Sustainability at Rensselaer

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In a world that is getting hot, flat, and crowded, the task of creating the tools, systems, energy sources, and ethics that will allow the planet to grow in cleaner, more sustainable ways is going to be the biggest challenge of our lifetime

– Thomas Friedman[1]

The basic knowledge — the seed corn — for developing and contributing to this new technological revolution already exists here at Rensselaer. We need only to capitalize on our strengths and draw from our historic core values to take our place on the leading edge of the revolution. Our mission — "to apply science to the common purposes of life" — has never looked more auspicious.

- The Rensselaer Plan[2]

Why not change the world?

Acknowledgements

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Executive Summary

An opportunity exists for Rensselaer to become a global leader in sustainability. An even greater opportunity exists for Rensselaer to provide the world with leaders who are capable of addressing the challenges of sustainability. Developing a sustainable world will require a myriad of solutions from individual awareness and lifestyle changes to technological innovations to creative local and global policies. Our society faces the task of developing appropriate solutions for the issues of energy security, climate change, pollution and waste management, remediation, food production, biodiversity, water use, land use, transportation and environmental health. These issues, encompassed under the term sustainability, will require action from organizations with global reach and global impact. Rensselaer must take a leadership role in innovating and implementing sustainable practices, not only to uphold its ideals embodied in the Rensselaer Plan, which calls the university to achieve global reach and impact, but also due to its duty as a global citizen.

This report provides comprehensive information regarding the past and present state of sustainability at Rensselaer (as a baseline), and it also presents information regarding what other institutions are doing, and how they are accomplishing it (as a benchmark). In this report, sustainability at Rensselaer is examined using a four-piece framework of research, education, operations and culture. In addition, leadership can be regarded as an overarching category.

Rensselaer already leads the world in sustainability-related research, as our university hosts some of the world's top researchers who are engaged in ground-breaking and forward-thinking technological research. From more powerful solar technology to more efficient lighting to advances in fuel cell and hydrogen technologies to the innovative Built Ecologies architectural research, Rensselaer has immense ongoing potential to lead our world towards a more sustainable future.

Rensselaer's education provides an interactive and interdisciplinary learning environment that will aid students in gaining the skills and experience needed to address the world's increasingly complex issues. Improvements could be made to ensure students' awareness of sustainability issues, and more specifically how these issues relate to their respective fields of study.

Rensselaer's operations include: buildings, dining services, greenhouse gas emissions, energy use, grounds, waste management, transportation, procurement and water. While several initiatives are underway in some of these areas, many opportunities exist to address inefficiencies and increase awareness. These improvements could lead to significant cost savings, reduction in Rensselaer's environmental impact, and educational opportunities.

A university's culture is likely one of the most important factors that will influence students'

perception of the world. A culture of sustainability fosters a specific worldview, one which acknowledges the importance of examining the world in a holistic manner. It requires understanding the impacts of our actions, policies and technologies on the environment, society and the economy. It involves recognizing the undeniable interconnectedness of our eco-, economic, and social systems. A culture of sustainability at Rensselaer needs to be developed. Currently, the behaviors and attitudes of many individuals in the Rensselaer community do not reflect the principles of sustainability. A comprehensive effort involving collaboration and communication between students, staff, faculty and administration is needed. A commitment to this goal will have exponential effects. Rensselaer graduates will leave with an expanded understanding of how their lifestyle choices and their work affects the world we live in. They will depart as global citizens, able to address the challenges that they will inevitably face.

Integrating sustainability into Rensselaer's research, education, operations and culture will require simultaneous leadership from all levels of the university, from individual students to faculty and staff to the executive administration. Much of this leadership and direction can come through the performance planning process and grassroots efforts. Increased communication and collaboration can enhance these processes. Additionally, a centralized resource could provide the increased benefit of necessary knowledge, resources, energy, organized communication and commitment enabling Rensselaer to capitalize on untapped, but fruitful opportunities. This centralized resource, consisting of expert professionals, would not work in isolation, but rather would collaborate with Rensselaer's departments and offices, assimilating into the existing structure. These professionals would facilitate the process, rather than prescribing solutions.

A renewed focus and commitment, coupled with additional resources, will place Rensselaer as a leader in all categories. This opportunity falls directly in line with Rensselaer's main goal: *To achieve greater prominence in the 21st century as a top-tier world-class technological research university with global reach and global impact.*[3] Developing a sustainable world will require that institutions with global reach and global impact contribute both solutions and leaders. The Rensselaer community is poised and ready to do so. Let us capitalize on this opportunity and prepare to lead the world toward a more sustainable future.

Introduction

The purpose of this report on sustainability at Rensselaer is to provide comprehensive information on the state of sustainability at Rensselaer, to examine how other institutions are addressing sustainability, and to identify areas in which Rensselaer is a leader and areas in which Rensselaer can become a leader. The report is broken down into several sections, including baseline, benchmark, culture, conclusion and suggestions. The **baseline** section addresses how sustainability is already integrated into the university's research, education, operations, and leadership. A timeline is provided to outline the past and present sustainability initiatives at Rensselaer. The **benchmark** section explores how other universities are addressing sustainability on their campuses. Benchmarking is separated into three parts. First, the sustainability comparison chart provides a quick glimpse at the similarities and differences between universities using basic indicators, such as existing LEED buildings, composting programs and environmental degrees/certificates. Next, the best practices section describes various creative and innovative initiatives at various universities. And finally, the report presents a sampling of the make-up and structure of sustainability resources (i.e. offices, centers) at selected universities. The subsequent section on **culture** addresses the importance of developing a culture of sustainability. The **conclusion** provides a concise summary of the findings of the report. And the **suggestions** section presents how additional resources dedicated to sustainability can provide enormous benefits to Rensselaer.

Baseline

The baseline section provides a comprehensive and objective outline of where Rensselaer stands on a variety of aspects related to sustainability. The section is broken into four main categories: research, education, operations, and leadership. Each of these sections will pose questions derived from or inspired by STARS, the Sustainability Tracking Assessment and Ratings System. STARS was developed by AASHE, the Association for the Advancement of Sustainability in Higher Education. In addition to answering these questions, we integrate relevant case studies concerning successful sustainability initiatives that have been carried out at Rensselaer.

The baseline section also includes a timeline of past and present sustainability initiatives at Rensselaer. The timeline indicates which projects are still operational and which have become defunct.

About AASHE

The Association for the Advancement of Sustainability in Higher Education describes itself in this way:

> *AASHE, the Association for the Advancement of Sustainability in Higher Education, is a member organization of colleges and universities in the U.S. and Canada working to create a sustainable future. Our mission is to promote sustainability in all sectors of higher education - from governance and operations to curriculum and outreach - through education, communication, research and professional development. We work in partnership with businesses, nonprofit organizations and government agencies that support our mission.[4]*

AASHE has many members that Rensselaer considers peer and aspirant institutions, as well as many of the best universities in the United States. Included among its membership are Boston University, California Institute of Technology, Carnegie Mellon University, Case Western Reserve, Dartmouth, Georgia Institute of Technology, Harvard, Johns Hopkins University, Middlebury, Stanford, SUNY Albany, Tufts, UC Berkeley, Worcester Polytechnic Institute and Yale. AASHE therefore represents a consensus of sustainability professionals from schools similar to Rensselaer. AASHE has produced rating system for sustainability called the Sustainability Tracking, Assessment and Ratings System, or STARS. It asks specific questions and uses a point system to quantify how sustainable a university is.[5] This paper will use the STARS questions as an organizational tool, to help direct its inquiry.

Baseline: Research

Are there groups of faculty engaged in long term sustainability research?

At Rensselaer, there are several research centers engaged in sustainability related work. The three major centers with major focuses on sustainability are: the Center for Future Energy Systems, the Lighting Research Center and the Darrin Freshwater Institute. The programs have existed since 2005, 1988, and 1970, respectively. All of them began with a grant from an external source. CFES is part of the NYStar program, from which it receives one million dollars annually; the LRC began with a grant from NYSERDA; and the Darrin Freshwater Institute's start up funding came from alumni David Darrin. Without communication between the university and external stakeholders, these programs, which have been successful as generating environmental conscious technologies as well as making discoveries in general, may not have existed.[6]

Rensselaer has recently launched the opening of the Center for Architecture Science and Ecology (CASE). At this interdisciplinary research firm, founded by Anna Dyson, researchers are seeking to substantially increase the efficiency of converting sunlight to electricity, beyond that of existing solar technology.[7] Other examples of research areas include: building-integrated wind generation and structural optimization through amplification of air flow, active hydroponic systems for air purification and energy reduction in buildings systems, and advanced EcoCeramic structural systems.[8]

Recently, a donation was made by Rensselaer Trustee Tom Baruch to open a new solar energy research center, the Baruch '60 Center for Biochemical Solar Energy Research. Researchers from various disciplines and research backgrounds will attempt to develop technology which closely mimics nature's processes of converting sunlight to energy.[9]

Other centers, while not specifically focused on sustainability research, are deeply involved in projects that do. At the New York State Center for Polymer Synthesis at Rensselaer, researchers are collaborating with various faculty members to research hydrogen fuel cells, specifically working to improve the fuel cell membrane.[10]

There are also several graduate programs, in which students are engaged in research related to sustainability. The NSF Integrative Graduate Education and Research Traineeship (IGERT) is a Ph.D. program in the Engineering, Science, and Entrepreneurship of Fuel Cells. This program gives graduate students the "opportunity to conduct research in an interdisciplinary and entrepreneurial environment."[11] Other examples of sustainability-related graduate programs include: Built Ecologies (in Architecture), Ecological Economics, Environmental Engineering, Geology, Hydrogeology and Lighting. Other indirectly related

programs also offer opportunities in sustainability-related research.[12]

Are there incentives for sustainability research awarded by the university? Is this program growing or contracting?

Rensselaer has developed a unique way of fostering interdisciplinary research: the constellation program. These programs are headed by faculty outstanding in their field, and are staffed by faculty and students. Together they work to make great advancements in the constellation's subject. Rensselaer has not created a constellation focused specifically on sustainability or energy security.[13]

There also are no professorships offered specifically for sustainability. There is one environmental professorship, the Kodak Associate Professor in Environmental Engineering, which belongs to James Kilduff.[14] However, under the Energy and Environment strategic initiative, Rensselaer is attempting to hire additional professors who have research strongly tied to sustainability.

Are there specific funding mechanisms for sustainability research?

Rensselaer's seed grant program is very small. It is competitive and open to all departments. There is no seed grant money allocated specifically for sustainability, but this is only because seed money is very limited in general. However the Office of Research administration and finance helps sustainability professionals acquire funding by helping to prepare proposals and acting as a "broker of information".[15]

Baseline: Education

Education is the primary goal of any university, and Rensselaer understands that the education process spans both the in-classroom and out-of-classroom experience. The questions taken from AASHE therefore focus on not only classes and curriculum, but also student run organizations and projects.

Education: In the classroom

Does Rensselaer have courses with a focus on sustainability?

Rensselaer has multiple courses across disciplines that focus on sustainability. Some examples include: Environment and Society, Environmental Economics, Science of the Environment, Materials and Enclosures, Environmental Impact Analysis, and Introduction to Environmental Studies. Many other classes include the topic of sustainability; however, it is not the primary focus.[16]

Does Rensselaer have programs focused specifically on sustainability?

Yes. Rensselaer has several programs focused specifically on sustainability, such as Environmental Engineering, Electrical Power Engineering, Ecological Economics, Values and Policy, Environmental Science and the Integrative Graduate Education and Research Traineeship (IGERT).[17] Rensselaer recognizes the importance of interdisciplinary study, which provides knowledge that is essential to addressing issues regarding sustainability.

Other programs, which may indirectly contribute to a student's knowledge on sustainability, include the Undergraduate Research Program (URP), the Study Abroad Program, and Vasudha. The URP provides undergraduate students with the opportunity to help conduct research, some of which surrounds topics of sustainability, such as fuel cell and lighting research. The Study Abroad Program provides the opportunity for students to travel abroad, potentially gaining insight on various issues that would affect global sustainability.[18] This year, a group of undergraduate students will be traveling to Pune College in India for the first Indo-US Research Academy, where three students will focus on the topic of energy and environment.[19] Vasudha, a university-supported program, is a first-year living & learning community focused on issues of energy, environment, and biodiversity. The students participating in this program live together on the first floor of Nason residence hall. They take courses together in their first-year, and also engage in learning beyond the classroom through field trips, lectures and campus events.[20]

Does Rensselaer have an ecological literacy graduation requirement?

No, there is no ecological literacy requirement.[21]

Education: Out of the classroom

Are there active outside the classroom sustainability projects that educate students?

Yes, there are several projects or programs that involve sustainability outside of the classroom. These include institute-supported, faculty-led and student initiatives.

National Science Foundation (NSF) GK-12 Program: Discovery-Based Activities in Energy and the Environment (DAEE)[22]
Using energy and the environment as a platform, this program was developed to address the need for better education in science, technology, engineering and math (STEM) in the grades K-12. Graduate student fellows work with high school teachers to aid in curriculum development, to bring in new perspectives and

ideas, and to help teachers understand how to best prepare their students for college and beyond. The ultimate goal is to ensure the preparedness of these students for the future issues regarding energy and the environment.

Faculty Learning Communities

There has been discussion of forming several Faculty Learning Communities, one of which would surround the topic of energy and the environment. This community would serve as a discussion forum regarding issues such as interdisciplinary research and curriculum development in the areas of energy and environment.[23]

Greening of Rensselaer Initiative (GRI)

The now-defunct initiative began in 1995, with efforts fading in 1997. In 1995, 1996 and 1997, Ecologic presented three Strategic Initiative (grant) Proposals which offered several ways in which the university could integrate sustainability into academics, research, culture and campus operations. Examples of propositions included: hiring a water conservation coordinator; a course in interdisciplinary sustainability studies; a reduction, reuse and recycling program; and an environmental information clearinghouse.[24]

Solar Decathlon

Several students and faculty worked together to submit a proposal to compete in the U.S. Department of Energy's Solar Decathlon, in which 20 colleges are chosen to compete to design and build the best energy-efficient home. In 2008, Rensselaer came in a close 21st, and therefore could not participate in the actual competition.[25]

Rensselaer Incubator Program

The Rensselaer Incubator Program was founded by the university in 1980. The purpose of the program is to provide students and faculty with a "living laboratory," in which ideas can be test in a real-world environment. This program has provided a platform for the development of several sustainability-related businesses. A few examples include: "Ecovative Design", "All for Local" and "Arclay, LLC." The highly successful "Ecovative Design", a company focused on producing environmentally friendly technologies, has produced "Greensulate", an environmentally-friendly insulation material. "All for Local" supports independently-owned and locally-businesses through an online database of good and services. Arclay LLC focuses on the development of natural technologies for health and personal care, agriculture and

environmental products.[26]

Wind Turbine

The 10 kW wind turbine, or the Rensselaer Wind Energy Facility (RWEF), was a project initiated by a former STS student, Jim Adams. The project saw its completion with the help of a fellow student, Shawn Shaw, who was director of the Environmental Education Center, and Oliver Holmes, who was the Director of Campus Planning. The project received grants from the New York State Energy Research and Development Authority (NYSERDA). One of the hopes for the project was for students to be able to easily study wind energy and for faculty to be able to incorporate it into their curricula. However, the website has not been updated since 2004.[27]

Student Organizations

There are several student organizations that facilitate learning outside of the classroom.

Ecologic, Rensselaer's first student environmental club, aims to make progress toward a greener campus and education the community about environmental issues. Programs and events include the Ecohall Challenge, Dumpster Diving, Earth Week, Recycled Notebook making.[28]

Case Study -- Energy: EcoHall Challenge 2008[29]

Program Details: The EcoHall Challenge is an energy conservation competition organized by the Residence Hall Association (RHA) and Ecologic. The freshman hill residence halls compete against one another to see who can reduce their energy usage the most. A baseline reading is taken in week one and energy reduction calculations are made from this.

Energy Savings: Figure 1 displays the weekly percentage change in real total power used by the various residence halls.

Figure 1. EcoHall Challenge 2008 Results

EcoHall Challenge 2008 Results
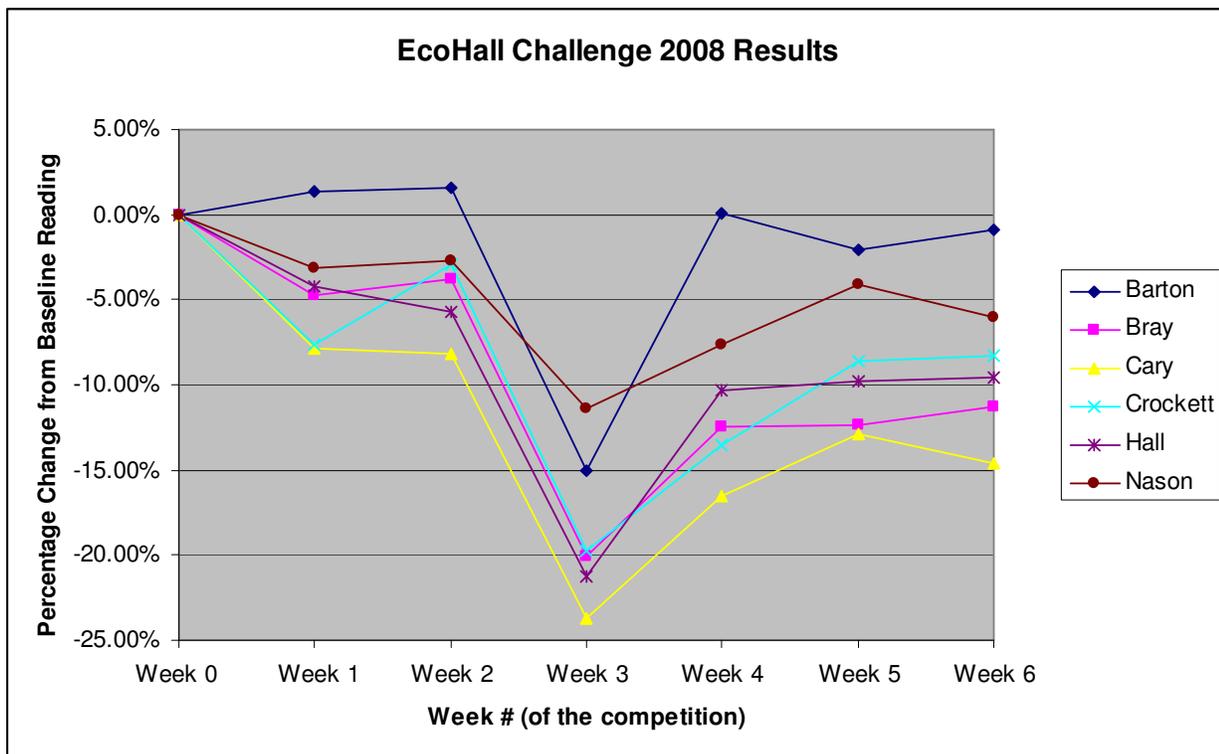
Engineers for a Sustainable World is a student-run organization focused on solving environmental, social, and economic problems, both in the surrounding community and the developing world.[30]

The Society for Environmental Professionals provides a platform for communication between students and members of professional associations. It aims to facilitate interdisciplinary learning through conversation between individuals from various backgrounds.[31]

The **Student Sustainability Task Force (SSTF)** is a student-led coalition, established by the student senate, and comprised of students, faculty, staff and administrators who work together to address issues of sustainability on campus. The SSTF seeks to create a vision of Rensselaer as a leader in sustainability best practices. The SSTF has established a strong campus network to facilitate communication and collaboration in regard to sustainability issues. The group has been engaged in making sustainable practices a priority in institute-wide performance planning and has met with nearly a dozen deans, directors and vice presidents to discuss this opportunity. Other initiatives include: a weekly Poly article on sustainability; establishing "champions of sustainability" in each campus building; aiding in the development of a "sustainability" Navigating Rensselaer and Beyond (NRB) event. [32]

Terra Café is a service provided by students to entertain and educate the Rensselaer community on the benefits of supporting the local and organic movement. The group works closely with Sodexho on meal

planning and preparation of a once-a-week café. This full service, sit-down restaurant, acts as an example for food service across campus, and throughout Sodexho, which accounts for over 900 college campuses nationally.[33]

Case Study – Green Greeks[34]

Program Details: Pi Kappa Alpha has taken responsibility for their impact on the environment by altering their habits and purchases. They now:

    - Use CFLs. They have changed 120 lightbulbs to compact fluorescent lightbulbs (cfls)

    - Recycle about half of the material that flows through their house

    - Purchase some green cleaning materials

Cost/Energy Savings: By changing lightbulbs, Pi Kappa Alpha has saved about 20% each month on energy costs.

Cultural Changes: "Equally important, guys now talk about sustainability." Awareness has been raised on these issues, and behavioral changes have been made.

Baseline: Operations

We begin this section with a case study, as this example encompasses several different categories within operations. This case study demonstrates how simple awareness, effort and outreach can reduce waste and cost. This example could have easily been placed in the education section, as organizing events in this manner can raise levels of awareness and influence cultural change.

Case Study – Greening of the Archer Center's Student Leadership Conference[35]

Program Details: Associate directors of the Archer Center for Student Leadership Development made it a priority this year to ensure an "eco-friendly" student leadership conference. They met with students from Ecologic to brainstorms ways in which this could be done. Some changes included:

    - Elimination of paper handouts. All presentations were done using overheads or powerpoints.

    - Use of flash drives. Students were given flash drives with all session materials

    - Students were given reusable shopping bags from Sodexho

    - Recycled notebooks were made with help from Ecologic, and given to participating students.

    - Marketing was reduced to email blasts, overheads and a few posters.

- Plastic bottled beverages were eliminated and pitchers were used instead.

Their efforts resulted in: an increase in the level of awareness of students regarding sustainability, a decreased environmental impact, and a significant decrease in cost. These types of ideas could be easily transferred to other departments or events. However, this generally does not happen on campus as there is no efficient method of communicating these ideas.

Operations: Buildings

Are new buildings being constructed to be more any efficient than similar buildings? Are they including innovative technologies that put them on the forefront of sustainable design?

RPI has committed to LEED certifications for all new campus building construction. EMPAC is LEED certified and the East Campus Athletic Village is planned to be LEED silver certified. The Biotechnology Building is extremely energy efficient with a naturally ventilated atrium, heat recovery on the lab ventilation air, and many other systems. Energy savings measures also include many innovative technologies like variable speed motor controls, lighting controls, and building management computer systems.[36]

Are renovations being made specifically to reduce environmental impact?

Renovations are done to further the mission of Rensselaer in accordance with the Rensselaer Plan. However, during the routine maintenance of campus facilities, changes are being made to increase efficiency, such as retrofitting to lighting and retro-commissioning of HVAC systems. Additionally, projects in distributed energy generation and solar water heating are being explored in new and existing facilities.[37]

Are there guidelines in place for green cleaning? Are they regularly implemented?

Environmental Services uses Green Seal certified cleaning products for all situations where practical, except for bathroom disinfectant, glass cleaner, and floor finish.[38]

Are certain people responsible for the successful implementation of the above?

Campus Planning and Facilities Design spearheads the LEED certification of new construction, while Physical Facilities manages the smaller retrofitting and renovation projects, and Environmental Services oversees the cleaning guidelines.[39]

Operations: Dining Services[40]

Is food being purchased from local producers when available? Are there local products we could be purchasing but are not? Has there been a positive trend in local food purchasing?

40% of produce is purchased locally. All of the milk comes from Binghamton, NY. Sodexho fully supports the Terra Café, the student-run local and organic once-a-week sit-down dining experience.

Is food waste composted? Is there a large-scale plan to reduce food waste on the part of students?

Currently, the average daily food waste about 600 lbs. The composting project is in the research and development stage. Sodexho is planning on composting all food waste, beginning in the spring of 2009. There has also been discussion regarding ways in which students can reduce their own food waste. Ideas include the elimination of trays and smaller portions.

Is there a wide range of organic foods? Does the university grow any of its own food?

Organic foods comprise 1% of all food, although Sodexho plans to increase this percentage. No food is grown by the university.

Has the university eliminated trans-fatty acids?

Yes, Sodexho eliminated all food products containing trans-fat in 2006.

Operations: Greenhouse Gas Emissions[41]

Has the university audited its greenhouse gas emissions?

No, but Rensselaer does track all of its fuel and electric usage. Presently, however, Rensselaer has begun working with Sightlines on developing its carbon footprint to be used for benchmarking against other schools.

Does the university have a plan to reduce green house gas emissions?

No formal plan has been established to reduce greenhouse gas emissions. However, Rensselaer did participate in a campus wide energy audit, which has resulted in plans for energy conservation investments, the construction of LEED buildings and the installation of PV, which will have a major impact on the

university's greenhouse gas emissions.

Operations: Energy Use[42]

Is energy use going down based on: overall consumption? Per capita? Per square foot?

From 2007 to 2008, overall energy consumption increased (it decreased during 2006-2007), but over the past five years, consumption per square foot is down overall (in some cases up to 15%). The overall increase in energy consumption is a result of the campus increasing in square footage. Figure 2 displays the main campus substation KWH history.

Does the university purchase renewable energy, and is this a significant amount?

The University purchases 5 million kwhs of wind generated electricity each year.

Does the university cogenerate?

Rensselaer does not cogenerate. Initial plans of cogeneration were drafted in 1990, however they ultimately did not go through because the campus was able to negotiate a very good electricity rate with the utility instead.

Is there a plan in place to reduce energy consumption throughout membership of the Rensselaer community?

After a series of successful energy reduction campaigns through the 1990's, RPI began energy reduction campaigns and initiatives anew in 2006 in the face of rising energy consumption and costs. Over the past two years, Rensselaer has re-energized the energy awareness program, utilized student help during the summer, and has hired a full-time facilities engineer this past fall.

Figure 2. Main Campus Substation KWH History[43]

MAIN CAMPUS SUBSTATION KWH HISTORY
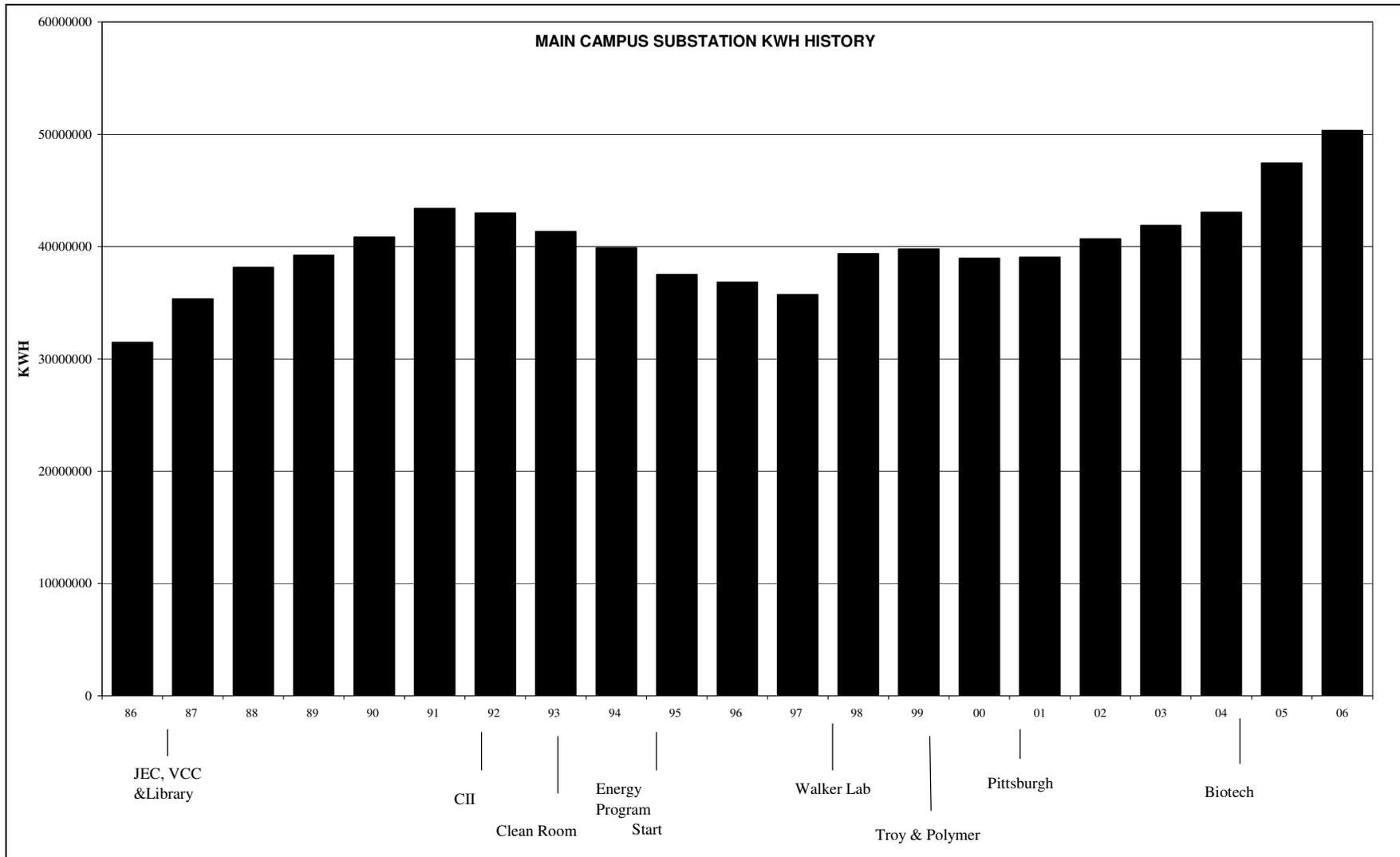
Case Study – Energy Incentive Program[44]

Program Details: In the early 1990's, buildings were offered a return of 30% of the cost savings if a 10% reduction in annual electrical usage was achieved.

Energy Savings: The overall result of this incentive program was about a 15% reduction. Annual peak demand was reduced by 1 MW. Figure 3 displays the projected energy avoidance due to this program. As the chart displays, the trend of increasing kilowatt hours was reversed. Projected energy avoidance totals 306,294,000 kilowatt hours (up to 2006).

Figure 3. Main Campus Substation Projected Energy Avoidance due to Energy Program
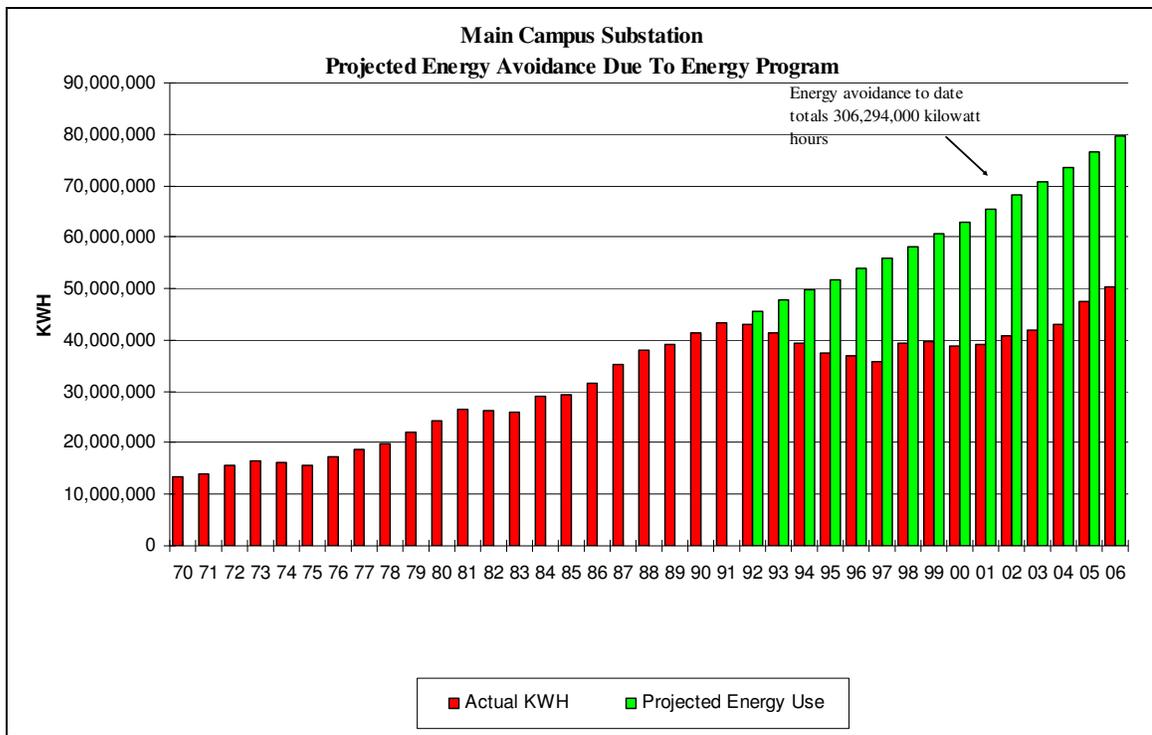
Cost Savings: As figure 4 displays, the trend of rising electricity cost was also reversed.

Figure 4. Main Campus Substation Electricity Cost & Usage Trends

Main Campus Substation
Electricity Cost & Usage Trends
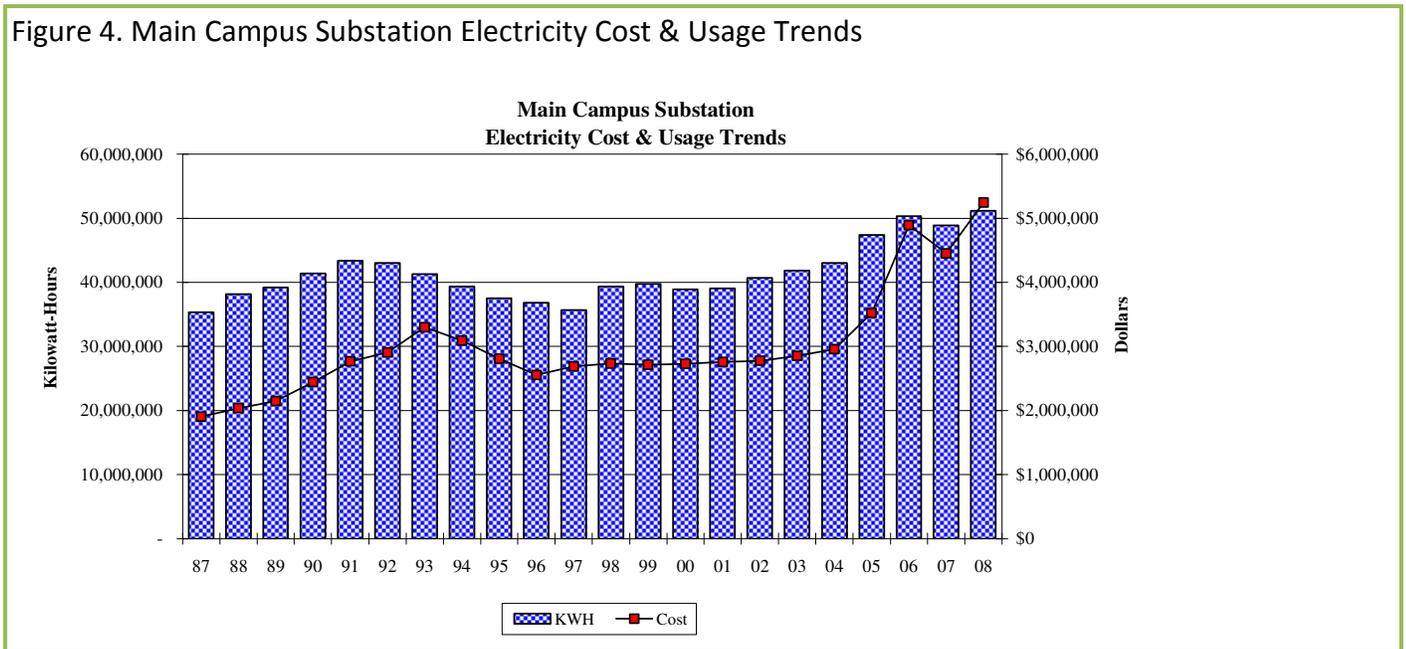
Operations: Grounds[45]

Does the university have integrated pest management that reduces pesticide use?

Yes, integrated pest management is implemented on campus and a working manual has been created.

Has the university reduced pesticide use over time?

Pesticides are rarely used due to the integrated pest management system. Pesticides are only used for athletic fields and high priority areas when infested with insects or a disease.

Operations: Waste Management

Is waste generation (waste going to the landfill) going down based on: overall production? Per capita? (can either be by mass or volume)[46]

As displayed in figure 5, waste generation (in blue) has remained fairly constant, with slight variations.

Figure 5. Rensselaer Campus Solid Waste 2002-2007

RPI Campus Solid Waste 2002-07
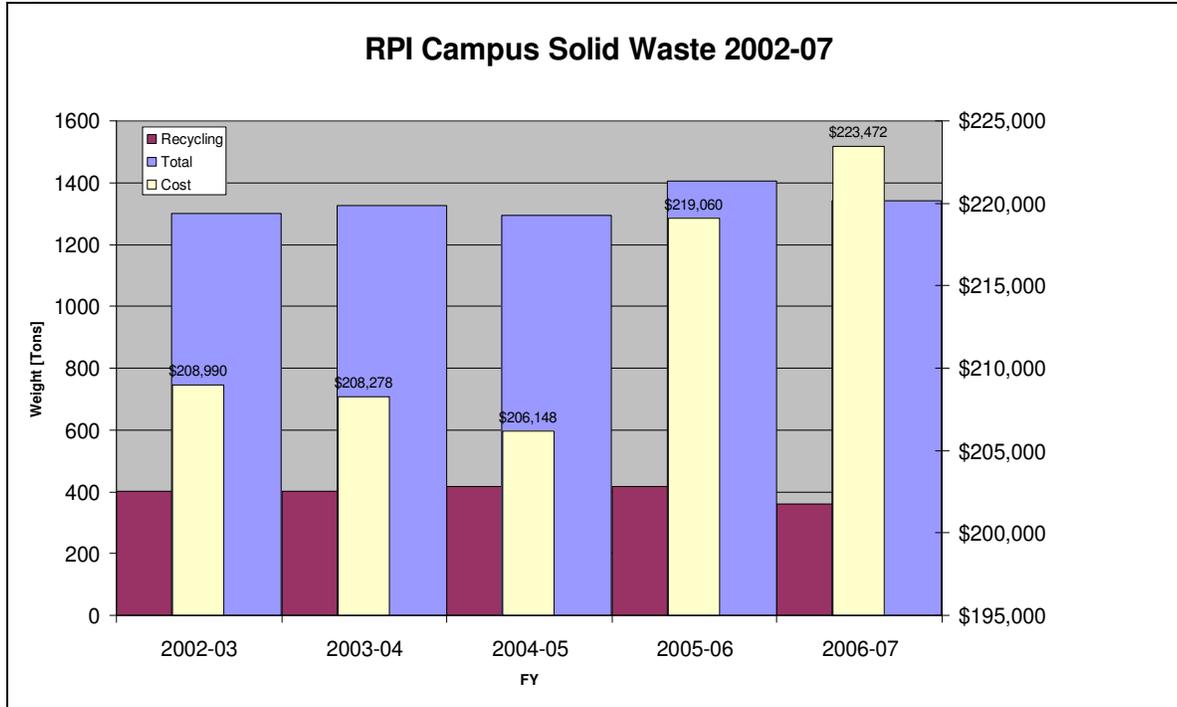
What is the recycling rate as a percentage of material defined by STARs? (no hazardous waste or construction waste included)

Environmental and Site Services reports that the overall campus recycling rate is between 25-35%, meaning that 25-35% of campus waste is recycled.[47]

Figure 6 provides a sample representation of what is found in campus dumpsters. This data was collected by students by means of "dumpster dives." The garbage in dumpsters is taken out and separated into the various categories, and weighed separately. The percentages are then calculated from the total weight of garbage in the dumpster. As the figure displays, approximately 75% of what is in the dumpster could be recycled or composted, implying that much could be done to reduce the amount of recyclable and/or compostable material in the garbage.[48]

Figure 6. Recycling data collected through "dumpster dives"
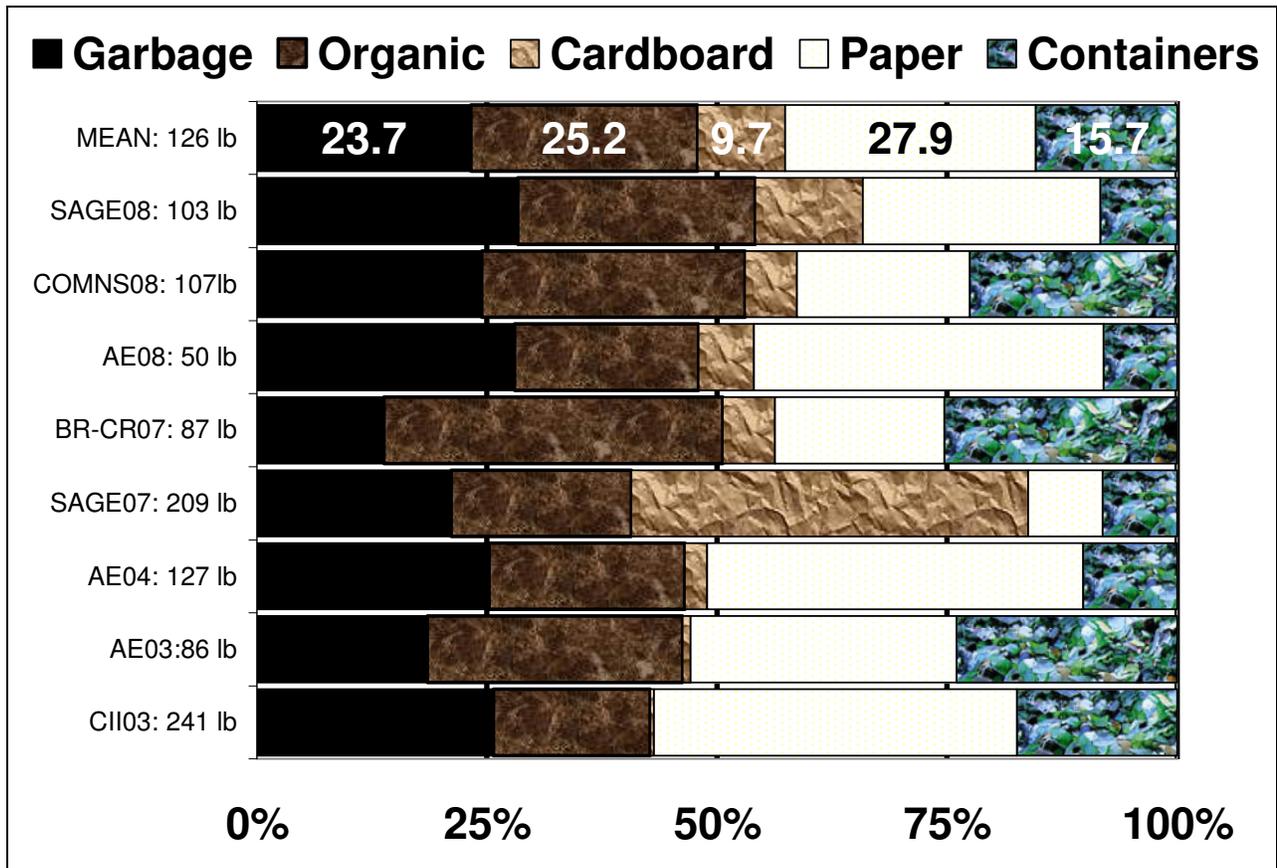
Is the rate of materials diverted to recycling going up based on: total? Per capita? Per unit of waste produced? As a percent of the total? (answer at least two of these)

The recycling rate has gone up as a percentage of the total.[49]

Is there a program for donating old computers to families without them? Other reusable materials? move out programs fall under this question

      In the past Rensselaer has given old computers to families who need them. Rensselaer also currently recycles campus computers and electronics with a local contractor, ELOT.[50] However, no electronics recycling program exists for students to use.

      Also, no move-out programs have taken place since 1999. The student group Ecologic, successfully ran the move-out program for only two years. The last attempt at a move-out program occurred in Spring 2008 between a student and the Office of First Year Experience. This attempt did not come to fruition because the student who had been co-organizing needed to step out and re-focus on schoolwork.[51]

      Students from Ecologic are currently working on creating an odd items recycling center in the

student union. This recycling center intends to provide a means for students to recycle CFLs, batteries, ink cartridges, sneakers, eye-glasses, and E-waste. There is also the possible expansion for a place to collect re-usable items year-round.[52]

Case Study -- Recycling: Purchase & Placement of Recycling Bins at the Student Union[53]

(Study conducted by Ben Cohen, mechanical engineering graduate student)

Program Details:

1) Balcony area
Initially, garbage bins were placed at the end of each table along the 3rd floor balcony. These bins were removed, and new recycling bins were placed strategically and an informational campaign took place alerting users of the changes.
2) Meeting rooms
Initially, none of the 3rd floor meeting rooms contained a recycling bin. Recycling bins were then placed in all 3rd floor meeting rooms (including the Student Government Suite – SGS), except room 3510.

Recycling Diverted:

1) Balcony area
Dramatic reduction in the recycling content (by weight) in the garbage bins, from 37.2% to 9.5%. Figure 7 displays the difference in garbage content before and after the change.

Figure 7. Union Third Floor Balcony Recycling Data
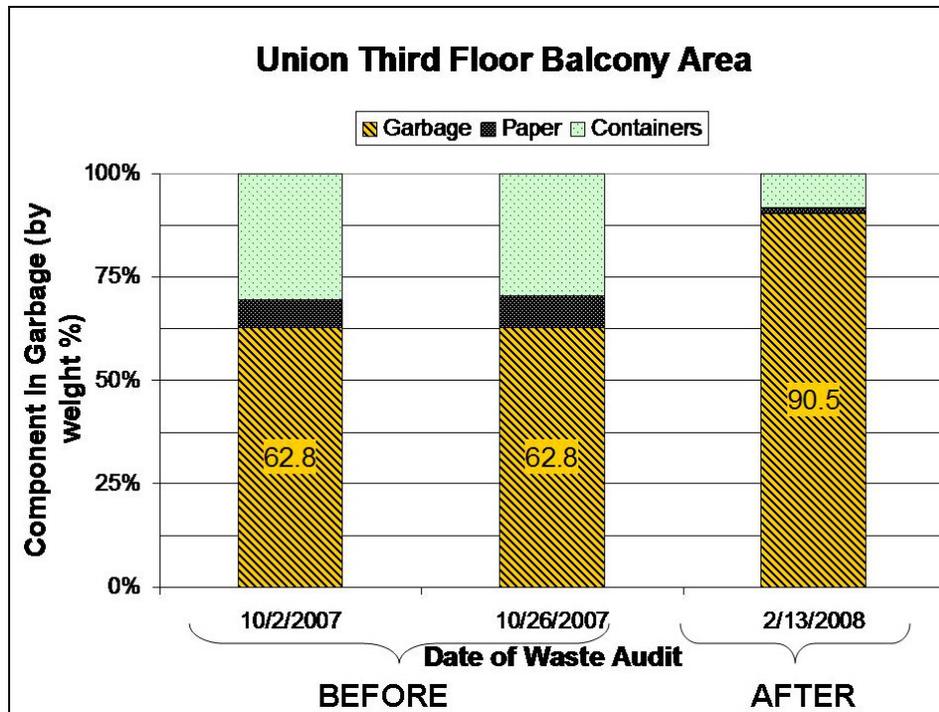
2) Meeting Areas

As figure 8 displays, the garbage bins in the meeting rooms with recycling bins contained nearly all garbage and no recyclables (except for SGS). However, the garbage bin in room 3510, contained a large percentage recyclables.

Figure 8. Union Third Floor Meeting Rooms Recycling Data

Student Union Third Floor Meeting Rooms						
Audit Date	Room Number	component in garbage (% by weight)			total weight (lb)	Had Recycling	Had Garbages
		garbage	paper	containers			
2/13/2007	3202	84.2	7.2	8.6	4.3	X	X
	3502	100.0	0.0	0.0	2.1	X	X
	3510	26.5	38.9	34.5	0.5		X
	3602	100.0	0.0	0.0	1.2	X	X
	3606	100.0	0.0	0.0	2.4	X	X
	SGS	50.0	45.6	4.1	6.1	X	X
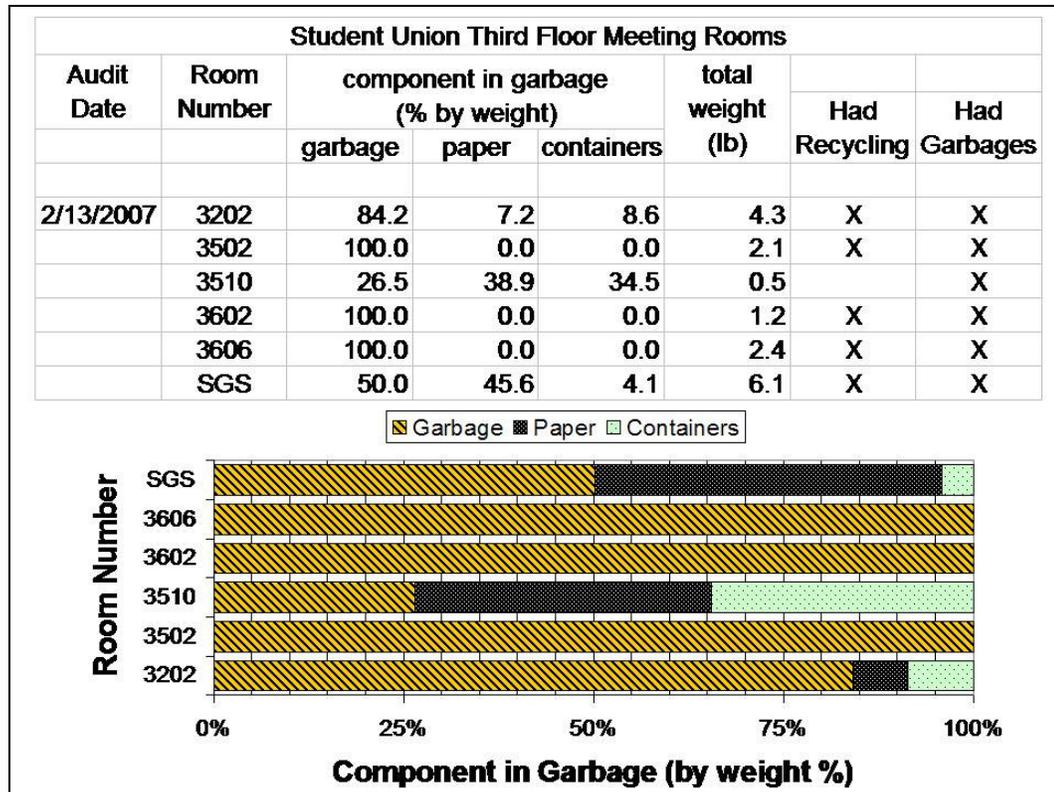
Cost Savings:

Balcony[1]

Cost for bins: $684

Cost Savings: ~$ 243/yr

Buyback period: ~ 2 years 10 months.

Meeting Rooms[2]

Cost for bins: $684

Cost Savings: ~ $ 584/yr

Buyback period: ~ 1 year 2 months.

SGS[3]

Cost for bins: $114

Cost Savings: ~ $ 125/yr

Buyback period: ~ 11 months.

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[1] Recycling percentage diverted: ~ 27.7 % by weight
Average garbage accumulation: ~ 10 lb per 8 hour period
Waste diverted to Recycling: ~ 0.277*3*10 lb = 8.31 lb/day or 1.5 tons/yr

[2] Recycling percentage diverted: ~ 66.7 % by weight
Average garbage accumulation: ~ 10 lb per 8 hour period
Waste diverted to Recycling ~ 0.667*3*10 lb = 20 lb/day or 3.6 tons/yr

[3] Recycling percentage diverted: 23.8 % by weight
Average garbage accumulation: 6 lb per 8 hour period
Waste diverted to Recycling: 0.238*3*6 lb = 4.3 lb/day or 0.78 tons/yr

Operations: Transportation[54]

Does university promote mass transportation?

The Office of Parking and Transportation regulates parking areas and regulations on campus, administers the Redhawk shuttle service, and negotiates a contract with CDTA for RPI students to ride public transportation freely around the Capital District.

The Redhawk shuttle route is also changed periodically to meet changing student demand and additional resident areas. While it originally began as a shuttle for commuters to easily reach main campus from the upper East Campus lots, it now serves as a main conduit of student traffic to and from campus and the East Campus area. However, no shuttle route exists for connecting the downtown area to campus. There is greater opportunity to utilize the shuttle system more widely and to take advantage of its ability to be a means for reducing car use on campus.

Is the university working to green its vehicle fleet?

There are efforts towards greening the Rensselaer vehicle fleet. The initiatives involving biodiesel on campus have in the past few years revolved around Wally Morris (former Graduate Council President) and were covered in the Poly. The last progress that was reported to the Senate and Parking Review Board (as of Fall 2007) were that a facility was being prepared for the project and was delayed for lack of interested students and professors.

Does the university promote carpooling and/or vanpooling?

Rensselaer does not promote carpooling or vanpooling. There are currently no programs for either, nor are there any programs in the planning stages. In the past, various programs in the areas of carpooling incentives, bicycle rentals, and other sustainability initiatives have been proposed or attempted.

Does the university have a pro biking program?

There are bicycle racks dispersed across campus at most buildings. There are no other campus bicycle programs. Through conversation with Parking and Transportation it is apparent that many programs, such as carpooling, vanpooling, incentives to use alternative transportation, bicycling programs, alternative fuel programs, and other such sustainable transportation initiatives are difficult to implement. Implementation requires the coordination of a diverse group of people on campus. This requires a vast amount of work in addition to what is normally required within Parking and Transportation. Most of these programs, while

they are within the scope of Parking and Transportation, also require a learning curve for people beyond that of Parking and Transportation. Therefore, to make these kinds of programs possible it may be necessary for help from some kind of school-wide coordinator.

Operations: Procurement[55]

Does the university have a green purchasing plan? Does it require certain products to be low impact?

The Rensselaer purchasing department does not currently have a green purchasing plan or any policies for green purchasing. Nor does Rensselaer use any specific guidelines for the purchasing of individual items such as paper, electronics, or ink, which are examples of items that have the ability to be purchased in more environmentally friendly options.

Does the university use EPEAT or a similar standard to determine what electronics to buy?

To aid in the purchasing of more environmentally preferred products standards guides such as the electronic product environmental assessment tool (EPEAT), energy star, green seal, and many others exist and have the potential to be utilized by the purchasing department.

Does the university buy: recycled paper or environmentally friendly ink?

Rensselaer purchasing does currently have a supplier diversity policy. Purchasers are required to consider local, small, and minority run businesses. From this example it can be particularly noted that the purchasing department seeks out and cultivates partnerships with diversity businesses in order to include them as preferred sources. Also, online training exists for researchers, business managers, and the purchasing staff, so that these people may better adhere to the supplier diversity plan. Green purchasing has the potential to follow diversity purchasing as a model program and to hold the same priority as diversity purchasing.

Operations: Water[56]

Is water use going down based on: overall consumption? Per capita? Per square foot?

Over the past five years, overall water use has remained fairly steady at about 120,000,000 gallons/year. Since significant square footage has been added to the campus, the water use per square foot is dropping.

Does the university use non potable water for irrigation?

No, non potable water is not used for irrigation.

Case Study -- Water: Awareness, Education & Technology[57]

Program Details: In the early 1990's, Rensselaer was informed that water rates were increasing by 43%. Our baseline water usage was:

Total: 250 million gallons/year

Academic Campus: 130 million gallons/year

Materials Research Center (MRC): 44 million gallons/year

Efforts for reduction were focused at the MRC. Through interviews with professors and lab tours, the greatest sources of water waste were identified.

Water Savings: Within 2 years, through behavioral changes, water usage decreased from 44 million gallons/year to 22 million gallons. Installation of closed loop process water system decreased water usage to 16 million gallons/year. Figure 9 displays the decrease in water usage, as well as the water cost history.

Cost Savings: Despite the increase in cost from $2.86/1,000 gallons of water (1992) to $5.10/1,000 gallons of water (2006), the total yearly cost of water has remained fairly steady due to water conservation.

Figure 9. History of Rensselaer's Water Usage and Cost.
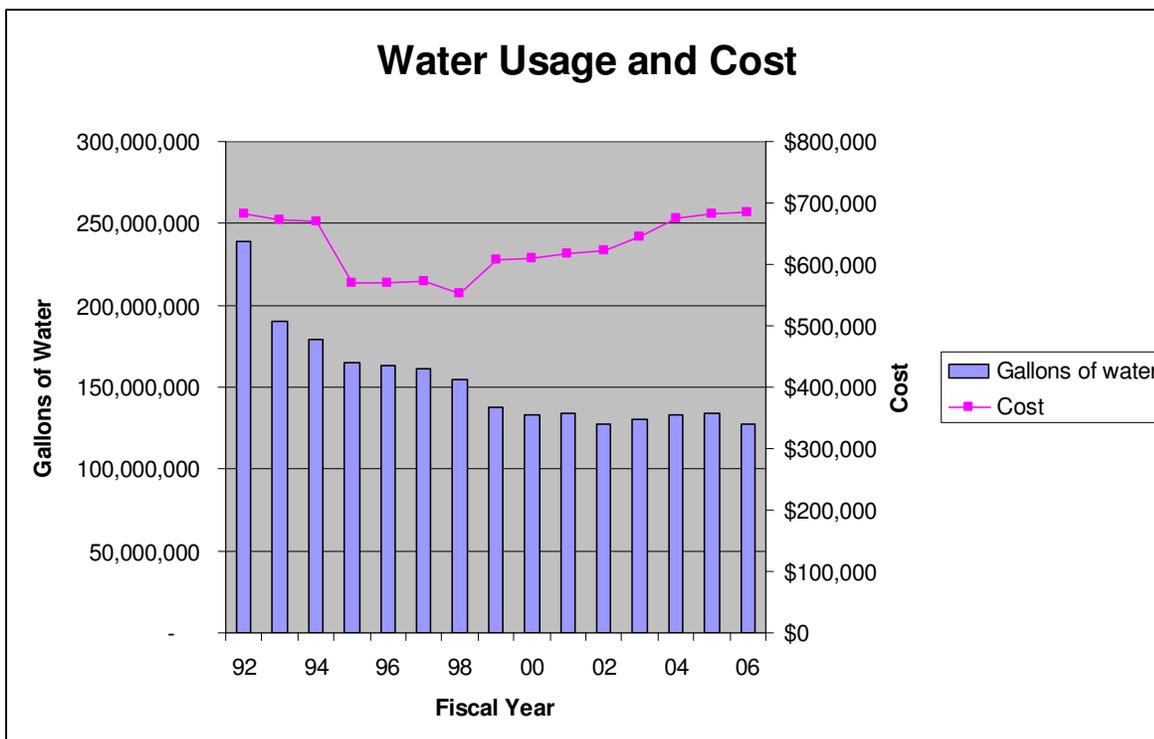
Baseline: Leadership

Sustainability leadership refers to sustainability initiatives taken on by administrative leaders, such as the president, vice president and others responsible for university portfolios. Leadership on the issue of sustainability can come from students, faculty and staff who volunteer their time to make positive change, but these individuals are not held accountable for their success. Administrative leaders are responsible for meeting goals defined in their performance plans, therefore, sustainability leadership is about creating and meeting official goals.

The following indicators for sustainability leadership are focused on the unique capabilities of university administrators. These capabilities are the ability to commit to goals and metrics, control of funding and resources, and ability to redefine university culture. Rensselaer's administrators have demonstrated all of these qualities, for example, through the creation of the Rensselaer Plan and the performance planning process. Administrators are especially capable of influencing overall university culture. The state of the university address, town hall meetings, presidential colloquies, and speeches beyond the university are all avenues for communicating university vision and policy to the rest of the community.

Do university leaders advocate for sustainability issues?

Dr. Jackson has given multiple speeches explaining the importance of achieving energy security, and how that goal is connected to sustainability. These speeches are usually delivered outside of Rensselaer, although the topics of sustainability and energy security have come up positively in the presidential colloquy. In speeches and articles, "Energy and Environment" has been labeled as one of the strategic thrusts of the Rensselaer Plan,[58,59] but no comprehensive statements or action plans are found within the version of the Rensselaer Plan posted online.[60] Dr. Jackson has addressed sustainability in various articles in the *Rensselaer Magazine* and on the Rensselaer website. Commitments to forming an institute-wide sustainability task force have also been made.

Does the university have a formal sustainability commitment or statement of principles?

A commitment or statement of principles publicly acknowledges the importance of the environment and commits the university to action. Rensselaer has not made a formal public commitment to sustainability principles.

Does the university have an action plan for addressing environmental stewardship in a systematic manner? Has the university set goals, quantifiable or otherwise, with deadlines?

No, there is no plan for addressing environmental stewardship in a systematic manner. Campus-wide goals with deadlines have not been set. However, certain departments and offices have addressed sustainability somewhat within their portfolios. In the fall of 2008, student members from the Student Sustainability Task Force met with various Vice Presidents and Directors to understand current sustainability efforts, and to encourage them to integrate sustainability into their portfolios.

Has the university committed standing funding to possible sustainability projects?

Rensselaer makes efforts to fund some sustainability projects, though most are financed through grants acquired by students and faculty. The funding of projects by the university seems to be project-oriented, and there is no specific funding mechanism for sustainability-related projects. Some examples of university-funded projects or initiatives include: the purchase of wind energy, investment in LEED-certified new buildings and in energy efficient technologies, support of the student-run "Face the Waste" event, and possible funding for a student energy competition.

Timeline[61]

1988	Lighting Research Center opened due to efforts of Russ Leslie
May 1995	Ecologic submits first recycling proposal*
1995	Greening of Rensselaer Initiative is first proposed*
1995	Greening coordinator positions created as a Co-op position using grant funding*
1996	Water Conservation Coordinator created as a Co-op position. It is later combined with greening coordinator to be the general conservation coordinator*
1996	Student Greening Coordinator Stephen Trowbridge*
Spring 1997	First water conservation undergraduate research project*
May 1997	Second water conservation undergraduate research project*
1995,1996,1997	During each year The Greening of Rensselaer Initiative (GRI) proposes strategic initiatives*
1998	Greenhouse built*
1998,1999	Temporary move-out collection program run by Ecologic and greening coordinator*
2001	Conservation Coordinator Jeremy Magliaro, student in Ecological Economics, Values and Policy*
2001-2003	Jim Adams, senior thesis project, 10 kilowatt, horizontal windmill co-sponsored by NYSERDA at RPI*
2002	Future chips constellation created
2004	Center for Fuel Cell and Hydrogen Research opens
2005	Global Energy Security: Exploration, Diversification, and Conservation: Elements for a Sustainable Future started
June 7, 2005	Center for Future Energy Systems opens
March 2006	American Nuclear Society Students conference held at RPI
January 2006	Purchasing: Rensselaer's Small Business (Diversity) Plan seeks to support local businesses
2007	Vasudha is launched
November 2007	Student Sustainability Task Force is formed**
November 2008	Center for Architecture Science and Ecology (CASE) is officially launched

*Indicates that student or faculty initiative listed, has ended or become neglected when its champions graduated or left Rensselaer for other reasons, indicating that even good programs will end if not integrated into operations or the curriculum. Individual or group championing is good to start

initiatives, but does not ensure longevity.

**Has the potential to discontinue if the leadership is not maintained due to the four-year turnover rate. Alternatively, it has the opportunity to become part of a larger university-wide task force.

Benchmark

In the benchmark section the focus is shifted from the present to the future. The practices of other colleges are examined to provide inspiration for directions Rensselaer could move. This section begins with an inter-university sustainability comparison chart. Next, benchmarking is broken into two sections, "best practices" and "structure of a sustainability resource."

Best practices follows the same format as the first portion of the paper, and is broken into research, education, operations, and leadership. Included are innovative takes on building, dining, greenhouse gasses, grounds, waste management, transportation, procurement, water, research, and sustainability faculty development. By using the term "best" we are referring to successful practices.

The second half of the benchmarking section exhibits various formats of resources that colleges have developed to help them become more sustainable. *Structure of a sustainability resource* gives examples of many different methods colleges are using to help them successfully identify areas to improve and help facilitate the improvement process.

Inter-university Sustainability Comparison Chart

This comparison chart, displayed in figure 10, was created to easily and quickly compare universities on a few basic indicators. Both the topics and universities were chosen by the researchers and data was extracted from university websites.

Figure 10. Sustainability Indicators Comparison Chart. (Numbers in the chart indicate references and can be found in appendix I.)

	Rensselaer	Boston Univ	Cal Institute Tech	Carnegie Mellon	Case Western	Clarkson	Cornell	Georgia Tech	Lehigh	MIT	Northeastern	Northwestern	Princeton	Rice	Rochester Inst Tech	Stanford	Univ Pennsylvania	Univ Rochester	Worcester Poly
Office of Sustainability					36	45	55		73		92	103			128				
Professional coordinator(s)	1	9	18	28	37	46	56		74	83	93	104	113		129	138			
Research/Center in Sustainability		10	19	29	38	47	57	66	75	84	94	105	114	120	130			152	
Sustainable Committee/Advocacy Council	2	11	20	30	39	48	58	67	76	85	95	106		121	131	139	145	153	
Sustainable degree/certificate			21		40		59				96			122					
Sustainable/LEED buildings/program	3	12	22	31	41	49	60	68	77	86	97	107	115	123	132	140	146	154	
Green Purchasing	4	13	23		42	50	61		78	87	98	108	116		133	141	147		
Energy conservation/generation Initiative	5	14	24	32	43	51	62	69	79	88	99	109	117	124	134	142	148	155	
Green/Local Dining/Food Service	6	15	25	33		52	63	70	80	89	100	110		125	135	143	149		
Composting	7	16	26	34		53	64	71	81	90	101	111	118	126	136		150		
Recycling	8	17	27	35	44	54	65	72	82	91	102	112	119	127	137	144	151	156	

Legend	
(dark green)	Yes
(light green)	Pending or limited in scope
(white)	No

Benchmark: Best Practices

The sustainability efforts of other leading universities were thoroughly researched in order to better understand what is being done across the country to address environmental and energy initiatives. The main branches of campus operations were evaluated, and innovative practices were identified that are practical to RPI's development. The 'best' practices were narrowed down through general criteria, in accordance to ease of implementation and cost/benefit scenarios. It is important to highlight how a few simple changes—often coordinated by a particular department or club—can make big impacts, and offering basic incentives often attracts larger groups.

Best Practices: Research

University of California at Berkeley

The University of California at Berkeley formed the Transportation Sustainability Research Center in 2006. This interdisciplinary center combines six existing campus groups, which includes the University of California Transportation Center, the University of California Energy Institute, the Institute of Transportation Studies, the Energy and Resources Group, the Center for Global Metropolitan Studies and the Berkeley Institute of the Environment.[62] The university also hosts several other sustainability-related research centers, including the Energy Biosciences Institute, the Institute for Environmental Science and Engineering, the Center for Environmental Design Research, the Berkeley Institute of the Environment, and the California Center for Environmental Law & Policy. [63]

Best Practices: Education

Northern Arizona University

Northern Arizona University developed "The Ponderosa Project," recognizing that issues of sustainability require interdisciplinary efforts. The Ponderosa Group, comprised of a set of diverse faculty members, participates in a 3-day workshop, in which they learn how to incorporate sustainability issues into course materials. The group also meets regularly throughout the year to discuss their goals, which in clued: educating and empowering faculty in an interdisciplinary effort, "greening the curriculum," educating students about sustainability in their respective fields, empowering students with the tools to become leaders, introducing sustainability issues onto their own campus, and working with the community (at various levels) on sustainability issues.[64]

Best Practices: Operations

Buildings: Emory University

Emory University has 836,500 LEED certified square feet, more than any other university in America. The Emory University Board of Trustees has set LEED Silver as the minimum standard for all future construction projects on campus. The university has residence halls, student halls and research buildings LEED certified. On August 25 2008 the New Turman residence hall received Silver Certification, and two more dorms rooms are on track to receive gold certification. All three will use a rainwater collection system for toilet flushing which receives pump power from photo voltaic arrays.[65]

An example of a classroom building with low environmental impact is the Goizueta Business School. It was originally built in 1997 and did not receive LEED certification. Because of its young age, the building was chosen for the LEED EB program. The lack of deferred maintenance on the building shows that the project is clearly a sustainability goal and not a maintenance goal. The building earned a gold rating in 2005, the first university to receive such a rating.

The Whitehead Biomedical Research Building is a research center that has been Silver Certified in 2002. The additional cost incurred to earn LEED silver was estimated to be 1.5% of the total project cost. "LEED makes good business sense," says Robert Hascall, senior associate vice president for Facilities Management, Emory University. "By building green we are reducing long-term operating costs for the university and our impact and footprint on the environment around us."[66] The university's master plan has set aside half the university's land so that it will not be developed.[67]

Dining: Brown University

Brown University has a dining services program commendable for its serious efforts to integrate sustainability principles into business as usual. Their sustainability efforts understand the full life cycle of food from production to disposal. This is encompassed by two programs: Community Harvest and After the Harvest. Community Harvest focuses on food supply, while After the Harvest attempts to eliminate waste by recycling nutrients through composting, or down cycling food as a food kitchen donation.

Under the Community Harvest Plan, Brown partnered with Farm Fresh Rhode Island, an organization for connecting local farmers with local buyers. Local foods provided on campus include milk, eggs, jam, bread, honey, tomatoes peppers, apples and potatoes. Whenever these foods are available from local farms the university gives the local farms priority when choosing a supplier. In addition, the university seeks to buy fair trade foods including both coffee and bananas, and is trying to expand its fair trade selection of exotic

foods. Brown has hosted a local food forum and has a farmers market weekly on its campus. Reusable beverage containers are sold for two dollars to students and can be used at coffee shops to receive a significant discount.

The After the Harvest program reduces the amount of waste the Brown Dining halls produces. Leftover food is donated to soup kitchens and the university hosts an annual food drive. Composting has been integrated into waste management. The food waste goes to farms that compost the food waste and use it to grow food the university purchases. Food scraps also get sent to pig farms to be used as feed. Environmental impact in the form of waste is further reduced by using biodegradable 'to-go' containers.[68]

Greenhouse Gases: Yale University

Yale has an aggressive sustainability program established in 2005 by the Yale Office of Sustainability. Yale's program includes the gung ho goal of reduction of atmospheric carbon levels to pre-1990 conditions: 150000 metric tons carbon equivalent. During the first two years of implementation carbon emissions have been reduced 17 percent. The reduction Yale is achieving is thus scalable to the global reduction necessary to keep the earth average temperature stable. Yale is accomplishing its greenhouse gas initiatives via comprehensive building heating and cooling renovation; conversion of campus transportation; local sustainable economic community partnerships and campus social and cultural involvement.

Buildings are designed or retrofitted to meet LEED standards. Currently, there are seven LEED compliant buildings on campus. Retrofitted buildings, such as the medical school, receive gold LEED standard compliance and have a reduction of energy by thirty percent. New buildings have been designed with energy savings in mind; these new building have achieved high performance energy reductions of up to 65 percent less energy.

Cooling for buildings is a combination of systems. Yale has added cooling facilitated by ground water, both making use of a natural resource and lowering greenhouse cooling emissions. All large buildings have centralized control HVAC systems, in which temperatures are set appropriately for maximum energy saving, while providing a good working environment. Smaller buildings are independently regulated by occupants.

Energy awareness is propagated amongst the community. This includes the energy pledge which currently has a base of 2500 committed people. The pledge involves committing to social and personal change. A strong environmentally aware community has been one the key factors in resource conservation, which directly correlates to reducing greenhouse gas emissions.[69]

Grounds Management: Oberlin College

Oberlin College is devoted to using environmentally friendly methods of creating and maintaining campus green spaces. Its efforts range from high profile sustainability projects to systematic changes to business as usual. High profile projects devoted to planted space are focused on the restoration of local habitats on campus land. In the spring of 2000 there was a restoration of the natural trees and wildflowers to the south east corner of campus. In addition the college successfully restored wetlands around the Lewis Center, home to the environmental studies program. It also manages a wetlands restoration experiment on a local farm, which aims to discover if restoration techniques can be applied throughout Ohio.

Two other high profile projects attempt to create more natural grounds and restore the local ecosystem at Oberlin. In 2006 Oberlin created a butterfly garden. It used the knowledge of its own faculty to decide which plants would best represent a local butterfly habitat. In addition the Lewis Center had a living machine which replicates wetlands to filter building effluent and recycle gray water.

Other efforts to improve grounds at Oberlin are focused on changing business as usual. Local landscaping is used around the Lewis Building. Lawns here are allowed to grow with an abundance of species and are not watered in the summer. Allowing for nature's natural entropy to exist on the lawns eliminates the large energy expenditure associated with traditional landscaping. Another example of sustainable business as usual is Oberlin's integrated pest management system. It will either replace damaged plants with insect resistant varieties, provide additional care and watering, or as a last resort apply chemicals directly to affected plants. It does not widely spray chemicals on its grounds.[70]

Waste Management: Middlebury College

Middlebury runs its own recycling center, diverting almost 60% of its waste stream, including food and waste composting, which comprises 20% of recycled materials. Also, over 90% of materials from deconstructing old buildings are reclaimed.[71]

Transportation: Stanford University

The school has a very comprehensive alternative transportation program which offers many incentives to the campus community. To help pay for parking permits, clean air cash (taxed) and carpool credit (untaxed) is offered—each for a possible $234 per year. The carpool program offers front row parking, and the carpool permit is transferable among vehicles in the group. The primary carpooler gets the carpool credit, and the clean air cash goes to the members in the carpool group. There is also a vanpool program, in which commuters meet up at a centralized location, and there is the opportunity to pay on a

daily basis depending on availability. The campus shuttle is free and goes to shopping centers and train stations, as well. Stanford has also teamed up with the Zipcar program and offers discounts to departments, which can be distributed to individuals. Zipcars are available to anyone in the campus community 18 or older, and the costs to join and operate are low; there is also a cash incentive for referring a friend.

Aside from automotive programs, Stanford also has an extensive bicycling program, which is organized by a coordinator within the transportation department. There are bicycle safety courses, as well as programs teaching participants how to ride a bike, and bike repair workshops. Lockers are available for $24 a year, and there are locker rooms with showers for bicycle commuters to use. Riders can also register their bicycles with public safety for a theft protection program for only $3.50 for three years. Those riding bicycles are also offered clean air cash for their efforts.

The participants of the alternative transportation programs are often eligible for the Commute Club, which is responsible for disbursing benefits. There is a $50 bonus for referring a friend, and each member receives a $96 credit for Zipcar use. There are also daily parking permits and rent-a-car vouchers, member appreciation benefits, and even emergency rides.[72]

Procurement: Princeton University

In February 2008, Princeton adopted a university-wide sustainability plan which, among other initiatives, outlined a green purchasing program. The institute has created a Cooperative Purchasing Program to open up joint bidding procedures with cooperation from other associations in the area to allow them to order sustainable goods in higher volumes, which means better pricing for those involved. There have also been several student assistants working on life cycle assessments to pinpoint which goods and services typically have a greater environmental burden, and thus could benefit the most from seeking sustainable alternatives. Several programs have been implemented, including the 100% Post Consumer Content (PCC) Chlorine-Free Paper Program, which was actually started in 2006. Through this, there has been a push to use 100 percent PCC in all of the general offices and public printing labs, and Princeton has seen a departmental compliance rate of 90 percent. There is also a program in place to purchase all Energy Star Certified equipment and appliances, and to evaluate existing machines in order to upgrade or replace them with newer, more efficient models. Princeton is also evaluating the benefits of recycling and reusing various products, from dorm furniture to light bulbs, to prevent the need to repurchase yearly routine goods or to even redistribute certain goods elsewhere.[73]

Water Conservation: MIT

Dating back to 1990, MIT developed a water conservation program to retire or replace the majority of the equipment that had previously utilized water for once-through-cooling systems (vacuum pumps, air conditioning, refrigeration, etc.). Along those lines, they have also developed policies for the laboratories which prohibit the use of domestic water for cooling of research equipment. Where possible, MIT has installed low flow shower heads, kitchen and bathroom sink aerators, and toilets and urinals. There is also current infrastructure which allows the reuse of reverse osmosis systems reject water in laboratories or other non-potable purposes. With the current rates of water and sewage services, the majority of the individual projects have approximately a two-year payback period. Some of these specific projects include rainwater harvesting for irrigation and toilet flushing and the installation of water tempering limiters for the autoclave systems—the latter of which has saved 3.4 million gallons per year. Overall, the water conservation efforts from 1997-2005 reduced campus water usage by 60 percent.[74]

Structure of a sustainability resource

In order to act sustainably many schools have developed an internal resource for assistance. This resource has taken many forms: an office, a director, a task force, interns, or a combination of multiple components. Since sustainability is encompassed in research, operations, education, and culture, an internal sustainability resource may function to undertake all of these aspects or only a few of them.

Below are examples of different structures. The resource description is then broken into two pieces, *purpose* and *people*. The *purpose* explains the intention of the resource and *people* shows both the amount of staff needed to make the resource function and the other constituents involved, such as students and faculty. Where relevant, a *background* section is given. It is also important to note that each school defines terms such as office, center, institute, and program differently. All such terminology fits into the hierarchical structure of each school differently.

 Many of these schools are considered to be leaders in sustainability.[75,76,77] While student groups play an important role in most schools, the most success is obtained from having administration support for an internal resource. Students, faculty and staff need a resource within the school to help begin and to ensure the continuation of their initiatives.

Cornell University[78]

Structure: Center with one director, three associate directors, four general staff and a faculty advisory committee

Center for a Sustainable Future (CCSF)

Purpose:

- CCSF "is a campus wide 'umbrella' organization designed to bring together many existing programs and to nucleate new efforts in sustainability. The major objective of this new Center is to seed and grow collaborations across Cornell and with key external partners that can lead to significant real world impacts and leveraging of Cornell resources."
- Fosters research programs, external partnerships, communication and visibility, faculty hires and retention, educational programs, outreach and public engagement

People:

- Director
- Associate Director – Energy Programs
- Associate Director – Environment Programs
- Associate Director – Economic Development Programs
- Executive Director
- Partnerships Director
- Assistant to the Directors
- Interim Webmaster

Faculty Advisory Committee for CCSF

Purpose:

- "Addresses the focus and priorities for CCSF"
- Helps develop requests for proposals for seed projects and helps choose which proposals to fund
- Helps determine appropriate metrics and milestones for the project and for the Center
- May stimulate and organize workshops and info sessions
- Expected to help engage external partners both on and off campus

People:

- 18 voting members, 7 Ex officio members

<u>Georgia Institute of Technology</u>[79]

Structure: Administrative policies, office, and advisory council

Administrative Policies

- Strategic Plan with sustainability in the mission statement

- Signatory of American College and University Presidents' Climate Commitment

Office of Environmental Stewardship

Purpose:

"focuses on sustainability in Georgia Tech's operations, maintenance, construction, and resource management as well as our Auxiliary Services such as Housing, Dining, Athletics, etc."[80]
People:

- Full time director

- 2 Energy reduction management engineers

- Recycling manager

- Recycling program coordinator

- Landscape master planner

- LEED certified green building manager

- Alternative Transportation manager

Advisory Council

Purpose:

- Helps develop and implement sustainability initiatives and programs

- Works with the Office of Environmental Stewardship

- Provides a means for collaboration amongst varied players

- Focuses on education, research, and operations

People:

- Staff and faculty representing administration, operations, research, and education

- Members from Office of Environmental Stewardship

- Student leaders

- Relevant community members

Harvard University[81]

Structure: Independent Office with a revolving green loan fund

Harvard Green Campus Initiative (HGCI)

Purpose:

- HGCI is an "office of sustainability"

- Administers the fund along with a variety of other programs.

- Researches possible projects then approaches the host department with a zero interest loan which must be paid back through project savings over five years, plus a fee to help sustain the office itself

- Yearly Green House Gas (GHG) inventory

- Holds a yearly "best practices" exchange

- Manages in depth website

- Holds sustainable design course for credit

People:

- 19 Professional Staff

- 40 part-time students

Harvard Green Loan Fund (HGLF)

Background:

- In 2001 a student task force and their newly hired sustainability coordinator obtained $150,000 dollars a year for an office and $3 million dollars for a green loan fund from the president of the university

- The fund was then eventually increased to $12 million

Purpose:

- To fund sustainably minded projects with the intent of gaining a return on the investment

- Average $3.8 million per year savings from projects administered using the HGLF

In 2006, then President and previous Secretary of the United States Treasury Lawrence H. Summers called the Harvard Green Fund a better investment than the endowment.

Princeton University[82]

Structure: Office with student interns which coordinates with a committee of faculty, staff, and students

Office of Sustainability

Purpose:

- Coordinates and advocates sustainability efforts in university, regional, and national affairs through collaboration with students, faculty, staff, and administrators.
- Works in close collaboration with the Princeton Sustainability Committee (PSC) to continue developing Princeton's leadership in sustainability.

People:

- Sustainability Manager
- Graduate student intern, assistant manager
- Two main office staff
- Student interns on various projects

Princeton Sustainability Committee

Purpose:

- "Collaborates closely with the Office of Sustainability to monitor the University's relationship with the environment and to encourage improvements"
- Gains insight from the varying perspectives of the administration, faculty, and students
- Provides a means for collaboration of varying groups within the university
- Encourages the implementation of these ideas when appropriate
- Establishes economic and environmental goals for improving Princeton's relationship with the environment
- Recommends and justifies to the administration those policies and practices that can only be implemented by mandate

People:

- 15 people: students, faculty, staff

<u>Rice University</u>

Structure: Administrative policy, office of sustainability, and eco-reps program

Background

- 1995 Signed Talloires Declaration on environmental responsibility

- 2007 Signed American Colleges and University Presidents' Climate Commitment

Administrative Policy: Approved by Board of Trustees, March 2004[83]

"Rice University recognizes the critical importance of sustainability. Its present needs must be met while protecting the interests of future generations. The Shell Center for Sustainability, the Center for the Study of Environment and Society, the Environment & Energy Systems Institute and student organizations should be utilized to foster environmental consciousness and mitigate the University's ecological footprint. Rice University works with students, faculty, and staff to improve environmental sensitivity. University practices will evolve along with the Rice community to keep abreast with changing needs and new technologies. The University believes that students who graduate from Rice need to understand the concepts of sustainability and possess a sense of responsibility for the future."

Office of Sustainability

Purpose:

- Maintains up to date website

- Integrates sustainability into curriculum

- Develops and facilitates with existing departments programs to reduce the University's ecological footprint.

People:

- Director: Under Associate Vice President of Facilities Engineering and Planning[84]

- Eco-reps program: Paid student representatives from each residential college work with the Office of Sustainability to identify and implement programs[85]

- 1 lead student representative

Syracuse University[86]

Structure: Greenhouse gas committee, campus sustainability committee, and sustainability division

American College and University Presidents' Climate Commitment Steering Committee

Purpose:

"evaluates all actions the University takes on its path to fulfilling the commitment"

People:

- Administrators and faculty

Campus Sustainability Committee

Purpose:

- Development of new initiatives
- Reviews suggestions

People:

- Chaired by the Executive Vice President and Chief Financial Officer
- Faculty, staff, and students

Sustainability Division

Purpose:

- *"This administrative unit, headed by the Chief Sustainability Officer, dedicates a full-time staff of four to the daily work of facilitating sustainability. The unit was formed in recognition of the value and potential impact of a formal sustainability program. It is a direct outgrowth of an energy conservation program which has expanded continually since the early 1970s."*

- Coordinates with campus sustainability committee

People:
- Chief sustainability officer
- Database coordinator
- Principle sustainability analyst
- Marketing manager

Culture

Culture is an intangible and elusive concept. It is difficult to characterize or compare qualitatively, and nearly impossible to do so quantitatively. This is the reason why we did not include culture in either the baseline or benchmark sections of the paper. However, culture is likely one of the most important factors that will influence students' perception of the world. A culture of sustainability fosters a specific worldview, one which acknowledges the importance of examining the world in a holistic manner. It requires understanding the impacts of our actions, policies and technologies on the environment, society and the economy. It involves recognizing the undeniable interconnectedness of our eco-, economic, and social systems.

Because sustainability permeates through all aspects of life at a university, from individual lifestyle choices to coursework to research, changes must necessarily occur at all levels. This also means that communication and education must occur between and at all levels. *What kind of changes can occur in the residence halls to promote more sustainable lifestyles? How can we best promote sustainable practices within campus buildings? How can sustainability principles be integrated into existing coursework and what will help professors to do so?* These are the types of questions that must be answered in order that we effectively begin to change campus culture.

Developing a culture of sustainability is possible. To do so requires simultaneous leadership from all levels of the university, from individual students to faculty and staff to the executive administration. A commitment to this goal will have exponential effects. Rensselaer graduates will leave with an understanding of how their lifestyle choices and their work effects the world we live in. They will depart as global citizens, able to address the challenges that they will inevitably face.

Conclusion

Research

Rensselaer is a definite leader amongst institutions in sustainability-related research. The university hosts some of the world's top researchers who are engaged in ground-breaking and forward-thinking technological research. From more powerful solar technology to more efficient lighting to advances in fuel cell and hydrogen technologies to the innovative Built Ecologies architectural research, Rensselaer has immense, ongoing potential to lead our world towards a more sustainable future.

Education

Rensselaer is also a leader in interdisciplinary and interactive or hands-on education. Rensselaer's students will also certainly be future leaders in their fields. The interdisciplinary and interactive learning

environment provides them with the skills and experience to address the world's increasingly complex issues. While certain programs sufficiently cover topics surrounding sustainability, a gap remains in many students' understanding of these problems.

Operations

Rensselaer's operations include: buildings, dining services, greenhouse gas emissions, energy use, grounds, waste management, transportation, procurement and water. There are some initiatives underway, but there are certainly many other programs that could effectively address both inefficiencies and human behavior. These improvements could lead to significant cost savings, reduction in Rensselaer's environmental impact, and educational opportunities, and could support a more robust culture of sustainability. A sustainability initiative at a university can be itself economically sustainable because energy efficiency and energy usage habits have respectable, low risk returns on investment. In addition, monetary savings could be made in regards to waste generation and water usage.

Leadership

Leadership has begun to occur at all levels, from students to faculty and staff to the executive administration. Certainly, there is room for everyone to begin to make stronger commitments to sustainability. Communication and collaboration among these leaders of the Rensselaer community will enhance our ability to successfully address sustainability at Rensselaer.

Culture

Rensselaer falls behind in this area, as students' attitude and behavior do not reflect the principles of sustainability. Much progress could be made in this area through educational programs and initiatives. A coordinated effort by the university, specifically amongst the various Student Life offices and academic departments could make a huge difference. While difficult to quantify, this aspect of sustainability is likely the most important. Our university's culture reflects the worldview of the student, and ultimately affects how the student will act in our world.

An opportunity exists for Rensselaer to become an overall global leader in all realms of sustainability, including research, education, operations and culture. A renewed focus and commitment, coupled with modest additional resources, can place Rensselaer as a leader in all categories.

Suggestions

Sustainability inherently requires multilevel and interdisciplinary collaboration and communication. Both decentralized and centralized approaches are necessary for success. Successful programs at other institutions have followed this approach. Clear and consistent communication across disciplines, offices and buildings provides efficient and successful planning and implementation of actions related to sustainability. At Rensselaer, some of this planning and implementation can and should be integrated into existing portfolios. An institute-wide sustainability task force or advisory committee, as suggested by President Jackson, could aid in this process. Additionally, however, centralization will provide the necessary knowledge, resources (time and energy), organized communication and commitment enabling Rensselaer to capitalize on untapped, but fruitful opportunities.

This centralized resource, consisting of expert professionals, would not work in isolation, but rather would collaborate with Rensselaer's departments and offices, assimilating into the existing structure. These professionals would facilitate the process, rather than prescribe solutions. This centralized resource would supplement the performance planning process by doing the following.

A centralized resource can:

- **Introduce expert knowledge**

    Professionals can more efficiently address opportunities or issues because of their knowledge and background. They can help to integrate sustainability into performance plans

- **Identify opportunities for cost savings**

    In collaboration with departments, such as Campus Planning & Facilities Design, Environmental & Site Services, as well as with research labs and building coordinators, inefficiencies and wasteful behaviors can be identified and addressee, which in turn can lead to significant monetary savings.

- **Provide improved internal and external communication (within and beyond Rensselaer)**

    Improved internal communication will facilitate the ease of communication and transfer of ideas between departments, eliminating the inefficient methods of reinventing existing ideas and programs that foster sustainability. Beyond interior communication, it can promote communication with the rest of the world regarding Rensselaer's successes in sustainability.

- **Develop a portal for communication between and among researchers, faculty and students, which will provide awareness of opportunities for interdisciplinary research and opportunities for**

undergraduate and graduate research

Development of a method of communication specifically geared toward interdisciplinary academic and research opportunities could greatly enhance the opportunities for collaboration between academic departments and between researchers in various fields.

- **Eliminate inefficiencies of repeating past efforts**

  As noted in this report's timeline and case studies, many previous efforts, while successful, have been neglected or forgotten. It is possible to avoid repeated efforts which have wasted time, money, resources and energy.

- **Identify past and current successful projects and provide continuous support for these projects**

  As noted in the baseline section of this report, much time and effort has been invested in successful sustainability projects. Identifying and continuing to support these projects can bring energy and costs savings, as well as educational benefits.

- **Ease the burden on current staff, administrators and faculty**

  Through conversation with numerous faculty, staff, deans, and directors, it has become evident that a centralized resource would provide the lacking time, knowledge and communication.

- **Enhance the student education and experience by addressing sustainability in regards to campus culture and student lifestyle**

  Through consistent co-curricular educational initiatives and programs, students' education can be enhanced. These types of programs coupled with sustainability in the curriculum will provide a consistent student experience, which is needed in order to develop a true understanding and awareness of issues surrounding sustainability.

The following suggestions could be implemented at any time:

Research

- Development of a search engine for communicating about Rensselaer research
- Improved publicizing Undergraduate Research Projects (URPs)
- Sustainability research lecture/demonstration series from Rensselaer professors
- Poly column written by Rensselaer researchers about their research
- Research regarding campus sustainability projects (i.e. feasibility studies for alternative fuels for campus vehicles or green roofs)

Education

- Integration of sustainability principles into all programs

- Programs to aid faculty in integrating sustainability into curricula

    o Development of faculty-learning workshops

    o Round table discussions among faculty members

- Development and distribution of sustainability-related courses to offer to students

- Development of additional programming outside of the classroom, such as sustainability workshops or lecture series

Operations

- Creation of "sustainability building coordinators" (SSTF is making an effort to establish this).

- Human Resources workshop – sustainability training

- Continuing efforts to reduce and/or conserve energy, water, etc.

- Establish composting

- Refurbish printing infrastructure

    o Elimination of RCS cover papers

    o Duplex printing default

- Establishment of environmentally and socially responsible procurement policies and guidelines

- Improved alternative transportation options

Culture

- Design charrette (as previously suggested)

- Sustainability in RA training program

- Sustainability NRB/SO/FYE programs

- Involvement in the Periclese Project[87]

- Rid the campus of plastic bags and plastic water bottles

- Development of Electronic and odd materials recycling center in EEC

- Funding for student participation in sustainability-related conferences

Overall

- Implementation of university-wide task force (as previously suggested by Dr. Jackson)

- Integration of sustainability into performance plans

- Development of sustainability website

A Call to Action

Rensselaer, though a sizable consumer, is only one consumer of energy, water, and resources and only one producer of waste. The impact Rensselaer has on the sustainability of the planet is miniscule when considering all individual actors together. However, this should not undermine the importance of Rensselaer to reducing its impact. It is important that every individual actor employs strategies for lowering their impact. What must be realized though is that in addition to individual efforts, the problems we are currently facing will require changes on scales larger than efficiency and what can be done as an individual actor.

The reason it is so important for Rensselaer to act is because of the impact Rensselaer has on the world as a producer of innovative, entrepreneurial, and research potential. Rensselaer graduates are what are important. Taken in the context of the world, the number of Rensselaer graduates is only a small percentage in terms of population, but a sizable percentage in terms of capability. Rensselaer graduates have the necessary intelligence and preparation, and will be in the position to face up to the challenges of pollution management, remediation, biodiversity, water use, land use, transportation, environmental health, food production, waste management, energy security, and climate change.

The likelihood of students taking responsibility to live up to this potential depends on their awareness of the problems. Awareness comes simultaneously from relevant incorporation into classes and from living in a community that itself is aware and active. This means research, education, operations, and culture. Students develop into global citizens while at college. It is absolutely imperative that the students who graduate from Rensselaer leave as global citizens who are fully prepared to take responsibility for the challenges of our lifetime.

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