Slippery Rock University

Climate Action Plan

A Roadmap to Climate Neutrality

This document envisions SRU's path toward climate neutrality within the framework of the American College and University Presidents' Climate Commitment and complements our University's history, vision and resources.

2037

[Mary Deemer]

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Executive Summary

As a signatory of the American College and University Presidents' Climate Commitment (ACUPCC), Slippery Rock University has dedicated itself to the goal of carbon neutrality and has chosen 25 years as the achievable time-frame. SRU's Climate Action Plan forms the foundation of sustainability that the University will build upon in order to raise awareness of the local and global issues associated with climate change and reduce its own environmental impacts. Climate Action Plans submitted to the ACUPCC are transparent living documents.

The Introduction of this document provides background information on: Presidents' Climate Commitment; Science of Climate Change; Pennsylvania's Impacts on Climate Change; and the History of Sustainability at SRU. The next section of the report, Education, Research and Public Engagement, addresses the academic mandate of the ACUPCC to integrate sustainability into the curriculum and community aspects of the University. An overview of current initiatives is provided: Master of Science in Sustainable Systems; Robert A. Macoskey Center for Sustainable Research and Education; Weather and Air Quality Observatory; Sustainable Enterprise Accelerator; McKeever Environmental Learning Center. A key strategy for SRU will be establishing an educational plan that comprehensively includes and incentivizes sustainability in our curriculum, research and faculty selection.

Greenhouse Gas Emissions (GHGE) Inventories are a key tool required by the ACUPCC to quantify emissions and establish baselines. SRU has contracted Sightlines to perform inventories for 2005-2009, with FY 2005 (52,874 $MTeCO_2$) serving as the baseline year. Purchased electricity and energy from on-campus stationary production (i.e. coal, gas, and oil) comprise 81 percent of total GHGE. Transportation (air travel and commuting) is also a large contributor at 12 percent. The remaining categories: transmission and distribution losses, waste water, paper, agriculture, refrigerants and solid waste round out the remaining 7 percent. These emission categories help to define the strategies necessary to achieve carbon neutrality. Addressing and guiding issues of growth are important to the planning process. Population and gross square footage affect the future emission trajectories of SRU.

Greenhouse Gas Emissions Mitigation Strategies are discussed in five main categories: Infrastructure Efficiency; Energy Portfolio Diversification; Sustainable Transportation; Sustainability as a Cultural Norm; Additional Mechanisms to Achieve Neutrality.

Key strategies include:

Infrastructure Efficiency

- Conduct studies of the Central Plant and energy audits of individual buildings to identify opportunities to increase efficiencies.
- Recommission building stock to improve energy efficiency and meet LEED standards in a systematic way.
- Increase monitoring abilities and provide feedback to building occupants.

Energy Portfolio Diversification

- Replace coal with biomass and utilize cogeneration technologies to generate 5-10 percent of total electricity at the Central Plant.
- Install a large standing solar array and individual building projects with the goal of generating an additional 10 percent of electricity.
- Bring the biodiesel processing equipment online and begin incorporating it into fuel for the fleet.
- Utilize geothermal technology to heat and cool campus buildings that are outside the reach of existing steam lines.
- Identify opportunities in our region to capitalize on the growing natural gas industry and lower emissions.
- Watch developing technologies for opportunities to reduce fossil fuel usage.

Sustainable Transportation

- Complete an alternative transportation study that emphasizes mass transit, walkability and biking; consider LEED neighborhood standards.
- Trim our fleet and increase its efficiency.
- Incentivize carpooling and high efficiency vehicles.
- Offset student, faculty and staff air travel.

Sustainability as a Cultural Norm

- Encourage sustainability goals by University stakeholders in all future planning documents.
- Enhance student and community engagement by using the University as a living-laboratory and targeting behavior change.
- Build student buy-in by having activities, clubs, departments, and experiences that incorporate sustainability.

- Adopt a Zero Waste philosophy that targets waste diversion strategies such as purchasing, recycling, donation, and composting.
- Increase sustainability initiatives among our dining operations and vendors.

Additional Mechanisms to Achieve Neutrality

- Renewable energy credits – continue to purchase 25 percent green power and increase the percentage over time to neutralize purchased electricity emissions.
- Offsets – financially invest in emission reducing projects either locally or regionally to achieve neutrality.
- Sequestration – develop a potential offsetting program that could utilize SRU's 440-acres of forest.

Creative financing opportunities are discussed in the Cost and Financing portion of the document. The Implementation and Tracking section describes a strategic method of setting goals and measuring successes. Strategies for reducing emissions are divided into three interim goals (short, mid-, and long-term) defined by a target date and reduction goal: 20 percent reduction by 2017, 70 percent reduction by 2027, and 100 percent reduction by 2037. Biannual Progress Reports are due to the ACUPCC detailing implementation and target progress.

SRU's Climate Action Plan fulfills the requirements of the ACUPCC and provides a roadmap to climate neutrality and institutional sustainability.

Slippery Rock University – Climate Action Plan

A Roadmap to Climate Neutrality

This document envisions SRU's path toward climate neutrality within the framework of the American College and University Presidents' Climate Commitment and complements our University's history, vision and resources.

Introduction

Global climate change due to increasing concentrations of atmospheric greenhouse gases is one of today's most pressing issues. Human activities result in emissions of four principal greenhouse gases: carbon dioxide, methane, nitrous oxide and the halocarbons. Carbon dioxide (CO_2) is the most recognized greenhouse gas attributable to human activities. The atmospheric concentration of carbon dioxide has increased from a pre-industrial value of approximately 280 parts per million (ppm) to an average annual concentration of 389.78 ppm in 2010 and 391.57 in 2011[1]. 2010 was the warmest calendar year on record with individual records for the warmest six months, the warmest year and the warmest decade. Nineteen nations set new all-time high temperature records, which in itself is a record[2]. For the past decade (2002-2011) average annual increases in CO_2 have been 2.07 ppm per year. The Intergovernmental Panel on Climate Change (IPCC)[3] has attributed this sharp increase in greenhouse gases to human activities in the industrial era. At the current rate, atmospheric CO_2 is predicted to reach 500 parts per million before the middle of this century, outpacing even the worst-case-scenarios predicted two decades ago.

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[1] Mauna Loa Observatory data. http://co2now.org/. Accessed 15 NOV 2011.

[2] McKibben, Bill. (2011). *Eaarth: making a life on a tough new planet*. New York: St. Martin's Griffin.

[3] Intergovernmental Panel on Climate Change (IPCC). (2007). "Climate Change 2007: Impacts, Adaptation, and Vulnerability." The IPCC Fourth Assessment Report. Cambridge University Press. http://www.ipcc.ch/ipccreports/ar4-wg2.htm. Accessed 7 NOV 2011.

Society has already experienced consequences of global climate change, including food shortages, species habitat loss, drought, increased frequency and intensity of wildfires and storms, unpredictable weather patterns, and rises in sea level. The urgency of global climate change not only necessitates changes in behavior and operations, but also a new perspective. We will have to look to our past to learn about what works in our region and we will have to imagine the future to plan for the long term. A business-as-usual approach to our future, where short-term gain takes precedence over strategic long-term mitigation, is a formula for failing future generations. Higher education has the potential and responsibility to be a critical leverage point for change.

The SRU Climate Action Plan began in 2009 with an inventory of the University's past emissions. These greenhouse gas inventories inform us how our actions directly influence the ecosystem and provide insight into necessary changes. They enable us to explore the steps necessary to become climate neutral by considering the different areas of campus life that generate emissions, and provide the necessary metrics to track progress against established goals. While we recognize that it will be challenging to reach carbon neutrality, we also accept the University's responsibility to prepare students for informed citizenship by ensuring they have the skills and abilities that will enable them to work with their communities to address the larger problems facing society. This document is intended to be a vision of the future that acts to focus our attention on a set of values and ethics which will guide our actions toward the ultimate goal of carbon neutrality. The Slippery Rock University Climate Action Plan is a living document subject to ongoing review and modification to reflect the latest available technology, information and circumstances.

Presidents' Climate Commitment

The American College and University Presidents' Climate Commitment (ACUPCC) is a high-visibility effort to address global climate disruption undertaken by a network of colleges and universities. These institutions have made institutional commitments to eliminate net greenhouse gas emissions from specified campus operations, and to promote the research and educational efforts of higher education to equip society to re-stabilize the Earth's climate. Its mission is to accelerate progress toward climate neutrality and sustainability by empowering the higher education sector to educate stu-

dents, create solutions and provide leadership-by-example for the rest of society.

The ACUPCC provides a framework and support system for America's colleges and universities to implement comprehensive plans in pursuit of climate neutrality. The Commitment recognizes the unique responsibility that institutions of higher education have as role models for their communities and in educating the people who will develop the social, economic and technological solutions to reverse global warming and help create a thriving, civil and sustainable society. ACUPCC has grown to include 674 signatories to date, which represents more than 30 percent of the student population in the U.S.[4]

ACUPCC institutions have committed to:

- Inventory greenhouse gas emissions on at least a biannual basis.
- Take immediate steps to reduce greenhouse gas emissions by choosing from a list of specific short-term actions.
- Within two years, submit a Climate Action Plan that sets target dates and interim goals for becoming climate neutral.
- Submit biannual Progress Reports.
- Integrate sustainability into the curriculum and make it part of the educational experience.
- Make the action plan, inventories and progress reports publicly available.

The college and University presidents and chancellors who are joining and leading the Commitment believe that exerting leadership in addressing climate disruption is an integral part of the mission of higher education that will stabilize and reduce their long-term energy costs, attract excellent students and faculty, attract new sources of funding, and increase the support of alumni, business and local communities.

Slippery Rock University's past President, Robert Smith, on November 9, 2009, was the first signatory in the state system to commit the University to net climate neutrality.

[4] http://www.presidentsclimn tecommitment.org/. Accessed 3/5/12.

The Science of Global Climate Change

When sunlight strikes Earth, much of it bounces off Earth's surface, but some is absorbed into Earth's atmosphere where it drives weather and climate. The "greenhouse effect" refers to the phenomenon wherein Earth's atmospheric gases (i.e. water vapor, carbon dioxide and methane) trap the sun's heat in Earth's atmosphere. These "greenhouse gases" act like the glass walls of a greenhouse and prevent the sun's heat from bouncing back into outer space; they also serve to help keep Earth's temperature at an average 60°F, which also allows life as we know it to exist. However, when the natural balance of greenhouse gases is disrupted, planetary temperatures rise and weather patterns are disturbed.

The National Academy of Sciences reports that Earth's surface temperature has risen by about one degree Fahrenheit in the past century, with accelerated warming occurring the past two decades[5]. Since the Industrial Revolution, atmospheric concentrations of CO_2 have increased nearly 30 percent. In addition, methane (CH_4) concentrations have more than doubled and nitrous oxide (NO_x) concentrations have risen by about 15 percent, increasing the heat-trapping capability of Earth's atmosphere. While plant respiration and the decomposition of organic matter release more than 10 times the CO_2 released by human activities such as transportation and manufacturing, these emissions were generally in balance prior to the Industrial Revolution because CO_2 was adequately absorbed by terrestrial vegetation and the oceans. Scientists believe that these natural carbon sinks, which are under their own environmental pressures, can no longer sufficiently absorb the rapid increases in human-caused CO_2 releases, which account for the rise in CO_2 concentrations in the atmosphere. The release of carbon dioxide by human activities has increased dramatically over the last few hundred years.

According to the National Park Service, 98 percent of CO_2 emissions, 24 percent of methane emissions, and 18 percent of nitrogen oxide emissions in the United States are the result of fossil fuel combustion for heating, electricity and transportation[6]. Changes in land use (i.e. deforestation and increased agriculture) also contribute to reductions in carbon sequestration. Increasing concentrations of greenhouse gases are likely to accelerate the rate of climate change. The National Academy of Sciences predicts an increase in average global surface temperature of 1 to 4.5°F in the next 50 years, and 2.2 to 10°F in the next century. Evaporation is also expected to increase as the climate warms, which will increase average global precipitation. Regional variations

[5] U.S. Environmental Protection Agency. "Why Sustainability?" http://yosemite.epa.gov/R10/OI.NSF/Sustainability/Why. Accessed 29 May 2008.

[6] National Park Service. (2002). Air Quality in the National Parks. Second Edition. U.S. Department of the Interior.http://www.nature.nps.gov/air/Pubs/pdf/aqNps/aqnps.pdf. Accessed 1 June 2008.

in temperature and precipitation change are likely, and predicted consequences include severe storms, floods, droughts, heat waves, and sea-level rise. These climate changes are expected to also increase the spread of disease and pest vectors and further stress vulnerable species and ecosystems, leading to a shift in species composition. In Pennsylvania, livelihoods based on agriculture and forestry may experience significant impacts.

Pennsylvania and its Impacts on Global Climate Change[7]

Pennsylvania contributes a full 1 percent of the entire world's greenhouse gas emissions and 4 percent of the United States contribution. In 2000, Pennsylvania emitted approximately 284 million metric tons of equivalent CO_2 ($MMTeCO_2$) [8] gross emissions on a consumption basis. Pennsylvania is the third largest producer of electricity in the nation, producing more than 226 billion kilowatt hours of electricity, an excess of 74,515 million kilowatt hours over consumption.

The Union of Concerned Scientists predicts that if no steps to decrease emissions are taken, western Pennsylvania can expect a climate similar to that of northern Alabama by the end of the century.

Coal generates almost half of Pennsylvania's electricity, while nuclear provides more than a third of the state's supply from its five operating nuclear plants. Most of the rest of its electricity generation is supplied by natural gas. While Pennsylvania is one of the nation's largest users of municipal solid waste and landfill gas for electricity generation, and has hydroelectric and wind generation, these resources contribute only minimally to the state's electricity production[9].

Pennsylvania has a rich endowment of fossil fuels, with substantial reserves of coal, recent production and reserves in natural gas found in its Marcellus shale formation, but only minor reserves of oil. Pennsylvania was the site of the world's first commercial oil well drilled at Titusville in 1859 and of the worlds' first oil boom, but the state's oil production is now relatively low. Despite producing little oil, Pennsylvania is the leading petroleum-refining state in the Northeast, getting its oil mainly from foreign sources. Besides its shale

[7] Pennsylvania Climate Action Plan (2009). Available: http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-10677. Accessed 17 FEB 12.

[8] **Carbon Dioxide Equivalent (eCO2)** -A metric measure (metric ton) used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). The eCO2 for a gas is derived by multiplying the tons of the gas by the associated GWP.

[9] Institute for Energy Research, Pennsylvania Energy Facts. Available: www.instituteforenergyresearch.org/states. Accessed 17 FEB 12.

natural gas resources, Pennsylvania gets its natural gas mainly from pipelines from the Gulf Coast. The state is a major coal producer, exporting coal to other states on the East Coast and in the Midwest. In addition to fossil fuel resources, Pennsylvania has the second-largest nuclear capacity in the United States and was home to the nation's first commercial nuclear reactor at Shippingport in 1957. This, along with the state's fossil fuels has made Pennsylvania one of the largest electricity generators in the country.

The Pennsylvania Climate Action Plan, which was completed at the end of 2009, details actions the state will take to reduce its greenhouse gas emissions (GHGE). A 30 percent reduction in GHGE below 2000 levels by 2020 was recommended, and these values fall within the range of reduction that is recommended by the Intergovernmental Panel on Climate Change (IPCC) as being necessary to stabilize the effects of climate change[10]. The plan lays out strategies, which if fully implemented, would reduce emissions by 60 percent. The most important impacts of policies already being implemented include:

- The renewable energy requirements in the Alternative Energy Portfolio Act (AEPS) and Act 129, mandating electric utility energy efficiency programs, will reduce emissions by 15 MMTeCO_2.

- Pennsylvania's adoption of the 2008 Biofuel Development and In-State Production Incentive Act, the Diesel-Powered Motor Vehicle Idling Act, and the Pennsylvania Clean Vehicles (PCV) Program will reduce emissions by an additional 16 MMTeCO_2.

- Recently enacted federal appliance efficiency standards as well as improved efficiency for new light-duty vehicles, which are estimated to further reduce emissions by 5 MMTeCO_2 by 2020.

The effects of global climate change are already apparent in the state of Pennsylvania. In the past thirty-five years, temperatures in the Northeast have steadily risen, and winter precipitation has increased. Projections for temperature increases of 7°F to 12°F above historic levels in winter and 6°F to 14°F in summer, combined with predictions of drought in summer and 20 to 30 percent more precipitation in winter over the next century, have raised concern over decreased snowfall, change in forest composition and effects on agriculture. Also of concern is public health, including a projected 50 percent increase in the number of heat-related deaths, increased symptoms of respiratory diseases such as asthma and accelerated spread of disease through increasing populations of pest vectors such as ticks (lyme disease) and mosqui-

[10] Pennsylvania: Final Climate Change Action Plan, Dec. 2009. PA Department of Environmental Protection. Available: www.elibrary.dep.state.pa.us/dsweb/View/Colletion-10677. Accessed 25 JAN 12.

toes (West Nile virus). The Union of Concerned Scientists predicts that if no steps to decrease emissions are taken, western Pennsylvania can expect a climate similar to that of Northern Alabama by the end of this century[11].

History of Slippery Rock University and Sustainability

Slippery Rock University was founded in 1889 by the citizens of the borough of Slippery Rock as an exercise in community sustainability similar to modern day permaculture. Permaculture is a branch of ecological design and engineering which develops sustainable human settlements and self-maintained agricultural systems modeled on natural ecosystems. SRU is now the region's premier public residential University. The University is shaped by its normal school heritage and characterized by its commitment to intellectual development, leadership and civic responsibility. Today SRU is a comprehensive University offering a broad array of undergraduate and select graduate programs to more than 8,800 students in 2010.

Located in the rolling hills of western Pennsylvania, SRU is the western-most institution of the 14-campus Pennsylvania State System of Higher Education (PASSHE). The 660-acre campus is less than an hour north of Pittsburgh, one hour south of Erie, and 45 minutes east of Youngstown, Ohio. Two major highways, I-79 and I-80, intersect within seven miles of the University, conveniently linking it to the entire Commonwealth and its contiguous regions. The campus is situated in the township and borough of Slippery Rock in Butler County, Pennsylvania, a safe and friendly community, flanked by rolling farmland, forests and glacial lakes.

True to its founding principles SRU reemerged as an early adopter and leader in the modern sustainability movement more than two decades ago. In 1990, the Robert A. Macoskey Center for Sustainable Systems Education and Research was founded and a unique graduate program, the Master of Science in Sustainable Systems (MS3), the first graduate program focusing on sustainability in the country was initiated. SRU has been a member of the Association for the Advancement of Sustainability in Higher Education (AASHE) since 2009. Taking full advantage of its membership, SRU received a Bronze rating in its original submission to Sustainability Tracking Assessment & Rating System (STARS) and is a 2009 signatory of the President's Climate Commitment (one of only two universities within the state system to do so). SRU has also consistently been featured in the Princeton Review's Guide to Green Schools.

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[11] Frumhoff, P.C., et al. (2007). "Northeast Climate Impacts Assessment." July 2007. Union of Concerned Scientists. http://www.climatechoices.org/ne/resources_ne/jump.jsp?path=/assets/documents/climatechoices/confronting-climate-change-in-the-u-s-northeast.pdf. Accessed 7 NOV 2011.

In May 2010, the President's Strategic Planning Committee released a five-part strategic plan, "Reaching for 2025 and Beyond." Shaping Trend 5 of the plan is the *Report of the Natural Resources Subcommittee,* which highlights SRU's sustainability goals and objectives,[12] many of which are reaffirmed in this document. Trend 5 focuses on the global problem of diminishing returns, which addresses the fact that climate change, along with food, water and energy security, will become increasingly important issues for future generations. With SRU's vision to "excel as a caring community of lifelong learners connecting with the world" and the use of holistic strategic planning, the University has established sustainability as a core value.

Education, Research and Public Engagement

Education, Research and Public Engagement are a working theme throughout this document and opportunities to engage the greater campus community are explored as topics arise. In 1990, SRU was the first University in the country to offer an innovative Master of Science in Sustainable Systems (MS3) and establish a 83-acre facility to focus on the multifaceted issues of sustainability. The influence of the graduates from this program on the region is noteworthy; many of the University's sustainable initiatives have been furthered through their research and passion. This section showcases a sampling of SRU's current programs and projects that directly enhance sustainability and support Trend 5 of the strategic plan.

Master of Science in Sustainable Systems

The Master of Science in Sustainable Systems (MS3) program was founded in 1990 as one of the first advanced degrees in the country focusing on the issue of sustainability. It was designed to produce environmental leaders with the skills to address our rapidly increasing environmental problems. MS3 graduates study the interconnections necessary to become system thinkers and to influence positive change in their communities. Graduates learn to critically evaluate our society's current interactions with the environment and have the knowledge and experience to lead others as we find ethical and equitable solutions to our environmental challenges. Courses offered in the program include: Principles of Sustainability (32-601), Introduction to GISci (32-325), Water Climate & Sustainability (32-650), Seminar in Professional Writing

[12] Slippery Rock University Strategic Planning Trend 5- Report of the Natural Resources Subcommittee of the President's Strategic Planning Committee.
(http://www.sru.edu/president/strategicplanning/Pages/StrategicPlanningTrend5.aspx)

(24-654), Energy and Society (32-632), Environmental GISci (32-625), Planning for Sustainable Communities (32-616), Environmental Economic Geography (32-631), Sustainability in the Built Environment (32-638), and six credits of a project, thesis or internship.

Graduates have gone on to further the work of sustainability in their relative fields with jobs in building efficiency, environmental architecture, the solar industry, green roofs, sustainability coordinating, land planning, and community development. Graduate assistants and MS3 students, working with other segments of the Slippery Rock community, have completed many sustainability projects for the University including: the STARS report, the first greenhouse gas inventory, LEED EB-OM certification, establishing the Green Fund, performing a waste stream study, commuting survey, energy conservation campaign, energy pledge, and this Climate Action Plan. Regrettably, the MS3 program was shelved in 2012. Hope remains that the program will be not only reinstated but expanded to accommodate the growing interest in this field.

Figure 1: Harmony house at the RAMC is certified LEED-Silver.

The Robert A. Macoskey Center at SRU

The Robert A. Macoskey Center for Sustainable Systems Education and Research (RAMC) was created in 1990 to promote sustainability at SRU and in the local community. The Center is located on 83 acres of the University campus and enacts its mission in three ways: education about sustainability, physical demonstration of sustainable technologies and systems, and supporting sustainability-focused academic initiatives and research. The Harmony House (shown in Figure 1) is a newly renovated facility certified LEED-Silver for existing buildings: operation and maintenance (EB:OM) and serves as a classroom and public meeting space.

The Center hosts the composting operation on campus, a small demonstration green roof, organic community and market gardens, conducts tours and hosts workshops throughout the year. The Center is powered by solar, wind and geothermal energy. The RAMC employs up to fourteen students and a full-time director.

Weather and Air Quality Observatory

The PA Departmental of Environmental Protection has partnered with Slippery Rock University to operate a weather and air quality observatory (WAQO) on the Slippery Rock University campus. This observatory produces environmental data that is publicly available to the Slippery Rock community and serves as an excellent resource for both teaching and research. The WAQO measures the following environmentally important criteria: ambient temperature, atmospheric pressure, relative humidity, wind speed, wind direction, incoming solar radiation, total suspended particulate matter, ultrafine particulate matter, ozone, nitrogen oxides, sulfur oxides, carbon monoxide and hazardous air pollutants (i.e. benzene, toluene and other organic pollutants). The WAQO budget includes funding for one student scientist who is responsible for maintaining equipment and is essentially a PA DEP employee. At least two students a year work on research that involves studying measurements made at the WAQO. These students present their results annually at national and regional conferences. In addition to making air quality measurements, the WAQO data is important for climate change and sustainability research. As this site continues to operate, data can be used to investigate long-term changes in air pollutants, such as ozone, which are expected to increase as global temperatures increase. SRU utilizes this data to investigate issues of environmental justice in western PA, increasing our knowledge of sustainability in the region. Environmental justice is an important aspect of sustainability which is often overlooked, and can be defined as economically disadvantaged citizens disproportionately bearing the burden of environmental pollution.

Sustainable Enterprise Accelerator

The mission of the Sustainable Enterprise Accelerator (SEA) is to promote regional economic development through applied student learning opportunities in new sustainable venture creation and business consulting. The SEA assists both aspiring and established entrepreneurs in the development of early stage business plans. The SEA provides information about financing, business environment and ways to broaden current customer bases through workshops and guest speakers. The “Food for Profit” series is a two day workshop partnered with Pennsylvania Association for Sustainable Agriculture (PASA) to include guest speakers who provided attendees with information about how to apply for a license to cook and sell food from one’s home,

food production guidelines and marketing strategies to sell homemade products. For students, the SEA offers an opportunity to pitch ideas in a competition to receive a cash prize. The annual "Rock the Boat" Elevator Pitch Competition provides inspiration and incentives for new business creation. This competition captures the spirit of entrepreneurship and recognizes the entrepreneur as an agent for change whose entrance into the market shakes things up. SEA addresses the fact that in a free market economy, the innovations and risk-taking behaviors of entrepreneurs are the primary source of improving living standards for all. The SEA also encourages its students to extend their skills in helping outside businesses to troubleshoot issues they may be experiencing and to help create a more profitable and sustainable business plan. The main objective of the SEA is to have student entrepreneurs and established businesses work together to create a world of sustainable businesses.

McKeever Environmental Learning Center

The McKeever Environmental Learning Center is folded into a natural wooded setting about 30 miles north of Slippery Rock, Pennsylvania near Sandy Lake in Mercer County. Realizing that we have a responsibility for the world in which future generations will live, the Commonwealth of Pennsylvania created the McKeever Center in 1974. The McKeever Center is a public service institute of the Pennsylvania State System of Higher Education and is administered by Slippery Rock University.

The McKeever Environmental Learning Center is a facility that runs a variety of environmental education programs including Earthkeepers, Sunship Earth, and Web of Life. Each year, thousands of school-aged students and hundreds of teachers participate in McKeever Environmental Learning Center's environmental education programs that offer residential and non-residential programs for schools throughout the year. School programs are designed to meet the needs of students in grades K-8. Program components include: hands-on, fully participatory learning adventures; activities designed to build upon one another, and curriculum integration with follow through back in the classroom. The majority of programs take place outdoors. Nestled amidst 205-acres, 10 energy-efficient buildings offer a private, natural atmosphere with modern conveniences.

McKeever's general mission is to guide individuals toward developing and maintaining a sustainable relationship between themselves and the natural world in his/her workplace, residence and recreational choices. The residential campus provides a unique educational setting for experiencing and ex-

ploring personal connections and associated impacts on the natural world. The facilities on-site showcase many forms of renewable energy including: a 10 kW wind turbine; solar panels for thermal heating of water; and two geothermal heat-pump systems. Recycled materials including bunk beds, decks, carpets and picnic tables made from recycled plastic bottles are used. Many of the meeting areas are equipped with energy efficient heat pumps.

Specific goals of the Center include: teacher education, undergraduate education, basic education, public service and continuing education, research and graduate education, and sustainable practices. Each year, more than 25 college students seeking degrees in education complete their student teaching and internships at the McKeever Environmental Learning Center. McKeever has a profound impact on the region, educating thousands of future citizens about their impact on the environment at the most influential stages of behavioral development.

Greenhouse Gas Emissions Inventory

The first Slippery Rock University Greenhouse Gas Emissions (GHGE) Inventory was conducted in 2009 by graduate students in the Master of Science in Sustainable Systems program using the Clean Air-Cool Planet Calculator (CA-CP). Upon signing the Presidents' Climate Commitment later that year, the University hired Sightlines, an outside firm also utilizing CA-CP, to conduct official greenhouse gas emissions inventories for reporting purposes. SRU has completed inventories of its GHGE for fiscal years 2005 through 2009, with FY 2005 at 52,874 $MTeCO_2$[13] serving as the baseline year. GHGE inventories were also recently completed for FY 2010 and 2011 and the data is currently being analyzed. Greenhouse gas inventories will be completed on at least a biannual basis going forward.

The ACUPCC defines the three categories of GHG emissions for accounting and inventory-reporting purposes:

• **Scope 1** accounts for direct GHGE from sources the institution owns or controls. At SRU, this consists largely of a central heating plant that utilizes coal and natural gas (largely used for space and domestic-water heating), fuel for fleet vehicles, and a small amount of chemicals (mainly fertilizers and re-

[13] Metric Ton **Carbon Dioxide Equivalent (MTeCO2)** -A metric measure (metric ton) used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). The eCO2 for a gas is derived by multiplying the tons of the gas by the associated GWP.

frigerants). On-site combustion of fossil fuels is responsible for more than a third of total emissions.

• **Scope 2** accounts for indirect GHGE from the generation of purchased electricity consumed by equipment or operations owned or controlled by the institution. Electrical consumption in our facilities accounts for nearly half of total emissions. Part of the reason purchased electricity contributes such a significant portion of the University's overall emissions is because of the high percentage of coal-powered generating plants within our eGRID subregion, RFCW, that supplies power to western Pennsylvania.

• **Scope 3** accounts for indirect GHGE from all other sources that occur as a consequence of the institution's activities that are not owned or operated by the institution. These are largely related to transportation (commuting and air travel by students/faculty/staff), Scope 2 transmission and distribution losses, and a small amount of emissions from solid waste, wastewater and paper. This category is dominated by our large commuting population and air travel and comprises approximately one fourth of total emissions.

The results of the greenhouse gas inventories (2005-2009) differentiated by scope are shown in Figure 2. SRU has managed to steadily decrease its emissions despite a decade of growth, partly due to an aggressive campaign to increase the efficiency of the buildings utilizing an energy service company (ESCO) program, adoption of smart scheduling practices, and improvements to the building automation system controls. However, the marked decrease in Scope 2 emissions between 2006 and 2007 is the direct result of the reorganization in eGRID[14] sub-regions that moved western Pennsylvania into sub-region RFCW which uses a less coal dependent fuel-mix than its former ECOV sub-region. Breaking emissions down further by type allows an institution to evaluate the areas of greatest consumption and therefore, greatest reduction potential.

[14] U.S. EPA's Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States. It divides the U.S. power grid into 27 sub-regions which represent a portion that is contained within a single North America Electric Reliability Council (NERC) region, and generally represents sections of the power grid which have similar emissions and resource mix characteristics, and may be partially isolated by transmission constraints. Available: http://www.epa.gov/edgrid. Accessed 03 JAN 12.

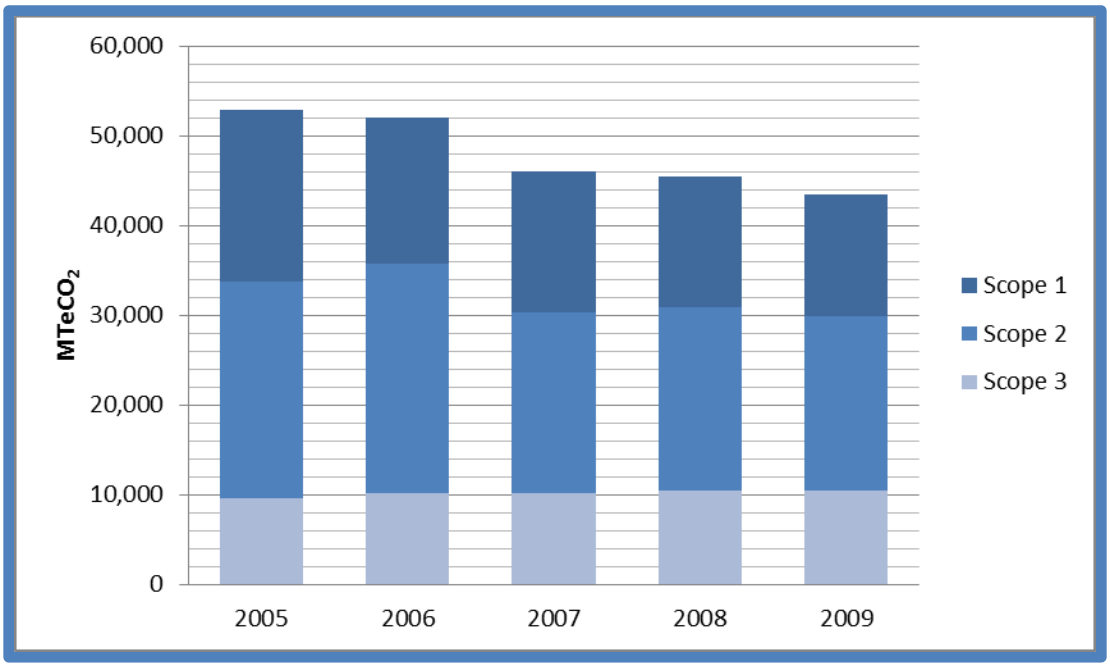

Figure 2: Results of SRU's Sightline GHGE Inventories for FY 2005-2009 differentiated by scopes

The GHGE for SRU's baseline year (2005) is broken down by type in Figure 3. Purchased electricity is the largest category comprising 46 percent of total emissions, followed closely by on-campus stationary (central plant) emissions at 35 percent. Commuting and air travel are the next largest categories at 8 percent and 4 percent, respectively. Transmission and distribution losses (T&D) from purchased electricity account for 4 percent of total emissions, and the University's vehicle fleet produces 1 percent of emissions from gasoline and diesel fuel consumption. The remaining categories of waste water, paper, agriculture, refrigerants and solid waste approximately equals the remaining 2 percent of total emissions.

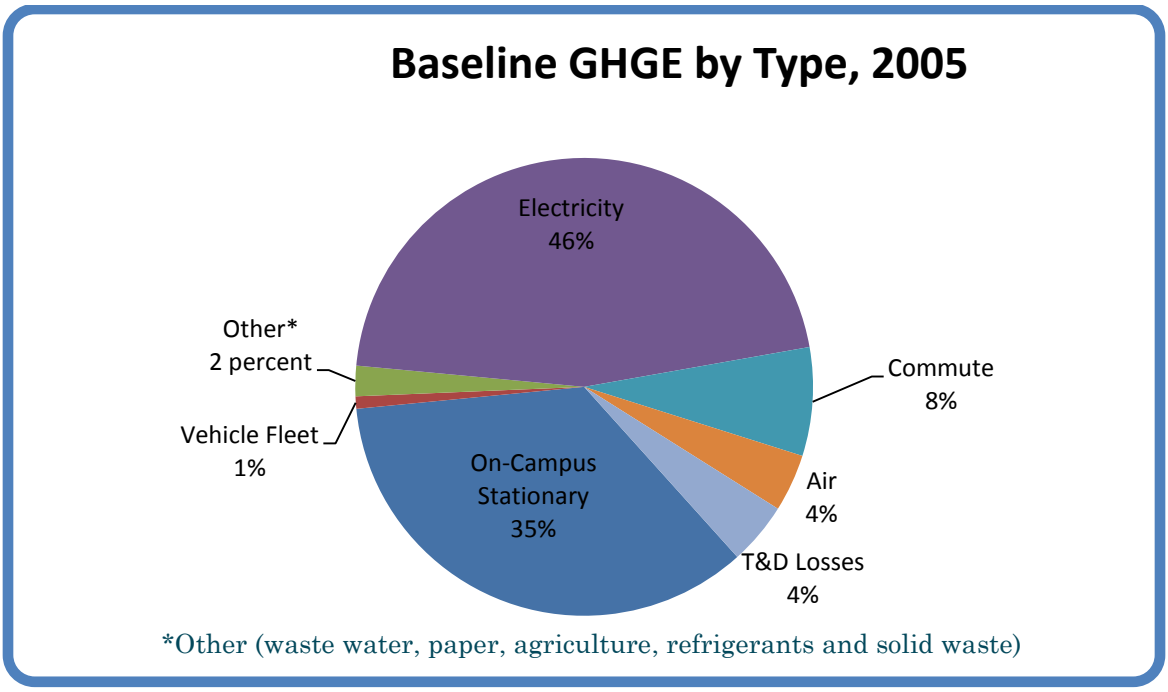

Figure 3: A breakdown of SRU's GHGE by Type for the baseline year, FY 2005

Business-as-Usual Emissions Trajectory

Business-as-usual (BAU) projections provide a window to the future, illustrating what GHGE would look like if the University made no further attempts to reduce them. Prior to setting a long-term goal for achieving climate neutrality and interim goals to foster progress along the way, it is vital that an institution understand how GHG emissions are expected to increase or decrease in the future under BAU conditions. To arrive at this understanding, two major assumptions were made related to campus growth regarding student population and building footprints.

After experiencing a decade of growth and expansion, SRU is considered a mature University. Future emissions can be predicted by evaluating the University's enrollment and building plans. SRU has developed a Strategic Plan, "Reaching for 2025 and Beyond," which provides the basis for estimating future growth and expansion at SRU. A shifting demographic which shows declining rates of Pennsylvania high school graduates means competition will be fierce and the opportunity for growth reduced in the near term. A modest population growth rate of 0.2 percent was assumed for the next 25 years. We do not anticipate substantial growth in our environmental footprint from increases in campus size; however, we do see our footprint changing as a result

of building renovations and a slight increase in the size of our built environment (campus square footage). A new Student Center, which will be LEED-Silver certified, came online July 2012 and several other renovations are planned. Although renovations are designed to improve our energy efficiency and will incorporate LEED EB:OM Silver standards, there is the expectation that SRU's footprint will increase in terms of gross square footage. Gross square footage was projected to increase at a yearly rate of 0.3 percent for the next 25 years. These conservative estimates of population growth (0.2 percent) and gross square footage (0.3 percent) were used to project BAU emissions in the Clean Air-Cool Planet (CA-CP) campus carbon calculator.

Several other factors will influence SRU's GHGE in the near future. The green power certificates that were purchased through the state system since 2005, offsetting approximately 3,500 $MTeCO_2$, were cut from the budget in 2011 by Governor Tom Corbett. In addition, a reduction in GHGE was seen as the central plant burned more natural gas in recent years to meet EPA Clean Air regulations. The completion of the new baghouse allows the central plant to return to burning more coal without exceeding emission regulations, which is significantly more cost-effective but carbon-intensive. Considering these factors CA-CP projected BAU emissions, if current efforts cease and nothing further is done to mitigate our GHGE, will increase to more than 54,000 $MTeCO_2$ by 2037 as shown in Figure 4.

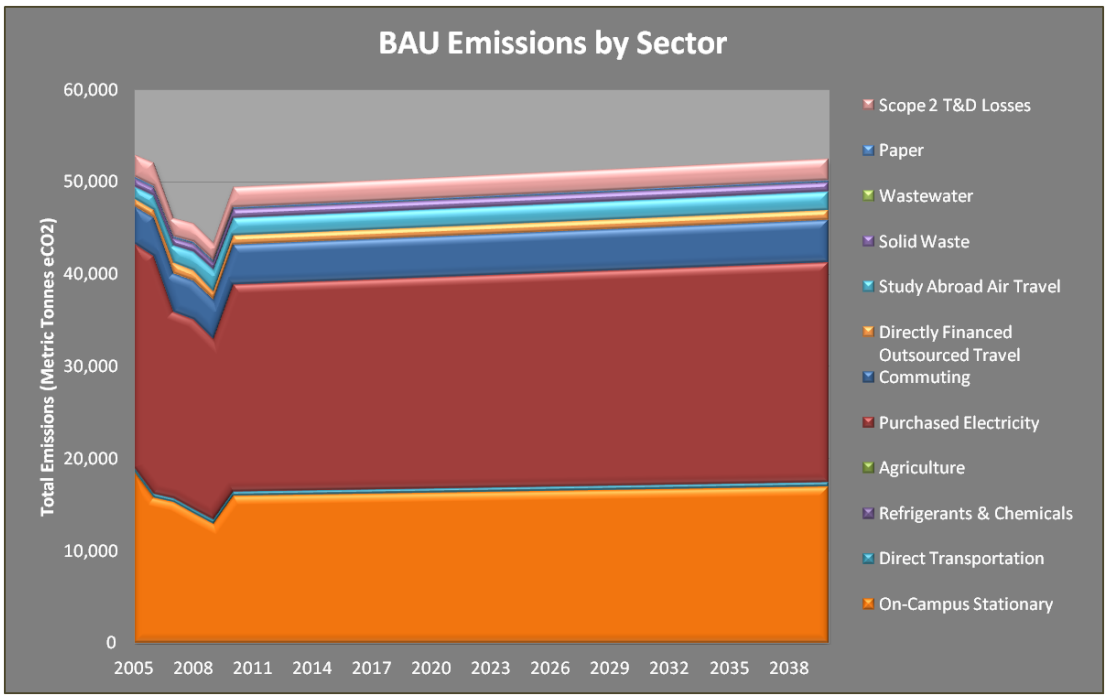

Figure 4: CA-CP projected business-as-usual emissions displayed by sector.

Greenhouse Gas Mitigation Strategies

The University is aware that to be successful in reducing its environmental footprint and achieving net climate neutrality by 2037, we have to be inclusive of all contributing emissions. More than 97 percent of our emissions are a direct result of conditioning our facilities and transportation associated with supporting University operations. Our mitigation plan is strongly focused on energy and travel, but includes all contributing emissions to successfully achieve neutrality. We feel strongly that a successful plan will result from our efforts to increase efficiency and diversify our energy portfolio, but also from focusing on the continued education of our campus community about how their behaviors can impact our footprint both negatively and positively.

A summary of the proposed mitigation strategies are presented in Table 1, which divides them into short, mid- and long-term goals as well as provides a description, estimated carbon reductions and a simple payback analysis where these numbers were available.

Table 1: Summary of mitigation strategies sorted into short, mid, and long-term goals w/ estimated eCO2 reductions and paybacks

PROPOSED GHGE MITIGATION STRATEGIES

Strategy	MTeCO2 Redux	Simple Payback (yrs)	Detailed Description/Assumptions
Short Term Actions to be taken within the next 5 years to achieve 20 percent reduction.			
Implement 2011 Energy Conservation Policy	516	0.02	Implement thermostat setpoints, setbacks, smart-scheduling, energy-star appliances, only facilities approved space-heaters; assumes 1.5 percent savings in fossil fuel and electricity per year.
Set 2009 standard for Central Plant minimum fuel ratio	--	--	Prevent return to increased burning of coal to save $$ in short term; 33 percent coal vs. 67 percent gas burned in FY2010-2011. Current pricing $3.19/mmBtu coal, $9.95/mmBtu gas. $409,622 premium per year at current fuel costs. FY 2005-2006 ratio was 67 percent coal, 33 percent gas.
Purchase 4 million KWH green power RECs	3,079	--	Replace green power (25 percent) previously purchased through the state system to avoid increasing Scope 2 emissions in 2012, support renewable energy projects.
Implement Energy Awareness Outreach Program, smart metering, behavioral changes campaign	1,267	0.04	Assume 5 percent elect. savings on institutional bldgs. (63 percent), 25 percent on residential housing (less in early years, more in later years) due to hiring Sustainability Coordinator, continuing energy awareness campaign/seminars/speakers/dorm energy competitions, campus surveys, peer mentoring, building energy liaisons, green office-dorm certifications, incentives/awards/recognition, green e-letter, sustainable living-learning community in residence halls.
Complete steam/condensate loop improvement projects	1,240	7	Replace last two major remaining segments of steam loop - steam/condensate lines at Art 1, Boozel - University Union to increase condensate return to boiler plant (48 percent boiler makeup water due primarily to lack of condensate return). Assume 10 percent reduction in boiler energy usage.
Implement annual condensate trap maintenance program	221	0.2	Annual program to ensure proper operating and maintenance of steam condensate traps to begin 2012; assumes 2 percent heating plant energy savings/year.
Insulate attics with little/no insulation	28	5	Maltby, Old Main, North Hall, West Gym attics are either not insulated or under-insulated (in process)
Implement comprehensive green purchasing policy	94	2	Implement best practice purchasing; recycled content >30 percent; paper towels, toilet paper >50 percent recycled (FSC cert.); RFP's to disclose vendor environmental practices; pallet/packaging take-back clause in contracts; reusable packaging; continue/increase use of eprocurement software. Assume 10 percent reduction in landfilled waste and 10 percent reduction in paper emissions.
Implement Phase I of Central Plant improvements	324	10	Implement non-fuel conversion recommendations of central plant study; assume 3 percent aggregate total savings, 10 yr. avg. payback for projects such as R.O. boiler blowdown water filtration, secondary pumping VFDs, steam turbine driven feedwater pump, etc... 2010-2011 central plant eff. 71 percent; Coal boilers 82 percent effic., Gas Boiler 79 percent effic. (80 percent avg, boil ef)
Implement single-stream recycling program	169	--	Restructure the recycling system to move towards single-stream recycling; assume 25 percent increase in amount of waste diverted from landfills.
Increase composting	--	--	Expand composting efforts to include post-consumer waste, explore partnership with Borough to handle yard waste and provide service.
Increase dining sustainability initiatives	--	--	Work with AVI Fresh to provide increased selection and awareness of sustainable alternatives. Increase organic and local purchasing, serve less meat, serve MSC-certified seafood, serve pastured/grassfed, and/or organic meat/egg products, support composting efforts, green operations, and actively participate in educational and efficiency programs.
Generate Biofuel to mix with grounds maintenance equipment gasoline, reduce gasoline usage.	13	--	Processor already in place, capable of generating 1500 gallons/year B10/B15 for use in landscaping equipment; only 750 gallons/year usage currently projected due to 12.5 percent mix ratio. Assume 1,500 gal/yr. to be used in future.
Improve green on-campus grounds and land management*	1	--	Establish no-mow zones (especially at grass banks requiring hand-trimming), use best practices to minimize chemicals and fertilizers utilization, utilize native plants in landscape
Recommission/Energy Audit/LEED EBOM 5 percent of Existing Buildings each year	144	5	Recommission and energy audit 5 percent of building stock on a yearly basis (126,700 GSF/year at cost of $1/GSF to generate 15 percent savings). $1/GSF assumes 75% of technical effort performed in-house, with difference paying for lamp replacements, control improvements, etc

Strategy	MTeCO2 Redux	Simple Payback (yrs)	Detailed Description/Assumptions
Mid Term Actions to be performed in the next 15 years to achieve 70 percent reduction.			
Implement Phase II of Central Plant Study: Install 750 HP Wood Chip Boiler w/ 250KW steam turbine	11,055	18	Use purchased wood chips ($30 - $45/ton), consider SRU forest management practice/rapidly renewable sources in future.
Implement Phase 1 of Alternative Ground Transportation Plan*	80	--	Improve traffic patterns and parking on campus and borough, address sidewalk and crosswalk issues, follow LEED-Neighborhood protocol, reduce traffic on campus, restructure parking/increase parking permit costs, reduce SUV use, provide incentives for high efficiency fuel vehicles, increase walkability and biking, tie to community and provide services, increase carpooling (software), increase use of mass transit, improve fleet fuel efficiency, consider high quality local offsets. Assume aggregate 25 percent reduction in conventional fuel use by fleet, faculty/staff/student commuting vehicles.
Maximize cogeneration or fuel cell capability (Phase III of Central Plant options)	2,145	20	Consider additional cogeneration via gas turbines (or steam turbines, incl. steam absorption chillers serving buildings with u/g tunnel access), microturbines in lieu of steam pressure reducing stations. Assumes additional 10 percent reduction in campus electricity purchased from grid. Assumes addtl. heating load offsets biomass or fuel cell fuel rqmt.
Retrofit exterior lighting with high efficiency lamps	199	10	Retrofit 100 KW exterior lighting (parking lot, sidewalk, street, athletic) with LED or better technologies; assume 60 percent reduction in electrical use for 11.78 hours/day, 365 days/year.
Increase waste diversion rate to 50 percent*	375	--	Perform a waste audit (i.e. wastewise) , single-stream recycling, move-out donation center/free store, cardboard corrals during move-in week, move away from plastic bottles/bags, RecycleMania; assume 50 percent reduction (to 345.5 tons/yr.) within 5 years
Implement water/sewage best practices	--	15	Minimize the University's impact on local water/sewage authorities by ensuring best management practices, investigate use of dried sludge as biofuel; investigate sludge gasification for fuel use
Install 500 KW PV (1-acre array) OR equivalent in Fuel Cell Technology	423	50	Install first part of a phased solar array OR equivalent Fuel Cell Technology. Assumptions: $8/Watt installed, 1,500 KWH produced per year per Installed KW of capacity; 550,000 kwh produced/yr. 15 year payback would be achieved at $0.30/kwh electric cost, 50 percent cost reduction, or some combination.
Purchase green power (50 percent)	6,673	--	Purchase green power RECS equal to 50 percent of electrical usage. Current premium approx. $0.001/kwh; reduction based on 2011 electrical usage that will decrease as other projects are implemented.
Long Term Actions to be performed in the final 10 years to achieve 100 percent reduction			
Implement 100 percent of Alternative Ground Transportation Plan*	80	2	Follow recommendations in alternative transportation, purchasing offsets.
Install 500 KW PV (1-acre array) OR equivalent in Fuel Cell Technology	423	50	Install second part of phased solar array OR fuel cell technology equivalent.
Approach zero waste (from 50 percent to >80 percent diversion from landfills)*	225	--	Reduce solid waste through composting, recycling, and purchasing practices.
Offset air travel (study abroad, faculty, staff)	3307	--	Assumes $50 offset charge for 4,000 mile air travel.
Offset commuting	--	--	Purchase or develop local offsetting program to address commuting footprint
Purchase green power for remaining purchased electrical needs (100 percent)	6,673	--	Assume premium escalates to $0.005/kwh in long term (as economy strengthens and/or carbon tax improves marketability of green power).
Implement carbon sequestration program	1166	--	Establish a carbon sequestration program; maintain/manage current woodlands; work with State Forest Service to plant trees; expand arboretum areas; grow rapidly renewable biomass crops, etc.
****Included in Trend 5 of Strategic Plan***			
-- indicates numbers not currently available			

A graphical representation of the project timeline and associated carbon reductions is displayed in Figure 5, a wedge diagram produced by the CA-CP campus carbon calculator. The large drop in emissions seen in 2017 is largely due to the biomass boiler and cogeneration technology coming online. This graphic suggests that by the target year 2037 approximately 20 percent of emissions will remain after all strategies have been deployed. This will require offsetting these emissions.

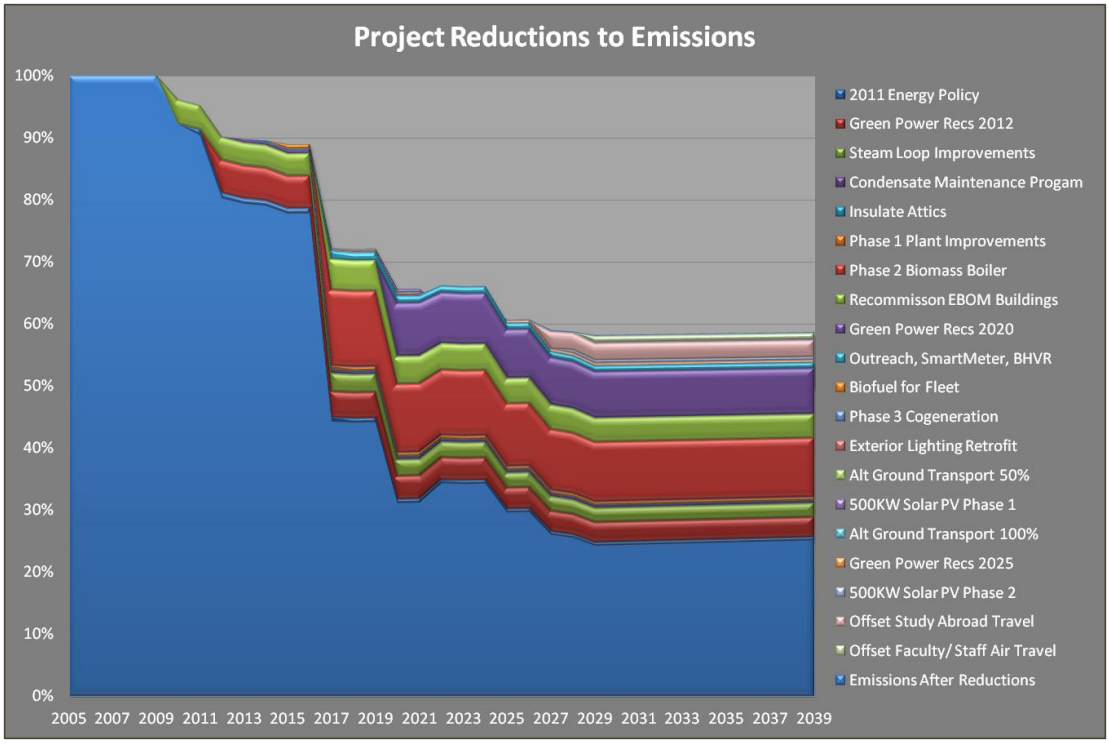

Figure 5: CA-CP wedge diagram displaying carbon reductions of proposed projects.

In the following narrative, mitigation strategies have been divided into four main categories: infrastructure efficiency, fuel source diversification, sustainable transportation, and sustainability as a cultural norm. The successful implementation of the strategies within these categories will fulfill the goals of the Presidents' Climate Commitment to further the cause of sustainability and achieve carbon neutrality.

Infrastructure Efficiency

Buildings are the leading energy users in the country, accounting for more than $280 billion in annual energy costs[15]. Colleges and universities control a large number of buildings including offices, housing, classrooms, labs and athletic facilities and must pay for energy use in all of them. Straightforward retrofits to windows, insulation, electrical, lighting or heating systems not only save money and reduce greenhouse gas emissions, they can also lead to increased productivity by students, faculty and staff who use the buildings.

Figure 6: Robert A. Smith Student Center will be LEED-Silver and opened July 2012.

SRU has performed many energy-efficiency projects and realized reductions in consumption despite growth in population and physical building stock. While infrastructure refers largely to the physical energy-using systems serving our buildings, we also recognize that user behaviors significantly affect energy consumption of the buildings. Energy monitoring systems can be used to provide the necessary feedback to optimize system performance, consumer awareness and energy usage.

[15] Department of Energy. 2004 Building Energy Data book.

SRU has adopted LEED-Silver standards for new buildings and major renovations as one of our short-term tangible actions. This includes recently constructed dormitories and the new student center that came online in July 2012, see Figure 6. In addition, the participation in ESCO contracting has made many buildings more energy efficient through the installation of low-flow water fixtures and the replacement of old windows and lighting retrofits. As a result, there has been a drop in water consumption and purchased electricity. Upgrades to the steam distribution loops have been completed and more improvements are in the works. The Energy Conservation Committee developed the first Energy Conservation Policy which was passed by Cabinet in September of 2011 and included such aspects as set point standardization, smart scheduling, reduced space heater use and increased user responsibility. At the same time SRU launched the Energy Action Campaign "Small steps. Big payoff." with an online Pledge to increase awareness of wasteful energy practices and their correlation to energy and the environment.

In the short-term, the most important actions will be to complete detailed studies of the central plant, energy audits of individual buildings and to begin recommissioning existing buildings. The central plant studies need to determine the feasibility of (1) using various biomass fuel sources, (2) electricity cogeneration and (3) making "conventional" upgrades to the plant and its steam distribution system. Some possible upgrades include: implementing a steam-trap leak detection and maintenance program; providing auto boiler blowdown recovery; various methods of heat recovery; use of backpressure turbines and steam microturbines; improved boiler throttling; oxygen trim; reverse osmosis filtering; free cooling, and variable speed motor drives. Recommissioning of existing individual buildings will include studying the original energy-using systems' design intent, identifying improvements needed to meet changed building functions, implementing more efficient technologies now available and training maintenance staff on efficient systems operations and LEED-EB:OM standards. Once these early investigations have been completed and financial mechanisms identified, a more detailed schedule of projects and upgrades will be developed and incorporated in future revisions of this document.

Energy Portfolio Diversification

Slippery Rock University is located along the northwestern portion of the Appalachian plateau, which is part of the ancient Appalachian mountain range known for its coal production. It has historically burned coal as an inexpen-

sive local fuel. In fact, the Pennsylvania state legislature mandates the use of coal by state-owned facilities unless a waiver is obtained. An overview of the current fuel mix utilized by the University is presented in Figure 7 which shows the University's reliance on purchased electricity, coal and natural gas. SRU currently uses a mixture of coal and natural gas to operate the central plant which provides heat and domestic hot water to the majority of campus through a central steam distribution system. In addition to the adverse public relations caused by burning coal on campus, the potential tightening of future emission regulations may result in significant increased capital costs of additional pollution control infrastructure. However, the need to address the aging central plant infrastructure provides an opportunity upon which the University intends to capitalize.

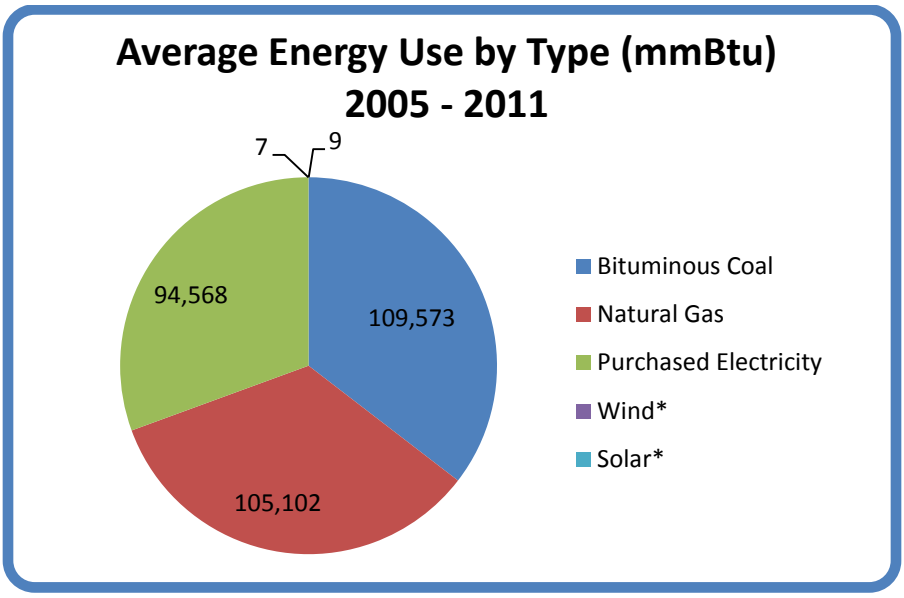

Figure 7: Average Energy Use by Type (mmBtu) for fiscal years 2005-2011.

Electricity produced in our region also relies heavily on the burning of fossil fuels and therefore, dictates a heavily weighted carbon coefficient for our eGRID region, RFCW.[16] Through PASSHE we have purchased up to 28 percent of our electricity from renewable sources from 2005-2010. However, this practice was eliminated in 2011 due to Governor Tom Corbett's concerns over the state budget deficits. The current market for purchasing green power makes it very inexpensive; costing only $4,000 per year to continue this past practice. SRU has allocated funds to continue purchasing it at current rates. The University is committed to reducing its dependence on fossil fuels by integrating a variety of existing technologies suitable to our infrastructure. The types of energy proposed in this plan to achieve carbon neutrality are highlighted in Figure 8. This section outlines the strategies intended to diversify the University's energy portfolio to reduce the use of fossil fuels and lower emissions.

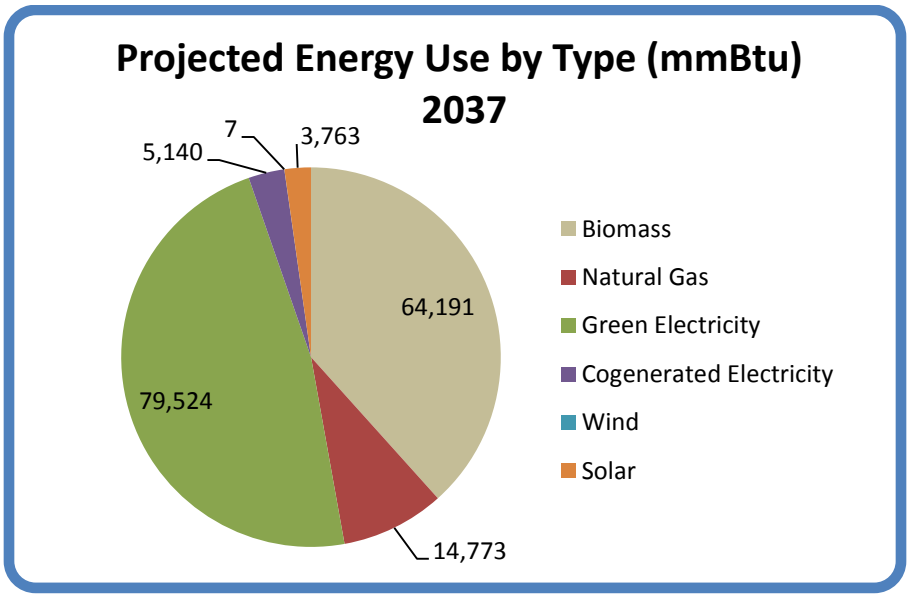

Figure 8: Projected Energy Use by Type (mmBtu) for target neutrality date, 2037.

[16] U.S. EPA's Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States. It divides the U.S. power grid into 27 subregions which represent a portion that is contained within a single North America Electric Reliability Council (NERC) region, and generally represents sections of the power grid which have similar emissions and resource mix characteristics, and may be partially isolated by transmission constraints. Available http://www.epa.gov/egrid. Accessed 03 JAN 12.

Biomass and Cogeneration[17]

Biomass is considered a carbon neutral fuel because it is a renewable resource that recycles carbon already sequestered from the atmosphere when the plant was growing, resulting in no net gain of emissions. A feasibility study to examine the use of biomass was conducted by the Wood Education and Resource Center (WERC) located in Princeton, West Virginia and administered by the Northeastern Area State and Private Forestry unit of the U.S. Department of Agriculture Forest Service. The study demonstrated the benefits of converting our current central boiler system, fired by coal and natural gas, to one powered by woody biomass.

A central plant fueled primarily by biomass would replace 92 percent of all coal and natural gas used by Slippery Rock University, reducing GHG emissions by almost 30 percent.

The location of the existing central plant and organization of the campus steam heating loops provide a suitable platform for the integration of a biomass fueled boiler. This central location also provides the potential for a biomass fuel storage facility that would be easily accessed by delivery trucks and would minimize the disruption of existing campus infrastructure. The University's location in a rural area of central-western Pennsylvania offers adequate sources of woody biomass located within economically feasible distances (fifty-mile radius of campus).

Two viable options were presented by WERC: a 700 HP biomass fired-boiler steam heating system and a similar system that employs cogeneration, both are summarized in Table 2. Cogeneration is the process of generating both electricity and thermal heat from the same energy source. The biomass boiler would replace 92 percent of fossil fuels currently consumed on campus, reducing our carbon emissions by 13,353 metric tons annually. Natural gas would continue to be used when demand either exceeds optimal capacity (winter) or falls below the minimum practical biomass-firing capacity (summer). A back-pressure steam turbine would add the ability to generate electric power. The steam leaving the boiler would flow through the turbine where it would expand to 120 psig and flow into the steam distribution system. An estimated 12 kW of electricity would be generated for every 1000 lbs. of steam that passes through the turbine, depending on the operating pressure of the boiler. The turbine operates efficiently through the same range of steam flow rates as the boiler, which would generate approximately 1,506,000 kWh or 5 percent of SRU's annual usage at an effective cost of $0.025/kWh or less with

[17] Wood Education and Resource Center. (2011). "Preliminary Feasibility Report, Slippery Rock University Biomass."

$45/ton wood chips. Reducing purchased electricity by 5 percent also reduces associated emissions by an additional 1,055 metric tons eCO_2 annually. The simple payback is around 18 years for both scenarios and does not include the avoided capital costs associated with replacing obsolete equipment or the installation of expensive future emissions control equipment.

Table 2: Summary of biomass project: estimated costs, fuel use and annual savings

	Capital Cost	NG Usage (mcf/yr)	Biomass Usage (tons/yr)	Electricity Generated (kWh/yr)	Annual Saving	Simple Payback (years)	Avoided $MTeCO_2$
Steam only	$5.3 M	13,947	17,972	N/A	$290,000	18.2	13,353
Cogeneration	$5.97 M	13,947	18,803	1,505,727	$334,000	17.9	14,408

Important aspects of the biomass resource supply chain include: local impacts, collection logistics and infrastructure. Procuring biomass is a rural labor-intensive activity that can create local jobs and stem rural to urban migration. The $800,000 spent on energy costs will promote economic development within the local area, particularly in the local forest products industry. Switching to biomass would also drive local renewable energy markets for lower value wood, thus promoting sustainable management of local forest lands. It should be noted that due to the decreased heat content of wood chips (10mmBTU/ton wood chips vs. 27 mmBTU/ton coal) and reduced boiler efficiency (71 percent vs. 78 percent) the number of deliveries can be expected to increase by a factor of three, therefore, increasing truck traffic on campus. This increase is reflected (from a campus perspective) in higher fuel costs and carbon emissions. The location and infrastructure of the current central plant is conducive to conversion to biomass, although an additional storage facility is recommended. Further investigation into the sources of biomass will be conducted to ensure harvesting is performed in the most sustainable and regenerative manner. An educational opportunity also exists to tie research and regional biomass resources and management to student experiences. The University could even investigate the feasibility of planting biomass crops on some of its agricultural land for offsets from sequestration.

Converting the central plant to biomass is considered the primary method by which Slippery Rock University will substantially reduce its emissions. A biomass fueled central plant could replace 92 percent of all coal and natural gas used by the University, reducing our GHG emissions by almost 30 percent. Cogeneration has the potential to generate 5-10 percent of purchased electricity and creates additional emission reductions. Although a substantial capital investment of almost $6 million dollars is needed, an estimated $300,000 per year could be saved on energy costs. This savings will be placed in a green revolving-fund to finance future emission-reducing projects. Biomass diversifies

SRU's energy portfolio and protects it from the volatility of the fossil fuel market; retaining the flexibility of burning either natural gas or biomass provides both economic options and more reliability in our fuel-supply chain. Converting to biomass places the University in a positive position should long-expected emission regulations increase or national carbon legislation be achieved. Finally, it would be impossible to calculate the value associated with ending the legacy of coal on campus in terms of public and community relations.

Solar Arrays

Globally, solar energy holds the most promising potential of existing renewable energy technologies. The industry is on the verge of greatly increasing efficiency and reducing costs. The Macoskey Center currently draws a small percent of its power from several solar arrays which serve as the only demonstrations of solar energy on campus, see Figure 9. The high-cost of purchasing and installing photovoltaic systems has prevented the greater utilization of the Sun's energy on campus thus far. SRU will expand the use of solar to include a large-standing array and potentially a few rooftop projects in highly-visible locations. The University plans to introduce large-scale solar in several phases working toward the long-term goal of generating 10 percent of electricity from solar. This is estimated to require two 500 KW arrays encompassing approximately two acres.

Figure 9: The solar arrays at the Macoskey Center provides carbon-neutral energy.

First steps include conducting a solar analysis of the University (potential student project) to identify potential locations and submit them to the Environmental Zoning Committee to determine the most appropriate location. The University intends to explore creative ways of funding the proposed solar projects including taking advantage of federal and state tax incentives. Some examples of possible approaches include: grants, revolving-funds and power-purchase agreements.

Biodiesel

The University currently maintains the ability to produce up to 1500 gallons per year of biodiesel rendered from waste-vegetable oil collected from the dining facilities. The biodiesel processor, shown in Figure 10, and a methanol recovery unit were purchased in 2010 with a grant from the Green Fund and passed a rigorous testing phase before being sidelined due to nearby construction.

Production of B10 and B15 diesel capable of being used in the lawnmowers and tractors on campus will commence in summer 2012. Further use of biodiesel will be explored for use as heating oil and as fuel for the diesel-powered vehicles in the fleet. The Macoskey Center will work with the Facilities De-

partment to create educational and research opportunities for parties interested in touring or researching the biodiesel processor. The capacity of the equipment surpasses the University's current demand. Ways to broaden the application of biodiesel are being explored.

Figure 10: Biodiesel processor purchased with a Green Fund Grant

Geothermal

The Macoskey Center, which is certified LEED-Silver for Existing Building: Operations & Maintenance, is heated and cooled by a geothermal heat-pump system. Due to the high first cost of the vertical pipe loops used to transfer heat from the Earth and the low cost of competing fuels in this area, the widespread utilization of geothermal systems is not cost-effective for many buildings within easy reach of the campus steam loop. However, the potential application and cost-effectiveness of using geothermal systems to serve buildings located in outlying areas will continue to be evaluated.

Natural Gas

The Marcellus shale is prevalent throughout much of the Appalachian basin and most of Pennsylvania, although its depth and thickness are variable. It has recently been discovered to contain an enormous untapped source of natural gas largely effecting central and western Pennsylvania. The rush to harvest this resource using hydraulic fracturing ("fracking") technology and its lack of regulation has caused concern among landowners, particularly in regard to potential local air pollution and far-reaching contamination of groundwater. There is pending legislation that would allow state-owned universities to lease property for drilling with a portion of the income to be used for energy-efficiency projects. Slippery Rock University has the potential to participate in and benefit from this program. However, careful stakeholder consideration should be exercised. The Borough of Slippery Rock has already begun the process of creating an ordinance to limit natural gas operations. Legislation is also being pushed to remove this right to self-governance through mandated "pooling" in order to maximize the efficiency of gas extrac-

tion while reducing the environmental impact of drilling. This issue will continue to unfold as the industry inevitably develops in this area. This local source of fuel is often cited for being clean burning with low emissions. However, the environmental impact of the entire extraction/recovery/delivery process is not well understood or documented and should be considered as additional information becomes available. The feasibility of constructing a natural gas fueling station for SRU and the surrounding community will be investigated to support the anticipated growth of natural gas-powered vehicles.

The central plant currently has one boiler powered by natural gas. The use of this burner has increased in recent years to comply with emission regulations and led to a reduction in our GHGE. The natural gas boiler will continue to be an important part of SRU's emission reduction strategy as we transition to biomass and strive to reduce emissions in the interim. A standard ratio of natural gas to coal (using 2009 as a minimum) will be established to prevent the temptation to cut costs by burning more coal. Furthermore, the cost of natural gas is currently declining as the industry undergoes a boom in our region.

Sustainable Transportation

Emissions from commuting and air travel have grown with the University in the last decade from 12 percent (of Scope 3 emissions) in 2005 to 18 percent in 2009, making transportation the third highest emissions generating category. The University's fleet also contributes a small portion (~1 percent) of Scope 1 emissions.

Commuting

The topography of western Pennsylvania in combination with suburban sprawl creates a culture of automobile-dependency that many people accept as normal. This social norm is so entrenched in our day-to-day lives that many people drive walkable distances seemingly out of habit. The rural location of SRU, as well as its accessibility to major highways linking it to the entire Commonwealth and its contiguous regions, further contributes to our large commuter footprint.

According to the 2010 Commuter Survey[18], 47 percent of students, faculty and staff commute to the University in a car alone and 27 percent have a dai-

[18] Slippery Rock University Greenhouse Gas Emissions Inventory for Fiscal Years 2005-2008. (2010). James J. Stitt & Karen Abrams. Appendix: Student, Faculty, and Staff Commuter Survey.

ly round trip of more than 30 miles. GHGE associated with commuting represents one of the largest percentages of SRU's GHG footprint (8 percent). The strategic plan calls for a transportation plan to be completed and this presents an opportunity to address many modes of transportation on campus that are underrepresented. SRU plans to better quantify and reduce GHG emissions from commuters through the following measures:

- Promoting awareness
- Increased use of public transportation
- Increased carpooling and providing rideshare software
- Increased biking on campus – bike lanes, service stations, bike lockers, bike racks on buses, safety education, bike-sharing
- Increased walkability of campus – sidewalks, crosswalks, and connecting trails
- Reduced traffic on campus
- Stop building new parking lots
- Increase the cost of parking permits to fund initiatives
- Establish a local offsetting program

It is estimated that the successful implementation of these activities can reduce the number of single-occupancy vehicles and increase the walkability of campus. However, the mass transit infrastructure needed to significantly reduce commuter emissions does not exist at our rural campus and therefore, the commuting footprint will remain a large contributor to our emissions and inevitably require offsetting.

Air Travel

Air travel includes faculty/staff traveling for business and conferences as well as students studying abroad. GHGE associated with air travel have doubled from 4 percent in 2005 to 8 percent in 2009, largely because of increased participation in study abroad programs.

Study abroad programs, which are a key part of the long-term strategy for providing engaging experiences for our students, are targeted for strategic growth and therefore, in the foreseeable future will have to be tied to offsets until such time that the travel industry provides viable alternatives. Study abroad programs should include the rationale and cost associated with offsetting the associated air travel emissions.

State budgetary cuts are anticipated to automatically lead to reduced air travel by faculty and staff as departments reduce travel expenditures to balance budget cuts. An increase in the use of webinars and video- and teleconferencing has already been experienced and is anticipated to continue reducing air travel needs with advancing technologies.

Fleet Efficiency

Although SRU's fleet generates just 1 percent of total emissions it is a highly visible and symbolic representation of fossil fuel usage on campus. A recent no-idling policy was established to begin reducing fleet fuel consumption and related emissions. The University's facilities department manages a fleet of more than 100 vehicles that could benefit from an assessment of the existing stock in order to identify opportunities to improve the overall efficiency of the fleet. A purchasing policy should be established for new vehicles that prioritizes the most fuel-efficient options. Alternative fuel vehicles (i.e. electric, natural gas, hybrid) should be continuously explored for viability. Converting the buses to natural gas would reduce their emissions by 25 percent. However, without a local fueling station this option is not feasible.

Additional recommendations to consider include:

- Reduce the number of vehicles in the fleet
- Downgrade size-classes where appropriate
- Purchase the most fuel-efficient vehicles
- Phase out the worst offenders
- Regular efficiency maintenance programs
- Incorporating biodiesel
- Showcase "green" vehicles in the fleet

Sustainability as a Cultural Norm

Integrating sustainability into the fabric of the everyday SRU experience not only fulfills one of the broader goals of the ACUPCC but also prepares students to be globally conscious employees and citizens. Raising awareness and support for the shared goal of increased sustainability will not only have an impact on our energy consumption but is extremely important to achieving climate neutrality. In addition to helping make SRU more sustainable in its operations, the increased knowledge of energy conservation and sustainable practices by SRU students will positively affect additional communities and businesses as students graduate and enter the workforce. Solutions to global climate change require an understanding of both technology *and* behavior.

This intersection creates an opportunity for action that is uniquely suited to the mission and perspective of a comprehensive University that blends liberal arts and professional education.

Our facilities professionals – and their budgets – should not bear sole responsibility for reducing energy use. There must be **a new paradigm of shared responsibility between the University and the individuals that comprise it:**

• SRU is responsible for providing living, learning and working environments that meet *both* minimum environmental standards (thermal comfort, indoor air quality, visual comfort, adequate space and access to natural environments) and minimum energy-performance and resource-consumption requirements (energy-use intensity, carbon footprint and space-use intensity).

• Members of our campus community are responsible for operating University facilities and equipment in an energy and resource-efficient manner (as defined in the Energy Conservation Policy[19]).

Shared responsibility for achieving climate neutrality must be further incorporated into the University's mission. The built environment, the behaviors of *all* members of our campus community, the curriculum taught in our classrooms, the research conducted by our faculty and the projects engaging our communities must all inform – and be informed by – our efforts to reduce greenhouse gas emissions.

SRU's efforts with respect to sustainable building design, maintenance, and efficiency improvements will need to continue in order to reduce energy demand and associated emissions. However, these improvements must be complemented by behavioral changes that are individually incremental, but collectively substantial. Building occupants need to understand at a very basic level how their buildings function, how much energy the buildings consume, and how their actions can reduce consumption. Creative incentives and recognition programs will be needed to stimulate desired behaviors.

One of the first actions, already laid out in the strategic plan to establish sustainability as a cultural norm, is the creation of the position of Sustainability Coordinator to provide the necessary support to administration and depart-

[19] SRU Energy Conservation Policy, 2011. Energy Conservation Committee Available: http://www.sru.edu /president/Sustainability /Documents/SRUEnergyConservationPolicy.pdf

ments as they begin the process of implementation. The Sustainability Tracking & Assessment Reporting System (STARS) is administered by AASHE and provides a benchmark of sustainability throughout University operations. Upon the initial application in 2011, SRU was awarded a Bronze-rating. Working toward the STARS-Gold standards will provide guidance and ensure equal distribution of the responsibility of sustainability throughout the University.

Planning and Policy Actions

Slippery Rock University established sustainability as a core function by incorporating it into the most recent strategic plan, "Reaching for 2025 and Beyond." Approved by cabinet in 2010, this plan paves the way for continued integration of sustainability into the fabric of the University experience with the goal of developing not only our students, but also the faculty, staff and larger community members into globally engaged citizens. Trend 5 of the strategic plan allowed for the quick development and implementation of the first Energy Conservation Policy and Energy Conservation Campaign in 2011. The Energy Conservation Committee works to reduce the wasteful use of energy on campus by targeting building efficiency and user education and behaviors. The continued support of the administration in incorporating sustainability in all planning processes involving University affairs and developing the necessary policies to support their implementation is crucial. We therefore propose that Slippery Rock University articulate, as an essential component of this Climate Action Plan, that *climate neutrality is a shared endeavor*.

Enhancing Student and Community Engagement

Physical improvements and technological advances may have a useful service life of 20 to 50 years, but education leading to behavioral change can influence generations to come. Student involvement is cyclical in nature and requires concentrated effort in order to capture the new students each year to replace those graduating. Often a few key students are very involved in sustainability initiatives and when they leave there is a lull that can last years. Exposing all students to sustainability topics and identifying student advocates early in their academic careers will help alleviate this swing in engaged students. The University will explore the implementation of the following activities to engage students in the issues of sustainability:

- Incorporate sustainability into new student orientation
- Establish a Living-Learning Community focused on sustainability

- Develop a peer-to-peer advocate program in residence halls (EcoReps)
- Host events that are carbon-neutral and/or waste-free
- Support student initiatives and organizations involving sustainability
- Target behavior modifications to reduce energy use (energy competitions, energy campaigns)
- Identify potential student projects to further sustainability goals
- Provide service-learning opportunities that incorporate sustainability

Since the health of the University and surrounding areas are intertwined, efforts will also be made to promote sustainability at the community level. Issues such as transportation, recycling, water usage, volunteerism, educational and business opportunities should all be considered at the community level. In this way the University facilitates the collaboration of students and the community in issues pertaining to sustainability.

Waste Diversion[20]

Solid waste accounted for 1.8 percent of GHGE in 2009 and is acknowledged as being a highly visible yardstick of campus sustainability. Many colleges and universities, including SRU, have implemented extensive recycling and waste reduction programs. Also included in the strategic plan is the goal to target *zero waste* as a long-term goal. *Zero waste* is a philosophy and a design principle focusing on the whole system approach to the vast flow of natural resources and waste through human society. It combines waste minimization solutions that maximize recycling and reduce consumption with a waste prevention industrial design principle requiring all products to incorporate minimum packaging content, be made from non-toxic materials and designed for reuse, repair, recycling or composting. *Zero waste* aims to eliminate waste rather than manage it, and to minimize conventional practices such as land filling and burning. According to research, the University composts 16 tons of pre-consumer waste, recycles 136.5 tons, and has a waste diversion rate of 35.8 percent. The University is committed to continuing to reduce its waste and associated emissions in the following ways:

- Implement single-stream recycling
- Create a purchasing policy – high-recycled content, carbon-neutral products, reduced packaging, compostable

[20] "Toward Zero Waste: Opportunities to Minimize Waste on the Slippery Rock University Campus" (2011). Vincent Rozzi. MS3, Department of Geography, Geology, and the Environment, Slippery Rock University.

- Compost post-consumer waste
- Handle move-in and move-out trash more efficiently – free store, donation, cardboard recycling
- Perform annual waste audit (WasteWise)
- Continued support and participation in Recyclemania

Sustainable Dining Initiatives

The food served in the eating establishments on campus not only contributes to personal wellness but also teaches some very important aspects of sustainability to thousands of students several times a day. AVI *fresh*, SRU's contract food vendor, has made impressive contributions to the sustainability initiatives on campus and remains a willing partner in continued efforts. Their desire to serve more local food was put into action when they recently purchased high-tunnels for a local farmer in order to provide a longer growing season for vegetables bound for student's plates. Trayless dining, reusable to-go containers, 100 percent recycled-content napkins, compostable cups and utensils are just a few of the current sustainability initiatives. Recommendations for future initiatives include:

- Increased local, organic, free-range and grass-fed purchasing
- Increased participation in educational and efficiency projects
- Take the Real Food Challenge[21]
- Serve less meat (i.e. Meatless Mondays)
- Begin post-consumer composting
- Go trayless

Currently, emissions from dining operations are not considered in total GHGE for reporting purposes. Clean Air-Cool Planet has a pilot program, CHEF, that would fill this gap in reporting and being proactive in this area will help reduce increases in future emissions as the reporting structure expands to become more comprehensive.

[21] A student movement to shift $1billion to real food purchasing by 2020. Available: realfoodchallenge.org

Additional Mechanisms to Achieve Climate Neutrality

In order to achieve climate neutrality for the purposes of the Presidents' Climate Commitment, it will be necessary to account for remaining emissions that cannot be reduced or eliminated. GHGE categories such as purchased electricity, commuting, air travel and electrical transmission and distribution losses will continue to contribute to our footprint and can be addressed by the purchasing of commercial renewable energy credits, offsets and carbon sequestration.

Renewable Energy Credits

Although renewable energy credits (RECs) have been traded in voluntary carbon markets and counted by some institutions as a credit against their GHGE, *a REC is not an offset or an allowance and does not necessarily represent a reduction in existing GHG emissions*. Therefore, a REC cannot be used as a credit against Scope 1 (on-site combustion) and Scope 3 (travel) emissions.

Collectively, the ACUPCC network has purchased more than 1.28 billion kilowatt-hours of RECs, making it the third-largest buyer in the country.

However, RECs *may* have a limited role to play as one element of a portfolio of actions we can take to achieve climate neutrality. RECs can be used by an institution or individual to demonstrate a valid claim that they are purchasing zero-emissions electricity. RECs also provide financial support for large-scale renewable projects often within the region or state they are purchased. Where RECs are certified and tracked by a registry, sold only once and then retired, they offer a mechanism to obtain electricity with zero-eCO_2 emissions. The purchase of "Green Power" as verified by a REC can be counted as a reduction in our Scope 2 (purchased electricity) emissions. In this way, we could reduce our carbon footprint for purposes of the ACUPCC.

Offsets

Also referred to as verified emission reductions (VERs), offsets are created through financial support of projects that reduce the emission of greenhouse gases at locations external to campus. The numerous types of offset projects may be grouped into four broad categories: fossil fuel reduction, sequestration, methane capture and combustion, and industrial gas destruction.

SRU's travel-related emissions will constitute the largest category requiring offsets. For Scope 3 emissions associated with directly-financed air travel, partnering with the airlines to create programs that will meet the spirit of the climate commitment will be pursued. For Scope 3 emissions related to commuting, the University will seek out opportunities for students, faculty and staff to participate in an offset purchase program where indirect GHGE reductions can be purchased to mitigate the impact of commuting.

An alternative path to achieve indirect emission reductions may be to develop or participate in a community offset program. This would be a program in which SRU collaborates with regional institutions of higher education and government entities to fund and/or facilitate GHGE reduction activities. An example could be to help local primary and secondary schools achieve GHGE reductions while educating younger students on the importance of climate stewardship. Or it could take the form of helping local businesses or other organizations reduce their footprints. A community offset program has the potential to become a valuable tool in achieving indirect GHGE reductions while achieving some of the broader goals of the Presidents' Climate Commitment including education and outreach.

Sequestration

Sequestration is a type of offset where carbon is stored in plant tissue. Agriculture, silviculture and other management techniques can be used to generate and enhance associated emission reductions. Slippery Rock University consists of more than 600 acres located in rural western Pennsylvania, 440 acres of which are mature mixed-hardwood forests. The opportunities for develop-

Getting to Zero:

RECs

renewable energy credits are a premium added to purchased electricity which are paid to support renewable energy projects. To reach neutrality 100 percent of remaining purchased electricity will need to be from green power by 2037.

VERs

verified emission reductions (offsets) represent a completed project that has led to a net decrease of emissions. Offsets will need to be purchased for an estimated 20 percent of remaining emissions in 2037.

SEQUESTRATION

biomass has the ability to store carbon and certain methods can count as a VER. SRU is rich in biomass and developing our own offsetting program can reduce dependence on purchased VERS.

ing sequestration projects are ample. SRU shares concern with similarly endowed colleges and universities that methods to account properly for the preservation and protection of existing trees and to encourage new plantings are not being addressed in the current ACUPCC reporting system.

> "The failure to include methods for measuring sequestration from existing trees when conducting a greenhouse gas audit is a matter of grave concern. Our world's entire environmental history is haunted by the failure to properly account for ecosystem services, leading to a pattern of ignorance, destruction and devaluation that now requires remediating measures like the Climate Commitment. What is not counted soon ceases to count, and it is our fear that failure to include trees into offsets or reduction plans will soon lead to the complete devaluation of trees as carbon sinks."[22]

One of our goals going forward will be to encourage policies within and beyond the ACUPCC that respect the preservation and precedence of trees before buildings, and encourage increased use of tree planting as a carbon reduction measure.

Cost and Financing

It should be acknowledged that the Presidents' Climate Commitment was signed by SRU during a global period of economic downturn and instability felt on the national and regional levels. The University is currently stressed to absorb significant budget cuts to the state system with additional cuts anticipated. Efforts to reduce emissions from burning inexpensive coal are pitted against concessions in the energy budget. Initial seed money will need to be generated from the Capital Budget, if necessary at the expense of other programs, and the energy savings generated by the switch to biomass and other mitigation strategies will need to be reserved to leverage further emission reducing projects. Currently, the primary sources of funding for GHGE mitigation projects are the Facilities Management Annual Operating Budget and the University's Capital Budget. In the future, SRU will explore the creation of funds dedicated to financing projects that reduce GHGE through energy conservation and efficiency, campus community awareness, enhanced data collection and utilities metering, renewable energy generation and purchases, and offset purchases. Examples of potential sources of future funds include:

[22] Chatham University. Climate Action Plan, 2009. Available: www.rs.acupcc.org/cap/248. Accessed 25 JAN 12.

revolving funds that are replenished by savings generated by conservation measures; sustainability-targeted alumni donations and fundraising; student activity fees and graduating class gifts; self-financing performance contracts; and grants from government, foundations, business partners, and the Green Fund. SRU will stay informed of the latest funding opportunities in this fast-changing landscape where legislation, incentives, rebates and maturing technologies can rapidly improve financial options for implementing planned strategies.

Implementation and Tracking

Implementation and tracking are extremely important to achieving the long-term goal of climate neutrality. Achieving this aggressive goal will require the commitment of SRU's leadership and dedication of our entire campus community to continue building on the great foundation of sustainability efforts that have been decades in the making.

Implementing the Plan

Upon the acceptance of this plan, the Administration will be responsible for implementing the strategies. The President's Commission on Sustainability will form sub-committees to put strategies into action. The commission will also need to develop a structure for implementing these recommendations and other related policies, as well as a process for determining priorities and/or the relative value of items such as "educational value," "financial payback," and "carbon emissions reductions." The team should be inclusive of the University's major stakeholders – administrative and operations staff, faculty, students and the community at large. It will be essential to create a permanent and well-integrated administrative structure to maintain focus on implementing this plan for the next decade and beyond.

Clean Air-Cool Planet (CA-CP) provides a graphical representation of mitigation strategies that is useful in comparing the cost of projects to the amount of emissions reductions they will achieve as seen in Figure 11. The taller and wider the bar is, the more attractive the project is in terms of dollars per $MTeCO_2$. For instance, switching to biomass (short-wide bar) reduces more emissions and is more cost effective than installing large solar arrays (shown as a negative-skinny bar). However, this method does not account for the educational value of projects or the spirit of the Climate Commitment which acknowledges the purchase of RECs and VERs as the last steps in achieving climate neutrality.

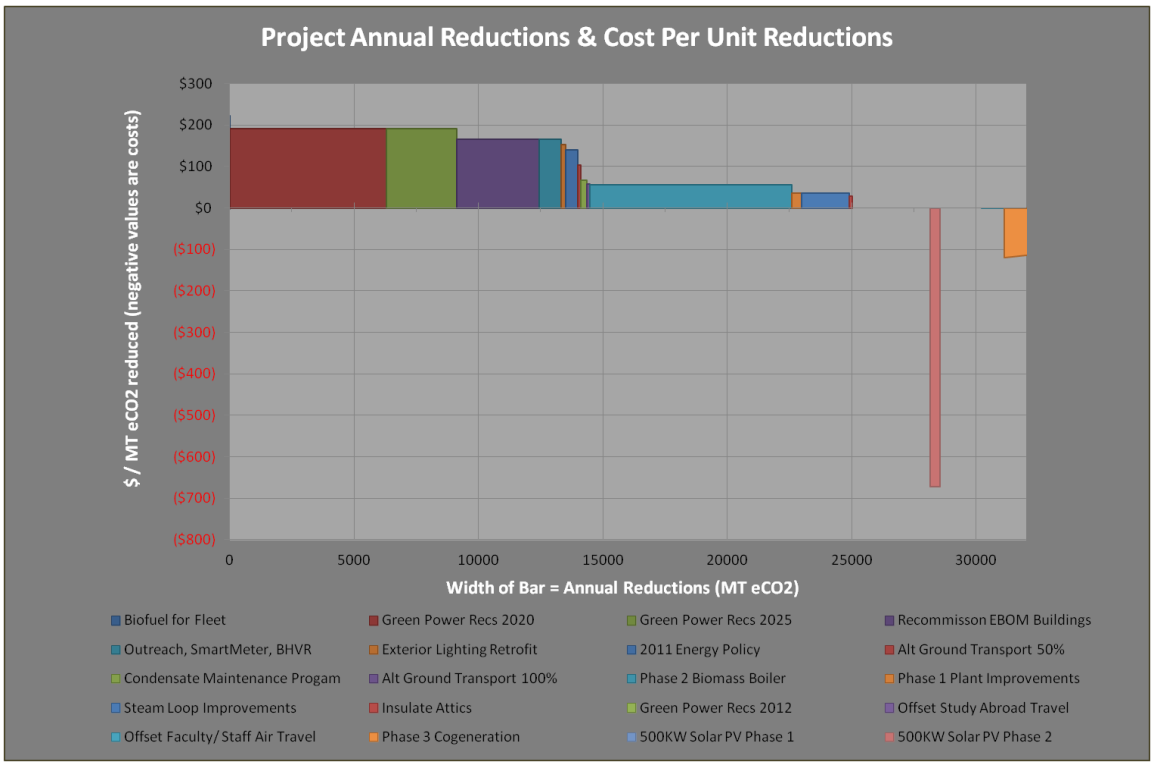

Figure 11: CA-CP Project annual reductions and $/MTeCO$_2$

Tracking Neutrality

Slippery Rock University signed the American College and University Presidents' Climate Commitment in 2009. Based on our 2012 Climate Action Plan, the University's goal is to be net climate neutral by 2037, allowing 25 years to implement the plan. The Climate Action Plan is a dynamic document intended to be revisited and revised. Beginning in 2014 a biannual report is due to the ACUPCC describing progress in implementing the plan. Furthermore, it is recommended that the plan undergo a complete review every five years. This review will consist of a thorough examination of existing and next generation energy technologies, conservation measures, behavior-based programs, planning assumptions and goals and strategies. If SRU is on-track to surpass its goals, new and more aggressive goals will be set.

Timeline:

Baseline year 2005 ……..52,874 metric tons (MT) of eCO2

Climate Action Plan 2012

Checkpoint 2017 ……..20 percent reduction (10,575 MTeCO2)

Checkpoint 2027…….70 percent reduction (an additional 26,437 MTeCO2)

Target date 2037……..100 percent reduction (an additional 15,862 MTeCO2)

In addition, SRU's biannual GHGE inventories will provide an opportunity to evaluate progress on a quantitative level. This feedback will facilitate informed decision-making on necessary adjustments to the Climate Action Plan as we strive for neutrality by 2037.

Conclusion

Slippery Rock University is committed to the cause of mitigating the adverse effects of human-induced climate change. We understand the responsibilities we have as a leading liberal arts institution to promote the seriousness of climate change issues in the world and to lead by example in reducing our own carbon emissions. Our ultimate success will be measured by the quality of our graduates and their successes in serving the growing needs of society. This Climate Action Plan identifies the challenges our institution is faced with today and lays out the guidelines we have established to achieve neutrality within the next 25 years.

To achieve this aggressive goal will require the commitment of the leadership of our institution and the time and effort of our entire campus community. The development of SRU's Climate Action Plan was the result of strong involvement by our students who urged the administration to take the Presidents' Climate Commitment, helped to establish our baseline carbon emission measurements and worked collaboratively with all stakeholders in the community to make recommendations on how to achieve neutrality. The completion of this planning document was the result of resilient leadership by our administration in proceeding forward with the strategic plan despite budget cuts and presidential searches. Approval of this plan by President Cheryl Norton demonstrates that SRU will continue down this pathway toward campus-wide sustainability.

This Climate Action Plan is aggressive yet achievable and will solidify SRU's reputation as a leader in our region for sustainable initiatives. Achieving the goal of carbon neutrality will take the efforts of the entire campus community, present and future, to ensure we are making the right choices that will reduce our carbon emissions and lessen our impact on the environment. Slippery Rock University is committed to the global effort of climate change and intends to reach climate neutrality by the year 2037.

APPENDIX A: MITIGATION STRATEGIES CALCULATIONS

Mitigation Goals Over Time: **Current Projections:**

20%	13%	7,095	MTeCO2 Reduction, Years 1 - 5
70%	53%	20,949	MTeCO2 Reduction, Years 6 - 15
100%	100%	24,829	MTeCO2 Reduction, Years 16 - 25
		52,874	

MITIGATION STRATEGIES

					2005 Annual Emmissions Baseline Rate, MTeCO2/Yr:				52,874	MTeCO2/yr														
					Projected C.A.P. Annual Reductions:				52,874	MTeCO2/yr														
					Estimated Capital Cost	Annually Recurring Costs	Annual Cost Savings	$/MTeCO₂ Redux	MTeCO2/yr after Strategy Implemented		Energy Unit Reductions													
	Strategy	MTeCO₂ Redux	Simple Payback (YRS)	Detailed Description/Assumptions	$21,254,789	$143,950	$293,626				Kwh Elect.	Tons Coal	mmBtu Nat. Gas	Tons Biomass	Gallons Diesel Fuel	Gallons Gasoline	Air Miles, Study Abroad	Air Miles, Faculty & Staff	Gallons Oil	Lbs. Refrigerant	Reduced MSW tons to landfill	reduction in 30% recycled content		
	Short Term			***Actions to be taken within the next 5 years to achieve 18% reduction.***																				
1	Implement 2011 Energy Conservation Policy	516	0.02	Implement thermostat setpoints, setbacks, smart-scheduling, energy-star appliances, only facilities approved space-heaters; assumes 1.5% savings in fossil fuel and electricity per year.	$1,000	$0	$47,850	$2	**52,358**		418,035	54	1,708	0	0	0	0	0	0	0				
2	Purchase 4 million KWH green power RECs	3,079	--	Replace green power (25%) previously purchased through the state system to avoid increasing Scope 2 emissions in 2012, support renewable energy projects.	$0	$4,000	-$4,000	$1	**49,279**		4,000,000	0	0	0	0	0	0	0	0	0				
3	Implement Energy Awareness Outreach Program, smart metering, behavioral changes campaign	1,267	0.04	Assume 5% elect. savings on institutional bldgs. (63%), 25% on residential housing (less in early years, more in later years) due to hiring Sustainability Coordinator, continuing energy awareness campaign/seminars/speakers/dorm energy competitions, campus surveys, peer mentoring, building energy liasions, green office-dorm certifications, incentives/awards/recognition, green e-letter, sustainable living-learning community in residence halls.	$0	$5,000	$115,812	$3.95	**48,012**		1,009,972	130	4,127	0	0	2,286	0	0	0	0				
4	Complete steam/condensate loop improvement projects	1,240	7	Replace last two major remaining segments of steam loop - steam/condensate lines at Art 1, Boozel - University Union to increase condensate return to boiler plant (48% boiler makeup water due primarily to lack of condensate return). Assume 10% reduction in boiler energy usage.	$1,000,000	$0	$134,541	$807	**46,773**		0	341	10,974	0	0	0	0	0	0	0				
5	Implement annual condensate trap maintenance program	221	0.2	Annual program to ensure proper operating and maintenance of steam condensate traps to begin 2012; assumes 2% heating plant energy savings/year.	$0	$5,000	$31,752	$0	**46,551**		0	61	1,941	0	0	0	0	0	0	0				
6	Insulate attics with little/no insulation	28	5	Maltby, Old Main, North Hall, West Gym attics are either not insulated or under-insulated (in process)	$41,500	$0	$8,300	$1,486	**46,524**		0	15	0	0	0	0	0	0	0	0	69	17,036		
7	Implement comprehensive green purchasing policy	94	2	Implement best practice purchasing; recycled content >30%; paper towels, toilet paper >50% recycled (FSC cert.); RFP's to disclose vendor environmental practices; pallet/packaging take-back clause in contracts; reusable packaging; continue/increase use of eprocurement software. Assume 10% reduction in landfilled waste and 10% reduction in paper emissions.	$0	$0	$0	$0	**46,429**		0	0	0	0	0	0	0	0	0	0	0	0		
8	Implement Phase I of Central Plant improvements	324	10	Implement non-fuel conversion recommendations of central plant study; assume 3% aggregate total savings, 10 yr. avg. payback for projects such as R.O. boiler blowdown water filtration, secondary pumping VFDs, steam turbine driven feedwater pump, etc... 2010-2011 central plant eff. 71%; Coal boilers 82% effic., Gas Boiler 79% effic. (80% avg, boiler eff.)	$443,276	$0	$44,328	$1,366	**46,105**		0	90	2,853	0	0	0	0	0	0	0	0	0		
9	Implement single-stream recycling program	169	--	Restructure the recycling system to move towards single-stream recycling; assume 25% increase in amount of waste diverted from landfills.	$0	$0	$0	$0	**45,936**		0	0	0	0	0	0	0	0	0	0		0		
10	Increase composting	0	0	Expand composting efforts to include post-consumer waste, explore partnership with Borough to handle yard waste and provide service.					**45,936**		0	0	0	0	0	0	0	0	0	0	0	0		
11	Increase dining sustainability initiatives	0		Work with AVI Fresh to provide increased selection and awareness of sustainable alternatives. Increase organic and local purchasing, serve less meat, serve MSC-certified seafood, serve pastured/grassfed, and/or organic meat/egg products, eliminate trays, support composting efforts, green operations, and actively participate in educational and efficiency programs.					**45,936**		0	0	0	0	0	0	0	0	0	0	0	0		
12	Generate Biofuel to mix with grounds maintenance equipment gasoline, reduce	13	--	Processor already in place, capable of generating 1500 gallons/year B10/B15 for use in landscaping equipment; only 750 gallons/year usage currently projected due to 12.5% mix ratio. Assume 1,500 gal/yr. to be used in future.	$0	$0	$5,250	$0	**45,923**		0	0	0	0	0	1,500	0	0	0	0	0	0		
13	Improve green on-campus grounds and land management	1	0	Establish no-mow zones (especially at grass banks requiring hand-trimming), use best practices to minimize chemicals and fertilizers utilization, utilize native plants in landscaping	$0	$0	$350	$0	**45,923**						0	100								
15	Recommission/Energy Audit/LEED EBOM 5% of Existing Buildings each year	144	5	Recommission and energy audit 5% of building stock on a yearly basis (126,700 GSF/year at cost of $1/GSF to generate 15% savings). $1/GSF assumes 75% of technical effort performed in-house, with difference paying for lamp replacements, control	$0	$86,080	$15,875	$598	**34,723**		187,012			141										
	Mid Term			***Actions to be performed in the next 15 years to achieve 70% reduction.***																				
14	Implement Phase II of Central Plant Study: Install 750 HP Wood Chip Boiler w/ 250KW steam turbine	11,055	18	Use purchased wood chips ($30 - $45/ton), consider SRU forest management practice/rapidly renewable sources in future.	$6,000,000	$0	$333,333	$543	**34,867**		1,506,000	2,622	91,297	-18,803	0	0	0	0	0	0	0	0		
16	Implement Phase 1 of Alternative Ground Transportation Plan*	80	--	Improve traffic patterns and parking on campus and borough, address sidewalk and crosswalk issues, follow LEED-Neighborhood protocol, reduce traffic on campus, restructure parking/increase parking permit costs, reduce SUV use, provide incentives for high efficiency fuel vehicles, increase walkability and biking, tie to community and provide services, increase carpooling (software), increase use of mass transit, improve fleet fuel efficiency, consider high quality local offsets. Assume aggregate 25% reduction in conventional fuel use by fleet, faculty/staff/student commuting vehicles.	$50,000	$0	$0	$624	**34,643**						1,492	7,642								
17	Maximize cogeneration or fuel cell capability (Phase III of Central Plant options)	2,145	20	Consider additional cogeneration via gas turbines (or steam turbines, incl. steam absorption chillers serving buildings with u/g tunnel access), microturbines in lieu of steam pressure reducing stations. Assumes additional 10% reduction in campus electricity purchased from grid. Assumes addtl. heating load offsets biomass or fuel cell fuel rqmt.	$7,000,000	$0	$0	$3,264	**32,498**		2,786,900			-21,000										
18	Retrofit exterior lighting with high efficiency lamps	199	10	Retrofit 100 KW exterior lighting (parking lot, sidewalk, street, athletic) with LED or better technologies; assume 60% reduction in electrical use for 11.78 hours/day, 365 days/year.	$154,789	$0	$15,479	$780	**32,300**		257,982													

20%	13%	7,095 MTeCO2 Reduction, Years 1 - 5
70%	53%	20,949 MTeCO2 Reduction, Years 6 - 15
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MITIGATION STRATEGIES

								2005 Annual Emmissions Baseline Rate, MTeCO2/Yr:				52,874	MTeCO2/yr										
								Projected C.A.P. Annual Reductions:				52,874	MTeCO2/yr										
								Estimated Capital Cost	Annually Recurring Costs	Annual Cost Savings	$/MTeCO2 Redux	MTeCO2/yr after Strategy Implemented		Energy Unit Reductions										
	Strategy	MTeCO2 Redux	Simple Payback (YRS)	Detailed Description/Assumptions				$21,254,789	$143,950	$293,626				Kwh Elect.	Tons Coal	mmBtu Nat. Gas	Tons Biomass	Gallons Diesel Fuel	Gallons Gasoline	Air Miles, Study Abroad	Air Miles, Faculty & Staff	Gallons Oil	Lbs. Refrigerant	Reduced MSW tons to landfill	reduction in 30% recycled content
19	Increase waste diversion rate to 50%*	375	--	Perform a waste audit (i.e. wastewise) , single-stream recycling, move-out donation center/free store, cardboard corrals during move-in week, move away from plastic bottles/bags, RecycleMania; assume 50% reduction (to 345.5 tons/yr.) within 5 years				$0	$2,000	-$2,000	$5	31,925												346	
20	Implement water/sewage best practices	0	15	Minimize the University's impact on local water/sewage authorities by ensuring best management practices, investigate use of dried sludge as biofuel; investigate sludge gasification for fuel use								31,925													
21	Install 500 KW PV (1-acre array) OR equivalent in Fuel Cell Technology	423	100+	Install first part of a phased solar array OR equivalent Fuel Cell Technology. Assumptions: $8/Watt installed, 1,500 KWH produced per year per Installed KW of capacity; 550,000 kwh produced/yr. 15 year payback would be achieved at $0.30/kwh electric cost, 50% cost reduction, or some combination.				$4,000,000	$0	$28,024	$9,450	31,502		550,000											
22	Purchase green power (50%)	6,673	--	Purchase green power RECS equal to 50% of electrical usage. Current premium approx. $0.001/kwh; reduction based on 2011 electrical usage that will decrease as other projects are implemented.				$0	$43,350	-$43,350	$6	24,829		8,670,053											
	Long Term	***Actions to be performed in the final 10 years to achieve 100% reduction***																					
23	Implement 100% of Alternative Ground Transportation Plan*	80	2	Follow recommendations in alternative transportation plan; may include purchasing offsets.				$50,000	$0	$32,716	$624	24,749													
24	Install 500 KW PV (1-acre array) OR equivalent in Fuel Cell Technology	423	100+	Install second part of phased solar array OR fuel cell technology equivalent.				$4,000,000	$0	$28,024	$9,450	24,326													
25	Approach zero waste (from 50% to >80% diversion from	225	--	Reduce solid waste through composting, recycling, and purchasing practices.				$0	$2,000	-$2,000	$9	24,101													
26	Offset study abroad air travel	2392	--	Assumes $50 offset charge for 4,000 mile air travel.				$0	$38,520	-$38,520	$16	21,709													
27	Offset faculty, staff air travel	915		Assumes $50 offset charge for 4,000 mile air travel.				$0	$14,730	-$14,730	$16	20,794													
28	Purchase green power for remaining purchased electricl	6,673	--	Assume premium escalates to $0.005/kwh in long term (as economy strengthens and/or carbon tax improves marketability of green power).				$0	$43,350	-$43,350	$6	14,121													
29	Implement carbon sequestration program	14,121	0	Establish a carbon sequestration program; maintain/manage current woodlands; work with State Forest Service to plant trees; expand arboretum areas; grow rapidly renewable								0													
	Achieve carbon neutrality	0		Maintain and increase University's reputation as a leader in the field of sustainability, have positive influence on community and region.																					
	Included in Trend 5 of Strategic Plan							$21,254,789	$143,950	$293,626															