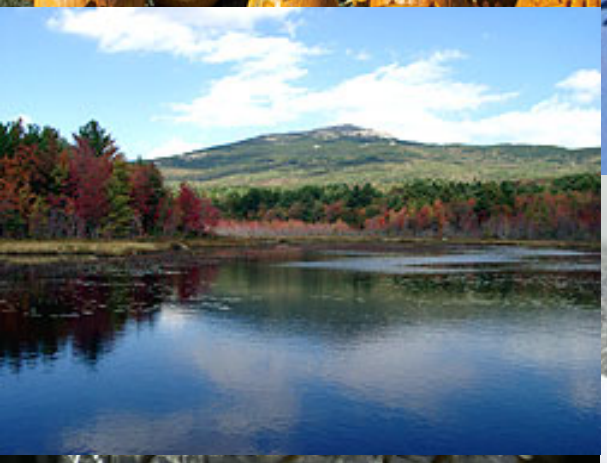
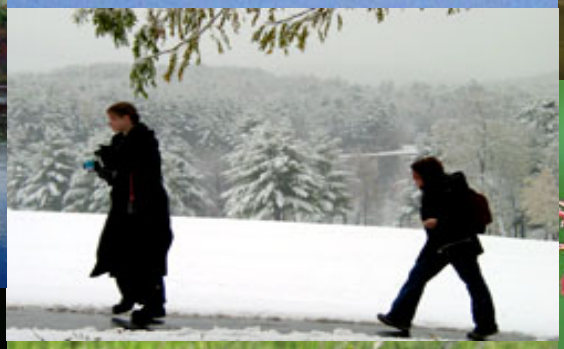
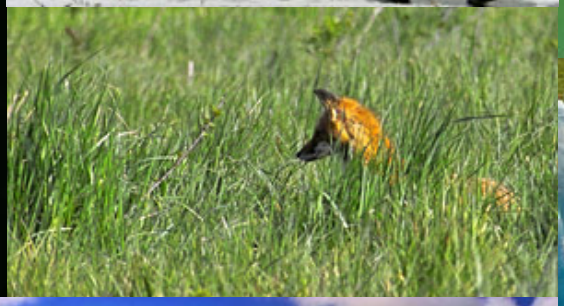


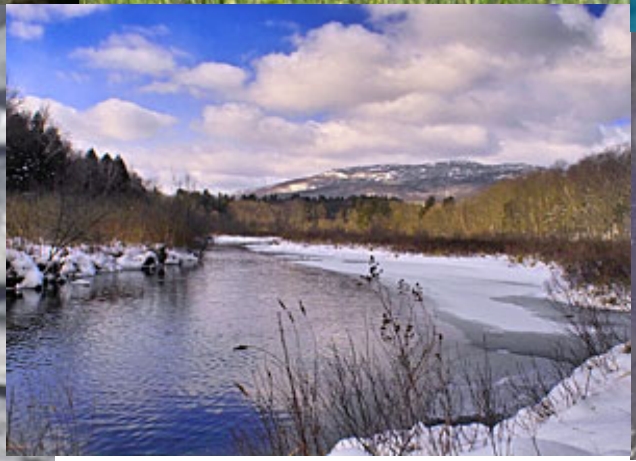
Franklin Pierce University
Climate Action Plan

2010

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1. Acknowledgements

The 2009 Franklin Pierce University Climate Plan has been produced by the FPU Sustainability Council.

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2. Executive Summary

Franklin Pierce University (FPU) became one of over 600 signatories of the American College and University President's Commitment to Climate Neutrality in 2007. Since this time, the newly formed Sustainability Council (2007) has worked diligently to meet the requirements of the commitment and promote the University's mission of environmental responsibility.

This Climate Action Plan addresses the requirements of the *President's Climate Commitment* and makes a point to "address target dates for achieving climate neutrality, targets and goals leading to neutrality, actions to make climate neutrality and sustainability a part of the curriculum as well as other educational experience for all students, actions to expand research or other efforts necessary to achieve climate neutrality, and create mechanisms for tracking progress on goals and actions" (ACUPCC, 2009).

In 2008, a Greenhouse Gas (GHG) Emission Inventory was completed and documented using the *Clear Air-Cool Planet on-line Campus Climate Action Toolkit Calculator*. Greenhouse gases are gases released into the atmosphere that absorb heat, causing the atmosphere to act as a "greenhouse", allowing for life sustaining temperatures on Earth. When GHGs become too abundant, either by natural processes or human activities (i.e. burning fossil fuels), the temperature of the Earth deregulates and begins to increase. Some forms of GHGs are Carbon Dioxide (CO_2), Methane (CH_4) and even water vapor. The Greenhouse Gas Inventory assesses the amount of GHGs the University either emits or sequesters on an annual basis. Assessment of each category of greenhouse gas emissions, Stationary (Scope One, i.e. on-site heating/cooling), Purchased (Scope Two, i.e. electricity created off-site) and Non-Stationary (Scope Three, i.e. transportation) led to the initiatives recommended in this Climate Action Plan. All emissions are calculated and evaluated in metric Tons (mT) [1]. Note that this report focuses on the largest, main campus in Rindge; facilities at the satellite campuses are leased, and the lease agreements are under review for data collection and future inclusion in the effort to achieve climate neutrality. Travel by faculty and staff to other campuses is included in the inventory, however.

The Council has recommended the following actions:

- Campus Wide Energy Audit

  The University must establish an energy base line and inventory/ranking of all campus buildings regarding energy use. In order to fulfill Climate Action Plan goals, the University must be able to prioritize building efficiency needs. Once the audit is complete and efficiency upgrades are addressed, it is possible that White Tag Credits may be assigned to recorded emission reductions. Essentially, any reduction in emissions may be transformed into a "White Tag" or emission credit.

[1] Greenhouse gas and Carbon Dioxide gas emissions are expressed as eGHG (emissions of Greenhouse Gas) and eCO^2 (emissions of Carbon Dioxide Gas), respectively.

This credit may then be used toward climate neutrality. While "White Tagging" is not practiced in the State of New Hampshire at this time, we will continue to research the opportunity and document all reductions[2].

❖ LEED Certification Policy

The Council recommends that all new building renovations, or construction, be built to Leadership in Energy and Environmental Design (LEED) standards or the equivalent "Green Building" standards. If Marcucella Hall, for example, were renovated in such a way that the *overall* use of electricity and heat would be reduced by 25%, this would reduce total emissions by 101 mT emitted Carbon Dioxide (eCO_2).

❖ Implement Climate Action Plan Goals

The Council recognizes three target goals to reduce emissions by approximately 58%, from 2007 emissions by 2020.

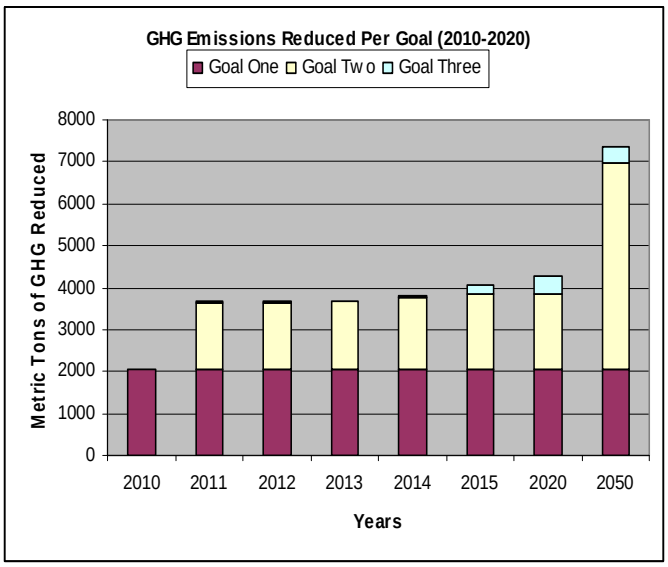
Goal One: **Elimination/Upgrade of Inefficient Energy Use** The closing of Crestview, RavenCroft Theater and Pierce Trailers, the upgrade of Peterson Hall boiler; and the upgrade of the "Bubble" and Granite Hall to biomass boilers reduces our GHG emissions by approximately **2040 mT**, annually.

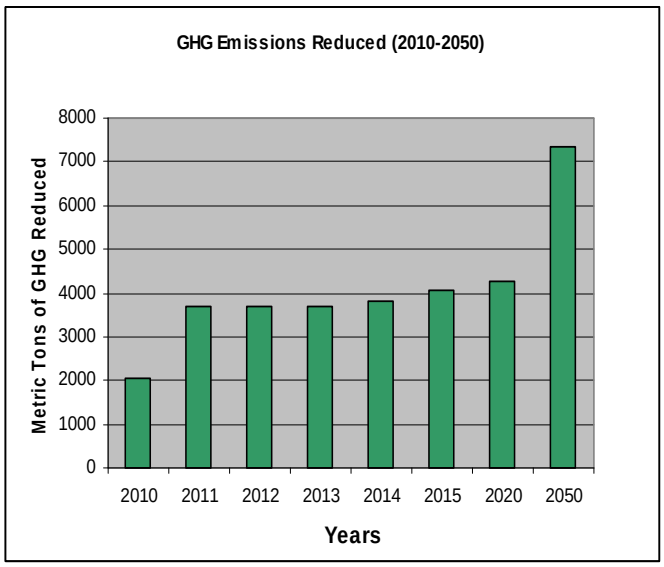
Goal Two: **Assess and Upgrade Inefficient Energy Use**
The lighting upgrade, extension of biomass boilers, Bits SmartStrip Pilot Program, upgrade of Marcucella to LEED certified, and possible new 'green' technologies, such as solar hot water heating for two campus buildings, reduces our GHG emissions by at least **1811 mT** annually, by the year 2020.

Goal Three: **Energy Conservation through Behavioral Change**
Education Initiatives ~ 10% reduction in emissions from purchased electricity by 2020 (Green Earth Initiative, SENCER Initiative, "Green and Off-the-Grid" Lab), Transportation Developments (CVTC), Recycling and Solid Waste Improvements reduces our GHG emissions by at least **411 mT**, annually, by the year 2020. Sustainability Council will continue to research and develop new strategies to achieve neutrality by 2050, or as soon as possible. The Council will continue to monitor the progress of the Climate Action Plan, tracking all reductions on an annual basis.

[2] A white tag, also referred to as an *Energy Savings Certificate (ESC), Energy Efficiency Credit (EEC)*, or *white certificate*, is an instrument issued by an authorized body guaranteeing that a specified amount of energy savings has been achieved (Hamrin, Vine & Sharick, 2007).

Figure 2.1 Metric Tons of Greenhouse Gas Reduction (2010-2050)





3. Introduction

In 1998, the Environmental Science Department proposed the “Ecological Conscience Initiative”, which was endorsed by President George Hagerty as well as the full faculty.

Ecological conscience is a collective awareness of the effects of our actions on all aspects of the ecological community, and a demonstrated respect for that community. The ecological community includes people as well as other species, and the land, air and water that sustain them. If we are concerned that future generations should be able to live happily, enjoy clean air and water, have a beautiful place to live, and continue as part of an evolutionary chain, then we must be responsible members of that ecological community. By helping individuals develop an ecological conscience, we will help them learn how to live well while minimizing their impacts on the community, thus becoming part of a sustainable society.

This initiative was a call action for the institution, and it identified several areas to work on: making environmental responsibility part of the mission of the University; increase interdisciplinary teaching about sustainability; reduce the environmental impacts of campus operations; protect FP-owned wildlands; increase opportunities for low-impact outdoor recreation; and create a low impact ”green building” for environmental science and related fields.

Franklin Pierce has made substantial progress toward all of these goals. In 2007, our efforts were kicked into high gear when President Hagerty signed the American College and University President’s Commitment to Climate Neutrality.

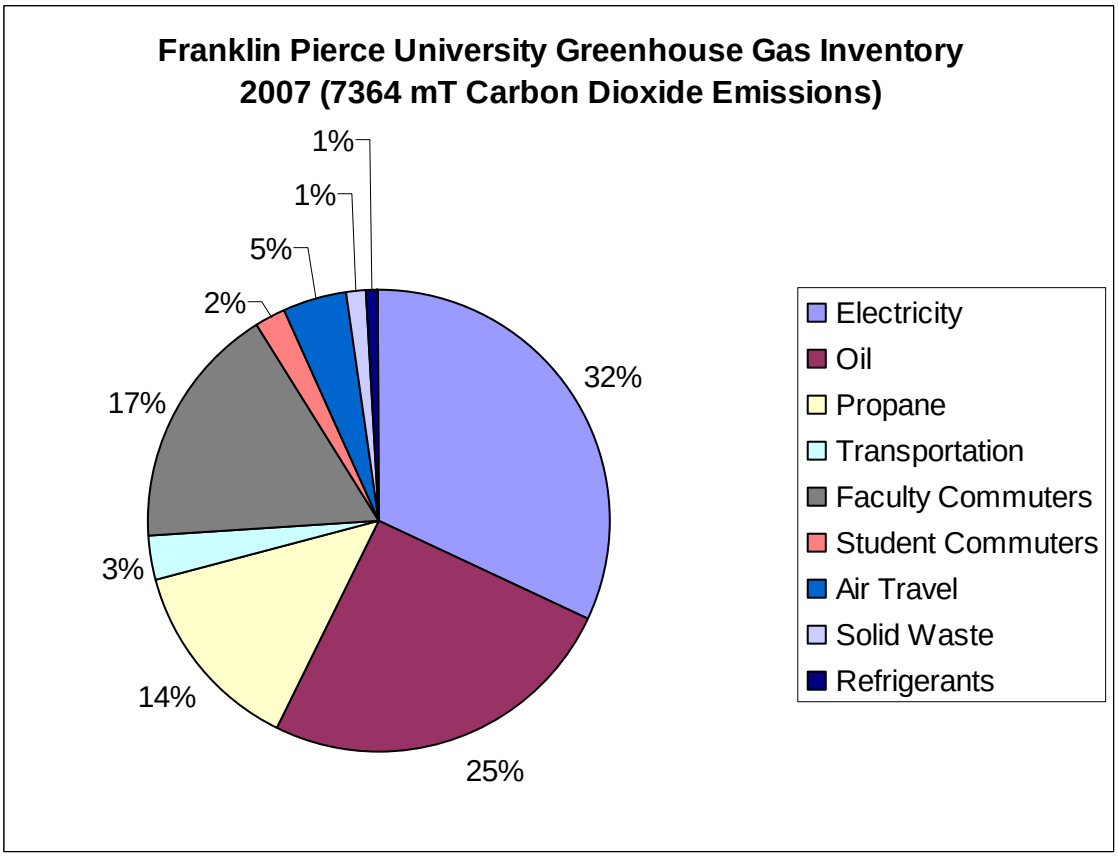
To fulfill its commitment to Climate Neutrality, Franklin Pierce’s Ecological Conscience Initiative became the Sustainability Council, and we are working on a number of actions to reduce greenhouse gases.

Many of these programs are now part of a larger strategic plan, the **Green Earth Initiative**, which strives to make the environment a central focus of all university actions.

Present Emissions

Franklin Pierce has finished its 2007 Carbon Inventory; a summary is shown below, based on the Clean Air-Cool Planet Carbon Calculator. The total amount of greenhouse gas production was 7364 metric Tons in 2007.

Figure 3.1 FPU Greenhouse Gas Inventory, 2007



4. Mitigation Plans

Shortly after the GHG inventory was complete, immediate actions took place to reduce our carbon footprint. Our mission is to reduce our emissions by 58% by 2020 and become completely carbon neutral as soon as possible. In order to meet our commitment, the Sustainability Council recognizes that in addition to the completion of a Campus Energy Audit and implementation of a policy requiring LEED certification, or equivalent, we will also assess the three main sources of emissions on our campus. The American College & University Presidents' Climate Commitment (ACUPCC) recognizes these sources as Scope One (stationary, i.e. on-site heating and cooling), Scope Two (purchased, i.e. electricity bought from local provider), and Scope Three (non-stationary, i.e. transportation). While there is over lap within each goal, Goal One primarily addresses Scope One Emissions. Goal Two primarily addresses Scope Two Emissions, and Goal Three primarily addresses Scope Three Emissions.

❖ ***Goal One***

Goal One reduces our GHG emissions by approximately 2040 metric Tons (mT) and saves $131,042 in energy costs, annually. The Sustainability Council recommends all of the actions proposed in Goal One. GOAL ONE ACTIONS ARE COMPLETE OR IN PROGRESS.

Elimination of Inefficient Stationary Emission Sources

Franklin Pierce will reduce its emissions due to the removal of inefficient buildings. Closing Raven Croft Theater (2008), Crest View (2008), and Pierce Village Trailers (2009) has reduced emissions by 413 mT, annually, without an initial capital investment, yielding an overall savings of approximately $88,505.

Upgrade of Stationary Emission Sources

Replacement of the Peterson Hall boiler (2009) with a more efficient boiler resulted in the reduction of 23.9 mT CO_2 annually with an initial capital investment of $42,000.00 and an annual savings of $3,037. Replacement of a Residential Hall (Granite) heating system with a Biomass (wood pellet)-Boiler (2009) and replacement of the Athletic Building (Bubble) heating system with a Biomass (wood pellet)-Boiler (2009) required an initial and annual investment of $142,790 (cost of BTUs), and yielded an annual savings of $39,500 and an annual reduction of 1603 mT of CO_2.

❖ ***Goal Two***

Goal Two may reduce our GHG emissions by at least 1811 mT per year and may save $133,913, annually, by the year 2020. The Sustainability Council recommends the expansion of the use of Biomass Boilers to include all other buildings on campus where this technology is feasible as well as the construction of the Solar Hot Water Heaters for two campus buildings. **The Council also recommends the upgrade of Marcucella Hall to LEED certified standards, or equivalent, continuation (Phase II) of the lighting upgrade, and the implementation of the SmartStrip Pilot Programs. . In addition, the Council recommends further research into other "green" technologies and implementation as funding allows.**

Research and Implement New 'Green' Technologies (Implementation: Sustainability Council, Facilities Dept.)

Franklin Pierce has investigated several options for reducing Scope One and Two emissions: Co-Generation Power Plant, Geothermal Technology, Wind Power Technology, Photovoltaic Technology, Solar Hot Water Heating Technology, and Biomass Fuel (Wood Pellet) Technology. There are several factors which may limit the implementation of each scenario. Limitations include finances (initial capital investment) as well as campus location (i.e. wind –meteorological tower analysis, geothermal - substrate analysis). **The Sustainability Council recommends both the expansion of the Biomass Boilers to accommodate more buildings on campus as well as the construction of the Solar Hot Water Heaters for two campus buildings**.

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A **Co-generation Plant** (an on-campus structure that produces combined production of heat and electricity from one fuel source, i.e. biomass) A two megawatt plant (2MW) would reduce our emissions from purchased electricity use to zero and reduce our oil use by approximately 73%, resulting in a reduction of 2575 mT e CO_2, annually. While this technology would be beneficial from an emission reduction standpoint, it would require a large initial capital investment (approximately $5,000,000), has significant labor costs and annual costs for maintenance, as well as potential permitting obstacles. While the annual savings would be approximately $300,000, recent controversy in regard to the true neutrality of biomass fuel use, and the large capital investment made us hesitant to place all of our efforts into a Co-Generation Plant at this time**.**

Geothermal Technology has been explored and proved to be an efficient mode for heating and cooling one of our buildings, DiGregorio, reducing our emissions by 30 mT CO_2, annually. A proposal by American EcoThermal for a 23 ton High Efficiency Closed Loop Geothermal HVAC system entailed drilling, excavation, piping, grouting, manifold, electrical, HVAC and geothermal heat pump installation for $89,760. This calculation was based on the current heat-load, no formal test bore holes have been drilled for actual feasibility. While impressed with the

technology and service, we were again hesitant to go forth with such a large project because of the initial cost of investment, but will continue to explore this option as we reach our goal of neutrality.

Wind Power Technology has been explored as well; however, a meteorological tower to assess feasibility on campus would have to be erected before we could implement this technology. We have estimated that if we were to place one 100kW turbine on campus it would have an initial investment of $500,000 with an annual savings of $1,000,000 and an emissions reduction of 59 mT of CO_2, annually. We would like to explore this further by erecting a meteorological tower to assess feasibility which would cost approximately $600. It might also be in the school's interest to sponsor a much smaller installation, in the area of 10 to 50 kW, the major purpose of which would be to make a statement and contribute to the educational mission of the University. Given the potential savings and the opportunity to work with the local community on a wind project, the Council has recommended that funding for the meteorological tower be allocated and a study begun in the near future.

Photovoltaic Technology has also been explored, resulting in a capital investment of approximately $375,000 with an annual savings of $24,254 and a reduction of 120 mT CO_2, annually. Although the cost per metric ton eCO_2 is lower than for wind, we expect the cost of photovoltaics to drop even further in the next five years with improvements in technology and pricing structure. As a result, the Council will continue to investigate the possibility of photovoltaics as part of our long-term climate neutrality strategy, and as part of our educational mission.

Solar Hot Water Heating technologies did prove to have a positive cost-benefit analysis in relation to emission reduction for two of our main campus buildings and is recommended by Council for implementation. The initial capital investment for this technology is $7,000.00 with an annual savings of $1,200, yielding an 8 mT eCO_2 reduction, annually.

Finally, we have explored the expansion of the present **Biomass Fuel Boilers** to accommodate other buildings on campus. The annual cost for heat metered in BTUs would be $264,605, approximately 14% less than oil or propane heating systems, and would reduce our CO_2 emissions by 1584 mT, annually. After much deliberation, this is the technology the Council recommends to implement first to reduce Scope One emissions. Again, precautions will be taken to assure our service provider is promoting sustainable methods of biomass production. As we go forth with this technology we will monitor forestry practices as well as the true carbon emissions from this type of system.

Upgrade of Marcucella Hall to LEED Certified, or Equivalent (Implementation: Sustainability Council, Facilities Dept.)

The upgrade of Marcucella Hall to LEED certified, as recommended by the Sustainability Council, would reduce electricity use by an estimated 66,714 kWh, for

a savings of $4670 per year and 30 mT eCO_2. Oil use would be reduced by 3743 gallons, for a savings of $7111 per year and 71 mT eCO_2. The potential addition of 8000 sq ft, which is approximately 25% of the existing building size, may negate these savings. The cost of "green building" has been estimated to be $4 per square foot over conventional building, with all of the additional cost quickly being returned many times over through energy savings and other benefits (Katz 2005). Both LEED-certified and non-LEED certified academic buildings were found to cost between $200-500 per square foot, with no significant difference due to LEED certification (Langdon, 2007). Assuming that a renovation of Marcucella would cost approximately $300 per gross square foot (Hammer 2009), a complete renovation of the building would cost just over $10,000,000 (MH is 33,510 sq. ft). The renovated building would save about $10,000 per year in energy costs.

Lighting Upgrade Phase Two: (Implementation: Facilities Dept., Sustainability Coordinator)

Prior to signing the Commitment to Climate Neutrality we made great strides in upgrading our lighting systems. We have found that as technology increases we are able to upgrade even more. We plan to reduce our emissions by more than 17 mT annually by investing a capital cost of $14,280 resulting in an annual savings of approximately $4,000.

SmartStrip Pilot Program: (Implementation: Sustainability Coordinator, Information Technologies, Residential Life)

Over the next five years (2010-2015) we will be implementing a Pilot Program using Bits Limited Smart Strip Technologies. *The Stanford University Green Campus Project Summary (2008)* states, "Smart Strips are a type of power strip that use a control outlet to manage phantom loads and idle currents. Users benefit from this device because they do not need to remember to switch off the Smart Strip, as with a normal power strip, to stop current flow from electronics. Students can plug their television or computer into the control outlet and DVD players, printers, speakers, chargers and other peripherals into the controlled outlets. When a student turns off or puts to sleep his television or computer, energy flow to his peripheral electronics will automatically be cut off. (Some outlets will always stay hot, so alarm clocks can stay on)." Through this investigation we have projected a savings of $3,600 and 13 mT of CO_2 annually by implementing 30 strips. The Smart Strips will be piloted (Phase I) within a metered environment, possibly a student project within the Environmental Science department or within the proposed "green" residential areas. In order to begin this Pilot Program we would need to invest an initial capital cost of $30.00 per Smart Strip, or $3000.00 total initial investment. If the Pilot Program proves to be a success, we will then implement Phase II (2015-2020) of the Program to include use by incoming freshman students, or 600 Smart Strips for an initial capital investment of $18,000. The second phase of this Pilot Program will save $72,000 and 78 mT CO_2, annually.

❖ ***Goal Three***

Goal Three may reduce our GHG emissions by at least 411 mT and save approximate $73,277 in energy costs, annually, by the year 2020. The Sustainability Council recommends all proposed actions in regard to Education, Solid Waste Reduction, and Transportation Development. Projects that have the greatest Net Present Value (NPV) [3] and the greatest CO_2 (GHG) emission reduction are recommended to be implemented first. (see Section 5 Financing) The proposed recycling program upgrade and the proposed rideshare program both have a negative NPV, but are still recommended for implementation by 2015. Procurement of funds and further financial analysis through continued research will determine the recommended implementation for larger educational initiatives.

Education

Given the mission of Franklin Pierce, and the potential widespread impact of these efforts, our plan includes a number of educational steps. All of the educational efforts are also potential marketing tools. We are assuming that these educational steps, taken together, will allow us to decrease our use of electricity, through individual behavior change alone, by 10% over the next 5 years, from the baseline GHG inventory, after subtracting out the substantial electricity use by the buildings that were shut down (Ravencroft, Crestview, Pierce Village). This is estimated to be 475,295 kWh of electricity, or 197 mT eCO_2 by 2015 as well as $33,270 in energy costs ($0.07 per kWh) per year. By 2020, with an additional 10% reduction we could reduce a cumulative 377 mT emissions as well as approximately $66,000, annually.

Making Sustainability part of the central theme of general education at FPU ~ Green Earth Initiative (Implementation: Environmental Science Faculty)

The general education curriculum is under review at the present time (AY 2009-2010), and it is likely that the existing Individual and Community theme will be replaced with another structure and possibly another theme. Many other schools have adopted sustainability as their central theme, and the General Education Revision Committee intends to bring up the possibility of weaving this theme into the new general education curriculum in a meaningful way. Sustainability, which includes components of economics, ecology and social equity, would be consistent with the University's recent focus on positioning itself as a regional leader in this area with the Green Earth Initiative, which identifies a number of steps that Franklin Pierce needs to take in order to achieve this goal. Included in this initiative is the

[3] *The American Heritage Dictionary of Business Terms* defines Net Present Value as the discounted value of an investment's cash inflows minus the discounted value of its cash outflows. To be adequately profitable, an investment should have a net present value greater than zero.

Sustainability Certificate Program, as well as a number of other components described below. By identifying environmental sensitivity and environmental behaviors (sensu Hungerford et al. 1990) as prominent outcomes of the general education, or the overall education at FPU, many of the goals of the Climate Action Plan would be easier to realize, since the campus community would understand the concepts of sustainability and would take significant actions towards it. No new funding would be required for this step, although it might be wise to seek input from other institutions in order to chart a course of action.

Adding sustainability components to existing courses ~ Green Earth Initiative (Implementation: Sustainability Coordinator, Environmental. Science Faculty, Monadnock Institute Director)

As a way to build support for making sustainability a part of the general education curriculum, it would be useful to integrate components of sustainability across the curriculum, into the areas where it logically fits in. One way to do this would be to offer a voluntary workshop to educate faculty about the interdisciplinary aspects of sustainability and environmental issues. This has been done on several campuses, and has gained popularity since the promotion of an earlier effort called the "Ponderosa Project' at Northern Arizona University (Barlett and Chase 2004); this has since been repeated in many areas, using bioregional themes, such as the "Piedmont Project" at Emory University. All of these saw, as outcomes, the addition or revision of numerous new courses and modules across the curriculum, the reinvigoration of faculty. Logically, FPU might partner with Keene State College, Antioch University and New England College on a "Monadnock Highlands Project" to achieve similar goals. Funding would be needed to pay for speakers, materials, and stipends for the workshops; for 30 faculty members for 5 days, an estimated $15,000 would be needed.

Promoting the new Sustainability Certificate program ~ Green Earth Initiative (Implementation: Sustainability Coordinator, Env. Science Faculty, Admissions)

As part of the Green Earth Initiative, the Sustainability Certificate program has been passed by the Curriculum committee and it will be implemented for the first time in AY 2010-2011. Newly hired Sustainability Coordinator has been tasked with teaching the introductory Sustainability Seminar and guiding the students to work on their project through their intermediate courses and in the final Sustainability Project course. A critical component to the success of this program is its immediate promotion. The Sustainability Coordinator and Environmental Science faculty will advertise the program personally through personal appearances in classes (Integrated Science, Introduction to Environmental Science, and all courses that are part of the Sustainability Certificate), email lists, a regular table in the glass foyer of the Campus Center, a dedicated bulletin board in the Campus Center, posters, and of course a place on the website. There are no new costs associated with these actions.

Sustainability Trail ~ Green Earth Initiative (Implementation: Sustainability Coordinator, Sustainability Council, Director of Marketing)

During the recent Greening of the Campus conference sponsored by the Association for the Advancement of Sustainability in Higher Education (AASHE), FPU representatives had the idea of creating a "Sustainability Trail" on the developed part of campus to showcase our efforts and to educate people about environmental issues. This would include educational signs at the new wood pellet boiler, a prominent new sight outside Granite Hall, as well as Eco-kiosk (which would need to be outfitted with the promised recycling containers), locations where energy star appliances or high-tech efficient lights are used, the Eco-Club native plant garden and other native plant areas, specific areas where problem invasive species have been eradicated, the Medicine Wheel and the conservation easements near the lake, and other sites. Each building might have some greening initiative to include. The trail could lead to the Office of Sustainability, and could also highlight the history of the central campus, which would help to foster a sense of place. This will be an excellent collaboration between the Monadnock Institute of Nature, Place and Culture, the Environmental Science Dept. and the Sustainability Office. Some funding would be needed to expand the garden, add interesting features and landscaping, produce the permanent signs and other promotional materials, and maintain it; this is estimated to be $4000 initial cost, and $2400 annually.

Sustainability Posters ~ Green Earth Initiative (Implementation: Sustainability Coordinator, Sustainability Council, Director of Marketing)

High-quality, large framed posters, with a coherent graphic look and message, should be designed to be placed in the Campus Center, Peterson Hall, Admissions, and the Residence Halls, to inform people about specific efforts that have been undertaken all over campus. Similar signs exist in the cafeteria and student center at Middlebury, to inform students about the value of local foods, sustainable forestry on campus property, and other topics. To produce, print and frame each poster could cost $50-100 each. Assuming perhaps 6 sets of 5 posters (different ones with a coordinated look), to go in 6 different buildings, this would cost about $1500-3000.

Orientation activities ~ Green Earth Initiative (Implementation: Residential Life Staff, Sustainability Coordinator, ECO Club)

This plan proposes that sustainability education be incorporated into orientation for new students, faculty and staff. During freshman orientation in the residence halls, residential life staff and the Sustainability Coordinator will provide information about what, how, when and where to recycle, the importance of reducing energy use, and other sustainability issues involved in the residence halls and elsewhere on campus, focusing on the key items in this Climate Action Plan. Similar efforts will be made with new staff and faculty orientation. These efforts will begin with the information provided to students, faculty and staff before they arrive on campus.

Eco-Rangers and Green Residences ~ Green Earth Initiative (Implementation: Residential Life Staff, Sustainability Coordinator, ECO Club)

To spread the word and help students understand the importance of recycling, reducing electricity use, carpooling, etc., our plan would identify 2 students per residence hall to serve as "Eco-Rangers". This could be a volunteer position, but ideally it would be either a reduction in housing cost ($1000 per student) or work-study. The Eco-Rangers would help in the implementation of any residence-hall based sustainability efforts. They would maintain the recycling stations, put up signs, show people how to use different technology (such as Smart Strips or compact fluorescent light bulbs) in their rooms, help with orientation and move-out days/freecycle, maintain the Sustainability Trail, etc. They could also assist with activities such as putting up power-down stickers, widen the comfort zone stickers, a Sustainability Decathlon, and other educational tools.

The Eco-Rangers might also live in "Green Halls" in each Residence Hall. Residents in these halls would agree to take several important changes in lifestyle, such as recycling, composting, eating local foods, shutting down appliances, reducing the use of appliances altogether, etc.

SENCER Initiative (Implementation: Integrated Science Faculty)

"Integrated Science I & II – Global Change" is a team-taught, two-semester, introductory science course sequence for non-science majors at Franklin Pierce University that fulfills their science core requirement. Approximately 180 students take the course sequence each year, and, for most of them, it is their last exposure to formal study of the sciences. Since Principal Investigator(PI) Frederick Rogers' and (Co-PI) Frank Hubacz's formal involvement with the National Science Foundation's (NSF's) Science Education for New Civic Engagements and Responsibilities (SENCER) began with the Summer Institute 2006 (SSI 2006), and continued with the support of a 2006 Implementation Sub-Award From the fall semester of academic year 2006 – 2007 to the present, "Integrated Science I & II – Global Change" has been taught according to the model developed by the SENCER program. SENCER was initiated in 2001 under the National Science Foundation's CCLI national dissemination track. Since then, SENCER has established and supported an ever-growing community of faculty, students, academic leaders, and others to improve undergraduate STEM (science, technology, engineering and mathematics) education by connecting learning to critical civic questions" (SENCER, 2009).

The basic science is taught through the lens of the on-going changes in our oceans (during the fall semester) and our atmosphere (during the spring semester), and through a strong civic engagement component via two student projects/public presentations each semester. Utilizing the polar expeditions of Will Steger with the Will Steger Foundation, and his legacy of adventure learning and the ocean

expeditions of National Geographic Society explorer Jon Bowermaster, and additional oceanographic and atmospheric data from our other sources, we will develop real-time laboratory investigations using data collected from the Internet and from the extensive expedition archives of Will Steger and Jon Bowermaster that explore the current status of various global systems and their effects on both the physical and human worlds. The results of the various laboratory investigations will be disseminated to the Franklin Pierce University community via large color posters, development of a web site on our Intranet, and through various evening presentations. Once developed, utilizing our contacts developed through the SENCER program, we will find colleges and universities with similar interests, both nationally and globally, in order to share information, develop a web site devoted to our laboratory discoveries (as well as to discoveries made by our students during the course of their research for their mid-term and final project presentations), and create student blogs for discussions. We will disseminate the results of our work through formal presentations at future SENCER Summer Institutes, at Teaching Professor conferences, at National Science Teachers Association conferences, and at other appropriate venues.

Proposal for "Green and Off-the-Grid" Education Lab (Implementation: Sustainability Coordinator, Relevant Faculty)

We are proposing the construction of small 800 sq. ft building on campus. This building will incorporate a single classroom, two offices and a bathroom with shower. The building will be designed to be completely self-contained and off the grid and will incorporate state of the art utility systems which will include the following: Hot water supplied by solar hot water heater, demonstration size photovoltaic grid, demonstration size wind turbines, small scale heat and electricity cogeneration system, LED lighting, battery Pack for electricity storage, demonstration size geothermal heating and cooling system, integrated energy monitoring and control system, and toilet Flushing with captured rainwater.

The building will be constructed of and furnished with recycled and renewable materials, wherever possible, and will incorporate the most energy efficient insulation, windows and construction methods.

It is intended that this building be a living laboratory and demonstration unit for alternative energy and energy efficient systems for the student population of Franklin Pierce University. Every aspect of this building from the conception phase to the design to construction and utilization will present opportunities for students to become involved and get hands on experience with energy efficient structure and alternative energy systems. We anticipate many Senior undergraduate projects and Energy and Sustainability MBA student projects associated with this building.

Moreover, once completed, the building will serve as a demonstration center for various small scale energy systems which could be of great interest to members of the larger Franklin Pierce community as well as local businesses.

As with any project, funding the design and construction of such a building presents a challenge but we believe the small scale of the building makes this project more feasible. The use of recycled materials as well as the small scale demonstration energy systems provides us with an opportunity to engage with designers, builders and equipment vendors and to encourage them to donate time, materials and equipment. For certain outside parties the building could serve as a useful demonstration unit for their services and/or equipment as well as providing the tax benefit of the charitable donation.

Solid Waste Reduction

Solid Waste Reduction through Increased Recycling Capacity (Implementation: Sustainability Coordinator, Director of Purchasing, Manager of Environmental. Services)

Our waste hauler, Monadnock Disposal Services, takes our solid waste to a waste-to-energy incinerator 75% of the time, which actually generates 0.11 mT of eCO_2 *offset* per ton of solid waste (Clean Air Cool Planet Calculator 2009), or to a landfill, which produces 0.33 mT of eCO_2 per ton of solid waste. The 435 Tons of solid waste produced by FPU in 2008 produced a net 11.77 mT eCO_2. Therefore, for the purposes of this report, each ton of solid waste produces a net of 0.027 mT of eCO_2.
A recent audit of garbage on campus (Kotusky et al. 2009) showed that 42% of the materials that were thrown out consisted of materials that are currently being collected for recycling on campus (paper, cardboard, cans and bottles).
An earlier report similarly estimated that 41% of the trash was recyclable; 59% of it was non-recyclable trash, 3% was metal/aluminum, 7% was glass, 7% was plastic, and 24% was paper (FPC Sustainability Report Card, 2006). Our total solid waste production in 2008 was 435 Tons. About 34 Tons of this is during move-out days in May, which may be a different set of materials (and will be discussed later). 42% of the remaining 401 Tons is about 168 Tons. This represents 4.5 Tons of eCO_2, (assuming a 75/25 mix of incinerator/landfill for our solid waste).

Based on this estimate, we should be able to reduce our solid waste, under the current recycling system, by 10% per year for the next 4 years. As we expand our recycling to include more items, then we will reduce solid waste even further. This means we will have to increase recycling by a substantial amount; in 2007-08 we recycled 72 Tons, so we will have to recycle a total of 240 Tons to achieve our goal, more than tripling our current recycling.

To create capacity for that amount of recycling, we will need to have more recycling containers and more recycling pick-ups. Our current cost for the recycling dumpsters is $475 per month. This would increase to $1425 per month, plus the additional cost for pick-ups would be $1050. This increased cost would be offset by the decrease in our regular monthly service charge.

To encourage recycling on campus and to make it clear that it is important, more recycling bins would need to be added on campus. Recycling totes would be provided to all students, free, by Monadnock Disposal Services. Every garbage can on campus would need to have a recycling container next to it; this is already the case except for the outdoor locations. An estimated 20 outdoor recycling bins would need to be added, at approximately $1000 each. Additional labor for picking up this recycling would be about 2 hours per week. Recycling bins would need to be provided and picked up at all events. Thus the total initial cost of expanding the recycling program is estimated to be $20,000, plus an annual added cost of $10,400 for labor (Labor cost: Extra 2 hrs./wk X 52 weeks X $10/hr = $10,400). This total initial cost is $20,000, with an annual cost of $14,000, for a reduction of 4.5 mT of eCO_2,

Expansion of recycling to include other materials (Implementation: Sustainability Coordinator, ECO Club, Eco-Rangers, Manager of EVS)

A large amount of additional material could be recycled, further reducing our solid waste stream. This includes batteries, electronics, and textiles. Re-chargeable batteries can be recycled for free by contacting the freecycle.com organization. Other batteries can be collected and recycled at minimal cost, about $100 per year. This is an excellent activity for the ECO Club to take on, making it part of their responsibilities to put the boxes out, maintain them, educate people, collect them and send them back. The ECO Club could raise money to do this each year. A similar system could be established for used printer cartridges. The activity would be supported by the Sustainability Coordinator and EVS as needed. To collect and recycle clothing, several collection places would be needed. This is another potential activity for the ECO Club, or a collection box could be placed on campus and emptied regularly by one of several volunteer organizations, such as PlanetAid. This would be free. Electronics are already recycled on campus, but few students know about it. Information about how and where to recycle old computers, cell phones, etc. should be made available.

Annual Recycling Audit (Implementation: Sustainability Coordinator, ECO Club, Eco-Rangers, Manager of EVS)

To verify our progress in reducing solid waste, we need to conduct a “garbage check” each year to find out how much we are throwing out. This could become part of the ECO Club’s regular activities, supported by the Eco-rangers and the Sustainability Coordinator. There is no additional cost.

Move-out days (Implementation: Sustainability Coordinator, ECO Club, Eco-Rangers, Director of Purchasing, Manager of EVS)

Currently, student move-out days are accompanied by massive dumping of potentially recyclable materials. Approximately 14 extra dumpsters are brought in, an additional 290 cubic yards of solid waste capacity and an estimated 30 Tons of

additional solid waste, which costs $14,000; at 0.027 mT eCO_2 production per ton of solid waste, this represents 0.81 mT of eCO2 . If the amount of trash were reduced by half through recycling, this would save little CO2, but a lot of money; saving approximately $7000, and we would reduce the eCO2 by 0.81 mT. This will be a priority of the Sustainability office, so that some of the money saved can be put towards other sustainability efforts. Student Eco-rangers will be recruited to get the word out to other students that any unwanted items will be picked up or can be brought to a special location. For a designated time, all materials will be available for free to any FPU community member; at some point, a "yard sale" may be opened to local residents to raise some money. Space and transportation may be required to pick up and store the materials.

Composting (Implementation: Sustainability Coordinator, Sodexo Food Services Manager, Facilities Manager)

In the cafeteria, a senior thesis study (Wetmore, 2004) found that on average each person eating in the cafeteria wastes 0.5 lbs per meal. Added to the food wasted in preparation and clean-up of meals, this amounts to 800 lbs per day of food waste. A lot of this is put into the garbage disposal, where it goes to our already-overburdened wastewater treatment facility. The rest goes into the trash.

Health codes require that food that has touched a consumer's plate (post-consumer food waste) be heated to kill any bacteria before composting. The nearest facility that performs this task is in Brattleboro, Vermont, almost an hour away. Therefore, only pre-consumer food waste will be considered in this composting proposal.

An estimated 0.1 lbs of pre-consumer food waste is produced per meal (UCDavis 2008); assuming that 1300 meals are served per day, and if the food waste were collected 5 days per week, for 47 weeks, this results in 59.4 short Tons of food waste per year. This waste, sent to the incinerator 75% of the time, and to the landfill 25% of the time, would generate 1.6 mT eCO_2. If composted, not only would these emissions be avoided, but an offset of 10.7 mT eCO_2 would be gained, yielding a net benefit of 12.3 mT eCO_2.

The cost of picking up the pre-consumer food waste from the cafeteria 5 days per week (leaving the weekend food waste to be thrown out), by one person for 2 hours per day at $10 per hour and trucked to Tracie's Farm, a Community Supported Agriculture farm in Fitzwilliam, would be an estimated $10,340 per year ($9400 for labor, $640 for gas, $300 for bins. Note: a truck with 4WD is required) Because the Net Present Value per mT of eCO_2 is so low for this project (Figure 5.1), the Sustainability Council recommends that composting on campus NOT be pursued until the project becomes cheaper. A demonstration composting project may be implemented, however.

Reducing waste in the cafeteria (Implementation: Sodexo Food Services Manager)

Sodexo plans to renovate the cafeteria in the Campus Center over the next 3 years. In order to go to a "trayless" system, which would reduce food waste, new dish return equipment is required, and funding for this is currently unavailable. However, Sodexo has completed a study to look at the advantages of implementing a trayless system. Data collection shows that by removing trays from the cafeteria, Sodexo could eliminate 0.116 lbs of food waste per meal served. Trays have been shown on many campuses to encourage people to take more than they can eat, so they end up throwing away a lot of uneaten food. Since Sodexo serves approximately 376,327 meals per year, this represents 43,560 lbs of food waste, most of which is put into the garbage disposal right now. This would save some money because of more favorable operations in the wastewater treatment plant (less sludge, so fewer truckloads of sludge being removed), but would not translate into any reduction in greenhouse gases since the wastewater treatment plant operations are not included in the greenhouse gas inventory. Some decrease in electricity use in the cafeteria garbage disposal would be realized, which would reduce greenhouse gases. If funding for the required equipment becomes available, the Sustainability Council recommends implementation of a trayless food system in the cafeteria.

Transportation Development

More fuel- efficient vehicles (Implementation: Sustainability Coordinator)

By 2020, gasoline use will be reduced in all US cars by 40% per order of the Energy Independence and Security Act signed into law on December 19th, 2007 which mandates a 40% increase in fuel economy by 2020 (Dieselnet, 2008). This reduction in fuel (15,578 gallons) will reduce emissions by 139 mT CO_2 annually.

CVCT Rideshare Program (Implementation: Sustainability Coordinator)

The Contoocook Valley Transportation Rideshare Program (CVTC) is a locally owned, internet-based, carpooling tool used by regional residents. The goal of the program is to reduce the region's carbon footprint through rideshare opportunities that are managed by program personnel via the internet. CVTC has offered to partner up with Franklin Pierce University to address ecological issues as a united community. The rideshare program will cost approximately $600.00 per semester and will be available to students, via Franklin Pierce University's intra-net. CVTC Rideshare program includes two (2) half day events with promotional materials provided by CVTC. The Mobility Manager would be available as a contact person at CVTC to assist in registering on the Rideboard, coaching to begin carpooling and a resource for assisting with situations concerning their rideshare experience. Promotional Materials include 100 Brochures, 25 Rideshare flyers to post on

campus and rideshare tips. CVTC Rideshare program will cost $1200.00 annually, reducing emissions by approximately 29.4 mT (average).

Air travel (Implementation: Sustainability Coordinator)

Policy that would require carbon offset purchases for air mileage traveled has been considered by the Council. Current estimates show that business related flights total 447,000 air miles, annually. On average, $15.00 per plane ticket would be assessed to offset emissions. If all flights were required to pay this fee, 247 mT CO_2 would be reduced annually.

Commuting (Implementation: Sustainability Coordinator)

Data gathered using a carpool survey of campus activities suggested, on average, 111,289 miles are driven annually by staff personnel, alone. This mileage could be reduced by 20% if staff were able to reduce their commuting by only traveling to the campus four days, rather than five, per week. This reduction would not result in an initial cost or savings, but would reduce emissions by 20%, or 199 mT CO_2, annually. **In a recent Public Forum on the Climate Action Plan, it was noted that not all staff may be able to complete their obligations in a '4-day work week', further research will determine feasibility.*

Preferred Parking (Implementation: Sustainability Coordinator)

Creation of preferred parking for rideshare users, carpooling commuters and hybrid owners will be an incentive for staff, faculty and students to take part in reducing the University's carbon footprint.

5. Financing

Franklin Pierce has completed thorough research on numerous options for reducing our greenhouse gas emissions in a cost efficient manner. Table 5.1 explores the three goals recommended by the Sustainability Council. Goal One recommends the elimination or upgrade of Scope One Emissions (Stationary). The initial capital investment is $42,000 (the cost of the Peterson Hall Boiler upgrade). The Annual savings is $131,042. The total emission reduction is approximately 2040 mT annually. Goal Two shows recommendations for reducing Scope 2 (predominantly) emissions. The initial capital investment to complete Goal Two is $10,042,280 (Marcucella Hall upgrade is estimated at 10 million dollars). The annual savings for completion of Goal Two is $133,913 and the annual reduction of GHG emissions is estimated to be 1811 mT. Goal Three would elicit an initial capital investment of approximately $20,000 with an annual savings of approximately $73,277.

The Council prioritized the respective goals' actions by examining the Net Present Value in comparison to the mT CO_2 emissions for each action. **Figure 5.1** shows the comparison of Net Present Value with the amount of mT of CO_2 released for each proposed action. Essentially, the left side of the figure shows Recycling as the most expensive action to take per unit of emission reduction. Comparably, the second phase of the StripSmart Study (2015-2020) will be the least expensive way to gain the greatest amount of emission reduction.

Financing for Goal One and Two must come from grants, external funding or finance options. Goal Three will be achieved through internal fundraising, "green-fees" or "earth gifts". The student governments of many schools have agreed to impose a small fee to support sustainability initiatives; one school suggested $1 per credit hour, or about $16 per student. We will suggest $5 per student per semester. If this were passed, it could help fund a number of sustainability efforts.

Department and institutional budgets, such as that of the Sustainability Coordinator or any other department or institute that may sponsor green initiatives, will continue to sponsor semester-long seminars, symposiums, Community Outreach (via Green Business Forums, 350.org Climate Action Days, Town Meetings, Earth Day Events, Focus the Nation, Will Steger Foundation Seminars, etc.) in order to embrace the CAP. Departments involved to date are: Monadnock Institute, New England Center for Civic Life, Division of Natural Sciences, Department of Residential Life, Information Technologies, Department of Facilities, Sodexo, Purchasing and the Department of Environmental Services. The commitment has increased over time and will continue to do so.

The basis of Goal Three is Education and our Franklin Pierce Community takes great pride in sharing research and knowledge beyond the classroom with the surrounding community. Our community shares in our commitment and Franklin Pierce University seeks regional involvement through Community Outreach initiatives. This relationship has opened doors for grants to be proposed in regard to renewable power programs.

Table 5.1 Comparison of Net Present Value and Emission Reduction (mT) per Action

Action	Initial Capital Investment	Annual Savings	Annual Cost	mT eCO_2 saved (annually)	NPV	NPV/MT CO_2	
Goal One							
Raven Croft Theater (2009)	$0.00	$8,177.60	$0.00	43	$62,424.14	$1,451.72	X
Crest View Closure	$0.00	$30,344.00	$0.00	147	$231,632.53	$1,575.73	X
Pierce Village Trailers	$0.00	$49,983.40	$0.00	223	$381,550.92	$1,710.99	X
Peterson Hall Boiler Upgrade	$42,000.00	$3,037.00	$303.70	23.9	($18,024.10)	($754.15)	X
Wood Pellets Bubble	$0.00	$25,000.00	$142,790.00	1110	($899,156.18)	($810.05)	X
Wood Pellets Granite	$0.00	$14,500.00	$97,510.00	493	($633,661.21)	($1,285.32)	X
Goal Two							
Co-gen	$5,000,000.00	$300,000.00	$30,000.00	2527	($2,568,570.38)	($1,016.45)	XX
GTHP DiGregorio	$89,760.00	$5,700.00	$4,243.20	30	($71,990.55)	($2,399.69)	XX
Wind	$500,000.00	$13,100.00	$1,310.00	59	($372,963.38)	($6,321.41)	XX
Photvoltaics	$375,000.00	$24,254.01	$2,425.40	120	($180,592.38)	($1,504.94)	XX
Solar Hot Water	$7,000.00	$1,200.00	$120.00	8	$1,762.76	$220.34	X
Marcucella Upgrade	$10,000,000.00	$10,000.00	$1,000.00	110	($9,190,557.28)	($83,550.52)	X
Wood Pellets Other Buildings	$0.00	$43,075.00	$264,605.00	1584	($1,691,060.94)	($1,067.59)	X
Lighting Upgrade Phase (II)	$14,280.81	$4,038.00	$403.80	18	$14,518.89	$807.05	X
SmartStrip Pilot Program Phase I	$3,000.00	$3,600.00	$0.00	13	$24,703.01	$1,900.23	X
SmartStrip Pilot Program Phase II	$18,000.00	$72,000.00	$0.00	78	$532,949.13	$6,832.68	X
Goal Three							
Education 2010-2015	$0.00	$33,270.00	$0.00	197	$253,968.30	$1,289.18	X
Education 2015-2020	$0.00	$33,007.80	$0.00	180	$251,960.68	$1,399.78	X
Recyling (Phase One and Two)	$20,000.00	$0.00	$10,400.00	5	($97,907.47)	($21,470.94)	X
Move-Out Days	$0.00	$7,000.00	$14,000.00	0.4	($53,434.87)	($133,587.17)	X
Transportation (CVTC)	$0.00	$0.00	$1,200.00	29	($9,160.26)	($311.57)	X
Composting	$300.00	$0.00	$10,039.72	12	($76,916.51)	($6,253.37)	XX
Carbon offset (Airtravel)	$0.00	$0.00	$1,788.70	115	($13,654.14)	($118.32)	XX
4-day staff work week	$0.00	$0.00	$0.00	199	$0.00	$0.00	XX
PPA	$0.00	$0.00	$25,000.00	236	($190,838.82)	($808.98)	XXX

Approximate Reduction by 2020 = 58% or 4262 mT eCO_2	
X	Sustainability Council Recommended Actions
XX	More Information Needed Before
XXX	Alternative Reduction, Not Likely Used

The values shown in (red) parentheses represent a negative cost or negative NPV. This means that over time the project will not elicit a positive cash flow and should not be implemented as a means to make profit. The green-shaded areas indicated by "XX", depict projects that were not cost beneficial for Franklin Pierce University to conduct at this time, but warrant further investigation for future educational (and emission reduction) purposes.

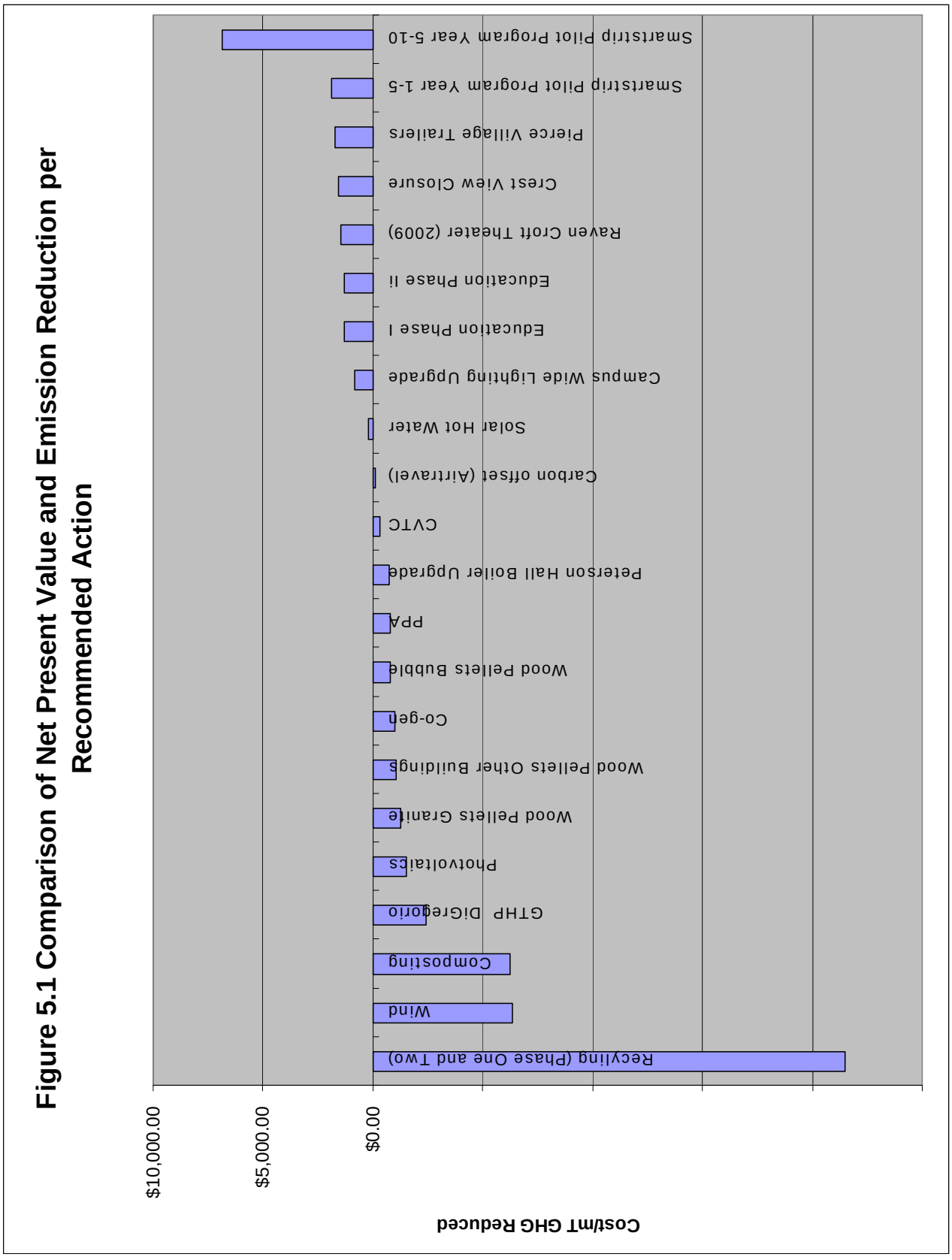
Figure 5.1 Comparison of Net Present Value and Emission Reduction per Recommended Action
Recycling (Phase One and Two)
Wind
Composting
GTHP DiGregorio
Photovoltaics
Wood Pellets Granite
Wood Pellets Other Buildings
Co-gen
Wood Pellets Bubble
PPA
Peterson Hall Boiler Upgrade
CVTC
Carbon offset (Airtravel)
Solar Hot Water
Campus Wide Lighting Upgrade
Education Phase I
Education Phase Ii
Raven Croft Theater (2009)
Crest View Closure
Pierce Village Trailers
Smartstrip Pilot Program Year 1-5
Smartstrip Pilot Program Year 5-10
$10,000.00
$5,000.00
$0.00
Cost/mT GHG Reduced

6. Conclusion

In addition to instituting a Campus Energy Audit and implementing a LEED Policy for all new campus renovations or constructions, the Franklin Pierce University Sustainability Council recommends the following actions to achieve Climate Neutrality:

Table 6.1 Sustainability Council Recommendations Per Year

	Action(s)	Goals	GHG Emissions Reduced (mT) Per Year (Estimate)	GHG Emissions (mT) Per Year (Estimate)	
2010	Goal One (Complete)	Goal One	2040	5324	**2010**
2011	SmartStrip Pilot (I)	Goal Two	13	3678	**2011**
	Wood Pellets Phase (II)	Goal Two	1584		
	Lighting Upgrade Phase (II)	Goal Two	18		
	Solid Waste Reduction	Goal Three	1		
	Transportation Development	Goal Three	29		
2012	Solid Waste Reduction	Goal Three	1	3677	**2012**
2013	Solar Hot Water	Goal Two	8	3668	**2013**
	Wind Feasibility Study	Goal Two	0		
	Solid Waste Reduction	Goal Three	1		
2014	Marcucella Upgrade	Goal Two	110	3557	**2014**
	Solid Waste Reduction	Goal Three	1		
2015	10% Education	Goal Three	197	3282	**2015**
	SmartStrip Pilot (II)	Goal Two	78		
2020	~20% Education	Goal Three	180	3103	**2020**
2050	Research and Development	Goal Two	3103	0	**2050**

The target date set for neutrality is 2050, or as soon as possible. The target goal for 2020 is to reduce emissions by 58%, or 4262 mT. The Climate Action Plan will be reviewed and upgraded on an annual basis, by the Sustainability Coordinator, working with the Sustainability Council, to ensure reduction is documented, research is implemented, and neutrality is achieved, as soon as possible. Table 6.1 shows the recommended actions taken per year to achieve climate neutrality by 2050, or as soon as possible.

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