Analyzing an Energy Reduction Policy at WPI

SZG EN09

Worcester Polytechnic Institute

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Abstract

This project analyzes the effectiveness of emissions and energy usage reduction policies at universities. WPI currently does not have a policy describing a plan for the reduction of emissions or energy use on campus. The goal of this project is to encourage WPI to enact a reduction policy of its own. The primary research conducted during this project was an investigation of the policies of other universities and how these universities created their respective targets. The project team also calculated approximate emissions reduction levels from proposed improvements in lighting and heating at WPI. The group used its findings to help formulate an outline for a feasible emissions reduction policy at WPI.

Acknowledgements

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Chapter 1: Introduction

Sustainability is a growing concern among around the world. The idea of sustainability is that the people of today can meet their needs without jeopardizing the needs of future generations. The concerns of sustainability include, but are not limited to pollution, air quality, water purity, and natural resources (Daniels, 2003). These concerns are even being discussed on a national level at UN conferences which shows the magnitude of the importance of sustainability in the modern world.

Leaders at the United Nations Framework Convention on Climate Change (1997) have created a policy on sustainability called the Kyoto Protocol. While being a part of the UNFCC commits nations only to "consider climate change" (1997), the Kyoto Protocol is a legally binding commitment for the reduction of greenhouse gases. The Protocol commits leading industrial nations to become more sustainable in development and energy usage. According to the UN (UNFCC, 1997) the Kyoto Protocol commits 183 industrialized nations to collectively reduce their 1990 greenhouse gas emissions by 5 % between the years 2008 and 2012. The United States has not committed to the Kyoto Protocols, but this is nevertheless an example of how daunting the global community perceives this growing problem to be.

The United States government is making its own effort to slow down the process of global warming. The American Recovery and Reinvestment Act, which was signed by President Obama in 2009, committed over $80 billion to clean energy investments in an effort to improve the economy, reduce America's dependence on foreign oil, and make America more sustainable as a country (whitehouse.gov, 2009). The investments include $11 billion for a better grid for the transportation of renewable energy from the rural areas where it is created to larger cities and $600 million to green job training programs. President Obama also released memoranda (2009)

directing the Department of Transportation to establish higher fuel efficiency standards for carmakers' 2011 models and to allow California and other states to raise their emissions standards beyond the national standard. These actions, among others, are proof that the United States fully plans to address global warming.

In order to obtain this goal an effort to reduce emissions also needs to be made on a community level. Individual communities are becoming more sustainable by conserving more and using alternative sources of energy such as solar, wind, and geothermal. Formal policies committing institutions to energy and emissions reductions are now common among many universities including the University of New Hampshire, Clark University, Lehigh University and Rensselaer Polytechnic Institute. These policies include plans for the implementation of renewable energy sources and other more immediate ways to conserve and save energy. However, by the admission of WPI's own Sustainability Coordinator Liz Tomaszewski (2009) WPI has not made any commitments or policies towards the reduction of energy usage or emissions.

The goal of this project is to analyze the effectiveness of energy usage and emissions reduction policies in order to encourage WPI to enact a policy of its own. The Chief Financial Officer of the President's Task Force on Sustainability, Jeff Solomon (2009) expressed that the reason why WPI has no formal policy in this area is because policies are too great of a commitment and that the university does not want to place limitations on itself. He also said that although some institutions have signed onto commitments to emissions reductions the financial status of such institutions is preventing them from meeting their goals.

Many universities that are similar in composition to WPI have made policies to reduce their energy consumption and greenhouse gas emissions with specific targets of reduction, while

others have not. This project will investigate why schools have or have not adopted such policies, if the commitments they have made are realistic, and what initiatives they are taking to reach their target energy and emission reduction levels. This report will also include the different ways in which institutions can improve their sustainability including renewable energy usage and conservation methods. The report will use other schools' initiatives as examples and analyze them to determine which would be the most effective at WPI. The report also will examine how policy is made at WPI and determine the factors that have prevented WPI from creating such a policy in the past. Lastly, this project will use all of this data to attempt to find ways around these factors to achieve the goal of encouraging WPI's decision makers to draft a formal sustainability policy.

Chapter 2: Background

Sustainability is the ability to endure. In a very broad sense this means society's ability to have living standards that will not jeopardize the future of the Earth. This project examines the effects that a policy on carbon emissions and energy usage reductions would have at WPI. This section of the report provides an overview of the growing problem of global climate change and its causes. It will also examine what actions can be taken by an institution to reduce its effect on this growing problem including energy efficient lighting and appliances, conservation of energy, and policy implementation. This chapter will also detail WPI's current sustainability policies and the university's stance towards carbon reduction policies from the opinions of its important faculty. The overall goal of this project is to help WPI become more sustainable by providing an understanding of policy because sustainability is now a major concern throughout the world (UNFCC, 2009).

Global Climate Change

It is important that efforts are made towards more sustainable energy consumption because the future of the Earth depends upon it. The Intergovernmental Panel on Climate Change (2009) is a scientific organization which appraises the effects of human interactions with the environment and is considered to be the leading body in this area. The IPCC has claimed that an 80% reduction in global greenhouse gas emissions by 2050 is likely essential to preventing the worst effects of climate change. Figure 1 is published in its fourth assessment report (2007). These charts clearly show an increasing trend in both global average temperature and sea level, specifically over the past 100 years.

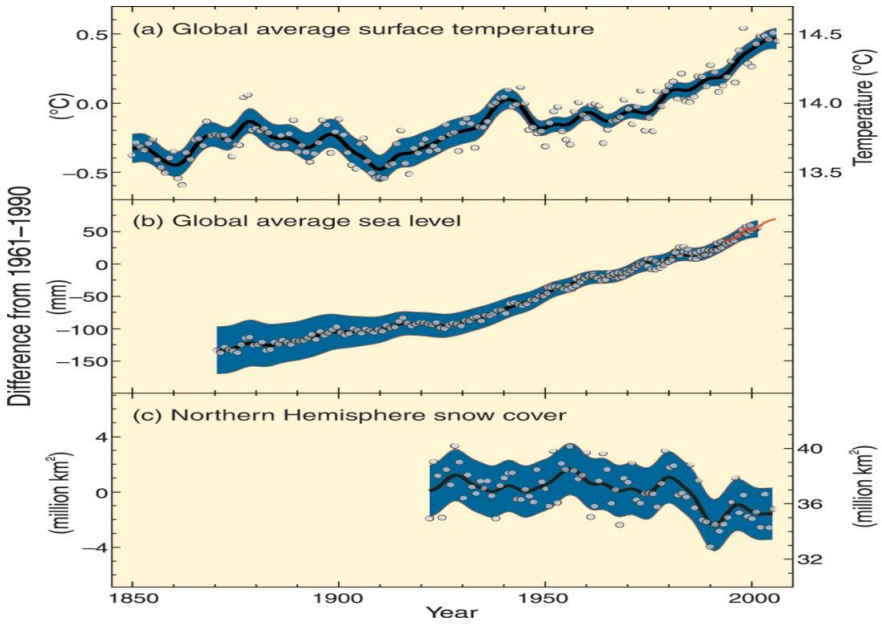

Figure 1: Global Differences in Temperature, Sea Level and Snow Cover from 1961 – 1990. (IPCC, 2007)

The IPCC lists the worst effects of climate change as increased temperatures, increased frequency and intensity of storms, public water supply shortage, rising sea levels and increased erosion. According to the Environmental Protection Agency (2009), rising sea levels will result in land loss in coastal regions that will disrupt wetland and salt marsh ecosystems which provide a home for many species of organisms. The EPA also explains that climate change can have many harmful effects to human health both directly from extreme weather conditions and indirectly from problems with agriculture and food supply. Figure 2 below, also published in the IPCC's fourth assessment report, shows that the concentration of greenhouse gasses in the atmosphere increased dramatically in the past few decades. This is due to increased human activities that emit the greenhouse gases (IPCC, 2007).

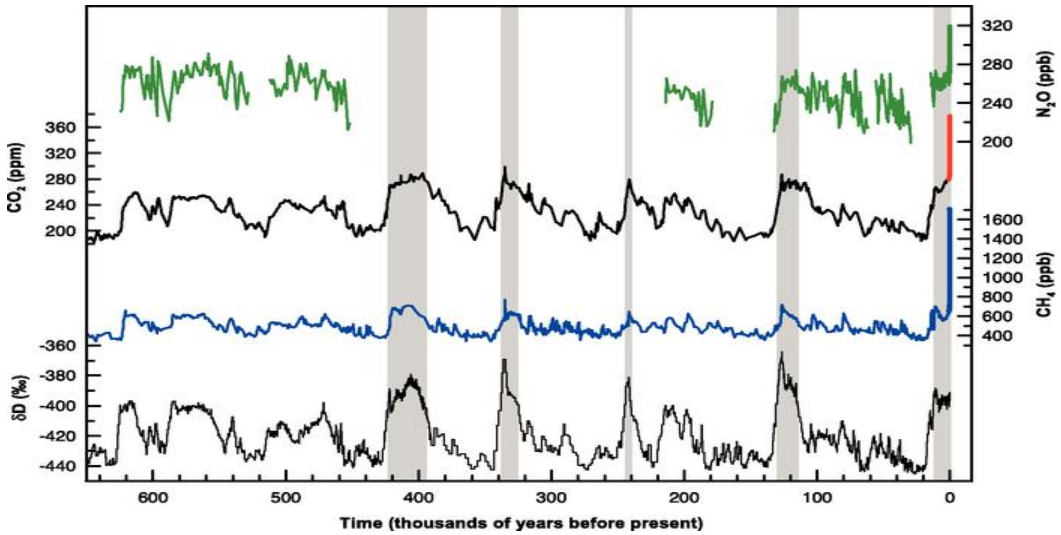

Figure 2: Concentrations of Greenhouse Gases from 650,000 Years ago until Present. Data Taken from Glaciers. (IPCC, 2007)

The exhaustion of the Earth's natural resources is another reason that fossil fuel consumption should be reduced. It is accepted in the global community that the Earth will eventually be depleted of its fossil fuels if people continue to use them at the rate they are used today. Chief among this community is the Association for the Study of Peak Oil and Gas (2009) whose self proclaimed mission is to study the world's endowment of oil and gas, model depletion of these resources due to various factors of human economy and technology, and to raise awareness of the problems this may cause. Figure 3 below shows the discovery rate of oil vs. the production of oil. This graph (Campbell, 2009) also suggests that the rate at which oil is used is higher than that at which it is being discovered. Statistics taken from the U.S. Energy Information Administration (2007) show that 6.5% of Massachusetts' electricity from utility companies comes from oil.

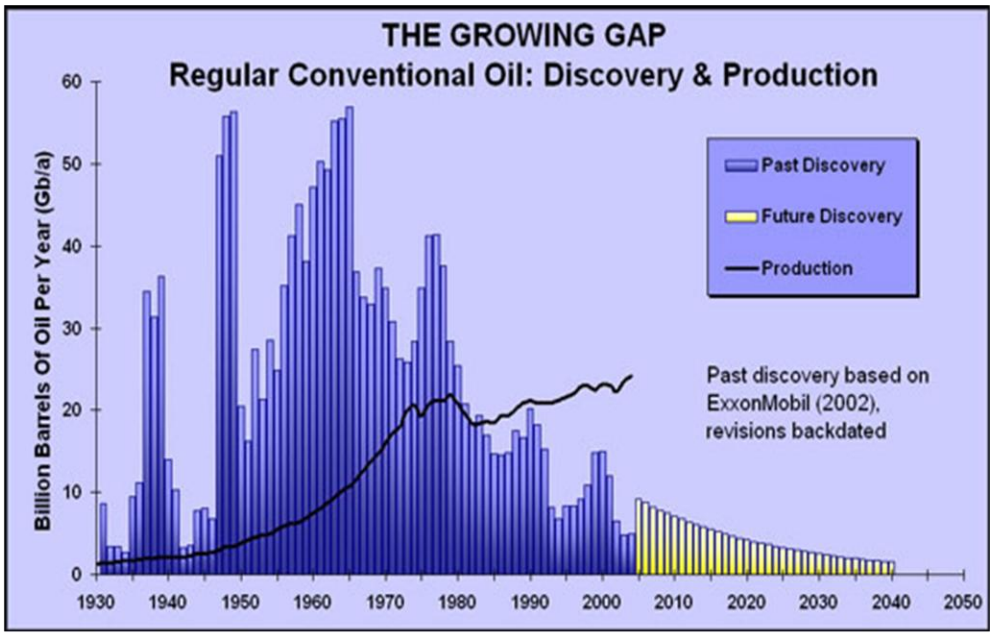

Figure 3: Oil Discover vs. Oil Production. (Campbell, 2009)

Another significant contribution to greenhouse gas emissions is from the burning of coal to create electricity. Electricity is a secondary source, meaning other sources are needed to produce energy. According to the EIA (2009) 26% of electricity in Massachusetts comes from coal which contains 60% - 80% carbon. Burning 1 ton (2000 pounds) of coal produces 5,720 pounds of carbon dioxide. Burning natural gas, which accounts for 53% of total electricity produced in Massachusetts (EIA, 2007), produces half that amount of carbon dioxide.

Reducing emissions leads to upholding a cleaner and safer environment and protecting the Earth against climate change. Reducing fossil fuel usage subsequently reduces emissions and saves money for the user.

Energy Consumption Reduction

There are many different ways to reduce energy usage and emissions, such as using more energy efficient appliances, being more conservative, and using renewable energy resources. The

following sections of the report will explain and give estimates on the savings that these alternatives can yield for the user.

Energy Efficient Lighting and Appliances.

Many universities including Clark University and UNH have adopted an Energy Star rating purchase policy. Energy Star qualified products use 10 – 50% less energy and water than standard models (U.S. Department of Energy, 2009). Energy Star also offers a discount when products are purchased in bulk.

According to the DOE (2009) lighting in the U.S. uses approximately 25% of the nation's electricity. From observation it is clear that most of WPI's buildings are lit by fluorescent light bulbs. While these are more efficient than incandescent lights, an even more efficient and sustainable type of lighting is the Light Emitting Diode (LED) type. Ashton, Bean, Knight and Nich (2009) found that a 15 watt LED tube light can replace the 32 watt fluorescent tubes used in many of WPI's buildings, making them two times more efficient than fluorescent lighting. According to manufacturers (DOE, 2009) LED lighting also has an average lifespan of 50,000 hours compared to the 12,000 hour lifespan (DOE, 2009) of fluorescent bulbs. Fluorescent bulbs are much cheaper than LED bulbs, making them more economically feasible in the short term.

Table 1:

Fluorescent vs. LED Lighting

Type of Lighting	**Cost**	**Power Needed**	**Lifetime**
Fluorescent	$60 for a case of 25 = $2.40	32 Watts	12, 000 hours
LED	$60	15 Watts	50,000 hours

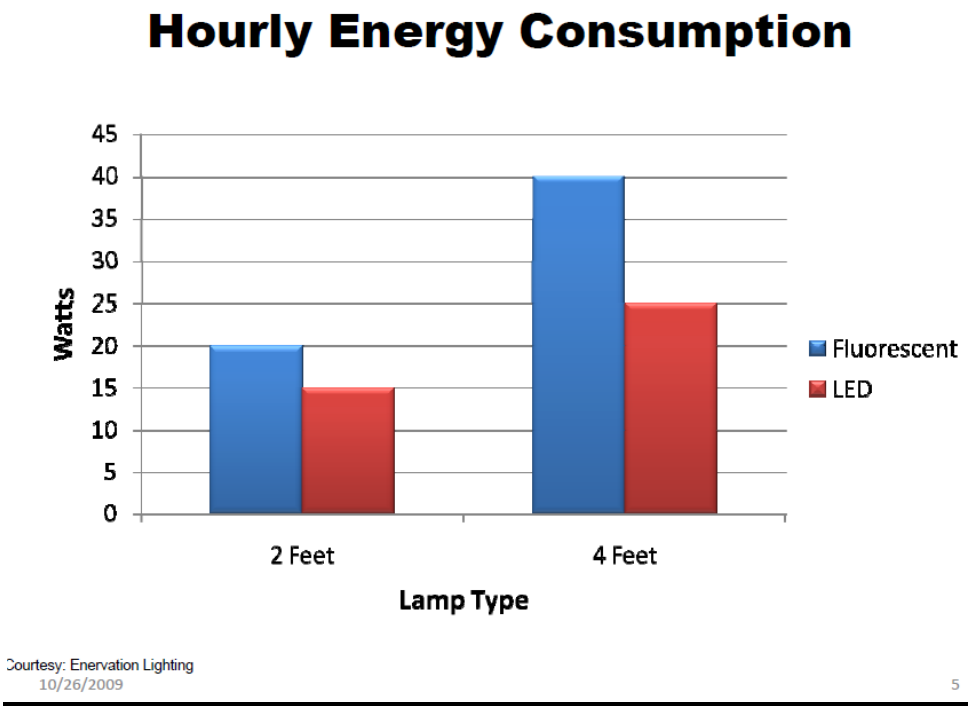

Figure 4: Fluorescent vs. LED Hourly Energy Consumption. (Enervation Lighting, 2009)

Another way to save on energy with lighting is to use daylight dimming fixtures. These fixtures dim lights when natural lighting is available and are 35 – 70% more efficient than non - dimming fixtures (Ashton et al., 2009). Ashton et al. found that to implement this feature in the Atwater Kent building, with the cost of $1,000 per fixture and maintenance costs of $140 per year, the system would pay itself off and save $4,700 in ten years for WPI.

Fluorescent light bulbs can also have a negative impact on the environment and human health. They release toxic chemicals when they are broken, including 3.5 – 15 milligrams of mercury (Environmental Protection Agency [EPA], 2009). Although this is a very small amount, mercury poisoning can still pose a threat to an unhealthy person with a weak immune system or to infants and young children. According to the EPA 76% of fluorescent light bulbs are not disposed of and recycled properly, meaning the toxic chemicals contained in them are released into the environment. LED lighting does not contain any toxic chemicals.

Renewable Energy.

The implementation of renewable energy is a large part of the sustainability policies of some institutions. The feasibility of implementing such a policy has been challenged by both Solomon (2009) and Tomaszewski (2009) of WPI. They believe that the initial start up cost of implementing any kind of renewable energy is unreasonable for WPI at this time. Other institutions such as UNH are more optimistic about renewable energy and have made them a part of their sustainability policies. They plan to obtain 85% of their energy through an Eco – line project which takes methane gas produced by a nearby landfill and uses it as fuel for energy. UNH also currently uses a cogeneration plant, which uses heat usually lost in electricity production to heat the campus.

Usage of renewable energy sources has become more popular as concerns about greenhouse gas emissions have risen. According to the EIA, in 2006 renewable energy only accounted for 7% of the United States' total energy consumption. Over the past three years there has been an increase of 6%, almost doubling renewable energy consumption to 13% and a decrease of 14% in the consumption of coal (Kraemer, 2009). Nobel Prize winner and former Vice President Al Gore (2008) has challenged the United States to produce 100% of its energy using renewable energy, stressing that it would help prevent climate change and U.S. dependence on foreign oil. Such a change would make the United States much more sustainable both in terms of energy and economy. President Obama has taken notice of the value of renewable energy and in signing the American Recovery and Reinvestment Act (whitehouse.gov, 2009) allotted $11 billion dollars to a larger grid for transporting renewable energy from rural areas where it is produced into cities where it is most used and $6.3 billion to state and local renewable energy and energy efficiency efforts.

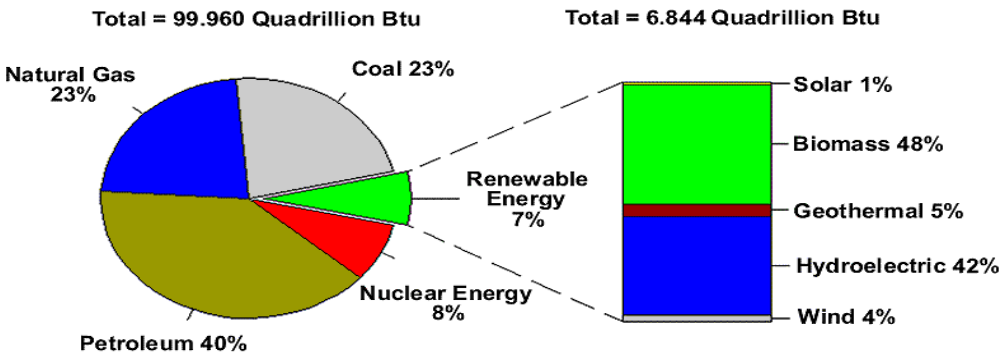

Figure 5: The Role of Renewable Energy Consumption in the Nation's Energy Supply, 2006. (EIA, 2006)

A major disadvantage of renewable energy is the large initial start – up cost, which is the major reason WPI has not invested in renewable energy (Tomaszewski, 2009). The purchase of renewable energy as an offset from the electric company is also more expensive than fossil fuels. Calculations made by award winning journalist Ronald Bailey (2008), from examples of recently created large scale renewable energy systems, stated that if the U.S. were to be powered by solar energy alone (as Gore suggested) it would cost $3 trillion over the next ten years, $6.5 trillion if wind were to be used or $2.5 trillion if geothermal were to be used to produce 100% of America's energy. Another disadvantage of renewable energy is that it is not always readily available and the energy produced when it is available is very difficult to store.

Solar.

The conversion of sunlight to another form of usable energy is called solar power. Light from the sun is usually collected by flat, modular panels mounted on roofs of buildings of homes and large solar plants. The energy created is renewable in the sense that the sun will continue to shine for a very long time. Solar energy is a clean source of energy that does not give off any of the harmful emissions that burning oil produces. The only costs associated with solar energy systems are from installation and maintenance. Money spent on the startup cost of the actual

system and installment of the system will eventually be paid back through the energy that the system provides (Wyk, 2005). Solar power systems are silent, low-maintenance, and are easy to clean(Clark, 2006).

The two ways in which light from the sun is converted into energy are photovoltaics and solar thermal collectors (EIA, 2009). Solar thermal collectors provide energy in the form of heat. Sunlight heats up water in the collector, and this water is used as a source of heat or is used to run a turbine for electric power. There are three types of solar thermal collectors; flat plate, evacuated tube, and concentrating.

Flat plate is the simplest and most common type of collector. A panel encloses a series of tubes uses dark backing to absorb the Sun's light and traps heat, a liquid traveling through the tubes in the panel is heated by this. The liquid can then travel through pipes and radiators as boiling water or can be converted into steam which will heat a designated space (Apricus Solar Co., 2008).

Evacuated tube solar water heaters are a bit more complicated, but work better than other solar water heaters in overcast conditions. A series of parallel glass tubes are placed in an area that receives adequate amounts sunlight. For each parallel section two glass tubes are fused together at one end, then the air between them is taken out of them creating a vacuum. The evacuation of the tubes acts as an insulator and inhibits conductive heat loss. The inner tube has a coating which absorbs heat from the sun, and this heat can be transferred to a designated space (Apricus Solar Co., 2008).

The last form of solar thermal collectors is the concentrating collector. This system requires direct sunlight and thus does not perform in overcast conditions. A parabolic trough lined with mirrors focuses an extreme amount of sunlight into a receiver which contains a heat-

transfer liquid. These troughs can get very hot due to the concentration of the sunlight at one point, and so are generally used for commercial power (Apricus Solar Co., 2008).

A photovoltaic (PV) system directly converts sunlight into electricity using a semi-conducting material such as silicon. This material is excited by sunlight and produces an electric current, which is stored as potential energy (Carlin, 2004). The electricity produced can be used to power electronics or can recharge batteries.

Factors that go into the purchasing and installment have to do with making the system as efficient as possible. Tilt angle, the direction the panels will face, and the amount of sunlight the panels will receive are all taken into account. Technical problems with solar energy are that the energy produced by it is difficult to store and it can also be difficult to configure a meter and inverter box. The payback periods on solar energy systems vary greatly depending on the type of system to be installed and what type of system is being replaced. Approximate calculations can be found on the Department of Energy website (DOE, 2009).

Geothermal.

Geothermal heat pumps harness the constant temperatures found in the ground beneath our feet to provide both heating and cooling for buildings. The system is made up of pipes which are buried deep in the ground where the temperature stays more constant throughout the seasons. Geothermal heat pumps can provide heating, air conditioning and hot water.

The heat transfer process involves pulling heat from one source and putting it into a different area. In the summer a geothermal heat pump takes the heat from a home or building and discharges it into the ground. In the winter the pump takes heat from the ground and moves it into the building (California Energy Commission, 2006). This process works even in areas that have large temperature variations above ground throughout the year.

Installation of geothermal heat pumps involves drilling deep enough into the ground so that the temperature variation between the surface and the soil is great enough for the system to work effectively. Pipes are then installed which contain liquids such as refrigerants, water or antifreeze (alternative-heating.com, 2006-2009). In the winter the heat from the ground is transferred to the fluids as they run through the pipes below ground. The pipes then return the liquid to the building and release whatever heat they attained underground. This heat is coursed throughout the building while the liquids start the process over again and head back under ground. This process also works the other way around for air conditioning purposes. Geothermal heat pumps require much less energy than conventional air conditioners because it is discharging into the cool ground rather than into the hot outside air.

According to a report from the Office of Geothermal Technologies (a sector of the U.S. Department of Energy) (1998) geothermal heating and cooling systems can save users as much as 50% in terms of heating costs over other climate control systems. The DOE (2009) explains that geothermal systems generally cost several times more than conventional air-source systems, but have payback periods of 5-10 years. They are also known for being easy to maintain and as having long life-spans of around 20 years.

Energy Conservation.

As an alternative to installing the systems described above, some experts stress conservation because the amount of energy needed by the developed nations of the world is not sustainable even by renewable energy. In other words, the current needs of developed nations cannot be sustained as is shown in the data presented earlier with respect to the depletion of natural resources and global climate change (IPCC, 2007 and EPA, 2009).

Reducing the amount of energy we use and being aware of how the choices we make affect the environment are two very important aspects of sustainability. Hughes (2009) expresses this opinion and offers two ways to reduce the amount of energy used: conservation and efficiency. Hughes (2009) and Trainer (2008) both believe that conservation is the most effective way to reduce emissions and save money. Policy regarding conservation objectives is an integral part of a sustainability policy that reduces energy usage and emissions.

The Importance of a Sustainability Policy

Policy, in a broad sense, is something that places a requirement on a group or organization typically in order to achieve a goal. The group or organization decides how to format, revise and enforce their policies so that the policies are efficient, constantly meet the needs of the organization and are effectively applied. Colleges and universities each have their own separate needs and thus each have their own way of creating and enforcing these policies. The purpose of this project is to examine whether there may be need for such a policy by reviewing the effectiveness of policies at other institutions.

Purdue University (2002) defines policy in a number of ways. According to the university's policy website, the important aspects of any policy are that they mandate either requirements of or provisions for the members of the university, have a broad application throughout the university's system, enhance the university's mission, reduce institutional risk, and/or promote operational efficiency. Cal Poly Pomona (2006) explains in its strategy on policy-creation that a policy is something that guides some kind of action plan for the university and its constituents. Purdue's website also diagrams their process and lists the starting point for any policy as indentifying the need for a policy as determined by an individual or group. Cornell

University (2004) also listed this as the first part of the policy-creation process in a document they published online on the topic.

There are currently a number of large scale initiatives that set forth goals in the area of sustainability and force institutions to form their own sustainability policies. Two of these which are pertinent to universities are outlined below:

American College and University Presidents' Climate Commitment (ACUPCC).

The ACUPCC is a commitment that has been signed by many different colleges and universities around the nation to be more sustainable. According to the ACUPCC website (2010), it was created in December of 2006 and was originally signed by 12 founding signatories. As of February 12th, 2010, 667 universities had signed on to this commitment. A policy called the Climate Action Plan is a requirement of the ACUPCC and requires universities to creating their own plan towards eventual carbon neutrality by a target date. Under the ACUPCC, schools have two years to create a plan with their own specified target dates. These plans may be changed and are flexible depending upon the feasibility of the plan.

Executive Order 484.

State Universities such as UMass Medical School are required by the state to make energy and emission reductions. Executive Order 484 mandated by the state and signed by Governor Deval Patrick requires that state agencies reduce energy usage and consequently reduce emissions by the amounts below by 2012:

- 25% greenhouse gas emission reductions from 2002 levels
- 20% energy reduction per square foot from 2004 levels
- 15% of energy consumption procured from renewable energy sources (either through purchase of renewable energy or through installation of on-site resources)
- 10% reduction in water use from 2006 levels

Global Warming Solutions Act

The Global Warming Solutions Act requires Massachusetts to reduce its 1990 level greenhouse gas emissions from 10%-25% by 2020, and by 80% by 2050. According to the Intergovernmental Panel on Climate Change (2009) an 80% reduction in global greenhouse gas emissions by 2050 is essential to avoid the worst effects of climate change. Post 2007 greenhouse gas reduction policies in Massachusetts, including Executive Order 484, energy efficiency policies and transportation policies are expected to result in an 18.6% reduction in Massachusetts greenhouse gases (ERG, 2010).

Sustainability at WPI

According to Elizabeth Tomaszewski (2009) WPI does very well when being graded on its sustainability. She explained in an interview that WPI's results placed us near the top of the schools that took part in the Sustainability Tracking, Assessment and Rating System (STARS) pilot conducted this past year. The STARS assessment was created by the Association for the Advancement of Sustainability in Higher Education (AASHE). The AASHE was officially created in January, 2006 and was the first professional higher education association for the campus sustainability community according to their own website (2010).

WPI also performed well on the 2010 version of the College Sustainability Report Card, (see Appendix A) receiving a B+ score (Sustainable Endowments Institute, 2009). Mrs.

Tomaszewski, among others, has spearheaded WPI's sustainability initiatives since she took on the role of sustainability coordinator. Previous to Mrs. Tomaszewski's position being created, however, no one held a comparable position. According to her this led to a lack of effort in reporting to the College Sustainability Report Card which explains why WPI did not perform well on past evaluations (see Appendix B). However, WPI's performance greatly improved on the 2010 edition of the same evaluation, increasing from a C- to a B+ (Sustainable Endowments Institute, 2009). According to Jeff Solomon (2009) the significant improvement was largely due to a greater effort in reporting and publicizing the sustainability initiatives taking place on campus.

The leading organization which deals with sustainability at WPI is called the President's Task Force on Sustainability. The purpose of this group is to act as an advising body in WPI's move towards becoming more sustainable. The organization focuses on topics such as climate protection and materials management and also works to improve the sustainability of other communities in Worcester and around the world at our global project centers (Presidents Task Force on Sustainability, 2009). An example of a project run by the Task Force is the improved effort in recycling. WPI recycles many materials that other organizations may not including mixed paper, cardboard, bottles and cans, mixed electronics, consumer hazardous wastes and chemical waste (Presidents Task Force on Sustainability, 2009a).

The newest addition to WPI's sustainability team is the student run Green Team. Mrs. Tomaszewski (2009) explained that the Green Team has had several meetings in which students have led spirited discussions about important issues involving sustainability on campus. She said that their primary topics for discussion include recycling and waste management, but that they currently have not considered policy creation.

Energy Usage on Campus.

Over the past several years WPI has made big strides in improving energy usage on campus. Most distinguished amongst these was the replacement of the power plant boilers in 2005. William Grudzinski, WPI's chief engineer in the power plant, estimated $8.5 million was spent on the project. He also explained that the boilers efficiency was increased from the low 70s to 83% (2009). Improving boiler efficiency not only saves WPI money, but it also greatly reduces fuel consumption and emissions. Table 1 below shows the amount saved per every hundred dollars spent in average annual energy costs (U.S. Department of Energy, 2009).

Another step that WPI has taken recently was in making the newest residence hall on campus, East Hall, built to LEED standards. LEED is an organization that rates all types of buildings according to a specific list of categories that evaluate the building in the context of sustainability. These categories include energy savings, water efficiency and CO_2 emissions reduction amongst other factors (U.S. Green Building Council, 2009). East Hall was built to LEED Gold standards which is the highest level that a building can attain. According to Jeff Solomon (2009) most of the requirements to receive a high LEED score do not cost any additional time or money. He explained that when planning and designing new buildings, asking the architects to design the building to consume the most sunlight during the day does not cost any extra money, but earns the building points when it is being LEED certified, for example. Designing rooms this way allows for the room to be naturally heated from sunlight and thus reduces the amount of energy needed to heat the room from the conventional systems.

The only project in the planning and building of East Hall that needed a significant additional investment was the green roof. According to an article by a LEED Accredited Professional and founder and editor of Greenroofs.com, Linda S. Velazquez (2005), a green roof

is essentially a roof that is covered with various kinds of vegetation or soil. The environmental effect of a green roof is to reduce water runoff during storms and improve air quality by trapping or filtering certain pollutants amongst other things. She also explains how green roofs can save money by reducing energy consumption and increasing the life span of the roof. Currently East Hall is the only building on campus that has actually been LEED certified, but both the Bartlett Center and Gateway Park both were built with these standards in mind. Jeff Solomon (2009) informed our group that all new buildings at WPI will be built to LEED standards. He did comment that the high cost of documentation in getting buildings certified is something that will prevent the university from actually getting them certified by LEED, however.

An area that WPI needs to improve significantly in terms of energy usage is conservation. According to a student energy audit project even the Bartlett Center, which is one of the newest buildings on campus, does not reduce the temperature at which the building is maintained overnight despite the building being closed at 5 pm. The report also investigated Alumni Gym, which is the oldest building on campus, and found many problems that would cost little to fix and significantly reduce the amount of energy needed to heat the building. An example was a broken window—which they estimated would cost under $100 to repair—that they estimated was costing WPI over $350 every two days during the winter (Mossa & Pope, 2007). These seemingly small problems lead to much wasted energy.

Renewable Energy at WPI.

Renewable energy usage is another aspect of sustainability that WPI has only begun to implement. The only existing renewable energy system WPI has in place is the use of solar powered walkway lamps near the athletic fields. The return on this is not significant when we

take into account the energy wasted when the football field lighting fixtures are left on late at night when the field is not being used.

Energy Policy at WPI.

WPI currently has few formal policies in place that pertain to sustainability. The President's Task Force does have goals and ideas, as discussed above, but none of these are actually strictly enforced on campus, which is a problem if the university hopes to become significantly more sustainable. This is a problem that Mrs. Tomaszewski (2009) acknowledged in our interview. She admitted that some sort of energy policy was something that WPI needs to implement, but one is not currently in the works. In our interview with Jeff Solomon (2009) he elaborated on the problem. The only policy he could think of which pertained to sustainability was that WPI is planning to build all future buildings to LEED standards. He explained that WPI has been conservative in the area of implementing formal policies on any topics pertaining to sustainability because the university does not want to commit to anything that it is not positive can be achieved without spending a significant amount of additional money. As we stated earlier, he explained that the policy on building new buildings to LEED standards does not necessarily mean that they will have to spend any additional money in planning or building.

This presents a problem for WPI because the university claims to have the goal of being more sustainable, but does not have a policy as defined above. Creating tangible formal policies would solve this problem and part of our project will be determining how/if this would significantly benefit WPI.

Policy at other Institutions.

Although WPI currently has no policy on sustainability there are many other institutions across the United States that do. Many of these have signed onto the American College &

University Presidents' Climate Commitment which holds them to a commitment of reducing emissions (ACUPCC, 2009). Two institutions in the area that have signed the commitment are Holy Cross and Clark University. Part of this commitment is the promise to create a sustainability policy, something WPI, amongst other schools, has chosen not to do. This project investigated the reasons behind different institutions' choices to create these polices and also how they came about their targets.

Chapter 3: Methodology

The goal of this project is to analyze the effectiveness of energy usage and emissions reduction policies in order to persuade WPI to enact a policy of its own. To help determine feasible targets for a policy at WPI and understand the reasons why institutions create such policies the policies of other universities were investigated. Various energy saving calculations were made to help the institution understand which energy use areas it could easily be improved upon to save money and reduce emissions either without incurring any additional costs or having quick payback periods. Another objective was to investigate the actions being made by other institutions to improve their sustainability and to discuss how they might apply at WPI. WPI's own sustainability initiatives and policies were also investigated.

Collecting WPI Sustainability and Policy Data

WPI's current policy situation was assessed in order to evaluate the usefulness of implementing a formal commitment to energy and emissions reductions at WPI. Five people who know the most about energy usage and sustainability on campus were interviewed. The interviews focused on finding the areas that WPI has room to improve upon with respect to energy usage and sustainability. This information was needed for calculations and to better focus its research. Interviews were also geared towards discovering what form of sustainability policies WPI already has in place. Experts on WPI's energy and emissions reduction initiatives and background information were given by interviewees.

The group used a snowball sampling technique to acquire many interviews. Snowball sampling is the use of existing study subjects to recruit future study subjects among their acquaintances or of who they know would fit the need. Early interviews were chosen with the help of Professors Savilonis and Vernon – Gerstenfeld who used their existing knowledge of

campus staff to determine who might have the information needed for the project. From then on almost every interviewee led the group to its next interview for the questions that were not answered or could be answered better by one of their associates. The problem with snowball sampling is that it is not random, so information gathered may not be representative of the entire population. However, for this project the group needed to specifically interview WPI staff who knew the most about its energy consumption and polices. For this reason snowball sampling was appropriate for this project.

In order to get a better understanding of how the power plant on campus worked, Chief Engineer of the boiler room Bill Grudzinski was interviewed. Grudzinski is in charge of running the power plant and knows the most about overall energy usage on campus. He was also a good source to ask about the problem areas with energy usage on campus. WPI's data on energy usage and emissions, obtained from Grudzinski, was used to calculate the approximate amount of emissions reductions that the group's proposed plan would require. Grudzinski suggested interviewing Liz Tomaszewski for information about the sustainability policy and initiatives WPI is currently taking.

Mrs. Tomaszewski is the Facilities Systems Manager and Sustainability Coordinator on campus. Tomaszewski did all of the reporting to the College Sustainability Report Card, and was familiar with all of the sustainability initiatives on campus as well as WPI's current sustainability policy. Provost John Orr and Vice President Jeff Solomon, the Chairman and Chief Financial Officer of the President's Task Force respectively, were interviewed for similar reasons, but also had the perspective of two more powerful administrative figures.

Solomon and Orr were both interviewed for more information on WPI's sustainability policy and to investigate the reasons why WPI has been hesitant to make any formal

commitments to energy and emissions reductions. Being in charge of the budget for the President's Task Force, Solomon knows the most about the financial reasons behind WPI's reluctance to make any commitments in deciding what sustainability initiatives and policies are to be adopted at WPI. As part of the Task Force, he also was highly familiar with sustainability initiatives that WPI was currently taking. Provost Orr was another high ranking person the group chose to talk to about these issues. The Provost offered a less financial, but equally important, perspective on the topics. Orr suggested interviewing Chris Salter of the facilities department for information on the possibility of the installation of a photovoltaic system on campus and on problem areas in energy usage.

Salter gave us a contact at Canon Design for information on the energy system that will be used for the new recreation center at WPI. He also referred the group back to Grudzinski for information on the installation of a PV system by Citizens Energy.

How to make a Policy Change

One project objective was to determine the process of creating a policy at WPI. The Provost was an obvious choice for this interview because of his high rank in WPI's hierarchy. Policy creation was also discussed with Vice President and CFO Jeff Solomon for both his high rank and his financial viewpoint.

Determining Effectiveness/Feasibility of a Sustainability Policy

Another project objective was to investigate the effectiveness of sustainability policies at universities. To achieve this, members of other institutions with whom WPI tends to compare itself with were contacted. These universities primarily included the schools which are members of the AITU and are also similar to WPI in some other aspect such as geographic location or enrollment. Schools in Massachusetts who had signed the President's Climate Commitment were

also interviewed. These criteria were deemed the most important because the focus of this project was to investigate emissions reduction policies and because these are the schools who are in a similar demographic to WPI. Members of seven different institutions were interviewed, five of which have signed onto the President's Climate Commitment. These schools were: Brandeis University, the Rochester Institute of Technology, Clark University, the University of New Hampshire, Smith College, Rensselaer Polytechnic Institute, and Lehigh University. This is an appropriate sample size because it included schools that are similar to WPI in terms of educational focus and geographic location. The group felt its interview process was mostly complete when the responses to the interview questions showed clear trends.

The current sustainability policies from university websites were reviewed for initial information. More specific information on initiatives these schools are taking towards achieving their specific environmental goals and what kind of progress they have made since implementing their respective sustainability policies was gathered through communications with school representatives. This data was used to analyze the effectiveness of sustainability policies and gathered ideas for initiatives that may be effective at WPI. Other interview topics included reasons why institutions had chosen to sign the President's Climate Commitment, how they had approached the task of creating target emission and energy reduction levels, and how effective their policies have been in decision making on campus.

Calculations

Calculations were made to show that an emissions and energy reduction policy could be feasible at WPI if certain steps are taken by the institution in the areas of efficiency and conservation. These calculations were used to show that there are easy, cost effective ways to reduce energy and emissions by a significant percentage. Specific calculations included

investigating the results of having better control over the heating of buildings and the retrofitting of the lighting system at WPI. These were suggested by Professor Savilonis and were also chosen because of the group's personal experiences with inefficiently heated and lighted rooms at WPI.

Heating Reduction Calculations.

Before doing calculations, data on room temperatures throughout WPI was collected. This was done through personal observation as well as through interviewing facilities staff member Chris Salter. Once temperature control at WPI was understood, percent reductions calculations that would result from a more efficient control over the heating were made.

The following equation was used to calculate energy/emissions percent reductions due to heating:

$$Q = \frac{\Delta T}{R}$$

- Q = heat load
- ΔT = change in temperature (indoor – outside)
- R = thermal resistance

Two ways that reduce the heat load, which decreases the energy used and emissions emitted, are by increasing R and by decreasing ΔT. To increase the R value of a building insulation needs to be added and to decrease ΔT the inside temperature simply needs to be decreased. This project was only concerned with heat reduction policies, which only involve ΔT. Percent heat reductions were calculated by taking the heat load calculated by decreasing ΔT and dividing this by the current heat load (Q). Data on heating emissions from other schools was used to calculate the overall emissions reductions that reducing the temperature kept in WPI's buildings would account for.

Heating accounts for a large percentage of greenhouse gas emissions in campuses. Heating is responsible for 44% of emissions at Trinity College in CT and 29% of emissions at Hamilton College in New York, both of which are similar in size to WPI. On average heating also accounts for 30% of K – 12 school's emissions nationally (Princeton Energy Resources International et. Al., 2004). Based on these values the group used 30% as a reasonable percentage of total emissions that heating emits at WPI.

Lighting.

After research and the suggestion of Professor Savilonis, the group decided that lighting retrofits were an easy and cost effective way to reduce energy usage and emissions. Percent energy and emissions reductions as well as the payback period of replacing all fluorescent lights with LED lights were calculated. Mr. Grudzinski supplied the group with WPI's electric bill which was used in the cost analysis. The approximate total cost of electricity at WPI is $0.11654 per kWh. The assumptions that were made in these calculations were that according to the Carbon Dioxide Analysis Center (2009) 2.3 lbs of CO_2 is emitted per kWh of energy used, lights were kept on for an average of 16.8 hours a day all year round and that lighting accounts for 22% (DOE, 2009) of total energy used on campus.

Further research resulted in finding other sources claiming that lighting accounts for much more than 22% of a college's electric bill. Trinity College (2009) claims that 51% of their greenhouse gas emissions comes from electricity usage, mainly from lighting and cooling. The American Society of Landscape Architects declared that lighting is responsible for 20% of all building emissions in New York. Princeton Energy Resources International et al. (2004) suggests that lighting accounts for 30% of the national average of total school energy end – use for K – 12

schools. For this reason a higher value of 30% of total emissions and the lowest value of 22% of electricity consumption to give a range of possible emissions reductions.

To calculate the emissions reductions of a lighting retrofit assuming that lighting accounted for 22% of electricity at WPI, the annual kWh used by WPI was calculated by adding the kWh usage for each month throughout the 2009-2010 year. This was then multiplied by 22%, giving the amount of kWh lighting accounted for, which was then multiplied by the 2.3 lbs of CO_2 emitted per kWh used. This gave a total of 1.38183 x 10^7 lbs of CO_2 emitted from lighting, which was then divided by 79,812,962 lbs of CO_2(WPI's total emissions given by Grudzinski). These calculations gave a value of total lighting emissions value of 5.8% which would be reduced to 2.9% if LED bulbs were installed. This is because LED bulbs use half of the energy that fluorescent bulbs use. If the larger value of lighting accounting for 30% of total emissions at WPI were to be taken, then emissions would be reduced by 15% if WPI were to switch to LED lighting for the same reasoning. 30% was chosen because it is a value in between the collected data but lower than the average.

The payback period for replacing fluorescent lights with LED lights was calculated on a per – bulb basis. The following equation was used to calculate the cost to use a fluorescent and LED light year round:

$$Cost\ per\ year = \frac{Wattage\ x\ 16.8\ hours}{1000}\ x\ \frac{\$.11654}{kWh} x\ 365 \frac{days}{year}$$

Once the cost per year was calculated for both types of bulbs the cost of the LED bulb was divided by the difference between the two to determine the payback period. After the payback period was calculated, the amount of money each bulb would save WPI through electricity costs was determined by multiplying the number of years left in the lifetime of the LED bulb by the

amount of money it saved each year when compared to the fluorescent bulb. This number can be multiplied by each bulb replaced at WPI.

Chapter 4: Findings

Policies At Universities

Over half of the universities that have reported to the College Sustainability Report Card have made a carbon reduction commitment. All six of the universities interviewed had detailed sustainability policies. Four out of the six schools that were interviewed have signed onto the ACUPCC committing them to eventual target emissions reductions. Rochester Institute of Technology and Smith College have signed onto the ACUPCC but has not yet created a Climate Action Plan (CAP). Clark University, Brandeis University, and the University of New Hampshire have created CAPs in accordance to the ACUPCC in which they state their reduction goals and how they plan to reach them. Their reduction targets are as follows:

Table 3: Target Emissions Reductions at Colleges

Brandeis University: 2008 level Baseline	Clark University: 2005 level Baseline	University of New Hampshire: 1990 level Baseline
• Carbon neutral by 2050	• 20% greenhouse gas reduction by 2015 • Net zero greenhouse gases by 2030	• 50% greenhouse gas reduction by 2020 • 80% greenhouse gas reduction by 2050 • Net zero greenhouse gases by 2100

Although Lehigh University and Rensselaer Polytechnic Institute have chosen not to sign on to the ACUPCC and do not have target reductions, they do have specific policies and initiatives that result in reductions in energy usage and emissions. These are similar to many stated in the CAPs of Clark and UNH. Lighting retrofits/policies, electronic policies and the use

of sustainable energy are being implemented at all four universities. Policies and initiatives specific to schools are shown in Table 4 below:

Table 4: Sustainability Policies and Initiatives at other Colleges

School	Lighting	Sustainable Energy	Electronic Policy
RPI	Retrofits Shut off lights when not in use	5,000,000 kWh of wind energy from utility company 50 KW PV array 10 KW wind turbine	Energy Star products Unplug or shutdown equipment when not in use *Smart refrigeration
Lehigh	Shut off lights when not in use	Bio fuels for campus transportation and heating	Shut off electronics when not in use
Clark	Lighting retrofits/Sensors	Cogeneration plant uses excess heat in energy production to heat buildings By 2016 all energy not produced in cogeneration plant will be sourced by renewable energy By 2025 all cogeneration plant will be replaced with a renewable fuel source By 2030 remaining emissions will be offset by purchase of carbon offsets	Energy Star products Shutting off equipment when not in use **Computer management
UNH	Turning off lights when not in use	Cogeneration plant uses excess heat in energy production to heat buildings Ecoline project – using methane gas from landfills	Energy Star products Power down campaign over breaks
Smith	Aggressive lighting retrofits campus-wide	Currently have a dam on campus Are considering installation of a cogeneration plant	

* Smart refrigeration – students living in dorms share a few large refrigerators which are kept in either dorm rooms or common rooms.

**Computer Management – setting school computers to hibernate when not in use and turning them off overnight.

Some of these universities' most successful initiatives were the easiest to accomplish. According to Associate Director of UNH's University Office of Sustainability Sara Cleaves, (2009) the UNH "Power Down Campaign" over Thanksgiving break saved UNH an estimated $10,000. Students were simply asked to unplug all electronics and shut off all lights before going home for break. Cleaves (2009) also stated that UNH's Eco – Line and cogeneration plant were very successful in reducing greenhouse gas emissions. One sustainability policy adopted by both RPI and Clark is a heating/cooling policy. During the heating season RPI sustains occupied rooms at 68° and unoccupied rooms at 50°. During the cooling season RPI holds occupied rooms to 74° and turns off the air conditioning in unoccupied rooms. Clark's Campus Sustainability Coordinator stated that a 2 degree reduction from 68° to 66° and raising the temperature in the chiller plant from 45° to 47° will result in a 352 $MTCO_2$ reduction. Lighting retrofits were the most successful initiative at RPI according to Manager of Engineering Stephen Angle. According to Ashton et al. (2009) more efficient LED lights can replace the fluorescent tube lights present throughout most of WPI without changing the lighting fixtures, making retrofits very easy.

Janna Cohen-Rosenthal (2010), the sustainability coordinator at Brandeis University, emphasized that little changes can make the biggest difference in cutting costs and reducing energy use. She cited energy efficiency and the retrofitting of lighting and other equipment as the biggest factors in helping Brandeis move towards achieving its goals. Mrs. Cohen-Rosenthal also explained that some of the actions the university is taking will not directly reduce the campus' carbon footprint, but are still valuable because of the impact they have on the University's students in terms of how they think about sustainability. An example of this is the University's small solar energy system, which is too small to directly count towards reducing its emissions or

energy usage, but is something that visibly shows that the university has taken an interest in sustainability. Witold Bujak (2010), the Sustainability Director at RIT, believed that efficiency in heating and cooling has the biggest impact on RIT's commitment to be more sustainable. He also expressed that heating, ventilation and air conditioning (HVAC) systems are something every college needs and thus making them more efficient cannot be overlooked when a university is hoping to reduce energy costs.

Dano Weisbord (2010), Smith College's Director of the Office of Environmental Sustainability, said that Smith College had taken an aggressive approach to campus wide lighting efficiency. In his opinion, the steps they had taken in that area had made the biggest impact in helping the university achieve estimated emissions levels which are currently 10-11% lower than the university's 1990 levels.

Energy efficiency was the foremost factor discussed in this part of the interview process. Reducing energy usage often does not cost a university anything at all. Making sure lights are turned off when not in use or turning the temperature down in an unused part of a building at night are perfect examples that often go unnoticed at WPI, which Chris Salter (2010) addressed in an interview. Salter explained that the controls for the heating systems are effective over about 80% of the campus's buildings. He said the remaining 20% include the older buildings on campus where the systems have either failed or don't exist. These buildings, such as Alumni Gym and Atwater Kent, because of their age are also some of the most poorly insulated buildings on campus. Salter said that the cost of putting controls back into these buildings is very high and is currently not a priority of WPI.

Purpose of Signing the ACUPCC

Another purpose of interviewing members of other universities was to discover why their university had chosen to sign the President's Climate Commitment and create an energy reduction policy. The importance of the issue of sustainability among the student body was the main reason at both Brandeis and Clark according to Mrs. Cohen-Rosenthal (2010) and Dave Schmidt (2010). The students are the most important members of a university because without them, the university would not exist. This is why their opinions have been taken so seriously at other institutions. According to Mrs. Cohen-Rosenthal, the ideals of a student's university also reflect on the students themselves which was another reason Brandeis chose to create a climate action plan.

Sara Cleaves (2010) of the University of New Hampshire explained that creating a carbon reduction policy helped to culminate all of their sustainability plans into a concrete set of goals. Both Cleaves and Cohen-Rosenthal stated that creating a formal policy on energy and emissions reductions followed the path that their universities had already taken in those areas. UNH already had a Climate Education Initiative under way which committed the university to reducing greenhouse gasses and educating students in the areas of climate and public and ecosystem health, amongst other things.

WPI currently has a Sustainability Task Force which commits itself to similar ideals. Members of the Task Force include several decisions makers in the WPI community, including the Provost and Vice President who could have the influence necessary for WPI to step into a formal emissions reduction policy.

Witold Bujak (2010) explained that the reason RIT recently signed on to the ACUPCC was because the university felt it needed a vehicle for change in order to be more stringent in

meeting its sustainability goals. He also said that RIT needed to go beyond what it was already doing in order to become more sustainable.

Creating Reduction Targets

In creating their climate action plans, these universities needed to create specific target levels for reduction by certain years. Another focus of the interviews was to investigate how these schools decided on their targets. The most common response to this inquiry was that the schools simply estimated the effects that their current sustainability initiatives would have over a longer time span. Mrs. Cohen-Rosenthal (2010) explained that she broke down the effects of Brandeis' activities into short, middle and long term benefits and was able to estimate when the university would feasibly meet certain targets. She did however express that the final determination was not entirely scientific because there are many factors that can change between now and the anticipated dates for Brandeis to reach its goals. Climate action plans do not have to be final, but can be altered over time according to how a university's situation may change. The plan is still formal however and gives the university something concrete to aim for.

The other schools interviewed used almost identical processes to create their targets. Collecting data on the effects of their current initiatives allowed them to look into the future and create feasible goals. Witold Bujak (2010) of RIT specifically pointed out that the changes that could be made without any additional cost to the university are the ones that RIT is currently most heavily considering in making their climate action plan. According to Mr. Bujak, this type of outlook will allow them to go forth with their current projects until the benefits are exhausted and then use the expected savings to expand where ever becomes necessary to meet their goals.

Dano Weisbord (2010) of Smith College explained that Smith is currently examining all of their sustainability initiatives closely and is projecting how big of an impact they will have

over the next 20 years, in order to determine what appropriate targets they could set. He said that the university considered economic factors in their analysis, which included examining the heating system, window replacement possibilities, transportation and renewable energy.

Lighting at WPI

The four foot long fluorescent lighting that is used throughout most of campus can be easily replaced with LED lighting. The 15 Watt LED lights, which are compatible with the lighting fixtures already installed throughout WPI, are $60.00 each compared to the $2.40 32 Watt fluorescent tubes. Although the initial investment into LED lighting would be costly, the payback period is five years and each bulb replaced would save WPI $63.15 over its ten year lifespan. Each bulb replaced would also reduce the amount of energy used by about 200 kWh per year, decreasing greenhouse gas emissions by about 450 pounds of CO_2 each year per tube replaced.

Greenhouse gas emissions generated from lighting would be cut in half if WPI switched from fluorescent to LED lighting. WPI used a total of 27,308,800 kWh throughout 2009, which creates 27,308,800 lbs of CO_2. According to the DOE, (2009) lighting accounts for 22% of a campus's electricity usage. 22% of WPI's 2009 to 2010 electric bill is $694,717, which would be reduced to $325,649 if all lights were replaced with LED bulbs. This is a savings of $3,690,680 over their 10 year lifespan. It would also result in a reduction of 6,477,330 pounds of CO_2 which accounts for 2.9% of WPI's emissions from 2009 - 2010. These values, however, vary greatly by source. Trinity College (2009) claims that 51% of their greenhouse gas emissions comes from electricity usage, mainly from lighting and cooling. The American Society of Landscape Architects declared that lighting is responsible for 20% of all building emissions in New York. Princeton Energy Resources International et al. (2004) suggests that lighting accounts for 30% of

the national average of total school energy end – use for K – 12 schools. This gives a large range of about a 2.7% to 15% emissions reduction if WPI were to switch to LED lighting. Initiating conservative lighting policies would further reduce emissions as well as WPI's electric bill.

Many lights throughout WPI remain on when not in use. Some do not have motion sensors installed, or the sensors simply do not work. If WPI could reduce their lighting usage by a conservative 15% after LED lights were installed it would save a minimum of $48,847 each year according to our range. It would also reduce its emissions at least .5%. Added together with replacing the fluorescent tubes with LED lights, that is a savings of $417,915 annually and an emissions reduction of 3.2%.

Heating at WPI

According to Chris Salter of WPI Facilities about 80% of WPI's buildings are on a limited computerized control system during the heating season. This system keeps the buildings at a temperature of 70° from 6:30 a.m. to 10 or 11 p.m. and is turned down to 64° overnight, but sometimes malfunctions. The other 20% of buildings are controlled manually, but are not turned down overnight because it is considered too labor intensive. Some of these buildings include Kaven Hall, Stratton Hall, the older residence halls and Atwater Kent. Multiple classrooms and residence halls throughout WPI are known to reach uncomfortably high temperatures throughout the heating season. Windows are often kept open to cool these rooms down and air conditioners have even been used during the winter. Having a better control on heating would result in a large emissions reduction at WPI.

Heating accounts for a large percentage of greenhouse gas emissions in campuses. Heating is responsible for 44% of emissions at Trinity College (2009) in CT and 29% of emissions at Hamilton College in New York (Bertino et. Al., 2008), both of which are similar in

size to WPI. On average heating also accounts for 30% of K – 12 school's emissions nationally (Princeton Energy Resources International et. Al., 2004). Based on these values the group believes that 30% is a reasonable percentage of total emissions that heating emits at WPI.

The temperature at WPI in the heating season can be turned down and still be kept at a comfortable level. Table 5 below shows the emission reduction percentages for day degree setbacks. The table assumes that the average temperature kept in all of WPI's buildings during the day is 70° and the average outside temperature is 35°.

Table 5: Daytime Heating Setbacks Emissions Reductions

Day Degree Reduction	Percent of Heating Emissions Reduced	Total Percent of WPI Emissions Reduced
1	1.90	0.57
2	3.81	1.14
3	5.71	1.71
4	7.62	2.29
5	9.52	2.86

Table 6 below shows the emissions reductions of overnight setbacks, which would be from roughly 11:00 p.m. to 6:30 a.m. This table assumes that 80% of the buildings at WPI are setback to 64° and that the other 20% are setback 6° in addition to the night degree reduction to reach the same temperature.

Table 6: Nighttime Heating Setbacks Emissions Reductions		
Night Degree Reduction	Percent of Heating Emissions Reduced	Total Percent of WPI Emissions Reduced
3	4.00	1.20
4	4.95	1.48
5	5.90	1.77
6	6.85	2.06
7	7.81	2.34

If WPI were to use a combination of reducing the daytime and nighttime temperatures in all buildings the percent of total emissions reduced for the values shown in tables 5 and 6 is 1.77% to 5.20%. To achieve these reductions WPI would have to fix any operational problems with the computerized control system as well as commit to manually turning heating down overnight in the 20% of buildings that are not on the system. Salter (2010) stated that the reason WPI has not retrofitted its old and out or date heating system is the limited amount of money WPI has to spend on maintenance. Although WPI has "a long way to go" (Salter, 2010) better management of our current heating system would reduce emissions and be cost effective.

Chapter 5: Conclusions and Recommendations

In this chapter we will present the target emissions reduction levels we believe WPI could attain from our estimates. We will also explain why we believe WPI should draft an emissions reduction policy and provide recommendations to WPI for ways of reaching these goals. Our recommendations are based on the initiatives of other schools and the ideas of WPI's own faculty members regarding areas for improvement. Lastly, we will suggest ideas for future projects at WPI that will expand upon our research and hopefully help persuade WPI to take a more aggressive stance towards sustainability.

Policy at WPI

WPI currently has no policy for the reduction of carbon emissions or energy usage. Based on the estimates presented earlier for reduction levels from lighting and heating alone, we believe WPI could feasibly reach an 8-10% reduction in its current emissions levels by becoming more conservative in these areas. A commitment to reducing the amount of energy usage from these sources would not only lower emissions, it would also reduce the university's energy costs without an initial investment. WPI's decision makers made it clear that financial sustainability was more important in the decision making process at WPI than environmental sustainability, but this plan would allow for improvements in both areas. WPI would need to make a more accurate estimate of the reduction levels it believes would be feasible, but even our rough estimates show that vast improvements could be made. We also believe WPI has other motivation for creating a policy.

A university's ideals often have a great impact on its students. As students, we can say that we are proud of the school we attend and that WPI has had a large influence on the type of people we have become since enrolling at this university. We are not currently under the

impression that WPI has a high enough level of interest in sustainability, however. As technology and innovation continue to rapidly grow in our society, the decisions of engineers will have an even greater impact on all aspects of society, including the environment. As WPI specializes in providing an education in the field of engineering, the university has the ability to largely influence these future decisions. Drafting an emissions reduction policy would show its students that WPI considers environmental sustainability to be important. This policy would not only make WPI itself more sustainable, it could have an even greater impact on the world as its graduates go on to design and build in the future.

Another reason why we believe WPI should implement a reduction policy is because so many other schools in the area have already chosen to do so. We understand that WPI has not given any real consideration to creating this type of policy because its decision makers believe it could be too expensive of an endeavor. However, WPI could use the processes of these other institutions, as presented in the previous chapter, as a guide to create its own targets. WPI could create a policy while remaining independent of the ACUPCC, which is something that not many universities have done. The university would thus only be held responsible by itself and could create targets that it believes to be feasible. We believe that an emissions reduction policy is an important step in WPI's sustainability initiative, even if WPI does not sign the Presidents' Climate Commitment.

Lastly, the Massachusetts state government has recently adopted its own commitments to reducing emissions including Executive Order 484, which requires state universities to create emissions reduction targets, and the Global Warming Solutions Act of 2008, which commits the entire state to a 10-20% reduction in GHG emissions. Despite being a private institution, if WPI were to implement an emissions reduction policy, it would be taking an active role in helping

Massachusetts reach its goals. WPI is part of a much larger society and it should take the initiatives of local governmental policy as a guide for its own actions.

Below are our recommendations to WPI for areas of improvement which could make emissions reduction goals easily attainable:

Recommendations to WPI

There are many ways that WPI could reduce energy usage and emissions. This project was concerned with initiatives that had low initial cost and quick payback periods. WPI does not have a large budget for energy related initiatives or deferred maintenance projects. Based on our calculations this group recommends that WPI considers switching to LED lighting, as it will cut lighting energy usage, cost, and emissions in half. Another recommendation based on this group's findings is that WPI manually sets back the temperature in the 20% of the buildings not on the computerized control system. This can be done by professors last to use rooms and offices to save labor costs. If those buildings were put on the same setback schedule as the other 80% it would reduce overall emissions by 1.14%. This would also result in cost savings.

This group also recommends that WPI initiate conservation policies and run a practice period to track emissions reductions. Using the data that is collected WPI can make accurate and attainable target emissions reductions. Conservation policies, such as heating setbacks and switching off the lights save money and reduce emissions at the same time. Although WPI does not believe that signing onto the ACUPCC is feasible, this is a way to spend no money and create realistic targets. This method of creating targets was used by Brandeis, RIT, Clark and Smith (2009).

WPI's current maintenance practices can also be improved and would save WPI money, energy and help preserve its current systems. The first recommendation regarding maintenance is

that WPI switch back to total re-lamping instead of re-lamping on a bulb-by-bulb basis. Benefits of re-lamping an entire building at one time, as stated by Salter, are saving on labor costs, increasing the overall lighting quality and solving large lingering problems. This group believes that WPI is more likely to switch to LED lighting if total re-lamping were to be reinstated. One other suggestion is that WPI switch the focus of renovations/fixes from aesthetic to cost beneficial and systems based. The budget cannot currently support both and heating and cooling systems are allowed to deteriorate. WPI should first investigate which systems are in need of maintenance and renovations, fix them, and use leftover money from the budget for aesthetics projects. There should be more money put in the maintenance budget so that the systems are not allowed to deteriorate in the first place.

Academic Project Recommendations

WPI would benefit from projects that investigate and analyze its energy usage. This group's project has touched upon aspects of sustainability policies and conservation practices that would help WPI to reach a target emissions reduction in a very broad sense. A better understanding of how energy is distributed throughout WPI specifically is needed to determine what energy saving initiatives WPI would benefit from the most. Cost seems to be the main concern of what energy projects WPI takes on, and so most of this group's recommendations for future academic projects have a cost analysis aspect. Using this and the information that has been obtained throughout the course of the project as a guideline, this group recommends the following projects:

1. An in depth analysis of WPI's heating, cooling and lighting systems. These three systems use the most energy in campuses. The goal of this project is to determine what is using the most energy at WPI and what can be done to make it more efficient. Problem areas in

each of the systems would be determined to show WPI where energy related projects would be most beneficial. A cost analysis of fixing the problem areas would then be used to show the feasibility of doing so. According to Chris Salter there is room for improvement in all three areas and so breaking them down and showing WPI what can be done would be useful.

2. An analysis of systematic and overall maintenance vs. waiting until systems are broken to fix them. According to Salter, problems with systems at WPI are not fixed until they are broken because there is not a big enough maintenance budget to fix and maintain the systems on a regular basis. This allows for systems to become inefficient and deteriorate over time, making them less energy efficient. This project would investigate how the core systems (heating, cooling, electric) deteriorate or become inefficient over time and would also take into account advances in technology. Another aspect of this project is to investigate how different systems interact and affect one another. An objective would be to determine what fixes should be made at the same time in order to be most beneficial to WPI. Salter mentioned how the renovation in Goddard Hall has actually had some negative effects on other parts of the building, which will cost WPI more money in the long run.
3. Investigate insulation costs vs. energy savings benefits in Gordon Library and Alumni Gymnasium. Both of these buildings are very poorly insulated, which means that they are wasting a lot of energy through heat loss. This project would determine which type of insulation would work best in both buildings and how much energy would be saved if it were installed. The amount of energy saved, money saved and emissions reduced would be the main findings.

4. A more in depth look into heating reductions and lighting retrofits on a per building basis. This project would include investigating the current computer controlled heating setback system to determine how operational it still is. Looking at each building individually would be the most accurate way to determine how much energy and emissions can be reduced through heating setbacks and lighting retrofits. A cost analysis would also be an important part of this project.

These projects would help WPI establish the most feasible initiatives to reduce energy consumption and greenhouse gas emissions. They would help push WPI to commit to emissions reductions through their findings as well as by showing WPI administration that students are concerned with sustainability issues. Once more is known about WPI's energy usage more specific recommendations can be made to make WPI more energy efficient and sustainable.

Appendix A

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COLLEGE SUSTAINABILITY REPORT CARD 2010

B+

Administration	B	The President's Task Force on Sustainability and a part-time sustainability coordinator promote and organize sustainability efforts. WPI purchases EPEAT-registered electronics, Energy Star appliances, and some organic pesticides, as well as environmentally preferable cleaning and paper products. Task force members maintain a website that promotes WPI's sustainability initiatives.
Climate Change & Energy	A	A new campus energy management system has been installed to monitor temperature setbacks based on scheduled occupancy of individual rooms. Occupancy sensors control heating and lighting in many locations around campus. Energy and water conserving systems were installed in the new East Hall, as well as a more efficient heating system. The institute recently completed its first greenhouse gas emissions inventory.
Food & Recycling	A	WPI contracts with a vendor that spends 27 percent of the food budget on local items, including dairy. Dining services purchases exclusively cage-free eggs and hormone- and antibiotic-free meats. All seafood is chosen in accordance with sustainability guidelines, and all coffee served on campus is fair trade. There are composting programs in some dining locations, and the institute estimates that a trayless initiative has resulted in a savings of 120,000 gallons of water this year. WPI recycles all aluminum, cardboard, paper, glass, plastic, and electronic waste.
Green Building	B	All new buildings are designed to achieve LEED certification. One building on campus is LEED-certified, and the newest residence hall has achieved LEED Gold certification. New construction projects have a waste diversion rate of 93 percent.
Student Involvement	B	Students are involved in sustainability issues through a number of campus groups. Various sustainability-themed living communities are located on each floor of the new LEED Gold residence hall. The President's Task Force on Sustainability employs a student intern. Students ran RecycleMania in the spring and a national teach-In seminar in February 2009. Students researched and proposed a carpooling program, which was accepted by the administration for implementation in the 2009-2010 academic year.
Transportation	B	The institute provides a shuttle service to on- and off-campus destinations. A commercial car-sharing program exists on campus, and premium parking spaces are allocated to carpool groups and users of hybrid and alternative-energy vehicles.
Endowment Transparency	C	The institute makes a list of all holdings available to trustees, senior administrators, and other select members of the campus community in the investment office. The institute does not make the shareholder voting record of its mutual funds public.
Investment Priorities	A	The institute aims to optimize investment return and is currently invested in renewable energy funds.
Shareholder Engagement	--	The institute does not have the ability to vote proxies, as the entire endowment is invested in mutual funds.

Appendix B

Worcester Polytechnic Institute - Green Report Card 2009 Page

WORCESTER POLYTECHNIC INSTITUTE

C-

Grade higher than last year

Administration	**D**	The President's Task Force on Sustainability is charged with promoting and coordinating sustainability efforts, both in education and in campus operations and facilities. A Sustainability at WPI website was launched in March 2008 that provides a space for the campus community to learn about and engage in reducing WPI's ecological footprint.
Climate Change & Energy	**D**	The institute conducted a major program to replace lighting with energy-efficient designs, install room occupancy sensors in renovated classrooms, and replace the campus boiler system with energy-efficient units that reduce greenhouse gas emissions. In 2007, a team of students initiated the development of a campus greenhouse gas emissions inventory as a first step toward understanding and targeting programs to reduce emissions.
Food & Recycling	**C**	WPI spends approximately 2 to 4 percent of its food budget on locally grown items. In addition, the institute contracts with a vendor that sources local dairy products, and purchases only cage-free eggs and antibiotic-free pork and chicken. Dining services is encouraging waste reduction by providing a reusable coffee mug to freshmen and offering a discount with use of the mug. Cooking oil is recycled. The institute recently expanded its recycling program, resulting in a 13 percent diversion rate.
Green Building	**B**	In February 2007, the board of trustees passed a resolution stating that all new buildings be designed to achieve LEED certification. One building project is LEED-certified, and the newest residence hall, which will feature a green roof, is expected to achieve at least LEED Silver certification. The institute is also designing a major new recreation center to LEED standards.
Student Involvement	**C**	The Global Awareness of Environmental Activity student organization promotes sustainability awareness on campus. The Task Force on Sustainability is organizing events and competitions focused on energy conservation. Students are involved in projects such as developing the sustainability website and the greenhouse gas emissions inventory.
Transportation	**D**	The institute is implementing a commercial car-sharing program on campus and has provided dedicated parking spaces for carpoolers and hybrid vehicles in the new parking garage.
Endowment Transparency	**F**	The institute makes neither a list of endowment holdings nor its shareholder voting record public. Endowment holdings information is available only to trustees and senior administrators and the institute does not receive information on shareholder voting records from the fund managers.
Investment Priorities	**A**	The institute aims to optimize investment return and is currently invested in renewable energy funds.
Shareholder Engagement	**F**	The institute asks that its investment managers handle the details of proxy voting.

Data compiled from independent research and survey responses from schools. For information on data collection and evaluation, please see the Methodology section.

Appendix C

*Annual Estimated Savings for Every $100 of Fuel Costs by Increasing Your Heating Equipment Efficiency**

Existing System AFUE	New/Upgraded System AFUE								
	55%	60%	65%	70%	75%	80%	85%	90%	95%
50%	$9.09	$16.76	$23.07	$28.57	$33.33	$37.50	$41.24	$44.24	$47.36
55%	----	$8.33	$15.38	$21.42	$26.66	$31.20	$35.29	$38.88	$42.10
60%	----	----	$7.69	$14.28	$20.00	$25.00	$29.41	$33.33	$37.80
65%	----	----	----	$7.14	$13.33	$18.75	$23.52	$27.77	$31.57
70%	----	----	----	----	$6.66	$12.50	$17.64	$22.22	$26.32
75%	----	----	----	----	----	$6.50	$11.76	$16.66	$21.10
80%	----	----	----	----	----	----	$5.88	$11.11	$15.80
85%	----	----	----	----	----	----	----	$5.55	$10.50
90%	----	----	----	----	----	----	----	----	$5.30

http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm?mytopic=12530
Note: AFUE stands for annual fuel utilization efficiency
*Assuming the same heat output

Appendix D: Interview Summaries (Alphabetical Order)

Interview with Witold Bujak

Sustainability Manager and Manager of HVAC Control Services at RIT

585-475-2343

1/26/10 2:37 PM

- What were the main reasons RIT decided to sign on to the ACUPCC and create a carbon reduction policy? Was it always a desire of the university or is it a new idea?
    - Natural resource depletion, energy costs/costs of operation. Needed a vehicle for change to be more stringent in meeting sustainability goals. Realized they needed to go beyond what they were currently doing.
- What are the key factors currently being considered in determining the targets your CAP will set forth? Did you make any calculations?
    - Schedule of activities and doing a GHG inventory now, preceding CAP. Looking where they are now and making a curve to see where their current projects will take them and where they can expand on their current projects. Seeing what impact they can make without a huge change (without spending money) then once those things are accomplished, see what is left and figure out what still needs to be changed.
- If you could pick one thing the university has done or plans to do that will have the greatest effect in helping you reach your goals what would it be? Why is it so helpful?

- Efficiency with heating and cooling production has been the biggest factor (which is important because HVAC is necessary at a university). Look into carbon offsets last.

Interview with Sara Cleaves

(Associate Director of the University of New Hampshire's Sustainability Program)

603-862-4088 sarah.cleaves@unh.edu

12/10/09

Topics: (1) Sustainability Policies at UNH (2) Sustainability initiatives at UNH

1. What part do you personally play in the sustainability movement at UNH?
    a. I'm the associate director of UNH's University Office of Sustainability. We're the oldest endowed sustainability program in higher education in the US:
2. What is the process of creating a formal policy at your institution/who are the key role players in decision making(both with respect to sustainability and other things)?
    a. There is no one set formal policy; it depends on the policy. However, nothing can be advanced without lots of input and involvement of people and groups across campus. Sustainability is about collaboration, and UNH is committed to both sustainability and to shared governance.
    b. Typically the following groups/stakeholders are involved in the development, approval, and/or implementation of policy: UNH president and provost, including their cabinet of vice presidents and the deans council/academic leadership council, Faculty Senate, Student Senate and Graduate Student Organization, Three staff councils: PAT, OS, and EE, Faculty union, Office heads, Department chairs, Various faculty, staff, student and external stakeholder groups, such as our campus-wide Energy Task Force

3. According to your website, UNH's goal in the WildCAP is to cut greenhouse gas emissions by 50% by 2020, 80% by 2050 and 100% by 2100, how close are you to this goal? Do you have any similar goals for energy reduction? Is there some data that you may be able to share with us?
    a. Our energy goals are tied into our climate action planning, which we just submitted to the American College and University President's Climate Committee this past September. In our next update of our greenhouse gas inventory, we will track progress.
4. What other policies and intiatives are in place at UNH with respect to energy usage and emissions reductions?
    a. Up to 85% of energy on campus from Ecoline project: landfill gas to energy project expected to cut 36,000 to CO2e annually until 2020. Cat cycles, biodiesel - fueled transit, Energy efficient standards (energy star products) can save up to 30% in campus energy costs, power down campaigns over breaks - saved $10,000 over thanksgiving break, LEED silver standards.
5. Does your campus currently use any sustainable energy or does it plan to? If so, how is it financed? Do you receive any grants?
    a. We have an onsite cogeneration plant and EcoLine.
6. What were the reasons UNH decided to sign on to the ACUPCC and create an action plan with target emissions reductions? (any specific environment concerns, poilitical or economical reasons etc.)
7. It meshed with CEI mission: Committed to being a Climate Protection Campus that pursues a sustainable energy future through emissions reduction policies,

practices, research, & education

UNH's Climate Education Initiative (CEI) is actively engaging the university community in integrating the ethics, science, technology, and policies of greenhouse gas reductions into the university's identity and practices.

Under CEI, UNH is committed to:

• Educate students in all fields about the relationships among human activities, climate, public and ecosystem health, and appropriate civic and professional actions.

• Reduce emissions of greenhouse gases like carbon dioxide and other criteria pollutants like sulfur dioxide and nitrous oxide. WildCAP is the UNH Climate Action Plan to significantly lower greenhouse gas emissions.

• Research, develop, and demonstrate innovative solutions to energy challenges.

• Research climate variability, air quality prediction, and public health issues related to climate change.

• Act as a community model for the state and region.

Our overall goals was to unify and coordinate are variety of actions on climate change into a unified whole.

8. What were the biggest factors that went into deciding your target emission reductions? (costs and funding, how well initiatives would work etc.)
    a. The primary factor was the projected level of reductions from our "wish list" of projects developed over 5 years of work of the Energy Task Force. Once we realized that the reductions from those projects would put us on the path to achieving the commonly accepted goal of 80% by 2050, we solidified our target at that.

Interview with Janna Cohen-Rosenthal

Sustainability Coordinator at Brandeis University

781-736-4194

1/25/10 2:20 PM

- What were the main reasons Brandeis decided to sign on to the ACUPCC and create a carbon reduction policy? Was it always a desire of the university or is it a new idea?
    - Student pressure; very important to students. University had already taken steps and the policy fit right in to their progress. Helps reduce cost which is another main goal of all institutions in Ms. Cohen-Rosenthal's opinion. The committee on sustainability had already existed for three years prior to signing the commitment (relatively new idea to go ahead with the reduction policy)
- What factors were the key motivators in determining the targets that you climate action plan set forth? Did you make any calculations?
    - Feasibility under economic conditions. Broke down goals into short, mid and long term (cut back 5%, then progressively more). Guessing and analyzing: looked at what they did in the past few years and expanded the range through the next few years. Talked to other schools about what they had done in terms of policy and what they thought was feasible. The final goal was somewhat arbitrary (didn't get to scientific because factors may change). Tried not to think too much about growth of the university to avoid setting goals too conservative. Also use policies to help limit creep/growth, energy planning.

- If you could pick one thing the university has done or plans to do that will have the greatest effect in helping you reach your goals what would it be? Why is it so helpful?
    - A lot of the little things; energy efficiency, updating equipment/lighting. Installed some solar energy which doesn't directly count towards their carbon reductions, but it gives the impression that the university takes sustainability seriously. Transportation options to cut down emissions from commuting (a large portion of total emissions)
- How big of an impact has your policy had up until now in terms of decision making on campus?
    - Things are complicated. Hired a sustainability coordinator. Economic factors are still the biggest road block in many ways. Has helped somewhat, but it could be better. Wanting to expand the university conflicts with efforts to reduce energy use.

Interview with William Grudzinski

(Chief Engineer of WPI's Boiler Room)

508-531-5500 williamg@wpi.edu

9/24/2009

Topics: (1) Energy usage at WPI (2)Energy related problems at WPI (3)Renewable energy projects at WPI

- The boilers in WPI's power plant were replaced in 2005 for a cost of about $8.5 million. The efficiency of the boilers was increased from the low 70s to 83%.
- Supplied the group with WPI's 2009 electric bill as well as the inventory of WPI's greenhouse gas emissions.
- Citizen's Energy is doing an analysis of a solar energy roofing project at WPI. The project was still in its beginning stages and a lot of information was unknown to Grudzinski.
- Took the group on a tour of WPI's heating plant and explained different parts and how they worked.

Interview with John Orr

(WPI Provost, Chairman of the President's Task Force)

508-831-5222 orr@wpi.edu

11/13/2009

Topics: (1)Policy Creation at WPI (2) Sustainability Policy at WPI (3) Committing to an emissions reduction

- There is no formal process for the creation of a policy because WPI is not very political. There is a policy committee that decides which policies are adapted but Mr. Orr is not a member of that committee. The Board of Trustees is also a deciding factor on what policies are adopted.
- The main reason WPI does not have a sustainability policy committing them to reductions are time constraints and endowment. Endowment is used to maximize productivity and keep tuition down, which is why WPI cannot put a lot of money into sustainability efforts.
- There is no opposition to environmental policies, WPI is just more concerned with actions than with policies.
- Mr. Orr believes that a commitment would be feasible and save money in the long run, along with "the planet".
- In order to make a policy committing WPI to reduction we must be creative and involve many students and faculty. Looking at other schools and why they are successful will be helpful. Mr. Orr also expressed that he was frustrated that WPI is not doing more to save energy and reduce emissions.

- Citizens Energy came through WPI to talk about a possible PV installation that would be paid through the energy savings WPI had.

Interview with Christopher Salter

(WPI Facilities)

508-831-6060 csalter@wpi.edu

2/22/10

Topic: (1) WPI's heating system

- 80% of WPI's building's heating is controlled by a limited computerized control system. The system sometimes malfunctions, which is why it is called "limited". This system is set at 70° from 6:30 a.m. to 10:00 or 11:00 p.m. and set back to 64° overnight. The weekend settings depend on the building's use.
- Kaven Hall, Stratton Hall, the older residence halls and Atwater Kent are not on the system and their temperature is not turned down overnight because it is too labor intensive.
- The heating season is roughly from early October to early May or April depending upon the weather.
- WPI is looking to reuse Alumni Gymnasium as is due to the high cost of $25 million for retrofits. Many changes would be needed for retrofitting including additional bathrooms, windows and elevators in order to get the building up to code.
- The WPI power plant is very old and out of date, it has a "long way to go" but will be tough and expensive.
- No systems at WPI are fixed or retrofitted unless it reaches catastrophic levels, and then they are fixed minimally. An example of this is Boynton Hall, which was condemned in 1976 but already needs more renovations. WPI needs to look at the

whole building instead of its individual parts. The retrofits to Goddard Hall have caused unforeseen problems.

- There is not enough money in the maintenance budget to take care of all systems correctly. The people in charge of what gets fixed/renovations do not know the systems and so there is more spending on cosmetics than important systems such as heating.
- WPI used to have a budget for total re-lamping, which is re-lamping entire buildings at once instead of on a bulb-by-bulb basis. This saved money on labor, increased lighting quality and solved lingering problems.
- There is pressure for a different approach to heating WPI before gas prices rise and WPI can’t afford to heat in 2050;

Interview with Dave Schmidt

(Clark University's Campus Sustainability Coordinator)

508-793-7601 dschmidt@clark.edu

12/16/09

Topics: (1) Sustainability policy at Clark University (2) Sustainability initiatives at Clark University

1. Do you have any specific targets for emissions/energy usage reductions? If so, how close are you to these goals? Is there some data that you may be able to share with us?
    a. 20% gas reduction by 2015, net zero greenhouse gases by 2030 (baseline of 2005 - 20,442 MTCO2e)
2. What other policies and initiatives are in place at Clark with respect to energy usage and emissions reductions and are they enforced/effective?
    a. By 2016 all electricity not produced in Clark's cogeneration plant will be sourced from renewable energy sources. By 2025 the cogeneration plant will be replaced with renewable fuel source. By 2030 Carbon offsets will be purchased for the remaining 5,899MTCO2e left from travel.
    b. Renovations to the central heating and cooling system, distribution replacement and switching fuel to nat. gas will account for a 3,439 MTCO2e reduction. Switching from natural gas to biodiesal in 2016 will give a 3,177MTCO2e reduction. Clark will advertise their Climate Action Plan to receive funding and stay flexible to different technologies.

   c. Conservation Policies: Energy Star Policy, window replacements, airlock doorways, lighting and HVAC retrofits, lighting sensors, energy and water saving laundry facilities, student bike share program, computer management and airlock doorways. 2 degree reduction from 68 to 66 and raising chiller plant from 45 to 47 will save 352 MTCO2e.

3. What are the reasons that Clark signed onto the ACUPCC?
   a. My (Dave Schmidt) recommendation.
   b. Largely due to student influence. The proposal was given to the Sustainability Task Force by the students, and the college signed onto it as a good faith effort and as a great demonstration. Clark wants to wade through these (environmental) problems and feels that it is a benefit to the university.
4. How did you pick your target reductions?
   a. Clark chose the target year 2015, analyzed the projects, operations and policies that are currently or soon will give reductions over time and used this behavioral change to calculate where Clark would be in the year 2015.

Interview with Jeff Solomon

Executive Vice President and CFO at WPI

Solomon@wpi.edu

9/28/09 9:00 AM

- Explained that WPI's main sustainability initiatives were in the areas of recycling, carpooling, green building and the cafeteria
- Confirmed that there is no real policy in place at WPI
    - Gave reasons of cost and commitment: difficulty because WPI doesn't want to wind up with its hand tied
- Told us that funding was sparse at WPI for sustainability, but that some funding comes from other budgets such as the facilities budget
- Explained reasons for improvement in Green Report Card Score:
    - WPI did not report much or publicize its initiatives at the time of the survey
    - WPI had since implemented a policy on construction of new buildings, stating they will build them all to LEED standards
    - Carpooling initiatives were not in place around the time of the previous surveys
- Explained that WPI's chief concern in most decision making is cost
    - WPI is willing to do anything that it can to improve its sustainability as long as it does not have an initial cost
    - The green roof on top of East Hall is the only exception to this as it did cost them quite a bit extra
    - Explained WPI was not interested in renewables for this reason

Interview with Elizabeth Tomaszewski

Facilities Systems Manager and Sustainability Coordinator at WPI

ltomasz@wpi.edu

9/20/09 10:00 AM

- Liz Tomaszewski was just recently appointed WPI's sustainability coordinator. No one held the position previous to Tomaszewski.
- Explained that WPI did not currently have a clearly stated, formal policy on sustainability, but had made moves to improve its sustainability over the past few years.
- Attributed the low grade on the Sustainability Report Card previous to 2009 to a lack of interest in reporting.
- Showed us to the President's Task Force website for the projects that WPI is currently undertaking with respect to sustainability.
- Explained that WPI performed well on the STARS pilot it took part in, placing near the top of all schools surveyed.
- Explained that a sustainability policy of some kind is something that she would be interested in.
- Directed us to Jeff Solomon for more information on why WPI had not drafted a sustainability policy.

Interview with Dano Weisbord

Director, Office of Environmental Sustainability at Smith College

413-585-2427

2/4/10 8:30 AM

- What were the main reasons Smith decided to sign on to the Presidents' Climate Commitment and create a carbon reduction policy of its own?
    - Brand new idea. Almost entirely on President's decision.
- What are the key factors going into determining the targets of Smith's climate action plan?
    - Took all potential reduction strategies and lookd at how big they could be over the next few years with respect to their economic factors. Tried to consider how much efficiency could be achieved without violating economics and aesthetics. Calculations were made by student-advisor teams on areas such as window replacement and solar potential for the area. Looked at all these measures and predicted what would happen in the next 20 years.
- What initiative(s) that Smith has taken or plans to take will have the greatest impact in helping Smith reach its goals and why?
    - Aggressive lighting efficiency and the installation of a cogeneration plant. Smith is currently 10-11% below its 1990 emissions levels from the steps they have taken.
- How important of a factor is sustainability in decision making on campus?

- It is becoming more and more prevalent. The President has clearly taken a large interest in the area (he signed the ACUPCC without much backing). Smith is deeply committed to understanding the issue at hand. It is not considered in all of the decision making it should be, but it has become clear that it is a high priority

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