encourage sustainable change. Relationships between the campus and the community that have implemented projects for community growth create a strong qualitative basis necessary for future collaboration (Bringle and Hatcher, 2002). By Clark implementing a refined project such as a community effort to increase rain gardens throughout the city, it will create a stronger relationship between Clark and the surrounding community. Educational involvement when promoting sustainability is a strong catalyst for future initiatives. Working to help Worcester's Mayor Joe O'Brien in promoting sustainability around the city (Nugent, 2011), we plan to reach out to the community with a simple sustainable initiative, focusing on a project within our own campus.

Background

A rain garden is a simple solution to rain runoff, soil erosion and ground water pollution (King County, 2011). It holds quite a bit of educational value in the area of sustainability and can be easily planted by any homeowner. Clark University is always

looking for new and improved ways to encourage sustainable behavior on campus (Clark Sustainability Office, 2011). Clark also has a relationship with the surrounding community that gives us the opportunity to share our ideas of sustainability in an urban environment and spread new eco-friendly behavior throughout the city (Clark Admissions Office, 2011). With the potential to become an educational tool for both Clark students and the people of Worcester, our team decided to plant a rain garden in front of the Clark admissions building.

At the start of 2011, Worcester's Mayor, Joe O'Brien surfaced a goal to plant twenty-five rain gardens across the city (Nugent, 2011). However, Mayor Joe O'Brien's rain garden plan is not a city-funded project, but is solely dependent on community participation and support. To gain support, members of the Blackstone River Collation (BRC) and the Mayor formed a group made of committed Worcester citizens called the Worcester Stormwater Collation (WSC). With the help of this determined organization, a rain garden workshop was held and Worcester's first rain garden was planted in June of 2011 outside of the Youth Center on Chandler Street (Nugent, 2011). In order to further reach out, a group of students in their junior year at Worcester Polytechnic Institute (WPI) created brochures and how-to manuals in the hope that homeowners throughout the city will plant their own rain gardens. Working closely along side this group of students, another WPI group, Sustainable Landscapes, has future plans to construct a rain garden on their campus as well.

A rain garden is a garden usually dug in the shape in a kidney bean or some other kind of organic shape. Plants native to the area are planted within the garden because they have strong roots that effectively absorb and filter rain runoff. These natural sponges can prevent erosion of the soil over time and more importantly filter toxic chemicals out before the rain runoff reaches our ground water (King County, 2011). Water pollution is a common problem among urban environments such as Worcester because the water that flows off the many rooftops often does not have anywhere to go except into the dirty streets. The water flows toward the sewage drain gathering numerous toxic chemicals on its way. The now highly polluted water enters the Worcester water source risking the health of many citizens. Clark University and the City of Worcester get their water supply from ten reservoirs located outside of the city itself (City of Worcester Website, 2011). These ten reservoirs collect water from multiple watersheds throughout the area spreading across forty miles (City of Worcester Website, 2011). The issue with these watersheds is that they are a gateway for high levels of inorganic substances such as nitrogen that is found in fertilizer. Worcester's water supply is considered highly susceptible to contamination and needs to be better protected (City of Worcester Website, 2011). By educating more people on the issues surrounding rain runoff and spreading the importance of rain gardens, there is the possibility that the level of polluted water draining into the city's water supply may be reduced.

Planning a Rain Garden

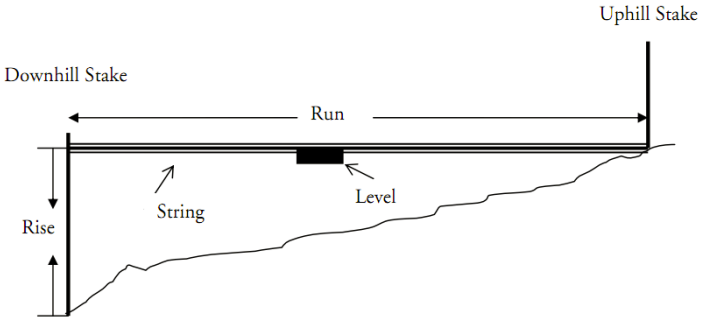
In order to plant a rain garden a few general tests should be done. These tests help to identify the most affective site for the garden as well as the depth of the hole and the proper height of the berm surrounding the plants and the proper size for the garden.

A percolation test is the first test that should be preformed, which involves digging a hole with a six-inch diameter in the preferred location of the rain garden

(Gustafson, 2009). The depth should be at least 12 inches from the surface (Gustafson, 2009). By adding 12 inches of clear water and allowing the water to sit and filter through the soil overnight, you measure if the soil will support a rain garden (Gustafson, 2009).

Once the location of the garden is chosen, a slope incline test should be completed. To complete a slope incline test, place two stakes in the ground, one at the top of the garden and one at the bottom. These stakes should be ten feet apart (University of Wisconsin, 2011). Next, tie and string at the base of the top stake and pull it tightly to the bottom stake and secure it (University of Wisconsin, 2011). Make sure the string is level and measure the distance from the string on the bottom stake to the ground. This distance relates to how deep your garden should be. The change in elevation plus the horizontal distance, multiplied by one hundred will be the slope percentage (University of Wisconsin, 2011). Generally, if the slope is less than four percent, the depth should be between three and five inches; six to seven inches deep for a five to seven percent incline and greater than eight percent requires an eight inch depth (See figure 1 below).

Lastly, to find the proper size for the rain garden, multiply the length by the width of the drainage area, such as a rooftop of sidewalk (Franti, 2007). The size of the garden should be approximately one-third of the size of the drainage area calculated (Franti, 2007). These simple tests will guarantee an affective rain garden.



Slope Formula

Rise (change in elevation) ÷ Run (horizontal distance) x 100 = slope %

Rain Garden Depth

< 4% slope = 3″ – 5″ deep garden
5 – 7% slope = 6″ – 7″ deep garden
8 – 12% slope = 8″ deep garden

Figure 1: Slope Incline Test (University of Wisconsin, 2011)

Process

Goals

Our main goal for the semester was to build a rain garden in front of the Clark Admissions building. A large part of our goal involves educating the Clark community and the surrounding neighborhood about the simplicity of constructing a rain garden. In order to do this, we planned to have an opening day demonstration for people to learn about the rain garden and the process of building one. We hope that by showing Clark and the South Main community how simple it is to build a rain garden, we then in turn promote more sustainable behavior.

What We Have Done

As a team we discussed early what we wanted the outcome of this project to be and how we were going to go about making our vision happen. Our first and most important step was to find out what had already been done involving a rain garden on campus. Jenny Isler, Clark University Sustainability Coordinator, told us to contact Ya'ara Persing, a Sustainable Clark Intern who had previously worked on the project.

Our first meeting with Ya'ara put the project into perspective for us, considering we had there would have already been more work done on the garden. We also had anticipated that she would be working with us, but instead she handed the project off to us. Ya'ara gave us a lot of background information including about rain gardens and in particular why they chose the location in front of the admissions building. She also gave us a packet of information including a native plant list to use when designing the garden. Along with the list, she informed us of people to contact with any questions we might have and who would be willing to work with us.

Within the next few weeks we were in contact with Chip Pybas from Physical Plant along with the Blackstone River Coalition (BRC). Both Chip and the BRC helped us plan the garden as well as do the tests needed to be done to ensure that the admissions building was the best place to put a rain garden on campus. With them, we discussed the design of the garden including the engineering of the garden along with the color and plant options. By working with them, our original timeline changed greatly due to some unforeseen issues. We continued to meet with the BRC a few more times to discuss design and other details involving the garden.

Our last meeting involved getting in touch again with Jenny Isler who helped us to develop a list of plants for the garden as well contacting Chip to try to get the rain garden built before the end of the semester. We discussed staying together as a group even after the semester ends in order to complete the project that we started. Towards the end we also met with WPI to talk about what they were doing. We were informed that they were in the process of creating brochures and a website for the purposes of spreading awareness throughout Worcester. We discussed being a part of each other's projects and how we can work with them in the future.

Securing Support

Building a rain garden requires financial support as well as support of key constituents on campus. To seek support, we broke our group up to work on three different presentations to different groups and people on campus. The first presentation was to Eco-Reps where we asked for $300 to purchase the plants needed for the rain garden. Our next presentation was to the Clark Sustainability Collaborative, concluding with our last presentation to Jarrad Nunes from Clark Admissions. We wanted to present to him in order to get the support and the "okay" with Admissions for constructing the rain garden in front of their building. Jarrad was very supportive and assured us that all the admission staff was just as excited about the project as he was.

Problems

The biggest issue was that we could not have enough necessities in place to construct the garden by mid November like originally planned. This was due to planning that still had to be done along with acquiring the money needed, that we thought we originally had. We also ran into some issues when it came to getting in contact with people. For example, we discovered after the first meeting with Physical Plant that they

are better to contact by phone rather than email. Another example was that we never received an email back from University of Connecticut about their rain garden when trying to reach out and collaborate. The weather throughout the semester didn't make the idea of planting a rain garden any easier either. With a big snowstorm in October, Physical Plant had more work cut out for them than they had originally planned. With snow on the ground we couldn't plant the garden at that time.

Results

Design & Testing

From our research and work with Chip and the Blackstone River Coalition we were able to complete all the tests necessary for our rain garden: incline test, surface area calculations and percolation test. Our tests allowed us to draft up a design of the rain garden, and then finalize it with the help of Peter Coffin from the BRC. This design also allowed us to complete some of our work with Jenny Isler. We developed a document (Figure 2) with her that included the plants in our garden and all of their attributes. This way we could properly plant our garden, and design it in a way that would allow for maximum water filtration, while still being aesthetically pleasing.

	BOT. NAME	COMMON NAME	MATURE SIZE	ATTRIBUTES (color, birds, fall, etc)
2	Rhus aromatic	Low-grow sumac	Height 24inches, spread 7ft	Red,orange,yellow- well in city environment
	Vaccinium angustifolium	Low Bush Blueberry 'Northern Sky'	Height 1 to 2ft	Produces blueberries, burgundy fall color
1	Vaccinium x northcountry	Low Bush Blueberry 'Northcountry'	Height 1 to 2ft	Produces blueberries, burgundy fall color
2	Ilex verticillata	Winterberry 'Golden Glow'	Height 8ft, spread 8 ft	Attracts birds, tomato orange berries in fall
1	Ilex verticillata	Winterberry 'Jim Dandy'	Height 10ft, spread 8 ft	Occasional maintenance, prune in late winter, work well in standing water
4	Clethra alnifolia	Sweetspire; Summer-sweet; Sweet Pepper Bush 'Vanilla Spice'	Height 4ft, spread 4ft	White in summer, yellow in fall, prune in late winter, attracts bees and butterflies
2	Cornus sericea	Red twig dogwood 'Arctic Fire'	Height 4ft, spread 4ft	Intense red stems in winter, white flowers in late spring, white berries in late summer, prune anytime, attracts birds
1	Cornus sericea	Red twig Dogwood 'Ivory Halo'	Height 6ft, spread 5ft	White leaves with red stems in winter, whites flowers in late spring, white berries midsummer...not originally from North America?
1	Myrica pennsylvanica	Bayberry	Height 7 feet max	Green leaves, act as a natural insect repellent, blue flowers
2	Aronia melanocarpa	Black Chokeberry 'Autumn Magic'	Height/spread 3 to 6ft	Wine red leaves in late October, Black fruit in winter, white pink flowers in mid-may, attracts songbirds and small mammals
2	Panicum virgatum	Switchgrass 'Northwind'	Height 3 to 6ft	Bright yellow fall through winter. Prairie plant? Erosion control projects, eaten and enjoyed by many small animals, very aggressive with meek plants
2	Iris fulva	Louisiana Iris 'Clyde Redmond'	Height 1 to 3ft	Attracts hummingbirds, lavender-blue flowers in springtime
10	Aster ericoides	Heath Aster	Height 1ft	White in summer to early fall, attracts bees and butterflies

Another key aspect of our rain garden was developing a rough draft of our sign that we would like to have. As a group decided on a central message that we wanted to get across, and to keep the sign concise so that people would want to read it. Our draft of the sign reads as follows:

Stormwater runoff is a huge problem in the City of Worcester and leads to the

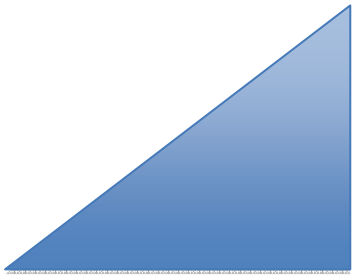
contamination of our drinking water. This rain garden has been built as part of Mayor Joe O'Brien's plan to implement 25 rain gardens throughout the city. Containing native plants with strong roots, this rain garden helps to combat the detrimental effects of stormwater run off. Every single thing we do affects this earth in some way or another. So next time you plan a project, even if it is as simple as building a garden, think about our earth.

Calculations:

Drainage area

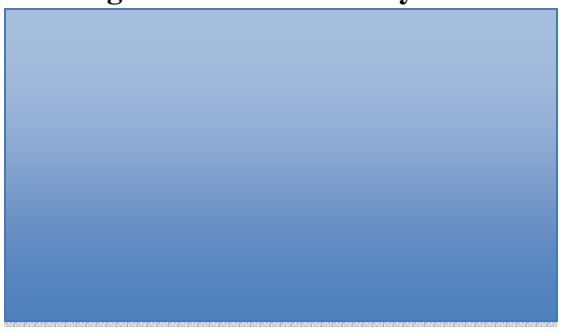
Height to roof: 23' to lowest point, 33' to highest point
10' is the height of the roof
Dimensions of Roof: 19' X Unknown
Distance from corner of house to apex of roof: 14'

Admissions Building Roof Profile



Pythagorean Theorem:
(10' x 10') + (14' x 14')=
296 '
Square root of 296' is approximately
17'

Drainage area of Admissions Building Roof Bird's Eye



17' x 19'= 323'=Size of Drainage Area
Area of Rain Garden= 1/3 Size of Drainage Area
323'/3=
Approximately 108 square feet

Incline Test

Height of String off ground: 13"
Distance between two stakes: 164"
Slope= (Height/ Distance)= (13/164)= roughly .08
Therefore the slope was 8%

Drainage area

Height to roof: 23' to lowest point, 33' to highest point

10’ is the height of the roof
Dimensions of Roof: 19’ X Unknown
Distance from corner of house to apex of roof: 14’

Incline Test
Height of String off ground: 13”
Distance between two stakes: 164”
Slope= (Height/ Distance)= (13/164)= roughly .08 x 100= 8
Therefore the slope was 8%

Funding

As far as our efforts for funding go, we were successful in obtaining all the funding we need for our project. We were at first handed a budget that was from a very rough estimate. However, talking with Physical Plant and Jenny Isler, we realized that many of our anticipated cost could be covered and therefore allowed us to only require the funding for plants and the sign. On our presentation to Eco reps on November 8th, 2011, they said they could not fund us the full amount requested, but would definitely be happy to help out with whatever the CSC could not provide. The next day, the CSC voted to fund all the costs we were requesting.

At this point we were very content with the assistance we had and were looking at different grants to acquire more money for the sign. However, when we proposed the rain garden to Jarrad Nunes from Admissions, he offered to help fund more of our project. This means that we should have most, if not all the money necessary to complete our project. In the end of November, Jenny Isler went out and purchased the plants for our garden for us.

Support and Relations

This project has allowed our group to connect with many groups on and off campus. First off, we gained strong relations with Physical Plant and the Sustainability Office. As students committed to our environment, these two contacts will be very important in the future when developing more projects in our next three years here in Clark. We also were placed in contact with Admissions, and have a strong relationship with Jarrad Nunes. We are now in contact with Eco Reps and the Clark Sustainability Collaborative- two of the most prominent environmental student clubs on campus.

In addition to our on-campus relations, we were also able to meet with a group from WPI that was developing and promoting the Mayor’s rain garden project here in the city. Talking to them, it seems like we will be highlighted in their published work and be an active component of the city’s goal. From this group, we were also directed to contact another group, Sustainable Landscapes, at WPI involved with the actual implementation of the Rain Garden.

Conclusions

At this point, our team is not finished with the rain garden. Due to the seasons and timing with Physical Plant, we will not be able to plant the rain garden this semester. However, all members of the initiative have decided to continue with this project and follow through with it until the end. During the next stages of this project, we hope to be

working very closely with Jenny Isler, Joe O'Brien and students from WPI.

Our next steps in this project our going to be to continue contact with Joe O'Brien and students from WPI. With them we hope to develop an overall message for the sign. Seeing as how the Mayor wanted to have 25 rain gardens here in the city (Nugent, 2011), we thought is pertinent to develop signage for all 25 to deliver a similar message throughout the community. The sign would teach people purpose of the rain garden, the effects of stormwater run off and how simple it is to plant a rain garden. Currently, we recognize that it is hard once again to find a time when the Mayor and WPI could meet with us. However, we feel confident that we will be able to find a convenient meeting time, hopefully in late January or early February. Since we are bringing our own draft of the sign with us, drafting the sign might only take one or two meetings. This means that we can probably order the sign by mid-March.

By working closely with Jenny Isler, we hope that we will be able to plant the rain garden this coming spring before graduation. We would be planning an opening day event for all the public to attend to inform people on our rain garden. This is going to take a lot of marketing and advertising for this rain garden to have our intended effect. In the end, the intended outcome of our project will have several effects. First, we want to help reduce the effects of stormwater runoff by the old admissions building. If the rain garden is effective, then we will most likely see reduced amounts of flooding in the basement. However, if the rain garden is not reducing flooding, we will have to take a second look at the design with the BRC and Physical Plant. Also, the opening ceremony would be a day where we would give a small presentation about the rain garden for members of our community to learn about it. The rain garden could be used as a learning tool for Clark and the South Main Community. We hoped not only to inspire others to build rain gardens, but for them to realize how every single action we do can cause a huge impact. We hope that this project will be a great catalyst of the multiplier effect- an idea that wherever there is good design; more positive things will come from it (Orr, 2004).

One of our biggest problems was coordination of schedules with our outside resources to develop the rain garden. Luckily, our group was able to continue and be proactive about delayed responses from some of our resources. We realized that even if one person was not available to meet, there was still other work to be done. As a team, we were well coordinated and found several times throughout the week to be able to meet. It seems like a common theme that we have discussed in our class was about bottom-up and top-down motivation. There are many people motivated to achieve sustainable goals, however it is sometimes limited through an institution. Our project demonstrates that a strong persistence and dedication is the key to overcoming this frequent obstacle. This idea strongly relates to Molnar et al.'s ideas in the article "Using Higher Education- Community Partnerships to Promote Urban Sustainability". There is a tension between the top-down power structures and the bottom-up one's like our group. We worked very hard to develop a strong plan for our project and sometimes felt limited by the top-down regulations like funding and almost having to find permitting. Creating a sustainable relationship requires a more collaborative effort between the two where both parties will feel involved and on equal playing levels. Eventually, I think our group was able to create this type of relationship with many of our contacts.

Another key point that we discussed in class was developing an intimate relationship while working within a local community to adjust to their specific needs

better (Orr, 2004). This class has given our group such a great insight to how Clark, our home for the next three years, works. Through all the networking we achieved, we have developed a strong relationship with many key members within our community. This relationship will hopefully be very important in the future because if we are developing more projects here at Clark, we will have a place to start. We also look to continue reaching out to more clubs on campus such as the Herban Gardeners, Clark's student gardening club, to help support this project in the future. Being advocates of the environment, we hope to only continue our efforts at making Clark a sustainable campus. We hope that this rain garden is just one way of accomplishing this goal and that others will be inspired to do the same. Getting the word out there about rain gardens is important, but it is more important that actual behaviors change (McKenzie-Mohr, 2008). Changing our actions is the only way that a "green tomorrow" is ever going to occur.

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Clark's Arboretum

Jixian He, Olivia Bourque, Phong Bui

Abstract

Very few people are aware of the simple fact that Clark University owns its very own arboretum. The Hadwen Arboretum is located in Worcester, not far from Clark's campus. It is an entirely natural area that has been underutilized and neglected for too long, but holds the potential to act as a source for both recreational and research opportunities on a regular basis. Plus, maintaining green areas in our world's cities is extremely important as our climate changes due to an increase in carbon dioxide emissions. Our team recognized the key role Clark's arboretum plays in these scenarios and decided to work on raising awareness for the arboretum across Clark's campus. We helped organize a walk through the arboretum to increase student involvement, as well as implement a web page and Facebook page dedicated to the arboretum and slides to showcase its beauty. Our attempt to incorporate student learning by contacting faculty members proved less successful, but all five aspects of our project have contributed to the growing effort to raise awareness of the arboretum's existence as a whole.

Introduction

Current evidence proves that global-scale climate change, biodiversity loss and deforestation are major problems facing the world today (Stephens et al 2008). Yet while such facts cannot be denied, society struggles to reduce the impacts of our lifestyle choices. Rapid population growth and major changes in human activities since the industrial revolution have negatively impacted the earth's ecological system (Ecological Global Network, 2011).

As a result, the sustainability movement has been gaining momentum and working towards influencing a more sustainable future. The role of higher education has been considered as a potential change agent in global society's transition towards more sustainable practices (Stephens et al 2008). Sustainable education is of growing importance in today's world (Orr, 1994). There are many problems with modern higher education.

More often than not, higher education causes a disconnect between student learning and nature, separating the feeling from the intellect and the practical from the theoretical (Orr, 1994). Orr stresses that economists are likely not concerned with environmental issues as a result of a gap in the integration of sustainability, and nature, in higher education institutions. Therefore, there is an urgent need to transform the education system to work more closely with nature and promote sustainability.

The importance of promoting sustainable education has been recognized by many universities in the United States (President's Climate Commitment, 2011). Several schools have initiated their own sustainability programs on campus. In the trend of "going green", Clark University has attempted to boost sustainable education and become a greener university as well. Recently, Clark was recognized as one of the leaders of

sustainability, receiving the honor of being recognized as one of the greenest universities in the entire country (CSRP, 2011).

To fully address the growing issue of climate challenge by inspiring people to reduce greenhouse gas emissions in innovative ways, sustainability must be integrated into schools' curriculums and academic research. Students and faculty members will need to work in terms of practical problems and connect their research and studies with social mandate to help create a more environmentally-friendly society (President's Climate Commitment, 2011).

The Hadwen Arboretum is a natural piece of woodland owned by Clark University that has yet to be utilized to its fullest extent. It offers many opportunities for students and faculty to interact with nature and conduct hands-on research. Due to the arboretum's potential to heavily contribute to Clark's growing sustainability initiative, our team project mainly focuses on raising awareness of the arboretum's existence across Clark University's campus community. In doing so, we hope that both students and faculty will begin to take advantage of what the arboretum has to offer them both in and outside of the classroom.

Background

History of the arboretum

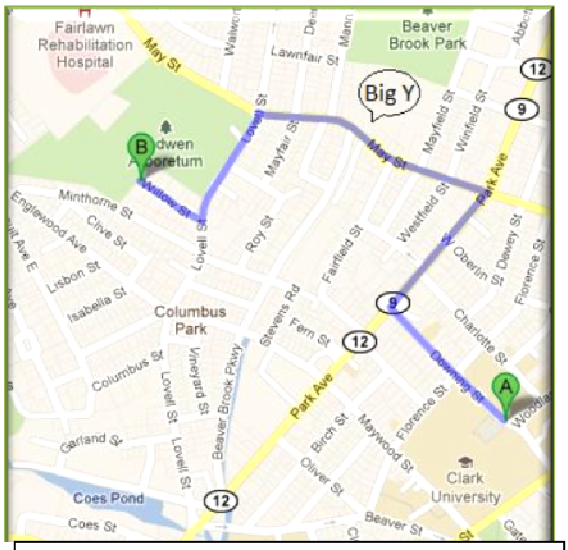
Obadiah Brown Hadwen (1824 – 1907), a naturalist and horticulturalist, bequeathed the arboretum to Clark University for the sole purpose of education upon his passing away at age 83 (City of Worcester, 2006). According to Herwets (2001), Hadwen donated the arboretum to the university with wishes that were clearly stated in his will: "Said estate to be forever kept for educating students in Agricultural, Historical, and Arboreal knowledge scientific and practical. I adopt this course with the purpose in view of preserving the trees and plants growing thereon, being a portion of my life work, shall be preserved as an Arboretum, and an object lesson to assist students in the education of the science and art of Arboriculture and improving the landscape." However, after more than a century since his death, Hadwen's dream has yet to come true.

According to Worcester's Open Space and Recreation Plan (2006), the arboretum was abandoned for several decades. In the late of 1910s, the Biology Department and students of Clark University attempted to submit reports of status and recommendations to clean and restore the arboretum (Clark University Outing Club, 2006). However, the arboretum was considered for sale in both 1921 and 1925 (Herwets, 2001). Opinions changed, however, in 1971 when a group of students found that numerous trees within the arboretum were still produced healthy offspring (Herwets, 2001). According to Herwets (2001), a 1978 report, which was carried out by two Clark students, determined that 40 different types of trees inhabit the arboretum. The report also concluded that the area should be restored to fully exhibit the functions of the arboretum, which held potential value to the university regarding studies within the Biology, Geography and Geology Departments (Clark University Outing Club, 2006). This finding triggered new interest in keeping and restoring the arboretum. As a result, Clark's trustees decided not to sell the land and began restoration efforts within the arboretum in 1985 (Clark University Outing Club, 2006).

General information:

The Hadwen Arboretum of Clark University occupies 6.4 acres, where non-native trees planted in the 1980s thrive alongside native ones (City of Worcester, 2006).

The arboretum is located close to the center of the city of Worcester at the intersection of May and Lovell Streets. It is about 1 mile northwest of Clark's campus (Google Maps, 2011).



How to get there?
- From Downing St. go to Park Avenue St.
- Take a right onto Park Avenue St.
- Walk down Park Avenue St. to CVS and take a left onto May St.
- Keep walking until you see trees on your left (past the Big Y).

Current status

The arboretum has suffered many years of neglect (Herwets, 2001). Despite the university's plan to begin restoration efforts in 1985, Clark has mainly used the arboretum as a compost yard and landscape waste dumping area for several decades (Clark University, 2011). Currently, invasive species have largely overrun the area, which negatively impacts the health of many native trees and blocks major pathways in the arboretum (Stein, personal communication, 2011).

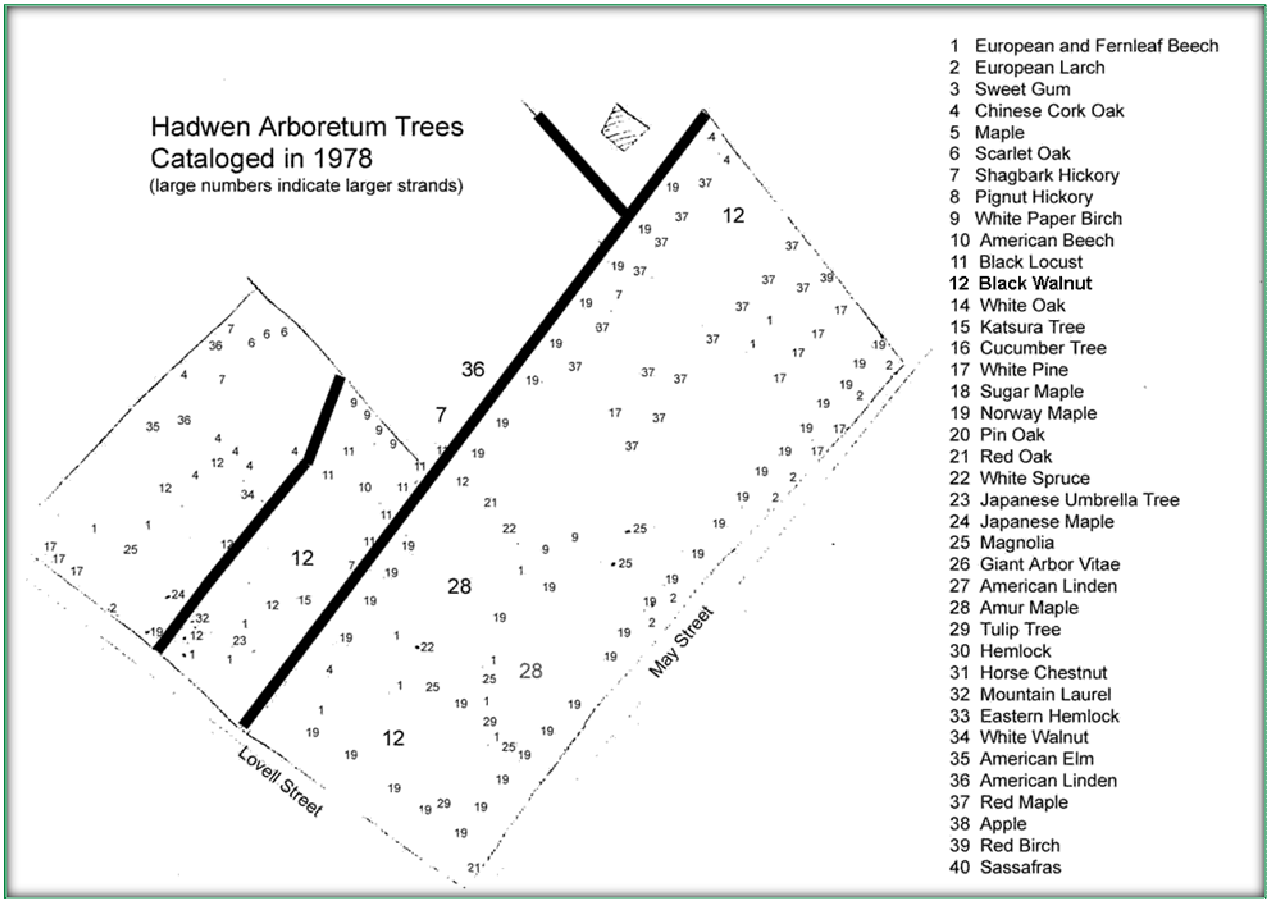
Even so, there are some hiking trails that are still being used by local people to walk through the arboretum (Stein personal communication, 2011). Students of the University Park Campus High School also use these trails for exercise, such as running through the arboretum and nearby Coes Reservoir when suitable weather conditions allow (Tran, communication, 2011). In the center of the arboretum, there is a community garden, which is managed by the Regional Environmental Council. A number of local people, as well as students, get involved by tending to the garden every summer (Arboretum Community Garden, 2009).

The Arboretum as a Resource

In addition to offering a place for recreational outdoor activities such as hiking, the arboretum possesses some other less obvious attributes. According to City of Worcester (2006), the Hadwen Arboretum plays an important role in improving urban and regional air quality for the city of Worcester. The arboretum's plethora of biodiversity constitutes a green area that absorbs carbon dioxide from the atmosphere. Therefore, efforts to maintain the arboretum support plant conservation initiatives as well as reducing air pollution (City of Worcester, 2006).

Moreover, the Hadwen Arboretum provides opportunities for improved human interactions with nature in multiple ways. The community garden, first of all, acts as a place where people can learn to grow their own vegetables for fresh food (Arboretum Community Garden, 2009). The arboretum also represents a potential resource to aid with natural and sustainable education, as it could be a location for outdoor classrooms and

field trips (Isler & Stein, personal communication, 2011). There are 40 different tree species, numerous invasive species, and a variety of small plants within the arboretum (see the following chart).



Sources: Clark University Outing Club
http://www.clarku.edu/students/outingclub

Process

Over the course of the semester, our team completed several different related initiatives that all focused on raising awareness about Clark's arboretum. Our first major effort involved coordinating a walk through the arboretum to increase student participation and awareness through advertising. Another initiative was adding a webpage dedicated to the arboretum to the Sustainable Clark website. We also contacted professors who may be interested in utilizing the arboretum's resources in their courses, submitted seasonal slides to showcase the arboretum's beauty at all times of year, and formed a Facebook page to further extend our efforts to the online community.

Walk through Clark's arboretum and Coes Reservoir

Our project began with the primary goal of getting more people from Clark University interested in visiting the arboretum. So, our team decided it would be a good

idea to plan an event that involved taking intrigued students to the arboretum and giving them a first-hand experience of why it is such an interesting place worth visiting. We collaborated with members of HAS TREES, the student-run organization that focuses on improving conditions within the arboretum and encouraging student involvement, because they were already planning on hosting a walk from campus to the arboretum and nearby Coes Reservoir in the coming month.

Members from our team attended HAS TREES' weekly meetings to discuss the possibilities, learn what they thought would be most effective, and receive feedback on our own ideas. We all eventually agreed that Saturday, October 22nd would be the date of our walk and proceeded by divvying up the responsibilities to prepare for the event.

Our team focused on advertising for the walk in several ways. To start, we sent emails to the various sub-communities within Clark including the International Development, Community, and Environment (IDCE) department, the Chinese student community, and the Vietnamese community at Clark. Then, in order to achieve more widespread awareness of the event, we hung posters made by HAS TREES member Jordan Stein all over Clark's campus after getting them approved by Residential Life and Housing. Posters advertising for the walk could be seen on bulletin boards in Jonas Clark, freshman dorms, the IDCE building, and outdoors. We also made sure that more Clark students knew about the walk by creating a Facebook event explaining what it was and inviting people to it. These three methods, in addition to effective direct communication, were all meant to raise awareness for the arboretum on campus and get people excited about visiting it.

After extensively advertising for the event, we began planning and organizing the walk itself as the date came closer. Our team asked for and received funding from the Graduate Student Council to purchase water and apples for those attending the walk. We also coordinated with HAS TREES once again to have at least two members join us and lead the group while explaining the importance of the arboretum along the way.

Web Page Implementation

The second stage in our process involved designing a webpage to be incorporated into the Sustainable Clark link on Clark's website. Since there was no mention on the website about the Hadwen Arboretum, we thought creating a webpage would be an effective way to raise awareness of the arboretum for those interested in what Clark has to offer.

We received help and support from Jenny Isler, the Sustainability Coordinator at Clark, who runs the Sustainable Clark website. She suggested providing general information about the Hadwen Arboretum that Clark students and the general public could easily access online. So, we submitted a draft for the web page that included the arboretum's location, directions on how to get there, and a description of what there is to do there.

Contact with Professors

In an effort to further extend the arboretum's use beyond purely recreational activities, our team decided to work towards incorporating it into the curriculum at Clark. While we knew that this would take a lot more work than we had time to accomplish in one semester, we wanted to at least get the process started. In order to do so, we

contacted professors who we thought might be able to utilize the arboretum within at least one of their courses.

We emailed professors Chi Ho Sham (International Development, Community and Environment), Dominic Kulakowski and John Rogan (Geography) explaining what the arboretum is and its potential use for their students. In doing so, our team both spread awareness of the arboretum through a portion the faculty community and encouraged the incorporation of more local field trips and outdoor classrooms within Clark's curriculum.

General Advertising in the Cafeteria and Academic Commons

Another step in our process included designing power point slides to be posted on the TVs in the library's Academic Commons and slideshow in the cafeteria. Our team began by creating one slide headed with the phrase "Have *you* visited Clark's Arboretum yet?" We then added general information including directions, what to do when you get there, and pictures taken during our walk event to showcase its beauty.

After completing this slide, Jenny Isler suggested creating four subsequent slides to advertise different aspects of what the arboretum has to offer in each season. So, we designed slides for each season, titling them: "Summer Retreat", "Fall Beauty", "Winter Wonderland", and "Spring Delight". Each one gives directions to the arboretum from Clark's campus, as well as seasonal photos and a unique description of what there is to do there at each specific time of year. Since we are not a formal club or organization on campus, Jenny Isler agreed to submit the appropriate slides when each season arrives.

Facebook Page Implementation

The final step in our process was to create a Facebook page dedicated to the arboretum. We hoped that doing so would contribute to greater community understanding of what the arboretum is and how people can use it. Given that so many Clark students use Facebook today, we thought this would be a good outreach tool. So, we designed a page titled "Clark's Hadwen Arboretum" that includes a brief description of where the arboretum is and what it can be used for. We also added pictures from the walk on October 22nd to give people a better understanding of what the arboretum looks like.

After completing the page, we invited our friends within the Clark University network on Facebook to look at and "like" it. By spreading information about Clark's arboretum online in this way, more people are bound to at least take the opportunity to learn what the arboretum is and gain a better understanding of why it is important.

Results

Walk through Clark's arboretum and the Coes Reservoir

On October 22nd, the walk was a success. Many people expressed interest ahead of time and twenty-eight enthusiastic Clark students actually attended the event. We walked from the University Center on campus, to and through the arboretum, around the Coes Reservoir, and back to campus. It was a beautiful fall day, allowing the hike to be both enjoyable and a learning opportunity. People took many pictures along the way while listening to Jordan Stein explain the history behind the arboretum, as well as its current state. Our team also provided water and apples to those who came.

As a result of our event's success, we continued to communicate with the students who attended or showed interest in the arboretum for various reasons. Additionally, since many were curious when another opportunity to walk to the arboretum would be, our team decided to send out a follow-up email to all the same people we sent the invitation for the event to. The email was meant to let students know how the walk went and further encourage them to get involved and visit the arboretum on their own. While we have no concrete evidence of whether or not more people are visiting the arboretum following this event, continuing to raise awareness is of crucial importance in influencing people to do so.

Web Page Implementation

With help from Jenny Isler and the Office of Sustainability at Clark, we were able to get the Hadwen Arboretum page added to the Sustainable Clark website. Some slight adjustments were made, and then it was fully implemented on December 6th. Now that a description and map showing the location of the arboretum are included on the Clark website, anyone who visits will be able to recognize that the university owns this piece of land in Worcester and learn more about it. Even though we have no measurable evidence to show the impact of this addition to the website quite yet, it can be assumed that the page's presence will further our efforts to raise awareness for the arboretum's existence.

Contact with Professors

Our first set of emails sent out to the three professors received no response. We understood that they must have been busy with the end of the fall semester coming up, but decided to send follow-up emails after about a week with no answer. Each professor responded to the second email and expressed interest in the idea of incorporating a visit to the nearby arboretum into one of their courses. However, they were all too busy to discuss the options at the moment.

While our team's efforts to get Clark faculty involved in increasing the arboretum's use by members of the Clark community did not result in any specific new initiatives, there is hope for the future. Some of the professors suggested contacting them in the spring to further discuss the possibility. Therefore, even though it may be difficult to achieve, there is still some potential to implement our plan in the following academic years.

General Advertising in the Cafeteria and Academic Commons

Once the first power point slide was completed, Jenny Isler submitted it to be put up at the end of November. It could be viewed by anyone on the first floor of the library in the weeks following fall break. Therefore, our slides effectively helped to raise general awareness of the arboretum during the first semester in this way.

As for the other four seasonal slides, they have yet to be showcased, but Jenny Isler is planning to send each one in for submission as the seasons change in the upcoming years. These slides, therefore, will continue to raise awareness after this semester is over by showcasing why people should go to the arboretum in each season. This message will be spread to much of the Clark community, since it will be viewed by anyone eating in the cafeteria or studying in the Academic Commons of the Goddard Library.

Facebook Page Implementation

So far, the Facebook page for Clark's arboretum has only gotten five "likes" and does not seem to be frequently visited by many Clark students. However, despite the fact that it is not yet widespread, our team plans to continue inviting more people to view the page. We will also continue to update it with current information and photos of the arboretum. Spreading the word through Facebook is an ongoing process that can continue on in the years to come and have a major influence on our efforts.

Conclusion

Our team's project effectively achieved our goal of raising awareness of Clark's arboretum within the campus community. Many people who had never even heard of the Hadwen Arboretum were suddenly interested in visiting it. This minor improvement can be deemed a huge success by being the first step in encouraging more student involvement with the arboretum. Even so, our project is just the start of a larger effort to encourage outdoor classrooms on college campuses and get people more involved with enjoying and preserving natural spaces like the arboretum in cities like Worcester.

Over the course of the semester, our team successfully spread the word about the arboretum's existence in several different ways. To start, we got more students interested in accessing the arboretum on a regular basis by co-hosting a walk through the arboretum. We then further raised awareness by providing information on the arboretum in different ways both across campus and online. While our team also attempted to promote the arboretum as a potential learning opportunity as well, we have only made significant progress regarding its recreational purposes.

In order to ensure that the progress we have made does not go to waste, our team recommends that contact continues in the future with any professors who may be able to utilize the space and resources within the arboretum. Hopefully doing so will allow for sufficient strategies to incorporate the arboretum into Clark's curriculum, even though altering it is often difficult to achieve. Our team also encourages raising awareness of the problems faced by the arboretum in its current state. Such efforts would hopefully further plans for restoration within the arboretum, including maintaining trails and suppressing invasive species, so that it can be more easily accessed and enjoyed. A final suggestion our team has for the future regarding Clark's arboretum is to organize more events such as the walk we had on October 22nd to show people just how easy it is to get over there and exactly what it has to offer them.

HAS TREES continues to work on these aspects of restoration and raising awareness for the arboretum. At the same time, our team is devoted to continuing our work in various forms of advertising past this project. However, more support from the Clark community would be beneficial to our efforts. In order to ensure that Obadiah Hadwen's wishes upon handing the arboretum over to Clark University are fulfilled, every learning opportunity that lies within the arboretum must be utilized.

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Campus Garden and Food Systems

Ginny Cooke, Ruth Vizard, Emily Smela, Zach McArthur, Corinne Jachelski

Abstract

Clark's Food Systems includes many organizations, devoted to making sustainable edibles more accessible. Food Truth, Ecological Representatives (Eco-Reps), and Herban Gardeners are especially focused on environmentally-friendly food practices. For the Sustainable University class, our team focused on projects that would assist the Herban Gardeners. We initiated endeavors that would enhance the gardeners' understanding about conservation agriculture, improve the club's internal organization, and enable their future expansion and outreach. To reach these goals, we set up an online resource guide and submitted a revised charter and applications for funding. Participation in other club events showed us techniques to engage the Clark community. To prepare the Herban Gardeners for future outreach, we made a closed terrarium, a pilot project for a workshop they will host in the Spring 2012.

Jenny Isler teaches the Herban Gardeners a springtime planting lesson

Introduction

Since the Green Revolution, consumers have become increasingly dissociated from the origin of their food. Agriculture expanded and advanced as the world population skyrocketed. Technological improvements allowed for these drastic changes to occur, but also contributed heavily to the issues that are seriously impacting the environment. Increased use of fertilizers and other harsh chemicals have polluted soil and water (Farm Sanctuary, 2011). Factory farming practices have released tons of toxins into the environment, rapidly speeding up the effects of climate change. The agricultural sector contributes to about 13.5% of human greenhouse gas emissions, such as carbon dioxide, methane, and nitrous oxide (McKeown, 2009). Cities import mass quantities of food from around the world. Large scale food preservation and transportation infrastructures require tremendous energy (Farm Sanctuary, 2011). The sustainability movement in the United

States works on many fronts, one of which addresses our prevailing food system. Centralized food manufacturing creates a lot of waste in growing, processing, packaging, and distribution. The sustainable food movement strives to bring all of these processes closer to the source of demand, the consumer. Community gardening is just one of many programs implemented to engage consumers with subsistence processes, which are normally overlooked.

Gardens can reduce energy that cities use to feed the population. Homegrown vegetables cut down on transportation and food packaging, two contributors of enormous waste. In 2008, the average amount of waste generated by each person in the United States per day was 4.5 pounds (Clean Air Council, 2010). Cultivation can teach consumers about energy inputs and outputs, perhaps making them more likely to reuse and conservatively use resources. Many gardeners reuse plant waste and graywater, which lessens the load brought to landfill and preserves runoff from sewage systems. Urban agriculture encompasses everything from window farms to greenhouses. Innovations to involve the consumer in food production and consumption are rapidly emerging (Farm Sanctuary, 2011). Fortunately, local and organic farming is a trend that is capturing many consumers' attention (Arias, 2009).

Urban and community gardens are beneficial not only for environmental reasons, but also for social and economic reasons. Farming can bring together communities, give direct links to food production, create jobs, and foster education in self-sufficiency and health (Hamm, 1999). Economically, local food can be beneficial to people of all income levels and create a stronger local economy. For example, Worcester has developed a program through the Regional Environmental Council called YouthGROW. Through this program, community youth learn organic farming, participate in skill-building workshops, develop group projects and participate in youth empowerment and leadership development activities (YouthGROW, 2011).

Institutions of higher learning have been very supportive of the movement to purchase and grow food locally. Colleges and universities of all sizes have begun to incorporate sustainable practices into their dining halls by getting rid of trays, composting, and simply trying to educate students about what they are eating and the origin of their food (Arias 2009). There are over a hundred universities that have developed some sort of campus garden, either run by student groups or by the university (Valluri, 2010). The community garden at the University of Portland, for example, has been running since the spring of 2007 (SLUG, 2011). It states its purpose is to help build relationships between students, their food, the environment, and the Portland community (SLUG, 2011).

Even in Clark's small community, food sustainability is a complex and multifaceted system. Dining Services is gradually purchasing more local, organic food. Food Truth is a club that was established to "raises awareness about the social, political, ethical, environmental, and health impacts and implications of what we eat" (FoodTruth, 2011). Ecological Representatives (Eco-Reps, 2011) promote sustainability within residence halls, recently implementing a successful composting program in Maywood Hall. Herban Gardeners is the name of the campus group that tends the campus garden and is an outlet for amateur planting. Based on meetings with members of the Dining Services staff and the success of community gardens at other schools, we started to focus

exclusively on the garden. Part of the basis of the Campus Garden is to increase awareness about sustainable food practices and healthy food choices.

Our team invested our time mostly towards the Clark Community Garden and strengthening the Herban Gardeners, as the other food related organizations on campus are more established and already fairly advanced in their sustainability efforts. Though the garden has existed for nearly two years, it has been slow to expand due to lack of funding and lack of knowledge that it exists. Upkeep and expansion of Clark's garden is a worthwhile venture to give momentum to food sustainability on campus. This project is meant to empower the Herban Gardeners' self-teaching, so that more members of the group have the skills to teach others about gardening and its role in the sustainability movement. This includes enhancing cooperation with other organizations, and establishing the clubs' rapport within the Clark community. As the garden grows, more opportunities may arise for sustainability to be incorporated at Clark.

Background

Two Clark seniors, Brenna Schwert and Abby Kaminski, started the campus garden in the spring of 2009. They won second place in the U-reka contest, a competition which offers grant money for student ideas focused on sustainability. The idea for the garden won them enough money to buy five raised beds, soil, seeds, tools, a tool shed, and many other necessities needed to start and run a garden (Clarku portal). Five raised garden beds now stand in the back of President Field, across from Estabrook Hall, on Charlotte Street. The garden got off to a slow start with only a handful of gardeners and beyond the U-reka funding, the initiative has not received additional support through Clark, because the group was not recognized as an established club. There were some vegetables being grown, however it wasn't until the summer of 2011 that crops filled all of the beds. This semester (Fall, 2011), while the club was busy preparing for the next growing season, our group assisted with administration and event planning to help the garden get back on its feet.

Aside from the garden, there are many other sustainability related initiatives around campus. Clark University Eco-Reps is a student run organization with the goal of promoting sustainability on campus and making sustainable living as easy as possible for students (Eco-Reps, 2011). Their emphasis is on student life in the residence halls; however, they still have piloted some food related initiatives such as the campus compost (Eco-Reps, 2011). They also occasionally set up group trips to the local farmers market (Eco-Reps, 2011). Food Truth is another student group that focuses on sustainable food practices on campus. They recently hosted an event called "A Better Plan for Clark Dining Services" which focused on outlining ideas for how Clark Dining Services could become more sustainable (Food Truth, 2011). They looked over Dining Service's already established sustainability action plan and asked students for their ideas and critiques of the plan in order to improve it. (Food Truth, 2011).

Food has become an important part of the sustainability movement, and Clark, along with many other universities, are doing what they can to tackle this issue. There are many sustainability initiatives in which Clark and its student groups participate, and environmentally-friendly food is a priority. Clark Dining services has also shown its commitment to sustainable food. Quality fresh food is not a common characteristic of cafeterias, but Dining Services has taken initiative and is continuing to put sustainability

at the forefront of its mission. The Campus Garden has the opportunity to play a significant part in these modifications, with the potential to sell herbs grown on the campus garden to dining services.

Process

When our team formed at the beginning of the semester, it was clear we would represent food systems from across Clark University's campus. The team included one FoodTruth representative, one Eco-reps member, and two Clark Herban Gardeners. We first decided to look into each part of Clark's sustainable food movement, which included organic and healthy living education and cafeteria green food policy. Initially, we considered focusing our project on the Real Food Calculator, a tool provided by the organization The Real Food Challenge, which assists colleges and universities in getting more sustainable food onto their campuses. The Calculator measures how much "real food" (local, organic, fair-trade, and humane) is present on a campus. At Clark, the Calculator had just begun being implemented in the summer 2011. We took a tour with Heather Vaillette, Dining Services Manager, who played a vital role in assisting with the calculator by providing access to purchase orders and contact information of all the providers Dining Services buys from. She gave this information to Anthony Oduro, a graduate student at Clark ('12), who is working on the Calculator for internship credit. Heather also gave us a tour of the kitchen and gave us the document "A Better Plan for Clark Dining Services", which can be found on the Dining Services website and provides an outline of initiatives Clark Dining Services engages in, statistics on current food purchasing, and future goals. Heather also told us that if the campus garden grew herbs, Dining Services would be interested purchasing them from the Herban Gardeners. This means the garden could attain some extra income and all Clark students would be able to sample some garden gleanings. After this meeting, it seemed that the Real Food Calculator did not need an exceptional amount of assistance, as Anthony was doing the research for it and receiving credit. Eco-Reps also had great projects going, but were very capable at implementing and outreaching. It was clear that the Herban Gardeners would benefit the most from our assistance, so this club became the project focus.

After talking with the gardeners about their goals and concerns, we thought our main goal would be to expand campus knowledge about the garden. Jenny Isler, Clark's Sustainability Coordinator, who also advises the gardeners, suggested that as we prioritize our activities we consider that the growing season was ending and winter was on its way. Advertising when there was not much garden work to do would perhaps not be the most effective way of strengthening the gardening club. This transitioned our goals away from outreach and towards projects that improve the physical space of the garden. We decided the best way to approach this would be to enact certain "rehabilitation projects" such as a sign for the garden and creating a sitting area. Presenting a aesthetically pleasing environment would hopefully help to give the community a positive impression and get people interested in coming to events or joining the club. In addition to the aesthetic improvements, we had some logistical fish to fry. Our to-do list: apply Herban Gardeners for student council recognition by submitting a charter, update LINK co-curricular website, get funding for the garden, and do research about winter planting to help the gardeners plan ahead. We also decided to propose future collaboration with Dining Services and some Food Truth events.

Our first project was sparked by our connection with other clubs on campus. Our Eco-reps representative Corinne Jachelski informed us of the sustainable dinner her club was organizing. The sustainable dinner is an event that brings together organic vegetarian dishes from Clark students in Tilton hall. At the request of the gardeners, we took two beds of green tomatoes from the garden and fried them so they could be served at the event. The two beds amounted to around 40-50 tomatoes which fed around the 30-40 people that showed up at the dinner. By clearing out the beds for the gardeners they were able to start planting for the winter months without having to worry about their excess food supply.

Our next project was to get the Herban Gardener club funded, so they could build an herb garden to sell to dining services. This took us into weekly meetings with the gardeners and a meeting with Katie Copenera, who works in Student Life and Planning and helps clubs with logistical aspects, to work on creating a charter and apply for funding for the group. It was a great collaboration with the gardeners who needed to focus on maintaining the last of the summer yields and didn't have time to focus on more office- minded work. After the charter was finished and submitted, we applied for a two-semester waiver for funding. The club has been listed as 'inactive' for the past few semesters, a label that limits certain grant qualifications. Overriding the mandatory wait period of two 'active' semesters would get the gardeners' needed finances to upkeep the beds. One thing we found helpful was the responsiveness of Clark faculty when talking to them in person. Like other groups, we quickly realized that e-mailing people was not as effective. It took almost all semester to get responses when it came to student council recognizing the charter, and responding to questions about funding and the two-semester waiver form. However, we did finally get confirmation that the garden was officially an active club once more and will hear back on the funding waiver and a budget for next spring before the Spring semester 2012 begins.

In terms of rehabilitating the garden, the biggest project we took on came to us by storm. After the huge snowstorm that blew through campus on Halloween, we came up with the idea to gather the large logs and branches that were scattered around campus and use them to make a sitting area. We spent about a week scoping out the best wreckage, and rolling (heavy!) logs over to the garden. One day during the transport process, physical plant workers saw our struggles and trucked over some of the biggest stumps, saving us time and lots of sweat. These stumps were the basis to create a spacious sitting/meeting area for people who visit the garden.

By request of the Gardeners, we also created an experimental terrarium. A closed terrarium is a sustainable ecosystem made out of rock, dirt, small plants, and moss. Water circulates through the system, so the contents rarely need hydrating. This was a project that the gardeners want to do as an event and needed a trial run to see just how well it worked. We successfully made a pilot terrarium and the Herban Gardeners are excited and prepared to do a terrarium making event next semester.

In the beginning of the semester, we had hoped to apply for outside grants for the garden. However, this proved to be more difficult than we previously thought, as the garden needed some general maintenance and direction before applying for some of the grants we were looking at. In response, we decided to set up a website the gardeners could access in order to get this grant information, as well as information on gardening tending and other helpful advice that we found in our research over the semester. We

actually put more energy into this website than into the co-curricular LINK page. This resource is easier for the gardeners to communicate through and share ideas, while LINK is a guide for events and advertising. The link to the website can be found here: http://herbangardeners.webs.com/

One of our biggest challenges this semester was working in a group of five. Being the largest group in our Sustainable University class, we needed to divvy up workloads a lot more. Each member had to take on a very specific role, and sometimes lines got blurred. This led to accidentally repeating other team members' work. One of our biggest advantages was that our group consisted of representatives from several sustainability organizations across the campus. Without connections to Eco-Reps, for example, dozens of our tomatoes would have been discarded as compost.

There was a huge mindset shift from the beginning to the end of our project. We started out trying to turn the garden into a campus wide resource, but realized it will be unable to be an educational facility until it is financially and organizationally stable and aesthetically appealing. We became the gardeners' liaisons to the more official sphere of Clark, which will enable it to expand and start holding workshops with the Clark community in semesters to come. The garden is an experimental and educational environment, creating awareness about sustainable food from the space it occupies.

Results

The results from our project came from tangible goals that we set and accomplished over the semester. Our first major goal was to re-establish the gardening club as an official club on campus. Submitting a charter to student council set the stage to get funding for next semester. We applied for a mid-semester budget for Spring 2012, and a waiver to override the two-semester wait period for club funding. Herban Gardeners had been active for the past two years, but unaffiliated with student council. We also created a website for the gardeners to access when they need information on gardening, funding, and food news: HYPERLINK "http://herbangardeners.webs.com/" http://herbangardeners.webs.com/

Review of Food Sustainability Events, Fall 2011

During this time, we also kept a list of food sustainability related events that occurred on campus during the semester. Eco-Reps, the sustainability club on campus that focuses on behavior change, specifically in the resident's halls, kick-started their composting pilot project this semester. They put compost bins on each floor of Maywood and Blackstone. When they completed their annual waste audit, in which they collected waste from each resident hall and sorted through it, they found that Maywood had the highest composting rate and lowest amount of landfill waste. The Eco-Reps also hosted a sustainable supper, which the Herban Gardeners contributed to by providing fried green tomatoes.

Eco-Rep logo
(LINK, 2011)

Food Truth, a club dedicated to raising awareness about food sustainability and working with Dining Services to provide more local, organic, fair trade, and humane food in the cafeteria hosted a variety of events this semester. They arranged for the Real Food Challenge, a national non-profit organization that helps students at colleges and universities work with their dining services to provide more sustainable food option, to come to Clark on their annual "Road Trip". This event allowed students to learn about dining services food systems and also provided a space to organize for future endeavors, specifically getting the University to sign the 20% by 2020 agreement, which would commit the university to achieving 20% "real food" (by the Real Food Calculator's criteria) by 2020. The Food Truthers also hosted an Eat-In, in which students brought their own dish for a potluck style meal that cost under $5 to create, in an attempt to show that homemade, fresh food does not have to be an expensive endeavor. They also promoted the "Just Label It" Campaign, a national campaign to label genetically modified organisms in the U.S. They hosted a collaborative event on Dining Service's Better Clark Tomorrow Plan, a document that outlines Clark's dining service commitments, accomplishments, and future goals. Students read through the document and presented critiques and ideas for future improvement of Dining Service's sustainable practices. Lastly, Food Truth hosted a granola making workshop, in which students were able to make their own custom granola.

Dining Services kickstarted many initiatives during the summer and fall. Over the summer, they began utilizing the Real Food Calculator, a tool the Real Food Challenge provides to universities to assess the amount of "real food" they have, focusing on categories of organic, local, humane, and fair trade. Dining services also hosted the first ever Food Day, a nation-wide event that many college and universities participated in for the first time. They had their vendors and local environmental and health organizations come to Clark to talk with students and offer tasty free samples. Dining services also finalized their Better Plan for Clark Dining Services and put it up on their website for the public to view. One huge achievement for Dining Services was receiving MassRecycles 2011 GOLD Award for its outstanding efforts to increase recycling and eliminate waste.

Herban Gardeners, the club on campus that maintains the campus garden and helps raise gardening awareness assisted in the Sustainable Supper by providing and abundance of Fried Green Tomatoes. They were also hard at work with the general upkeep of garden and planted some root vegetables in November to see if they could produce some yields during the winter months.

Hillel, the Jewish club on campus, hosted Eco-Kashrut, in which a rabbi came to talk about the religious connections to eating local, sustainable foods.
The Student Alliance for Vegetarian and Vegan Youth hosted their annual Thanks(l)iving, providing a vegan Thanksgiving meal and promoting awareness about humane food production.

The Food Co-op became established this semester and won $20,000 from student council. They are also applying for more funding through Ureka!, an annual competition for innovative ideas. They have arranged to set up the co-op in the Grind, located in the basement of the University Center, and will begin organizing and purchasing for the store to open sometime next spring.

Outcomes & Conclusions

Gardening encourages hands-on learning that our group deemed beneficial to the Clark community. Our goal to enable the Herban Gardeners' learning will result in more successful outreach efforts. Improving the garden administratively and aesthetically involved a series of small projects, like writing a charter, making a sign, and applying for a budget. Revisions on the club's LINK page, compiling an online resource guide, and testing activities for future events helped club coordinators develop methods to teach the community about urban gardening. Our group even put together a sitting area next to the beds, improving visitor friendliness. Students and faculty are beginning to notice progressions at the campus garden, sparking interest from a spectrum of gardening backgrounds.

Sitting area in the garden (Corinne Jachelski, 2011)

A summer day's harvest, enough for a two-person dinner

Alex Pollack (July 2011)

These projects worked towards the purpose of achieving goals, determined through collaboration between our team and the Herban Gardeners. The garden's expansion and community outreach is crucial to its influence on campus, but we quickly realized that the club had more internal needs. Changing the goals towards helping the club maintain internal stability was necessary for future expansion and outreach. We focused on projects that would enhance the club's organization and gardening—this goal helped the gardeners help themselves. We wanted to lead the gardeners towards knowledge of upkeeping gardens and where to get money to do so. Outcomes that support our revised goal include charter submission, an online information guide, a sitting area, and pilot projects for events (e.g. terrarium-making, fried green tomatoes). These accomplishments set the stage for garden expansion and outreach during next semester (Spring 2012). While we tackled these projects, the Herban Gardeners were able to reach landmarks for the gardening season. They harvested crops, constructed a setup for winter planting, put compost in beds to enrich soil for spring planting, and planned for next growing season.

While a school year lasts from September to May, the most productive harvests coincide with the summer. This incompatibility between maximum food production and maximum student presence could present challenges when promoting events and outreach. Relationships with other institutions (Clark Sustainability Collaborative, Food

Truth, Food Coop, Dining Services, future Sustainable University projects) are therefore vital for the garden's survival, especially over the summer.

There are schools, deep into education reform, that keep students involved in their own lives through an interdisciplinary curriculum. Natural processes and basic needs are at the foundation of domestic vulnerabilities and national tensions. Teaching about subsistence sets the context for the history, science, and politics that govern our lives. Environmental education is especially important in cities, where there is little display of human-nature harmony. Ecologically safe food production is a part of a larger sustainability movement aimed at countering environmental degradation. Sustainable food advocates encourage alternatives that avoid monoculture techniques, toxic runoff, and wastefulness that are all characteristic of factory farming. Backyard gardening is an excellent activity for the classroom, family, and any one who is curious about their food. Growing plants can foster a community's collaboration, a key element of a sustainable system. As the Herban Gardeners learn basic farming, solid teamwork skills will help efficiently maintain the beds. Genuine cheer among members will make it more likely for outside participants to have a positive experience working with Herban Gardeners. Sustainability is a broad concept, which includes behavior change for many activities. Since this movement promotes values that are different, sometimes against, the prevailing western culture, implementing change is a delicate process. Rewarding experiences, like gardening, that involve sustainable values may motivate people to start being ecologically mindful.

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Campus Sustainability Initiatives, Inventory, and Outreach

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Abstract

The goal of the Campus Sustainability Initiatives, Inventory, and Outreach project was to create a comprehensive communication message about all the initiatives underway at Clark University towards enacting and demonstrating sustainability on campus. The team investigated sustainability and outreach programs at other schools, met with numerous members of the Clark community involved in these initiatives, researched and expanded on three of the sustainability initiatives identified on the schools sustainability inventory list, and worked collaboratively with Sustainable Clark. Going forward, one of the benefits of these efforts could be the creation of a set of "stories" on sustainable initiatives that can be used to message and portray quantifiable success. These stories could be an effective communication tool for use by many of the school's interested parties, including Marketing, Alumni Affairs, Sustainable Clark, etc.

Introduction

On the American College & University Presidents' Climate Commitment (ACUPCC) website there is a document called "Leading Profound Change", which sheds light on the Presidents' Climate Commitment. This commitment is taken on by several colleges/universities throughout the United States. The ACUPCC calls for major change and leadership within an institution in regards to sustainability. Three tenets propel ACUPCC and its mission forward: The first tenet is to treat sustainability as a major transformative initiative employing all the leadership skills of major institutional change. Second is to invoke the power of communication and campus-wide involvement. And third is to empower a dedicated group to establish tangible metrics, milestones, and concrete results (ACUPCC, 2009). These tenets are not just vital to this climate commitment, but it is also imperative in motivating communication about the impact of sustainable initiatives and an institution's commitment to sustainability. Higher education institutions' communication and commitment is necessary in creating new ways of thinking, interacting, producing and consuming needed to overcome the interrelated sustainability challenges in global society (ACUPCC, 2009).

There have been many reports on financial and educational institutions' communicating accomplishments in sustainability both nation-wide and internationally. Existing communication methods include social networks, online surveys, one-on-one or group dialogue, corporate and scholarly magazines, electronic newsletters, postings and bulletins, and formal written reports. In fact, there have been proposals that formal written reports are often chosen as the primary means of communicating corporate sustainability initiatives. In 2007, two-thirds of the Global Fortune 500 issued some type of non-financial report about sustainability (Reilly, 2011). It is important to establish consistent and reliant communication outlets. Establishing effective and efficient

publicizing and communicating has been explored by various organizations and online sources, such as *aabri.com* and *sustainabilityroadmap.org*. There are several scholarly references on educational institutions and ineffective communication and commitment methods.

Professor Sheryl D. Breen's "The Mixed Political Blessing of Campus Sustainability" Breen argues that there is an illusion of institutions' dedication to sustainability and environmental causes within financial and educational institutions. Even though there is evidence of grass-roots movements and sustainability projects advertised throughout the campus and online "an examination of the campus sustainability movement gives far less satisfaction than its rhetoric suggests" (Breen, 2010). The language that is used to communicate sustainable initiatives must not only be impressive, but the description must convey the actual impact that the initiative has on the environment and sustainable behavior.

Professor Carina Molnar and the other co-authors of "Using Higher Education Community Partnerships to Promote Urban Sustainability" emphasize the significance of sustainability initiatives and their impact on the community. Institutions act as "microcosms for sustainability" and they reflect the importance of integrating sustainable initiatives and communicating their influence to their respective communities, as well as the national and global communities. Sustainable initiatives' presence in a community can a clear impact on their surround environments, and without solid communication established throughout the community "…a critical issue is that partnerships that include externally …defined solutions to local problems, without firm and grounded community input, often can result in negative, unintended consequences for the community" (Molnar, 2011).

There is the challenge of commitment to initiatives within an institution and how these initiatives are passed down amongst members of an institution. Higher learning institutions, global organizations, and local grass-roots movements all need methods to improve the publicizing of sustainable initiatives, and creating a system of inheriting these initiatives so that they do not die out. Breen pin points the difficulty in sustaining sustainability initiatives in an university for long enough to make a decent impact as "because most students cycle through the campus within a few years, projects and levels of commitment also tend to surge and wane" (Breen, 2010). People move on or are too busy to continue and some initiatives can disintegrate or do not move on from the primitive stages. But just how the campus environment breeds communication and commitment issues, it also provides solutions through the curriculum and student activism.

Communication and collaboration are critical to almost all sustainability initiatives, whether on a local or international scale. Sustainability problems can often be attributed to poor communication skills, competing priorities, geographic disparity, technological differences, and a myriad of other challenges. This issue of communication and collaboration, as well as potential solutions, is addressed in the American College & University Presidents' Climate Commitment and other scholarly documents and analyses.

The Sustainable University course is the concept of "the university acting as a microcosm for sustainability and sustainable behavior" put into action. Molnar's concept of higher-learning contributing to urban sustainability is also applicable to the structure and purpose of the Sustainability University course. The course takes an active role in

promoting sustainability on campus and in the community. The course also creates new opportunities for students, faculty, and the Worcester community to take on a more sustainable lifestyle. The course does this through the open dialogue-based structure and the team projects. The course also helps to solve the issue of passing down sustainability projects by instilling a passionate, collaborative, and committed mindset when it comes to sustainable initiatives. With the existence of the Sustainable University course and the Sustainable Initiative Inventory Google document there is continuous initiative development and their impact on the environment. It is important to focus on the issue of communication, collaboration, and commitment on a campus-level because of the fact that colleges and universities act as microcosms for sustainability.

Background

Instituting and promoting sustainable practices at educational institutions is growing and improving as a way to test the applicability of these practices in the public/commercial world (Sharp, 2009). Clark University has undertaken a number of sustainability initiatives and there is an acknowledged desire to use these initiatives to realize savings, enhance curriculum, and promote better alumni outreach programs (The Sustainable University, 2010). One obstacle to realizing the goal of alumni outreach is the lack of communication between the Alumni Affairs Office and the various departments and projects working on sustainability issues. A vehicle to consolidate and highlight these initiatives could help to bridge the various interests.

Hannah Terril-Wysocki initiated the creation of the Sustainable Initiative Inventory for her internship in the 2011 spring semester. Tung Huynh, an Environmental Science and Policy graduate student, has and continues to format, update, maintain, and further develop the initiative inventory on the Sustainable Clark webpage. The inventory list is on the sidebar menu under initiatives, labeled as "Sustainability Initiative Inventory (Google Doc)". It is formatted as an Excel spreadsheet in a Google Doc. There is an "Evaluation/Impact Assessment" column that, except for a few exceptions, is blank. However the contact information is very thorough and provides information to encourage communication with all student, administrative, and Worcester initiatives.

Recently, outreach to alumni in the sustainability fields has been limited. The Clark Alumni Affairs Office takes outreach very seriously and has multiple strategies to engage with alumni. They also appear to try to keep alumni engagement within their realm. Currently, the Alumni Office is the sole point of contact with graduates, and is considering ways to more effectively reach out to these potential sources of expertise and funding. At the same time, various Clark departments such as the Department of International Development Community and Environment (IDCE), Environmental Science, and Geography have maintained contact with many alumni, and desire to highlight the sustainability accomplishments of the school. However, these departments respect the role of the Alumni Affairs Office and do not want to overstep the purview of the department. The Clark University Alumni Affairs office is focused on engaging with Clark alumni. The Director of Alumni Affairs came and spoke to our class in November 2011 about how their office prioritizes the types of engagement. It is anticipated that increased incorporation and engagement of the Alumni Affairs office into Sustainable Clark would be beneficial to both funding projects and providing insight on the direction that these projects take.

In 2009, Clark created a comprehensive Climate Action Plan (CAP) modeled on the University Presidents Climate Commitment (Clark, 2009). The school has laid out an ambitious and obtainable schedule to meet commitments set out by the CAP. As an example of a large institutional organization that has addressed various aspects of infrastructure to lessen climate impacts, Clark could aggressively promote and demonstrate these achievements.

Process

The team's initial goals were to further develop the inventory and foster a partnership between Alumni Affairs and Sustainable Clark. This meant broadening, publicizing, and promoting sustainability awareness on campus by enhancing the sustainability inventory. This included adding evaluations to the initiatives on the inventory, as well as distributing information about the inventory through various campus media outlets such as slides for the University Center and the Academic Commons, stories for the Marketing and Communications' Facebook page and the Alumni E-Newsletter. Another outcome we had aspired for was publicizing the inventory list and using it to conduct alumni outreach. The goal was essentially to create an outreach strategy for raising awareness among Clark alumni to the various campus sustainability initiatives.

To tackle all these aspects of our project we divided the duties to each member of the group, having two members working on inventory development and publicizing, and two members working on collaboration with Alumni Affairs. The team met regularly throughout the semester and discussed each other's progress and what direction to move in next. About midway through the semester, both of our project components ran into some roadblocks that necessitated a change in project strategy. We then shifted our strategy away from the Alumni Affairs Office and towards the Marketing and Communications Office. This action was motivated by a class visit from Aixa Kidd, the director of Alumni Affairs, where the class found out the amount of influence Marketing and Communication has in a majority of university publications and messaging, including Alumni outreach. Additionally, meeting with Jenny Isler, the Sustainability Coordinator, the team was informed of the necessity for more stories featuring initiatives that could then be shared on Sustainable Clark's website and Clark's Facebook page.

Thus, the team was able to overcome these barriers and adjust the goal towards expanding Sustainable Clark's messaging by focusing on three initiatives from the inventory—Clark Bike Share, the Office of Admissions, and e-Billing. The remainder of this report provides details on each of these three initiatives in a format that we hope will be useful for future communication.

Clark Bike Share- Cycles of Change

The Clark Bike Share (CBS) program was started as a project in the Sustainable University class of 2007. The project was named *Greening Transportation at Clark University* by Ashley Trull, Lauren Blake, and Kate McGrath. (Addeo, 2007) The idea was to "evaluate the transportation system on campus and explore alternatives that might reduce Clark's transportation carbon footprint by reducing the Clark community's reliance on cars." (Addeo, 2007) Among the initiatives was to implement a bike sharing program that would allow students to sign-out bicycles and use them in lieu of fossil fuel-burning transportation. By 2009 the details, policies, and processes were put in place and

encapsulated in the Google document "Clark Bike Share Manual". (McGrath, 2011) The program rolled out with six bikes obtained through a volunteer arrangement with Worcester's Earn-A-Bike program, and Clark staff donations. The popularity of the program has resulted in a total of nine bicycles available at a covered kiosk outside the University Commons. Also, the club “Cycles of Change” has volunteered maintenance expertise, and has garnered space for bike storage and repair. The program runs year-round with the exception of December through January.

The success and enthusiastic response to the Bike Share program mirrors similar endeavors at schools throughout the New England region as well as nationally. Massachusetts colleges and universities have implemented many variations on bike-sharing, with the biggest organization being the Boston-based regional club HubWays. There has been considerable media attention to Clark's bike share program. Of particular note is an entry on the website of the Association for the Advancement of Sustainability in Higher Education (AASHE, 2009) and the lifestyle and entertainment magazine Pulse. (PULSE, 2011) Also, the program has helped the school gain "green" recognition in the Sierra Club's third annual Cool Schools list (Sierra Club, 2010), and the College Sustainability Report Card. (Sustainable Endowments Institute, 2011)

The CBS program contributes to the health and well-being of all its participants. Bicycle riding is a physical activity that has the benefits of reducing the risk of heart disease, diabetes, and obesity, hypertension, elevated blood pressure, and the prevention of osteoporosis. (Davis, 2011) It can also improve a riders balance, coordination, strength, endurance, and self-esteem. (Davis, 2011) Developing a routine of bicycle riding in lieu of motorized transportation as a student can have additional long-term benefits as students progress beyond their college life. Developing an appreciation and enjoyment of low carbon footprint transportation will give students alternative resources and aptitudes to face growing energy dilemmas in the future.

One of the products of the CBS program highlighted in the 2007 Sustainability Report was "collecting data in order to complete calculations of carbon emissions from vehicles at Clark to be included in Clark’s greenhouse gas inventory." (Addeo, 2007) Greenhouse gases (GHG) have been identified as one contributing factor in global climate change. (EPA, 2011) The Environmental Protection Agency (EPA) states "In 2008, transportation sources contributed approximately 27 percent of total U.S. greenhouse gas emissions. Transportation is also the fastest-growing source of U.S. greenhouse gas emissions, accounting for 47 percent of the net increase in total U.S. emissions since 1990, and is the largest end-use source of $C0_2$, which is the most prevalent greenhouse gas." (EPA, 2011)

As part of the effort to illustrate emissions savings from bike riding, CBS has been collecting some basic data from riders when they sign-out a bike (Table 1). Interviews with Kate McGrath (Clark University student and one of the original creators of CBS) and Greg Doerschler (Clark University Senior Analyst) were conducted to review and analyze the 2009 ridership data. Among the many benefits of collecting rider information discussed during these interviews, was that any GHG emissions savings represented in the data could be useful in helping Clark fulfill its emission goal as stated in the Clark Climate Action Plan (Clark CAP, 2009).

Table 1 - Clark Bike Share Fall 2009 Summary Data

Bicycles signed-out

Total bicycles signed out	570
September	
Sign-outs:	233
Days	29
Average sign-outs per day:	8.0
October	
Sign-outs:	173
Days	31
Average sign-outs per day:	5.6
November (pre-Thanksgiving)	
Sign-outs:	130
Days	24
Average sign-outs per day:	5.4
Nov./Dec. (post-Thanksgiving)	
Sign-outs:	34
Days	19
Average sign-outs per day:	1.8
Semester Total	
Sign-outs:	570
Days (excl. Thanksgiving)	103
Average sign-outs per day:	5.5

Bike Share users

Total Users:	215

Used a bike...	Users	Pct.
5 or more times*	29	13%
3-4 times	31	14%
2 times	50	23%
1 time	105	49%
Total users	**215**	**100%**

*Top users

27 times	1
24 times	1
16 times	1
11 times	2
10 times	4
9 times	1
8 times	5
7 times	3
6 times	7
5 times	4

Bicycles signed-out per day

Sign-outs per day	Number of days
14	4
13	0
12	4
11	7
10	1
9	2
8	11
7	13
6	11
5	5
4	10
3	6
2	11
1	11
0	7

Sign-out duration

Duration	Number	Pct.
0-20 minutes	46	9%
21-40 minutes	77	14%
41-60 minutes	75	14%
61-80 minutes	60	11%
81-100 minutes	53	10%
101-120 minutes	54	10%
2-3 hours	59	11%
3-5 hours	68	13%
More than 5 hours	41	8%
Total (known duration)	**533**	
	100%	
1 hour or less	198	37%
1-2 hours	167	31%
More than 2 hours	168	32%
Total (known duration)	**533**	
	100%	

Using the data it is possible to extrapolate some plausible $C0_2$ emissions savings from electing to use bicycle transportation over an automobile, and create two hypothetical scenarios. In order to build any evidence to this (and acknowledging that the data is incomplete and in need of further enhancement), the following assumptions can been made:

- All bike riders would have used a car for their trip if they had not borrowed the bike
- A trip by car would take half as long as a trip by bicycle
- The average speed of a car trip in the Worcester metropolitan area is 20 MPH
- The average fuel economy of a passenger car in the United States is 22.4 MPG (Project America, 2011)
- 55% of bike rides were between 1 hour to 5 hours
- Number of trips = 314 (.55 % of 570 total trips)

Using the above assumptions and the CBS data, 2 hypothetical scenarios can be created -

Scenario 1 - a 1 hour bike excursion replaces a .5 hour car trip

314 1 hour bike trips would equal 314 1/2 hour car rides:

314 / 2 = 157 hours

To calculate miles travelled by car, the trip hours is multiplied by 20 MPH:

20 X 157 = 314 miles

To calculate the number of gallons used in the miles travelled, the miles are divided by the average MPG of 22.4:

314 / 22.4 = 14 gallons of gasoline

U.S. gallons converted to liters:

14 U.S. gallons = 53 liters

To calculate how much $C0_2$ was released when gasoline was burnt in the car engine:

53 / 2.3 = 122 kg (1 liter of gasoline produces 2.3 kg of $C0_2$ (Samaras, 2008))

Thus, in scenario 1 the cumulative amount of **$C0_2$ emissions saved is 122 kg**.

Scenario 2 - a 5 hour bike excursion replaces a 2.5 hour car trip

314 1 hour bike trips would equal 314 1/2 hour car rides:

314 X 2.5 = 785 hours

To calculate miles travelled by car, the trip hours is multiplied by 20 MPH:

20 X 785 = 15,700 miles

To calculate the number of gallons used in the miles travelled, the miles are divided by the average MPG of 22.4:

15,700 / 22.4 = 701 gallons of gasoline

U.S. gallons converted to liters:

701 U.S. gallons = 2654 liters

To calculate how much $C0_2$ was released when gasoline was burnt in the car engine:

2654 / 2.3 = 6104 kg[1]

Thus, in scenario 2 the cumulative amount of **$C0_2$ emissions saved is 6104 kg**.

Although there are acknowledged inconsistencies in the data for 2009, with improved and expanded data-collection by CBS it would be possible to use the program to demonstrate GHG emissions savings through bike-sharing.

Office of Admissions

Associate Admissions Director Jarrad Nunes was contacted to gain insight about the impact the Admissions Office has in terms of sustainability. An interview was conducted as a means to evaluate the Admissions Office as a part of the Sustainable Initiatives Inventory on the Sustainable Clark website.

Originally the goal of the interview was to evaluate the office and come up with a number that could be used to represent the Carbon Dioxide Equivalent savings that the office had created in its sustainability efforts. However, after sitting down with Nunes, it became obvious that completing this task would be impossible. The Admissions Office makes numerous contributions to the sustainable Clark community, many of which are not kept track of throughout the year. Also, many of the actions of the office would be impossible to quantify; counting the savings made by the office was not as important as actually understanding what the office was doing to be a sustainable part of Clark's campus (Nunes, 2011).

The new John and Kay Bassett Admissions Center was the first thing that exemplified sustainability during the interview with Nunes. The new center for admissions is efficient enough that it could have been certified by the Leadership in Energy and Environmental Design (LEED) program had Clark decided to go through with the expensive process. Among the many green features that are part of the center the building is home to a presentation room for potential Clark students. The room also features highly efficient glass windows and shades to keep sunlight out when the building is trying to be kept cool, and a Trombe wall to regulate the temperature of the building. Also, instead of buying large Poland Spring jugs of water for the office, new faucets were retrofitted to keep everyone hydrated without the use of plastic jugs (Nunes, 2011).

Beyond the green technology present in the new admissions center, resource use as recently been reduced too. A new protocol for reviewing applicants transcripts has made a significant reduction in the amount of paper used by the office. Instead of printing out the transcripts of applicants for review, the office now saves one ton of paper yearly by reviewing transcripts electronically. Additionally, the office saves resources when it travels to high schools and college fairs by allowing interested students to provide their contact information electronically beforehand instead of providing the information on an admissions postcard at the event. Furthermore, admissions is decreasing the amount of paper based informational material about Clark that they distribute to prospective students by simply providing prospective students with information directly related to their expressed interests, rather than providing information related to all offerings at Clark. (Nunes, 2011). Additionally, a collaboration between the Office of Admissions and Sustainable Clark has resulted in sustainability tours to show prospective students the importance of sustainability on campus (Nunes, 2011).

Quite possibly the best part of what admissions is doing in terms of sustainability may be that what was listed here is only part of the progress the office has made to become environmentally friendly. Everyone in admissions is committed to furthering sustainability efforts and being greener (Nunes, 2011).

E-Billing

Clark's "e-Bill" initiative was investigated and its quantitative impact campus-wide has been estimated. Tammy Hearnlaye, Associate Controller of the University, was the primary resource for investigating this initiative. Clark's new "e-Billing system" allows Clark's Business & Financial Services office to distribute student bills electronically for both semester and monthly billing. Clark students then are able to pay their bills electronically through an online program called "Cashnet." Cashnet is an online "third party vendor" that Clark employs to handle student's financial accounts. This system allows students to access their monthly and semester bills through the CU Web online portal. Tammy Hearnlaye oversees the systems and receives the data from the vendor. Since the initiative official began in June of 2011 e-Billing has been incorporated for this fall's monthly billings. After conversing with Tammy, the team was able to gain a surprising amount of quantitative data on the amount of paper resources saved by this administrative initiative.

Katherine Cannon, Controller of Clark University, was the person to originally request this system of billing back in the 2011 spring semester. Cannon is in charge of Clark's Business & Financial Services office which takes over all accounting and billing aspects of the university. Departments under this office include the offices of Accounting, Cashier, Accounts Payable, Payroll, Grant Accounting, and General Accounting. She introduced this billing process so that the Business & Financial Services office could save on paper resources and in turn save money that would have been spent on purchasing those paper resources. This investment in sustainability has had a clear effect on the Clark community and the environment in general.

The conversion to e-Bill has saved the Student Accounts office from printing 6,623 pieces of paper and 13,246 envelopes, for semester billing and monthly billing, from June 2011 through the month of October. This fairly new billing system has saved the Student Accounts office from printing out 1,111 bills and used 2,222 envelopes for the November monthly billing. For the spring semester billing, the Student Accounts would have printed out 2,708 sheets of paper and used 5,416 envelopes. In total one of Clark's administrative offices has saved 10,442 sheets of paper and 20,884 envelopes. In perspective that means these 31,326 sheets of paper and envelopes the total paper resources saved equates to a stack of paper over 10 feet in height or approximately as tall as an average one story home.

Challenges

Alumni Outreach

Communication proved to be very difficult with Alumni Affairs right from the start. There was resistance responding to emails and if team members tried visiting the office in person, we were asked to send an email. The team was proposing that Alumni Affairs consider looking at what other universities were doing to engage their alumni in sustainability. Our first mistake when the team contacted Alumni Affairs was suggesting alumni consider creating a sustainability fund of sorts (similar Wesleyan's Class of '57 Fund). Money is a touchy subject for them, as it is in many departments and the issue likely should have been addressed more delicately or not at all. Furthermore, through

word of mouth it has become clear that Alumni Affairs often feels overburdened and understaffed, making it easy to push our project to the bottom of their priority list.

Sustainable Initiatives Inventory

Challenges were also encountered when attempting to work on the Sustainable Initiatives Inventory. At first, based on speaking with Sustainable Clark Director Jenny Isler, the team attempted to evaluate all of the specific initiatives listed on the Sustainable Initiatives Inventory in terms of a specific metric. To do so, a "Quantitative Survey" was sent out via email to all of the contacts listed on the inventory asking contact persons from each initiative to "Please state the metric ton equivalents of CO_2 your initiative has saved". It was also stated that groups who had generated this complex data could give us any other value that had to do with measuring sustainability. After receiving almost no response from the majority of the numerous initiatives listed on the inventory, it became obvious that asking contact people for the metric ton equivalents of CO_2 probably was asking for too much detail in the email survey. The team also realized, based on a few responses to the survey, that most initiatives listed on the inventory were impossible to quantify either because contact persons did not gather any data on their initiative or because they represented a sustainable initiative that did not have a quantifiable impact (i.e. EN103 The Sustainable University). In the end evaluating each individual initiative for a metric was an overwhelming task that could have been a semester long project in itself. What the group decided upon was to instead choose three important initiatives that seemed at least partially quantifiable and evaluate them in as many aspects as possible to make a sustainable story that could be used for messaging a sustainable message on campus.

Conclusion

The outcome of our project was certainly not what any of us expected, but what we accomplished was without a doubt beneficial towards furthering Clark's sustainability goals. Although, we were unable to collaborate with the Alumni Affairs Office, our efforts to communicate with this office will hopefully have some influence in guiding them and the community in moving in that direction. Our successful review of three specific sustainability initiatives (Clark Bike Share, e-Billing, and the actions by the Office of Admissions) demonstrate the strength and breadth of sustainability activities at Clark.

The Clark Bike Share program has met with enormous success as an alternative transportation model for students. However, it also represents other benefits beyond the specific behavior modification. Students individually gain health benefits from exercising, enjoy opportunities to ride away from the campus and explore the surrounding greater Worcester community, and the experience can help to develop an appreciation for alternative transportation. This appreciation is likely to be increasingly beneficial as energy and transportation challenges continue to strengthen in the future.

Likewise, the university derives benefits from the CBS program. As mentioned, the school has received recognition in many publications and articles detailing the synthesis of the bike-sharing program into the wider campus sustainability movement (PULSE Magazine, 2011, Sierra Club, 2010). Prospective students have reacted positively to the prominent red Clark Bike Share awning as they tour the campus as part of the Admissions process.

After talking with members and interested parties of the CBS program, the group faces some challenges that will have to be addressed if the concept is to persist and flourish. The student-run volunteer staff is beginning to suffer from burn-out and a lack of a cohesive direction and strategy. It would be in the best interest of the school to work with the CBS members on tactics and ideas to address these issues. Finally, if the staffing issues could be alleviated more thorough and pertinent ridership data could be collected. This information could be used to reinforce and strengthen the GHG emissions savings that bike-sharing and bike riding represents.

The e-Bill initiative was taken on only a few months ago and has already enabled the Clark community to impact sustainability on a campus-wide scale simply through the enrollment tuition payment process. Clark's administration has been taking noticeable steps in various departments to improve Clark's sustainability efforts and increase savings on natural resources. The Student Accounts "e-Bill initiative" is just one of the many initiatives being taking on by the Clark administration and their employees. The actions taken by administration and the actions of Clark students both influence and motivate one of another, and it is a great accomplishment that there are already so many administrative initiatives occurring on campus.

The Office of Admissions sustainability initiatives have had a positive impact in terms of sustainability on campus. Though the office is doing a number of things to be "green" and further promote sustainability, no single initiative can be pinpointed as having the largest impact because at the moment there is not enough data being collected (Nunes, 2011). In the future, the collection of data whenever possible could aid in improving the understanding of the importance of sustainability and further benefit Clark University in finding new and improved ways to continue to strive toward its goal of net zero emissions stated in the CAP (Clark CAP, 2009).

The team looks forward to publicizing these inventory initiative evaluations, and hopefully others; in the near future through Clark's various publicity outlets. We also hope to contribute these stories, and others, to Sustainable Clark's online "word press" that is "in the works."

Overall, it is our recommendation that all of these departments and individuals continue to publicize their accomplishments alongside the school's media outlets. As each initiative is successful, sustainable trends become more than just a worthy cause, but a community norm and a part of individual's mindset.

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