GETTING TO ZERO: THE UNCG CLIMATE ACTION PLAN

2013

ADOPTED JULY 31, 2013

THE UNIVERSITY *of* NORTH CAROLINA
GREENSBORO

Office of the Chancellor

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Dear UNCG Community:

UNCG recognizes the need to provide leadership in sustainability through our opportunities to influence and educate thousands of students, faculty, staff, and alumni to live in ways that enrich the quality of life for all. By embracing the principles of sustainability we become better stewards of natural, human, and financial resources. Further, UNCG students will benefit from new academic and research programs that better prepare them for opportunities in the new global, green economy. Therefore, I am pleased to announce that UNCG has officially adopted our Climate Action Plan, our comprehensive strategy to achieve climate neutrality.

Creation of the Plan marks a major milestone in fulfilling our obligations under the American College and University Presidents' Climate Commitment, which I signed in October 2011. The Plan was created by a team of more than 50 students, faculty and staff. Our Climate Action Plan establishes several short and long term goals to guide the university to climate neutrality by 2050. These strategies are also projected to save UNCG millions in utilities costs.

Our journey toward climate neutrality has only begun, and the involvement of every member of the UNCG community is needed to meet our ambitious goals. I invite each of you to join us to meet the challenges and sustainably, do something bigger altogether.

Sincerely,

Linda P. Brady
Chancellor

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TERMS AND ABBREVIATIONS

ACUPCC: The American College & University Presidents' Climate Commitment. It is a commitment endorsed by several universities "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 towards climate neutrality and sustainability by empowering the higher education sector to educate students, create solutions, and provide leadership-by-example for the rest of society."

B5/B20: Represent biodiesel fuel blends. Biodiesel refers to a vegetable oil- or animal fat-based diesel fuel. B5 is a blend of 5% biodiesel and 95% conventional diesel fuel; B20 represents a blend of 20% biodiesel with 80% conventional.

BAU: Business as Usual. The normal implementation of standard operations at the University.

CAFE: Corporate Average Fuel Economy. Federal regulations to improve fuel efficiency of vehicles.

CO_2: Carbon Dioxide. Most prevalent greenhouse gas except for water vapor.

Complete Streets: A transportation policy requiring thoroughfares to be planned, designed, operated, and maintained to assure safe, convenient and comfortable travel for all users regardless of their mode of transportation.

E10: Fuel blend of 10% ethanol and 90% is conventional gasoline.

Ecoliteracy: An understanding that ecosystems have developed to sustain life and that humans must recognize their roles in keeping these ecosystems healthy.

Energy Star: A voluntary federal program that helps businesses and individuals save money and protect the climate through energy efficiency in products and buildings

EPEAT: The Electronic Product Environmental Assessment Tool. It is a methodology for consumers to assess the lifecycle environmental impacts of an electronic product on the environment. Products are ranked based on a set of environmental performance criteria.

EUI: Energy Use Intensity. Represents the energy consumed by a building relative to its size.

Executive Order 156 (North Carolina): Titled "State Government Environmental Sustainability, Reduction of Solid Waste, and Procurement of Environmentally Preferable Products," this order was

signed by Governor Jim Hunt in support of the governor's sustainability initiative in 1993 and updated in 1999.

GHG: Greenhouse Gas. Atmospheric gases, including water vapor, carbon dioxide, methane, and nitrous oxide, that contribute to the greenhouse effect.

Gray water: Wastewater from non-sewage sources; i.e., washing machine, sinks, tubs and showers.

kWh: Kilowatt hour. Most common unit of energy when measuring electricity in the US.

LED: Light-emitting diode. Very high efficiency, long-lived light bulbs utilize this technology.

LEED: Leadership in Energy and Environmental Design. A rating system for the design, construction and operation of high performance buildings and developments, created by the US Green Building Council.

mmBTU: Million British Thermal Units. The most common unit of energy when referencing natural gas systems in the US.

$mtCO_2e$: Metric Tons of CO_2 Equivalent. Not all GHG emissions are CO_2, but for ease of calculation, other GHGs are converted to their CO_2 equivalents

REC: Renewable Energy Certificate. Represents the property rights to the environmental qualities of renewable electricity generation. One REC is equivalent to 1000 kWh of renewable energy sent to the grid.

ROI: Return on Investment. Ratio of money made or lost versus the amount invested.

SOV: Single Occupant Vehicle.

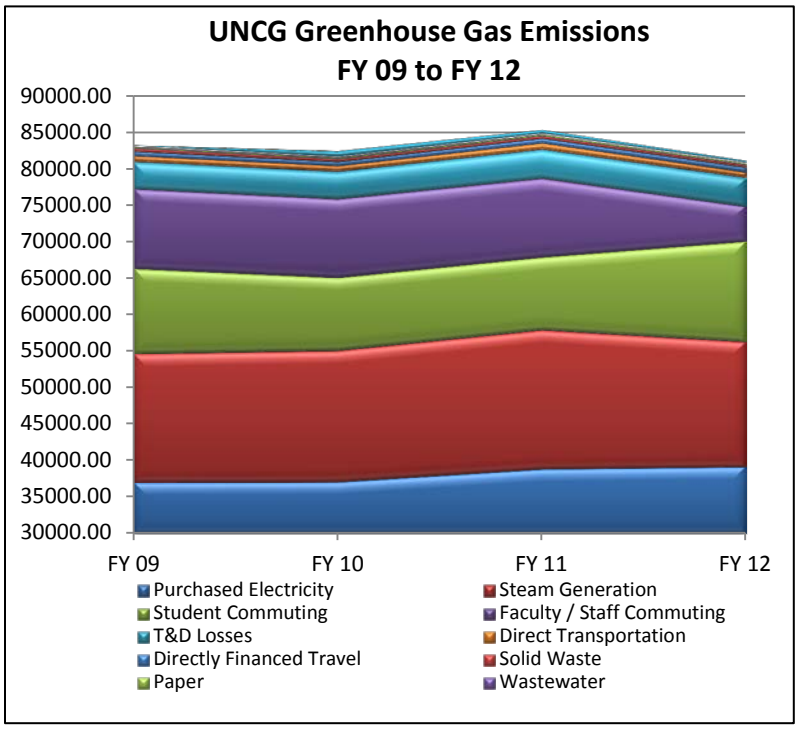
TDM: Transportation Demand Management. Strategies and policies to reduce travel demand and/or to redistribute that demand.

Xeriscape: Landscaping to reduce or eliminate the need for irrigation.

Recognizing the potential threats from global climate change to the environment, society and economy, Dr. Linda Brady, Chancellor of the University of North Carolina at Greensboro (UNCG), signed the American College & University Presidents Climate Commitment (ACUPCC) in October 2011, pledging the University to develop a strategic plan to achieve climate neutrality. This declaration was the culmination of years of effort by several faculty, students and staff to have UNCG emerge as a local and national leader in implementing and promoting sustainable practices. It was also an acknowledgement by UNCG of its obligation to prepare its graduates to meet the current and future challenges posed by climate change.

Development of this campus Climate Action Plan (CAP) was led by the UNCG Sustainability Coordinator, Trey McDonald. A CAP team comprised of more than 50 UNCG students, staff and faculty was established, divided into six (6) working groups around specific focus areas – University Administration, Infrastructure Energy Use, Transportation, Materials Management, Water, and Academics and Outreach. Five of the working groups were asked to develop potential actions to further UNCG's goal of climate neutrality, with estimates of financial costs and potential greenhouse gas (GHG) reductions. The Academic working group focused on creating strategies to make certain that UNCG students gain an understanding of sustainability via research and coursework; this knowledge can result in practical benefits for campus carbon reduction. The actions proposed in this document include many adapted from best practices at other universities as well as some unique to UNCG.

Involvement from the entire campus community was actively sought. Once completed in February 2013, presentations of the initial draft of the Plan were made to the Faculty Senate, Staff Senate and Executive Staff to encourage input and public support. This first draft was also made available online for feedback from the campus community. Comments were incorporated as appropriate into the final draft, and in late March 2013 members of the CAP teams led a public forum to share the Plan with the campus.



GHG emissions for which UNCG is responsible have held relatively steady since the University began tracking them in FY2008-09. That year, the GHG footprint of the University was 83,270.3 $mtCO_2e$

(metric tons of carbon dioxide equivalent), compared to 85,346.1 $mtCO_2e$ in 11-12 (**note**: FY11-12 estimate includes air travel emissions, a parameter not captured in the FY08-09 estimate. Removing that source, the profile for FY11-12 would be 81,210 $mtCO_2e$). Consistent with earlier years, in FY2011-12, the majority of UNCG's emissions emanated from electrical usage (45.2%), the campus steam plant (21.3%), and transportation (28.5%).

This CAP includes an estimate of future emissions based on current consumption, projected enrollment, inflationary forecasts and several other factors. This "business as usual" (BAU) projection excluded legislative mandates such as North Carolina SB668 and Federal Corporate Average Fuel Economy (CAFE) standard increases, as well as the reported future changes in the fuel sources for Duke Energy. Under these parameters, emissions are estimated to increase to 160,477.1 $mtCO_2e$ by 2050. This potential 89% growth in emissions is alarming, particularly in light of the recent revelation that global atmospheric concentration of CO_2, the most abundant GHG, has exceeded 400 ppm and the ramifications of climate change are becoming more evident.

Though most campus sustainability programs originate through student and faculty grassroots efforts, no comprehensive sustainability strategy can succeed without support from the University **administration**. Meeting the challenge of the Climate Commitment will require that UNCG develop financial and personnel resources to implement the strategies to attain climate neutrality, and ensure continuity in this support from one administration to the next. Creating and adopting formal policies and practices will help the administration establish a clear and powerful message around its dedication to sustainability; as such, proposed new policies are presented throughout this Plan.

Because **infrastructure energy use** contributes by far the highest percentage of UNCG's emissions, it is the primary area of focus for this plan. The steam plant, purchased electricity, and associated factors comprise approximately 71% of campus GHG emissions. The UNCG CAP Energy working group teamed with Affiliated Engineers, Inc., an engineering firm with experience in energy modeling and efficiency strategies. Though UNCG has reduced its energy consumption 16% per gross square foot since 2003, its overall consumption has increased more than 8% during the same time period, moving away from the goal of climate neutrality. The University will begin to address this by implementing tactics that increase energy efficiency in existing buildings as well as establishing more stringent standards for new construction. A continued push for everyone in the UNCG community to take responsibility for their personal energy use on campus will also occur, as these improved habits can contribute a 5-10% reduction in consumption. As technologies improve and the associated financial models produce shorter payback periods, UNCG will look to install on-site renewable energy facilities.

UNCG also continues its initiative to house a greater number of its students resulting in decreases in carbon emissions; GHGs from commuting students and employees have dropped more than 17% since 2009. However, **transportation-related** emissions still comprise over 28% of the UNCG carbon

footprint. Because the largest portion of UNCG's transportation footprint results is from commuting, the Plan calls for UNCG to expand and supplement the successful alternative transportation programs already in place, including carpooling, car-sharing, improved bike-ped infrastructure, and promoting telecommuting and flex-work. Disincentives are presented as options to be used only if the focus on education and outreach combined with viable transportation options are not successful. Beyond commuters, the Plan outlines campus fleet vehicle purchasing, maintenance, and operating policies as well as potential policies to offset and reduce emissions from University-related travel.

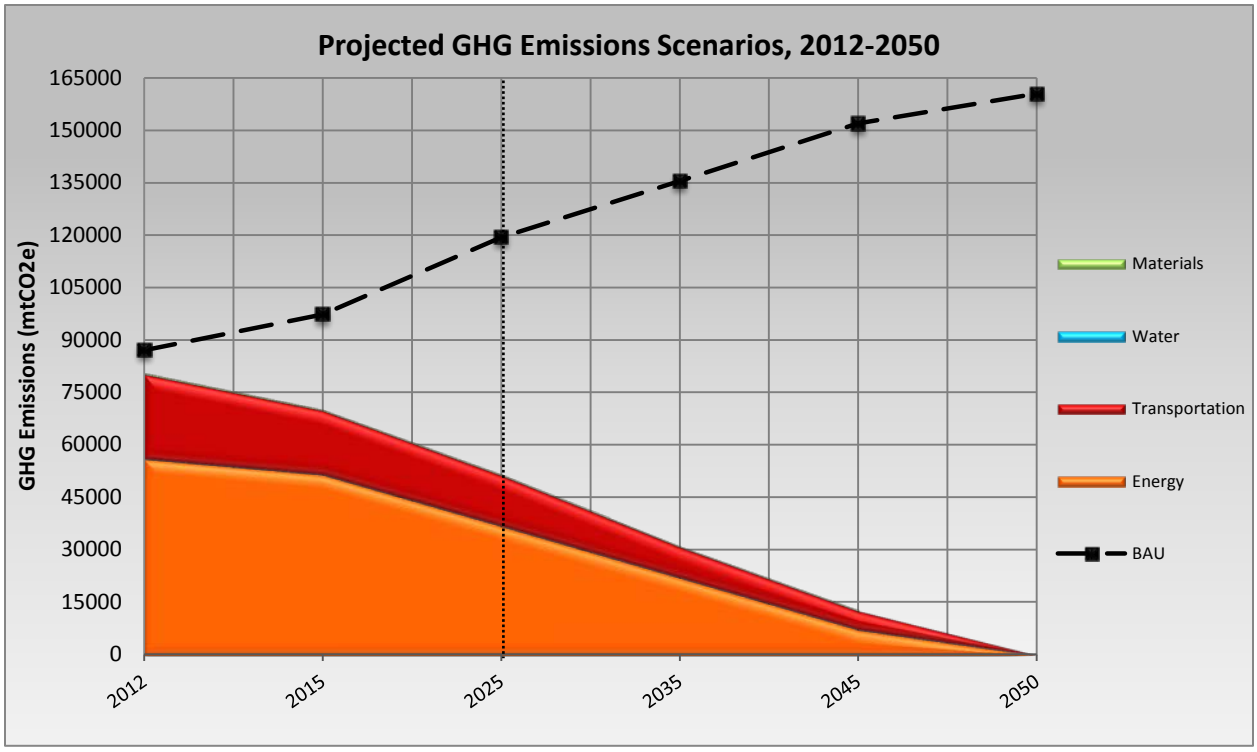
Myriad products are consumed by the UNCG campus, and disposal of these materials has financial, social, and environmental costs, including the production of GHGs (methane) from landfilled waste decomposition. GHG audits for FY 2008-09 – FY 2011-12 reveal that the solid waste generated by the University contributes an average of 404 $mtCO_2e$. Further, though not currently quantifiable, emissions emanate from the "embodied energy" contained in every product the university purchases. Embodied energy is the energy expended to extract resources, then manufacture, transport, and dispose of the resultant products. A comprehensive **materials-management** program, including an environmentally preferred purchasing policy, campus community education, and expanded recycling will reduce the amount of waste sent to landfills in the short term, as well as reduce emissions from decomposition and embodied energy. The long term goal for materials management in this Plan is that UNCG become a zero-waste campus.

Though not a focus of many Climate Action Plans, **water** is included in the UNCG Plan for several reasons. Water resources are projected to become scarcer as consumption grows in concert with the population of the Triad; droughts are also projected to be more frequency in the region due to the effects of climate change. Supplying water also has its own, albeit small, climate footprint. Though these emissions represent only a small portion of UNCG's emissions profile, the entire climate impact is not captured in this analysis, including emissions from the energy needed to pump water to campus and treat wastewater. Water consumption at UNCG has decreased over 63% since 2003, and the University will continue to implement the strategies that have proven successful over the last decade, including the leak detection and repair program and installation of water efficient fixtures. Longer term ideas within the Plan include installation of water capture and reuse infrastructure, expansion of xeriscaping, and perhaps building living machines to capture and treat wastewater on site.

The final section of the Climate Action Plan addresses **academics and outreach**. The efforts to move toward sustainability in any setting begin with education. Unfortunately, studies reveal that student knowledge of the environment and man's connections to it have diminished. UNCG has the opportunity to improve ecological literacy in its graduates through many avenues, including outreach, leadership by example, and research. But the most effective approach to influence and educate students regarding sustainability is through the curriculum taught on campus. Providing

more courses that inform students about sustainability and blending sustainability into core courses will ensure that these concepts reach all students and enhance their academic experience. Infusing sustainability into academics at UNCG will produce graduates who are able to: communicate the basics of sustainability; employ and promote sustainable practices during their time at UNCG; and apply relevant sustainable practices in their lives and careers.

The graph above shows the potential reduction in emissions as the result of implementing the recommended actions within this Plan compared to the business-as-usual scenario in 2050 (A table of many of these actions and their attendant costs and climate benefits is at the end of this



executive summary). Through these tactics, UNCG projects that its GHG emissions will decrease almost 40% between 2013 and 2025 (see dotted line in graph above). Beyond 2025, however, reduction estimates are more speculative. To achieve neutrality by 2050 will require technological improvements and innovations, continued conservation behavior by the campus community, and reductions in prices and increased availability of alternative energy, much of which is beyond the purview of the University. If UNCG determines that it will fall short of its goal, future administrations may consider purchasing carbon offsets. UNCG will continue to track its progress via an annual GHG audit and Strategic Energy Plan to the State of North Carolina Energy Office. Data collection has improved since the first audit in 2009; combined with ongoing refinements to the Clean Air Cool Planet Carbon Calculator tool, subsequent inventories will be more accurate.

This Plan is written with the knowledge that it is a living document that will grow and change as external influences change. The CAP will be reviewed annually for progress and revised periodically

to reflect changes in the political and legislative arenas, economic conditions, climate science, enrollment projections, and other factors. Attainment of neutrality will require implementation of not only the strategies listed in this plan but also additional actions that will be submitted by future UNCG Climate Action teams. Establishing some of these measures is also highly dependent on the State of North Carolina budgetary process. The flexibility within the CAP process ensures that these factors can be taken into consideration and adjustments to the Plan be made such that UNCG continues forward in its journey to climate neutrality.

SUMMARY OF STRATEGIES, POTENTIAL GHG REDUCTIONS AND ESTIMATED PAYBACK

	Approximate GHG Reduction vs. BAU ($mtCO_2e$)	Additional direct costs to UNCG	Estimated payback period
INFRASTRUCTURE ENERGY AND WATER			
Duke Energy responses to regulations	44,000 annually by 2050	-	-
NC energy efficiency construction standards (SB 668)	11,000 annually by 2050	-	-
SHORT TERM			
New Construction Energy Efficiency Beyond the State Mandate (SB 668)	4,000 annually, averaged through 2050	$2.00 – 4.00 per gsf	10 years
Space Planning and Management	3,620 annually, averaged through 2050	Minimal	<1 year
Energy Conservation in Existing Buildings	4,730 annually, averaged through 2050	$8 million	14 years
Behavior Change Initiatives	1,860 annually, averaged through 2050	Minimal	5 years
Steam Distribution Improvements	340 annually, averaged through 2050	$200,000	7 years
Steam Plant Improvements	1,170 annually, averaged through 2050	$500,000	11 years
Chiller Plant Improvements	310 annually, averaged through 2050	$75,000	2 years
Solar PV (315 kWh installation)	170 annually, averaged through 2050	$2.5 million	None
Solar Thermal (450 mmBTU installation)	30 annually, averaged through 2050	$250,000	None
LONG TERM			
Combined Heat and Power	2590 annually, averaged through 2050	$12 million	17 years
TRANSPORTATION (SHORT TERM)			
Improved CAFE standards	>6,200 annually by 2025	-	-
Diesel vehicle anti-idling retrofits	32.8 annually	$23,000 – 69,000	1.6 – 4.8 years
Carpool: increase to 10% of commuters	186 annually	Minimal	<1 year
Telecommute/flex work	97 annually	None	<1 year
Improved airplane fuel efficiency	703 annually by 2020	None	<1 year
Purchase offsets for air travel	4,136 annually (if air travel is constant)	$24,800–$62,000	None
Expanded education & marketing of TDM programs	970 annually	Minimal	<1 year
MATERIALS MANAGEMENT (SHORT TERM)			
Divert landscape waste to the city compost	61 annually	$5,120	None
Expanded education & marketing of recycling and reuse programs	5% reduction in landfill waste every 5 years	Minimal	<1 year

1 INTRODUCTION

CLIMATE CHANGE

Global climate change is one of the most serious and challenging problems the world currently faces, with potentially grave repercussions for our environment, our communities, and our economy. Most of the scientific community, including the Union for Concerned Scientists, the U.S. National Academy of Sciences, the American Association for the Advancement of Science, and the American Chemical Society, attributes climate change to various human activities. These activities, such as combustion of fossil fuels for energy, increased animal agriculture, and expanded deforestation, have raised greenhouse gas (GHG) emissions to the point that the atmosphere, and in turn earth's climate, are changing. Scientific models project many economic, environmental, and human health perturbations will occur as the global temperature increases due to these atmospheric alterations; many studies indicate that some of these changes are already occurring.

Greenhouse gases include water vapor, carbon dioxide (CO_2), methane (NH_4) and nitrous oxide (N_2O). They are referred to as greenhouse gases because they trap heat much like a greenhouse does, but on a global scale. Though some degree of this "greenhouse effect" is vital for life on earth, human activities are increasing the effect such that the earth and its atmosphere are warming to levels that disrupt global systems. According to the EPA, the U.S. emitted over 6.8 billon metric tons of greenhouse gases in 2010.

Carbon dioxide is the most prevalent GHG from man-made sources, emitted via the combustion of fossil fuels for energy and modern agricultural practices. Methane emissions result primarily from natural gas systems, decomposition of wastes in landfills, and activities associated with domesticated livestock. Agricultural soil management and mobile source fossil fuel combustion (automobiles, airplanes, etc.) are the major sources of nitrous oxide emissions. Other GHGs include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6); however these represent only a small percentage of an institution's total emissions (ACUPCC 2009).

Increases in emissions and a reduction in CO_2 uptake by plants due to deforestation and poor land use practices, have combined to cause CO_2 concentrations to rise from a pre-industrial level of 280ppm to 395 ppm at the end of 2012 (NOAA 2013). Scientific consensus is that in order to avoid the worst effects of climate change and prevent global mean temperatures from rising more than 4.3° F (2.4° C), CO_2 levels must be reduced to 350ppm by 2050, and emissions must peak prior to 2015 (IPCC Working Group 1, 2007).

Unabated, GHG emissions and the affiliated increases in global temperatures will result in significant climatic shifts around the world. According to NASA data, global mean temperatures have already increased approximately 1.4° F since 1880, and the impacts of global climate change are already evident. Accelerated glacial retreat, Arctic ice loss, shifts in species' ranges and migration patterns, and increased frequency of extreme weather events have all been observed. Further increases in these, as well as more pest and fire damage, higher frequency and strength of heat waves, and other ecosystem and agricultural stressors are predicted for North America by various climate models if the global population continues with business as usual (IPCC Working

Group 2, 2007). However, it is possible to mitigate these expected disruptions to our climate through responsible policies and practices. More effective and thoughtful approaches to behaviors, infrastructure, and land use will help stabilize greenhouse gas concentrations and mitigate potential upheavals to the environment (IPCC Working Group 3, 2007).

UNCG RESPONSE TO CLIMATE CHANGE

To avoid or mitigate the severity of these predicted outcomes, institutions and governments across the globe are creating strategies to reduce their GHG emissions. Colleges and universities have been among the most proactive in seeking to reduce their climate impacts. They have not only led via strategic planning and technological innovation, but many have also made public pledges and chosen to serve as examples for the broader community. The University of North Carolina at Greensboro (UNCG) is one such institution, acknowledging its responsibilities and promoting environmental stewardship through many of its policies and practices.

UNCG recognizes the need to provide leadership in sustainability. With the ability to reach thousands of students, faculty, staff, and alumni, UNCG has the opportunity to influence and educate a sizeable population to live in ways that enhance quality of life instead of degrade it. By embracing the tenets of sustainability the University will not only become a better steward of environmental and natural resources, it will concomitantly save financial capital through both resource-use reduction and improved worker health and productivity. UNCG will further benefit from increased academic and research performance, and its students will be better prepared for the realities of the new global, green economy.

ACUPCC Overview

In October 2011, UNCG Chancellor Linda Brady signed the American College and University Presidents Climate Commitment (ACUPCC, or Climate Commitment). The Climate Commitment, signed by almost 700 presidents and chancellors since its release in December 2006, is an effort to further the leadership role of universities in this realm, galvanizing these institutions to eliminate their emissions and to bolster research and education in sustainability. By endorsing the Climate Commitment, UNCG took another significant step in becoming a leader in campus sustainability. The University also accepted several responsibilities, including:

- Completing an emissions inventory;
- Taking immediate steps to reduce GHG emissions by choosing from a list of short-term actions;
- Creating a Climate Action Plan (CAP), with a target date and interim milestones for the campus to **achieve climate neutrality by (or before) 2050**, within two years of signing the commitment;
- Integrating sustainability into the curriculum and infusing its concepts into the educational experience; and

- Making the CAP, emissions inventory, and progress reports publicly available.

To date, UNCG has met the first two obligations under the Commitment. The University completed its first emissions inventory in 2009 and has enacted several initiatives to reduce GHG emissions. These initiatives include a policy to meet Leadership in Energy and Environmental Design (LEED) Silver standards for all new major campus construction; a program to promote and subsidize public transportation for all faculty, staff, students and visitors; and a commitment to participate annually in RecycleMania. The remaining responsibilities are part of the process of creating the University's Climate Action Plan (CAP), a comprehensive strategy to guide UNCG to climate neutrality. Climate neutrality (used in this document interchangeably with carbon neutrality) means that the net GHG emissions for which UNCG is responsible will be reduced to zero (for the full text of the Commitment, please see **Appendix 1**).

GHG production is typically divided into three scopes, based on the source of the emissions and the ability of an institution to control their discharge. The ACUPCC defines these scopes as follows:

- Scope 1: "…direct GHG emissions occurring from sources that are owned or controlled by the institution, including: on-campus stationary combustion of fossil fuels; mobile combustion of fossil fuels by institution owned/controlled vehicles; and 'fugitive' emissions. Fugitive emissions result from intentional or unintentional releases of GHGs, including the leakage of HFCs from refrigeration and air conditioning equipment as well as the release of CH_4 from institution-owned farm animals."
- Scope 2: "… indirect emissions generated in the production of electricity consumed by the institution."
- Scope 3: "…all other indirect emissions - those that are a consequence of the activities of the institution, but occur from sources not owned or controlled by the institution."

All ACUPCC signatories must report Scope 1 and Scope 2 emissions. The Commitment also requires that some Scope 3 emissions be reported, including University-related air travel and employee/student commuting to and from campus. Inclusion of other Scope 3 emissions is currently optional, but encouraged in the ACUPCC. Another Scope 3 emissions source that UNCG voluntarily includes in its GHG inventory is its landfilled waste disposal.

Process

This plan represents the culmination of months of effort by the 54 members of the Climate Action Plan Team and various outside experts and consultants. Soon after Chancellor Brady signed the Commitment, the Sustainability Coordinator was tasked with creating the CAP, and he in turn assembled a CAP Team. Six (6) subgroups comprise the Team and investigated options for GHG reduction in the following areas: University Administration, Infrastructure Energy Use, Transportation, Materials Management, Water, and Academics and Outreach. The subgroups consist of students, faculty, and staff representing various departments, and they provided an array of opinions and ideas for achieving climate neutrality.

In its approach, the team identified several principles to guide the CAP. The Plan is aggressive but realistic, acknowledging fiscal responsibility as well as the need to address climate change. The University values hard work and innovation over "easy ways out" (a sentiment echoed in the ACUPCC), so behavioral changes and thoughtful use of resources are the keystones of the plan; offset purchases, though likely to be employed, will be delayed until operational and behavioral options are exhausted. Reducing GHG emissions through switching to more efficient buildings and vehicles, relying more on renewable energy sources, and creating carbon sinks through re-vegetation and habitat restoration efforts are the primary strategies to combat climate change recommended by the US Environmental Protection Agency and are hallmarks of the UNCG Plan. The Team also recognizes the need to transition to "life cycle" thinking and analyses into all University decisions, which will require fundamental shifts in University business and operations over time.

Finally, these strategies have been developed with the full knowledge that the plan will be revisited periodically. The CAP is intended to be a living document, reviewed biannually and revised when necessary as UNCG progresses toward climate neutrality. Achievement of the 2050 goal will require a combination of many of the strategies listed in this plan and additional strategies that have yet to be added. Changes in economic conditions, regulatory landscape, political atmosphere and climate science will undoubtedly necessitate alterations to the University's strategies.

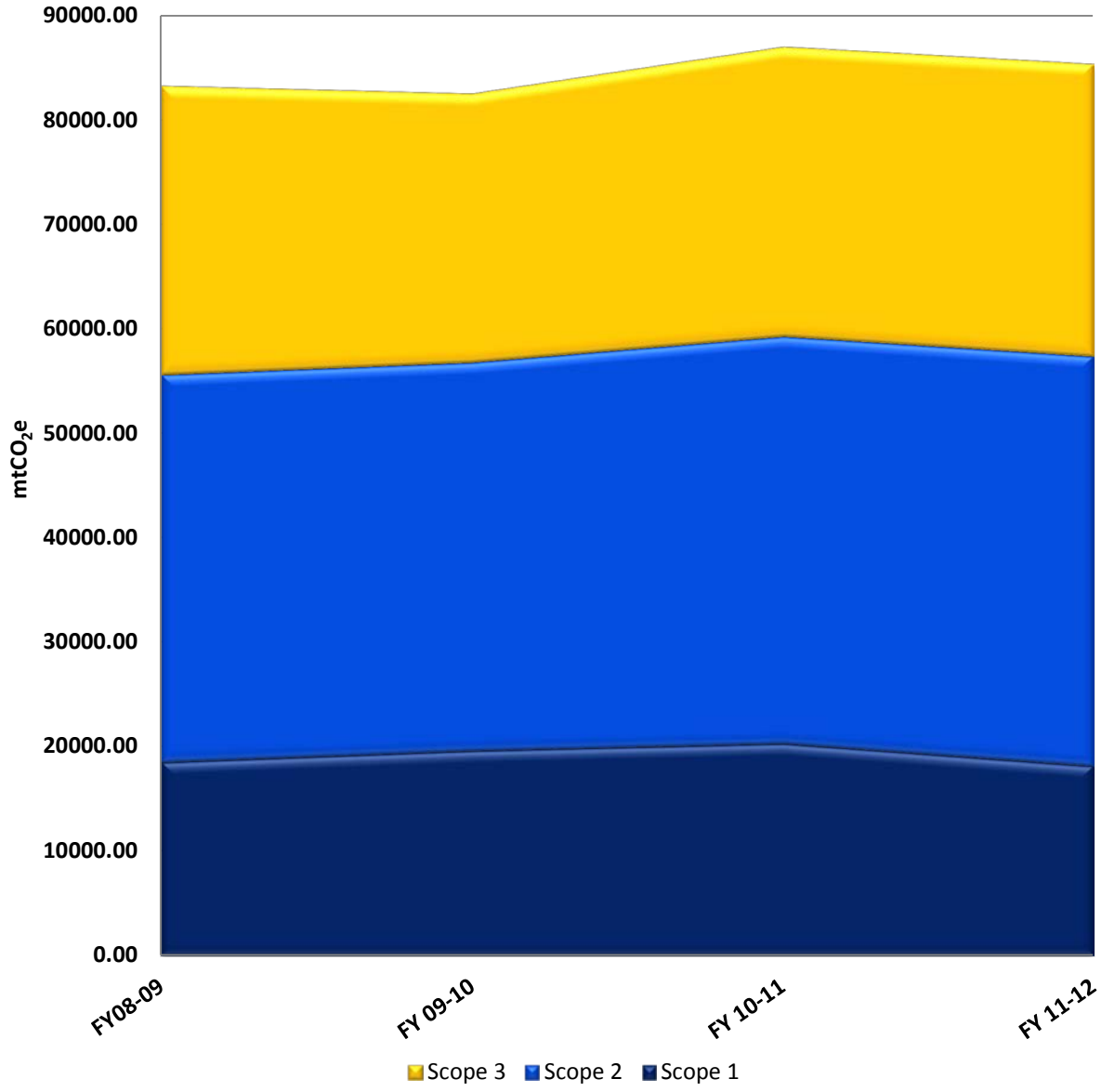
Tracking Progress

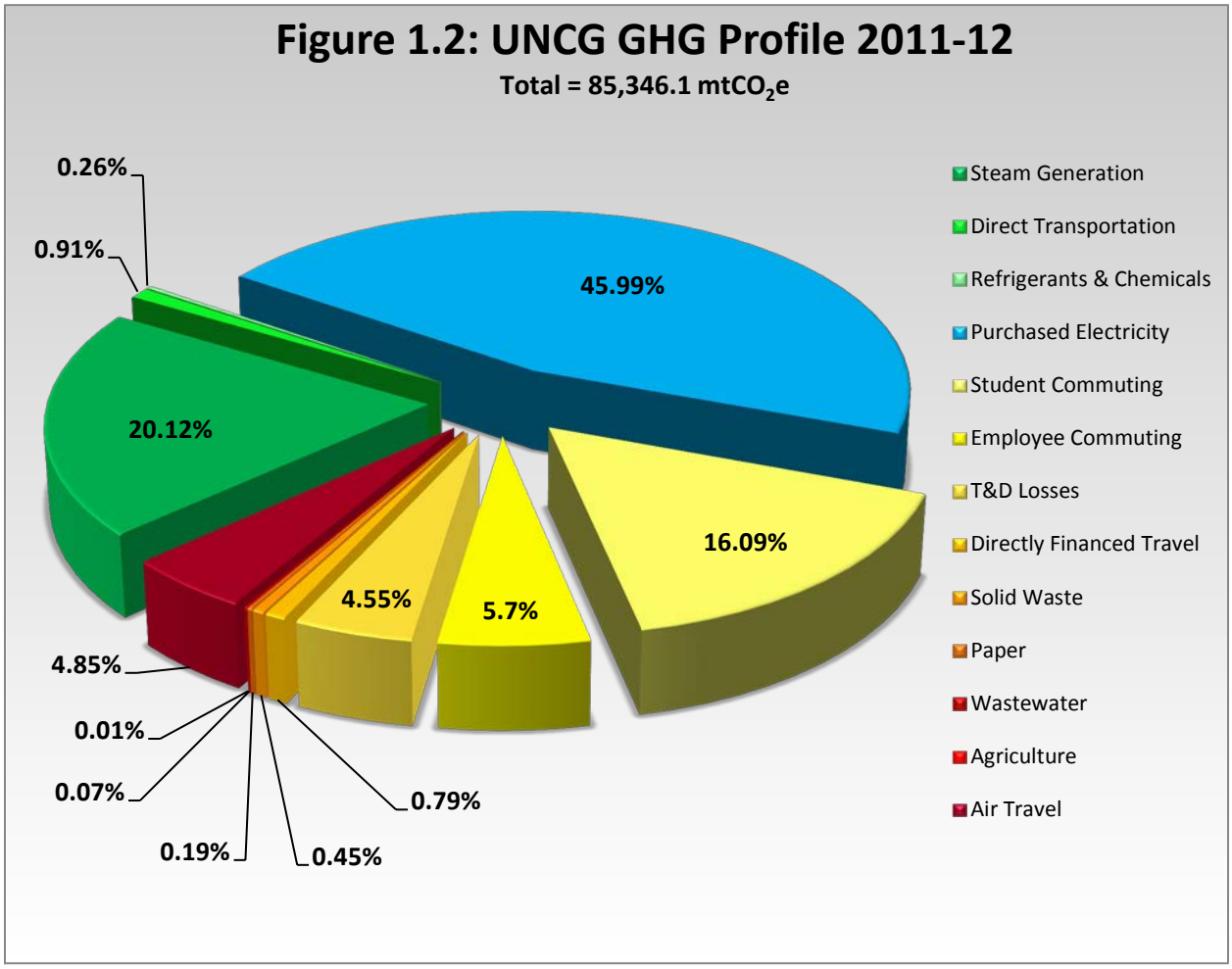
UNCG must conduct a campus GHG inventory at least every two years to satisfy its obligations to the ACUPCC. UNCG has already committed to conducting annual GHG audits to monitor its progress toward neutrality, and has done so since 2009. The data collected from this annual inventory will be used by the Sustainability Coordinator and CAP Implementation Team during their biannual reviews of the Plan to evaluate progress and revise strategies and targets as necessary. A list of concrete actions and deadlines will also be used to track progress and guide adherence to the plan.

GHG Emissions Inventory

UNCG completed its first emissions inventory in FY2008-09 using the Clean Air Cool Planet (CACP) carbon calculator version 6.4, and already has taken several steps to reduce GHG emissions. Available data indicated that the University was responsible for 83,270.3 metric tons of carbon dioxide equivalent ($mtCO_2e$ – not all emissions are CO_2, but for ease of calculation, other GHGs are converted to their CO_2 equivalents). However, data were unavailable for University-related air travel that year. This number is likely an underestimate due to numerous assumptions made in the calculations as well as the missing data. Subsequent audits have been conducted with the CACP calculator version 6.6, and have benefitted from refined and expanded data collection; e.g., in 2010-11 air travel estimates were first included. This is reflected in the GHG trend graph (**Figure 1.1)** that displays a significant increase in Scope 3 GHGs beginning in 2010-11. The UNCG climate footprint rose to more than 85,346.1 $mtCO_2e$ in 2011-12, as seen in **Figure 1.2**.

Figure 1.1: UNCG Greenhouse Gas Emissions by Scope
2009-2012

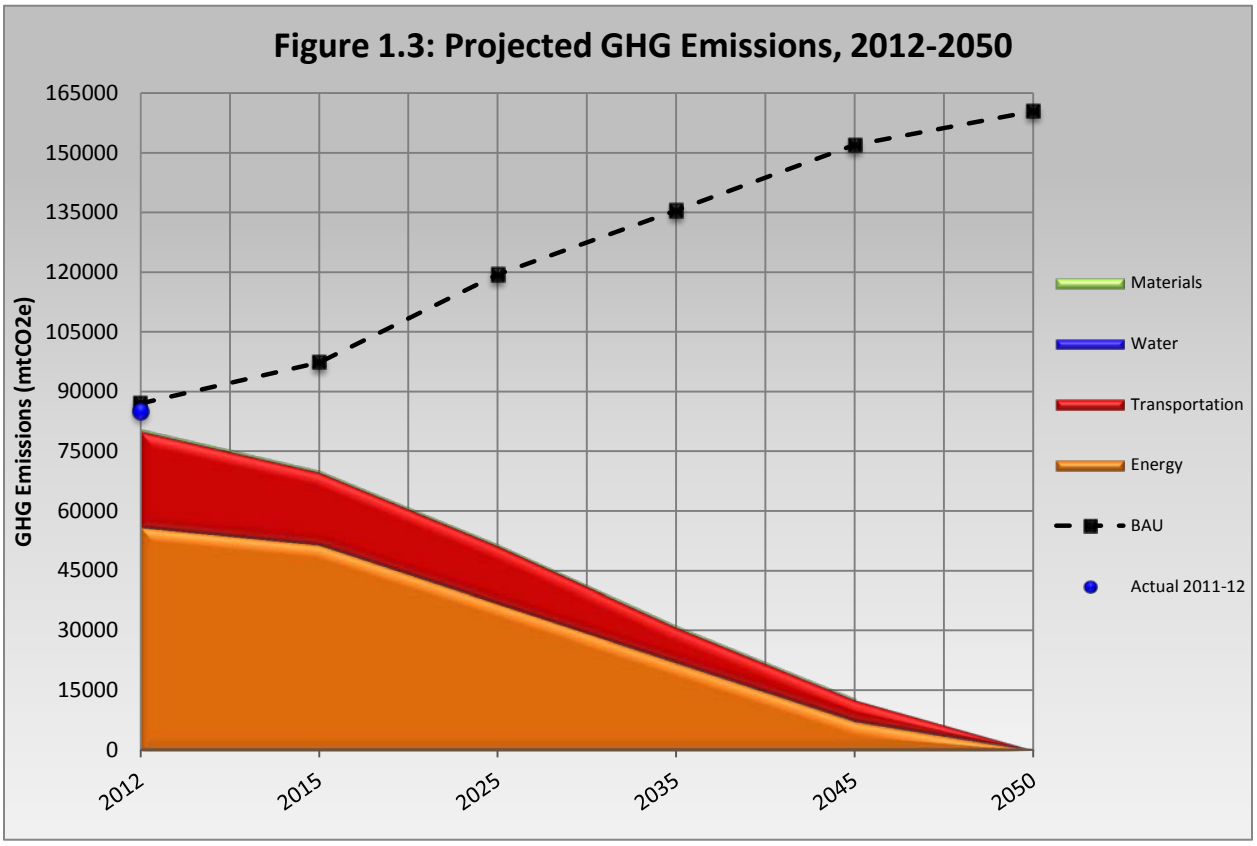




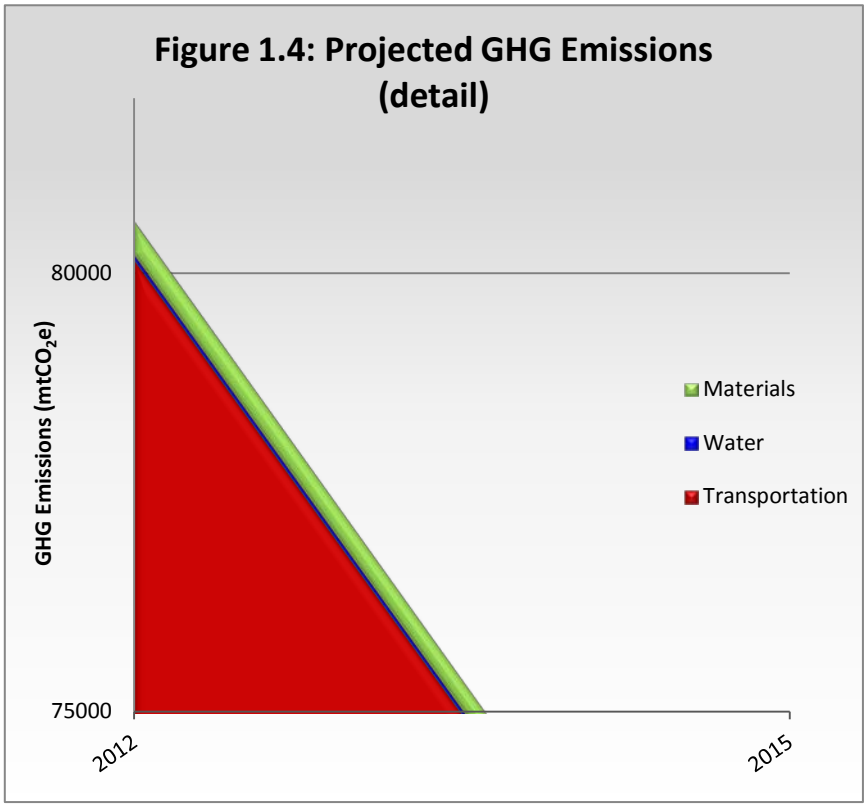
GHG Reduction Targets

The sections of the CAP that follow detail the initiatives that the Team has developed to achieve climate neutrality at UNCG. These initiatives include a combination of infrastructure and technological improvements, campus community behavioral changes, and offset purchases, which will work in concert with current and expected government and private sector policies.

Assuming implementation will begin in 2013 and all proposed GHG reduction strategies are executed, UNCG projects that it will reduce its GHG emissions approximately 39.2% by 2025, and will achieve climate neutrality by 2050 (**Figure 1.3**). Reaching neutrality by 2050 meets the requirements of the ACUPCC and The University of North Carolina Sustainability Policy, and exceeds the recommendations of the United Nations International Panel on Climate Change, which has targeted a GHG emission reduction of 80-95% (from 1990 levels) by 2050. All emissions projections in this document incorporate estimated enrollment increases and affiliated staffing and infrastructure growth (see **Section 3: Infrastructure Energy** for details). A "business-as-usual" scenario is also presented.



Note that the GHGs from neither water nor materials show up on this graph, due to their relatively small contributions to the overall UNCG emissions profile. A closer view of the first years of projections is provided in **Figure 1.4**.



2 ADMINISTRATION

BACKGROUND

Though most university sustainability programs originate through student and faculty grassroots efforts, no comprehensive campus sustainability plan can be successful without the support of the university administration. As an example, the renowned sustainability program at the University of Oregon began with a recycling program and bicycling plan created by student volunteers in the 1970s. Institutionalization of the concepts of sustainability at Oregon developed as student and faculty interest spurred the creation of an Environmental Policy Statement and a Sustainable Development Plan between 1997 and 2005. However, sustainability became widely adopted at Oregon in 2007 after the administration signed the President's Climate Commitment and the Office of Sustainability was established.

The philosophy an administration advocates can wholly alter a campus. Another notable example is the development of sustainability at Furman University. Former Furman President Dr. David Shi was a proponent of "simple living" and sustainability throughout his career. For over 15 years he championed these causes such that today Furman is widely acknowledged as a national leader in both academic and operational sustainability. Successful sustainability programs like the one at Furman receive support from university governance in various forms. Funding of programs and marketing to promote initiatives are essential elements of what an administration does to support its commitments. By creating and adopting formal policy statements, the administration sends a clear and powerful message defining its goals and its dedication to sustainability. In turn, these messages galvanize the campus community to achieve those goals.

HISTORY OF SUSTAINABILITY AT UNCG

The University of North Carolina at Greensboro has followed a path to sustainability similar to that of many schools. The sustainability initiative at UNCG can be traced to the inception of the recycling program in the early 1990s, a collaboration between the Grounds Department and interested students. Subsequent years saw the appointment of a full-time recycling manager, creation of a recycling office, and development of several independent initiatives within various departments and by student groups.

Beginning in 2008, UNCG experienced an uptick in interest and focus on campus sustainability, one that continues today. Significant events over the last five years include:

- Formation of the University Committee on Sustainability by Chancellor Patricia Sullivan, Spring 2008.
- Declaration of sustainability as a core value in the UNCG 2009-2014 Strategic Plan, May 2009.
- Adoption of the University of North Carolina Sustainability Policy by UNCG, October 2009.
- Institution of LEED Silver certification for major building projects in UNCG's 2009-2014 Strategic Plan, May 2009.

- Selection of the first Sustainability Coordinator for Operations, April 2010.
- Formation of the UNCG Sustainability Council, August 2010.
- Registration of UNCG as a charter member of the Sustainability Tracking, Assessment and Rating System (STARS), July 2011.
- Endorsement of the American College and University Presidents' Climate Commitment (ACUPCC) by Chancellor Linda Brady, October 2011.
- Endorsement of the Appalachian Energy Summit Signatory Commitment by Chancellor Brady, July 2012.
- Appointment of the first Academic Sustainability Coordinator, January 2013.

UNCG has developed both a philosophy and the institutional structure to support and encourage civic engagement, social responsibility, diversity, and community partnerships in its academics, practices and policies. By fostering these social aspects of sustainability and interdisciplinary approaches to curricula, as well as environmental aspects of sustainability, UNCG has received national recognition as a leader in this area. Among other honors, the University was named a "Campus Sustainability Leader" by the Sustainable Endowments Institute in 2010, ranked 39th in the 2012 Sierra Club "Cool Schools" list, and earned a STARS Silver rating in each of the last two years.

NEXT STEPS

UNCG has achieved much in the past few years regarding its sustainability programs, but considerably more work is necessary for the University to meet its obligations under the Climate Commitment. Because administrative support is essential to this effort, this Plan begins with a discussion of the role of the UNCG administration. To achieve climate neutrality, the administration must promote and model sustainable practices such that the concepts become institutionalized within the University. Further, UNCG must develop the financial and personnel resources necessary to implement the strategies to attain climate neutrality, and install mechanisms to ensure continuity in this support from one administration to the next.

Education and Outreach

As is evident throughout this Plan, a fundamental component to achieving climate neutrality is the active involvement of the campus community. Student, faculty, and staff behaviors directly influence the University's climate footprint. The Sustainability Office will develop a business plan to create a comprehensive outreach program to educate and encourage the various campus constituencies to adopt sustainable habits. The primary goal of this education program will be to create a culture of sustainability. Financial support for the plan and affiliated programs to promote sustainability as a value of UNCG by the administration are essential to creating that culture.

University Policies

Specific policies targeting activities that will reduce UNCG's climate impacts have been proposed for both the entire University and particular departments during the CAP development. To make these proposed policies more effective, the administration will review, and if appropriate, officially endorse these as University practice. The team recommends the following for consideration in the short term:

- A University Vehicle Purchasing Policy
- A University Vehicle Operations Policy
- A policy proclaiming new building energy targets
- A policy requiring that all Foundation construction projects meet UNCG standards
- A policy guiding planners to consider renovation before new construction
- A policy to mandate Environmentally Preferred Purchasing (EPP) alternate bids for commonly purchased products and services.
- A policy to specify that packaging used by vendors be recyclable via the UNCG recycling program.

Each is detailed in later sections of the Plan.

Financing

One obstacle that often impedes sustainability efforts is funding. The administration must financially support the initiatives proposed in this Climate Action Plan. Fortunately, many if not all of these yield returns on the initial investments, often within very short time frames. However, financial aspects must not be the sole parameter the administration uses to evaluate these projects; in UNCG's effort to become a truly sustainable institution, strategic planning must weigh the social and environmental considerations in conjunction with economic factors.

This approach is not novel, as many choices made at universities look beyond the financial. Architectural details, electronic message boards, fountains, and many other items may enhance the experiences one has at a University, but they do not have direct monetary paybacks. Some projects, particularly renewable energy and other large infrastructure improvements, have payback periods that often exceed what is conventionally acceptable for the financial bottom line, but pay back they do. Incorporating environmental and social externalities into the calculus makes the payback more attractive and accurate.

Many studies have sought to quantify externalities affiliated with social and environmental degradation. Estimates for external costs of transportation in the U.S. (Delucchi and McCubbin, 2010), the social and environmental costs of coal combustion versus wind power in Appalachia (Collins et al., 2012), and many other studies can help UNCG determine external costs. Further, UNCG leadership should be part of conversations with the UNC System, State Construction

Office, State Energy Office, and other General Administration and legislative bodies regarding the development of a return on investment (ROI) decision-making model that incorporates social and environmental costs into major projects, policy changes and purchases. Once this is addressed, UNCG will direct campus administrators to utilize the most appropriate tools to calculate external costs for their specific areas of responsibility and incorporate the results of these calculations into the decision-making process.

Not only do sustainability projects pay back financially, such practices and programs also attract students. A 2012 survey by the Princeton Review revealed that 68% of prospective students wanted information about a university's commitment to the environment and the results might impact their decision to apply to or attend the school. Studies by UCLA and the College of William and Mary revealed similar interest. To remain competitive in admissions and attract high caliber students, UNCG would benefit from a robust sustainability program. External costs for business-as-usual practices must be considered, including potential losses stemming from losing recruits to schools with better known and better financed sustainability efforts.

Alternative funding opportunities must also be exploited. Projects to make practices more sustainable will occur at many levels, from small student proposals to major new construction projects, and finances must be available for these. The University is in the process of establishing a "green" discretionary fund that will be used to incentivize energy conservation and other programs. Should the fund grow large enough, it could support a limited number of grants to student or employee projects that support the University's carbon reduction goals. This fund will be overseen by the Sustainability Coordinator and also be used to support outreach efforts. The administration can support this by promoting the fund through University Advancement.

The University will also consider instituting a revolving fund to loan capital to auxiliary departments. Under this arrangement the initial savings generated by a project go towards repayment of the loan, with future savings remaining with the auxiliary unit. The best example of this is Harvard's Green Loan Fund. The capital projects financed by the Green Loan Fund generated a return on investment of 30% (compared to a 2011-12 ROI of 0.05% for the Harvard endowment), and as of 2012, Loan Fund initiatives were projected to save $4.8 million per year in energy and maintenance costs and had reduced greenhouse gas emissions over 22,000 $mtCO_2e$.

To fund larger infrastructure projects, UNCG will investigate the creation of a "green" endowment. This endowment would be established and maintained primarily through private donations and targeted fundraising efforts. Other mechanisms to generate money for this endowment could include offering a "green fee" option that students could choose to pay in addition to their tuition or adding a carbon offset / environmental impact fee to parking permits (see Transportation section).

OFFSETS

On its path to climate neutrality, UNCG will almost certainly have to develop or purchase carbon offsets to meet its obligation. According to *The President's Climate Commitment Voluntary Carbon Offset Protocol*, a carbon offset is "a reduction or removal of carbon dioxide equivalent (CO_2e) greenhouse gas (GHG) emissions that is used to counterbalance or compensate for ('offset') emissions from other activities; offset projects reducing GHG emissions outside of an entity's boundary generate credits that can be purchased by that entity to meet its own targets for reducing GHG emissions within its boundary. Generally, offsets fall into two categories: 1) emissions reductions or avoidance, such as replacing a diesel generator with solar panels, and 2) sequestration, or removing GHGs from the atmosphere, such as planting trees that will absorb CO_2 as they grow."

Several factors must be considered in the decision to buy offsets, including the type, location, effects on indigenous populations, and project permanence and additionality. Additionality is the guarantee that the offset project would not occur if not for the funding received from the purchaser(s). Purchasing offsets is less appealing than direct action to reduce GHG production, for though offsets fund renewable energy or sequestration projects that eliminate emissions, these projects occur off site and have no impact on GHG production by the purchaser; some view offsets as payment to pollute. In part due to this negative perception, many universities moving toward climate neutrality decide to procure offsets only after all other on-campus emission reduction measures are in place.

Some offset projects, however, do directly sequester carbon, the only method of removing CO_2 from the atmosphere. These too have varying degrees of success and must be rigorously reviewed to ensure the GHG reductions claimed by the offset company. Local projects are preferred since the institution can have more oversight of projects and they may enhance local economies and provide educational opportunities.

A common type of offset is the Renewable Energy Certificate (REC), which is available through many outlets including Duke Energy, UNCG's electricity supplier. RECs are not carbon sequestration projects, but represent the property rights to the environmental qualities of renewable electricity generation. Purchase of RECs helps fund further alternative and renewable energy investment. The University must conduct due diligence before purchasing RECs just as it would for any other type of offset.

If UNCG wished to offset the emissions due to its electrical use via the purchase of RECs from Duke Energy via the NC GreenPower program, assuming consumption remains constant at 2012 levels, it would cost approximately $1.9 million. Based on Duke's current fuel mixture, this would mitigate 39,246.8 $mtCO_2e$, approximately 46% of the total carbon footprint of the University. Alternatively, purchasing carbon offsets from Duke to mitigate all UNCG emissions for FY 2011-2012, thus allowing the University to claim carbon neutrality, would cost $683,000. These costs would be incurred annually and are subject to considerable market volatility. Because many institutions and

organizations are aiming for neutrality by 2050, prices for offsets will almost assuredly increase in the years leading up to the deadline. Purchasing offsets for all emissions is an unlikely strategy for UNCG to achieve neutrality, but these scenarios are presented to offer an idea of the costs that may be incurred to meet the 2050 goal.

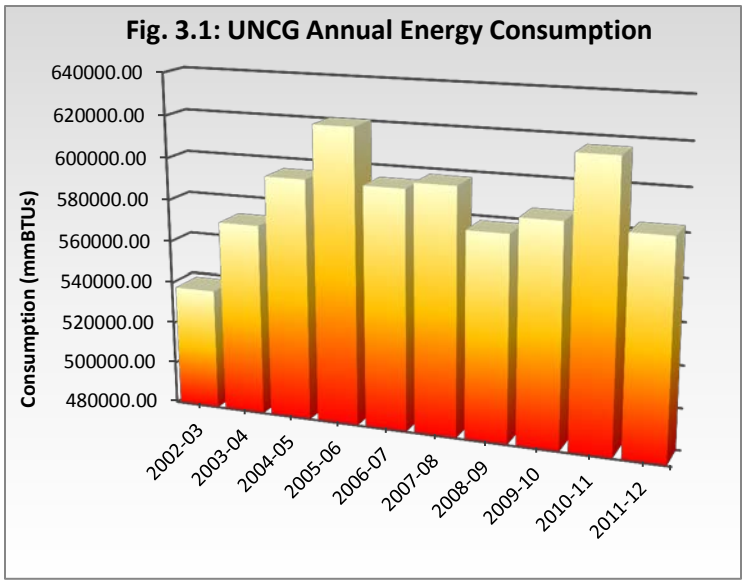
To overcome many of the drawbacks to offsets, the University could protect and restore to natural habitat lands it owns or acquires. By purchasing land and restoring its native ecosystems locally, UNCG would gain several benefits. The sequestration of CO_2 through reforestation or habitat restoration would neutralize some of the University's emissions. Over an 80-year period, one acre of reforested mid-Atlantic agricultural land can sequester approximately 64 metric tons of carbon (Galang, Zipper, Prisley, Galbraith, & Donovan, 2006). These offsets would be local and UNCG would be able oversee them directly instead of relying on a third party. Further, the University would have the option to incorporate these habitat restoration projects into its academics, particularly environmental sciences, biology, chemistry, and geography. UNCG already owns lands off campus that could be protected and/or restored for these purposes.

The University might also create offsets even closer to campus via a home weatherization program for employees. UNCG could support a group of employee volunteers to provide basic home energy audits and weatherization for UNCG employees. The team could be comprised of campus experts in the building trades, and volunteers who wish to learn more about these areas. With an expected 10-30% decrease in energy consumption per home, this program would offset 1 - 4 $mtCO_2e$ for each home the program weatherizes. Beyond the GHG benefits, the program will result in healthier and happier employees who have lower utility bills for many years, a financial bonus in this difficult budgetary atmosphere. Please see **Appendix 2: Proposed Home Energy Efficiency Program for Employees.**

BACKGROUND

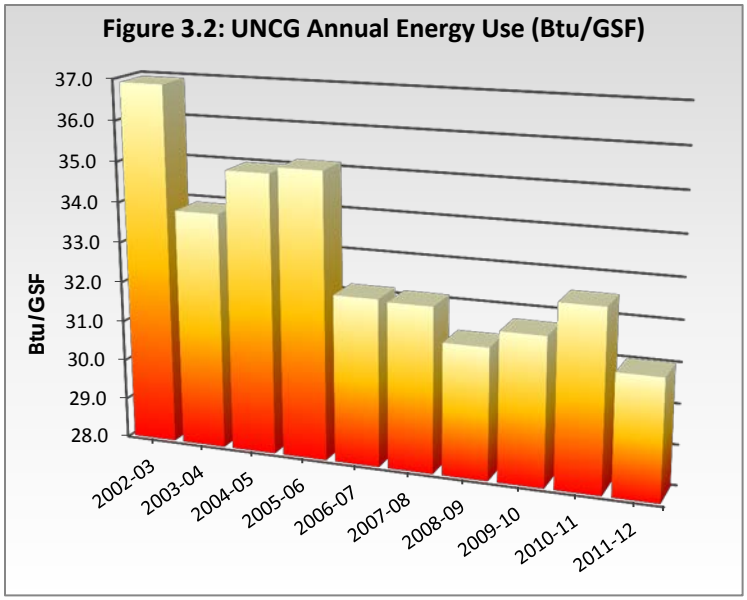
Energy Use Profile

For the purposes of this Plan, "energy" will refer to the energy necessary to operate campus infrastructure, unless specifically stated otherwise.



Annual energy consumption at UNCG has fluctuated between 538,000 and 620,500 mmBtus since 2002-03, with a peak in 2005-06 (**Fig. 3.1**). This has occurred despite a steady increase in both enrollment and building square footage over the same period; energy use per square foot has decreased 16% during the same period (**Fig. 3.2**).

Within that time frame, electrical consumption made up approximately 42.5% of total energy use. The University purchases electricity from Duke Energy, and the fuel mixture for the plants that serve UNCG is mainly comprised of nuclear and coal, with some natural gas and hydro. This purchased electricity is used primarily for lighting, running electronic equipment, and powering some of the campus chiller units.



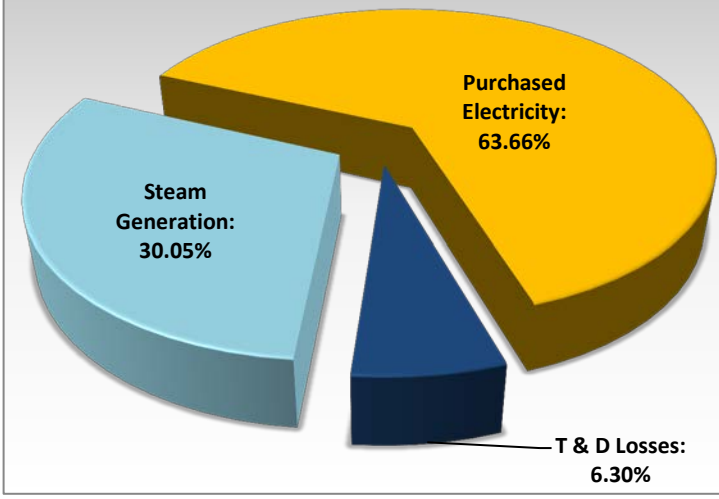
UNCG also has a central steam plant consisting of four boilers to create steam for heating and running some of the larger regional chillers across the campus; fueling the plant comprised 57.5% of energy consumption between 2002-03 and 2011-12. The boilers run almost exclusively on natural gas, though they are occasionally fueled with oil. Because natural gas burns cleaner than oil and coal, UNCG's emissions from steam generation are considerably lower than other schools in the region.

GHGs from Energy Sources

The GHG emissions for which UNCG is responsible come primarily from the purchase of electricity and on-campus generation of steam. According to the initial inventory of the

University's GHG emissions in 2008-9, purchased electricity accounted for 37,103.1 $mtCO_2e$ and another 3,669.5 due to transmission and distribution losses; the steam plant created 17,682.6 $mtCO_2e$. Combined these sources accounted for over 70% of the University's total carbon footprint. Over the four years that UNCG has conducted its carbon inventory, the contributions from these three sources have remained fairly constant, contributing an average of 70.98% of the total GHG emissions from UNCG. Purchased electricity produced an average of 38,125.5 $mtCO_2e$ (63.66% of total), transmission and distribution (T&D) losses 3,770.7 $mtCO_2e$ (6.30%), and steam generation 17,995.0 $mtCO_2e$ (30.05%) (**Fig. 3.3**).

Fig. 3.3: UNCG GHG Emissions from Energy - 4 Year Average



Existing Energy Efficiency Programs

Though data are currently unavailable to quantify the amounts, UNCG has saved money and reduced emissions through various energy efficiency measures over the past few decades. Avoided costs through more efficient electrical use between FY 2003-04 and FY 2011-12 total approximately $3.8 million. Some of the programs, technologies, and policies implemented include:

- Installation and operation of an energy management system
- Entered into an energy services contract to upgrade four campus buildings
- High-efficiency heat pumps for the Spring Garden Apartments and other buildings
- Energy-efficient laundry machines and Energy Star appliances
- Energy Star and EPEAT standards for all new appliances and computers;
- Low-energy lighting strategies:
  - Occupancy sensors in approximately 25% of building square footage
  - Energy-efficient lamps (compact fluorescent, T8, or LEDs) across ~55% of campus, including 100% LED exit signage
- Automated exterior lighting (time clock/photocell control) across campus
- Removed bulbs from vending machines across campus
- High efficiency chillers
- Steam plant upgrades

Campus Construction

When Chancellor Brady signed the Climate Commitment in 2011, the University had pledged to construct all new buildings to LEED Silver standards. UNCG had already completed one building prior that qualified for LEED certification, the New School of Education Building, which earned a LEED Gold certification. Soon thereafter the Jefferson Suites Residence Hall was completed, and recently attained a Silver rating. The seven (7) buildings of the Quad are in the process of LEED certification and will achieve Silver or greater, as will all the buildings of the new Spartan Village.

Energy Conservation Campaigns

UNCG also understands the value of involving students, faculty, and staff in conserving energy on campus. Not only does this reduce energy consumption and costs, it also helps build the culture of sustainability that is vital to the success of the CAP and to goal of producing ecoliterate graduates. Energy conservation campaigns have been deployed with some success so far. Energy awareness is a major tenet of the Green Office program, and the Vampire Energy Slayers group employs "guerilla marketing" to increase awareness of energy wasting activities in an entertaining fashion. The message of energy conservation is reinforced to the UNCG community through these and several other education and marketing outlets. These include periodic emails, lectures and presentations to groups and classes, posts on the UNCG Sustainability web page, blog, and social media outlets (Facebook and Twitter), posters and signs, and traditional media.

NEXT STEPS

Though UNCG has made considerable strides in curbing its building energy use and the accompanying GHG emissions over the past decade, this sector remains the largest contributor to the University's carbon footprint. To reduce its emissions over the next 10-12 years, UNCG will expand or create programs to instill conservation behavior, improve energy efficiency in its existing buildings, better utilize existing space, build more energy efficient new structures, and begin to incorporate alternative energy sources. Beyond 2025, strategies for reduction become more speculative. To meet the goal of climate neutrality by 2050, UNCG will depend on technological breakthroughs, reductions in costs and increased availability of alternative energy, and ongoing participation by the campus community in energy conservation programs.

This section of the CAP was developed in conjunction with Affiliated Engineers, Inc. (AEI), a technical consulting firm with considerable expertise in energy strategies and analysis. AEI and the members of the UNCG CAP energy subcommittee met several times to develop ideas on how to decrease the University's carbon emissions, both long and short term. AEI conducted financial and emissions analyses for the ideas that came out of these discussions. They are presented here with minor modifications to reflect updated information.

CLIMATE ACTION PLAN BASE CASE DEVELOPMENT AND ENERGY ANALYSES

Prepared for:

THE UNIVERSITY of NORTH CAROLINA GREENSBORO

October 26, 2012

Prepared by:

Affiliated Engineers

confluenc
SHARED INSIGHTS. CLEAR DIRECTION.

3 INFRASTRUCTURE ENERGY

CONTENTS

3 INFRASTRUCTURE ENERGY

EXECUTIVE SUMMARY

As a signatory to the American College and University Presidents' Climate Commitment (ACUPCC), the University of North Carolina at Greensboro (UNCG) has committed to achieving climate neutrality as soon as possible. One of the first steps towards achieving this commitment is the production of a Climate Action Plan (CAP) that will set goals and establish the actions necessary to achieve the goal of climate neutrality. This project focuses on the analysis of greenhouse gas (GHG) reduction from the energy-related sources of these emissions on UNCG's campus – primarily natural gas combusted in the University's central plant to produce steam and from electricity purchased from Duke Energy. In 2010, these energy-related emissions represent nearly 70% of UNCG's GHG inventory.

The first step of the project was to establish the Business-As-Usual (BAU) reference case which forecasts GHG emissions at UNCG from the baseline year (FY 2011) through 2050. This is necessary in order to understand not only the current GHG emissions that need to be mitigated, but also the forecasted volume of GHG emissions that need to be addressed as part of this and future GHG mitigation efforts. Beginning with UNCG's FY 2011 GHG inventory, a series of assumptions and metrics, or forecast drivers, were developed to scale current data to 2050 based on BAU (unmitigated) growth. The forecast drivers included factors such as enrollment, campus square footage, and energy consumption. A summary of the inventory and associated forecast drivers is shown below:

GHG INVENTORY SUMMARY ($MTCO_2e$)					
SCOPE	SOURCE	2008-09	2009-10	2010-11	EMISSIONS (%) of '10-'11
SCOPE 1	**Steam Generation**	**17,683**	**18,044**	**19,078**	**22.43%**
	Directly Financed Travel	624	556	669	0.79%
	Agriculture	27	25	19	0.02%
SCOPE 2	**Purchased Electricity**	**37,103**	**37,180**	**38,973**	**45.83%**
SCOPE 3	Faculty / Staff Commuting	10,987	10,870	10,858	12.77%
	Student Commuting	11,662	9,972	9,947	11.70%
	T&D Losses	**3,670**	**3,677**	**3,854**	**4.53%**
	Direct Transportation	782	825	823	0.97%
	Solid Waste	451	379	406	0.48%
	Paper	141	146	INCOMPLETE	
	Wastewater	83	89	69	0.08%
	Refrigerants & Chemicals	58	766	428	0.50%
OTHER	Offsets	-65	-72	-79	-0.09%
TOTAL		83,206	82,457	85,043	100.00%

In or Out of Scope	Forecast Drivers
In Scope	**Building Area (GSF), Energy Use Intensity**
Out of Scope	Not considered in analysis
Out of Scope	Not considered in analysis
In Scope	**Building Area (GSF), Energy Use Intensity**
Out of Scope	Not considered in analysis
Out of Scope	Not considered in analysis
In Scope	**Purchased Electricity**
Out of Scope	Not considered in analysis
Out of Scope	Not considered in analysis
Out of Scope	Not considered in analysis
Out of Scope	Not considered in analysis
Out of Scope	Not considered in analysis
Out of Scope	Not considered in analysis

NOTE: Offsets include forested University lands and composting of some leaf litter.

The growth trend resulting from the escalation of emission based on these forecast drivers projects a near doubling of energy-related GHG emissions in UNCG's inventory from current levels by 2050 as shown in the following table:

FYE	SCOPE 1 Steam Generation	TOTAL SCOPE 1	SCOPE 2 Purchased Electricity	SCOPE 3 T&D Losses	TOTAL SCOPE 3	TOTAL GHG EMISSIONS	GHG EMISSIONS PER KGSF
		MTCDE	MTCDE		MTCDE	MTCDE	MTCDE
Row	1		4	7		15	15
2008	17,566	**17,566**	40,321	3,988	**3,988**	**61,875**	**11.4**
2009	17,673	**17,673**	37,103	3,670	**3,670**	**58,445**	**10.8**
2010	18,032	**18,032**	37,179	3,677	**3,677**	**58,889**	**10.9**
2011	19,072	**19,072**	38,973	3,854	**3,854**	**61,899**	**11.1**
2020	24,430	**24,430**	**54,021**	5,343	**5,343**	**83,793**	**11.8**
2030	27,543	**27,543**	**62,610**	6,192	**6,192**	**96,345**	**12.1**
2040	30,656	**30,656**	**71,199**	7,042	**7,042**	**108,897**	**12.3**
2050	33,769	**33,769**	**79,788**	7,891	**7,891**	**121,448**	**12.5**

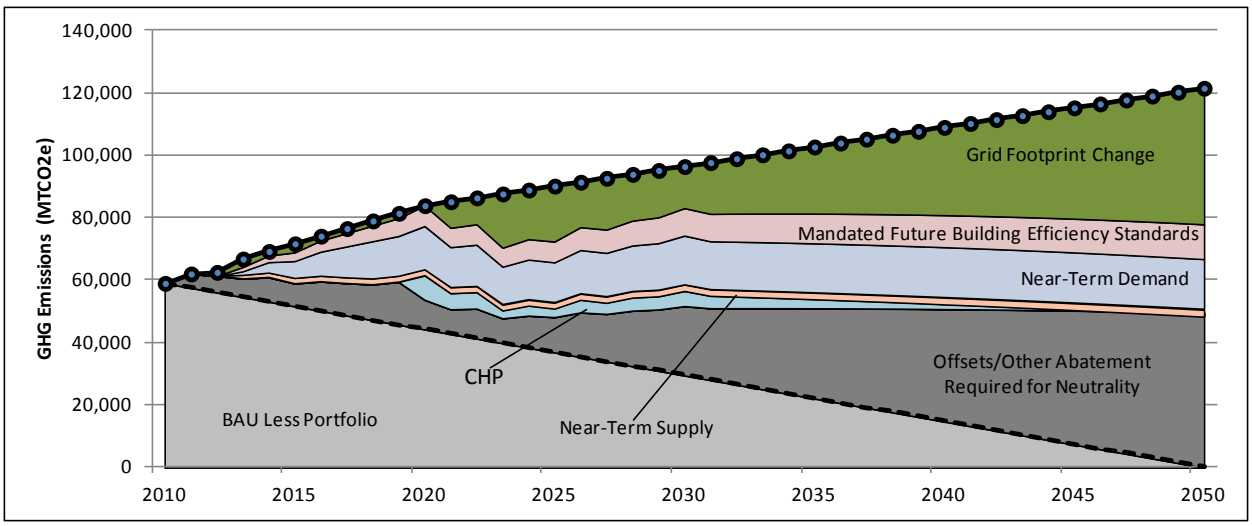
With this baseline of emissions growth in mind, several options for reducing energy use and GHG emissions were evaluated and modeled to quantify their impact on GHG reduction over time and their financial viability as energy saving opportunities. Both demand-side and supply-side options were evaluated. Demand-side options included:

- Emissions from Purchased Electricity;
- Energy Efficient New Construction (including both state-mandated requirements for new buildings and energy efficiency goals beyond the state mandate);
- Space Planning and Management;
- Energy Conservation in Existing Buildings; and
- Behavior Change Initiatives.

On the supply side, the following options were considered:

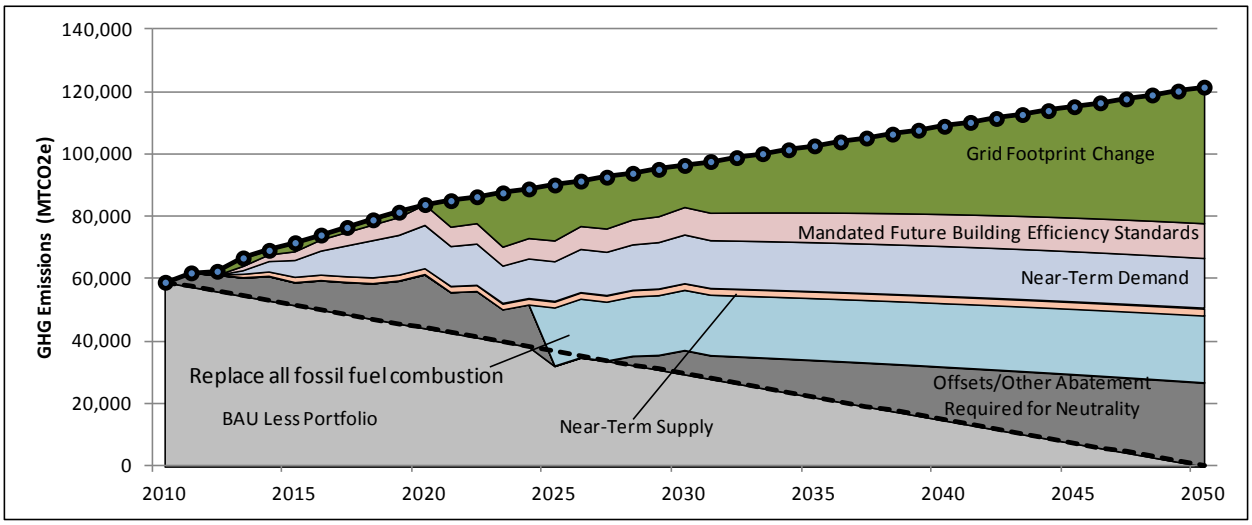
- Steam Distribution System Improvements;
- Steam Plant Improvements;
- Chiller Plant Improvements;
- On-Campus Renewable Energy (Solar PV and Solar Thermal); and
- Combined Heat and Power.

The impact and cost effectiveness of these options were modeled, evaluated, and assembled into a portfolio of options for UNCG's CAP and ultimately, to be considered for implementation. The estimated effect of this portfolio of options on the projected energy-related GHG emissions from UNCG over time is presented on the following graph:



By implementing the cost-effective measures identified by this project, UNCG can both save on its energy costs and reduce its GHG footprint over time. From the BAU projection of energy-related GHG emissions of just over 120,000 MTCO2e in 2050, the portfolio illustrated above shows the potential for emissions reduction to about 50,000 MTCO2e (**note**: MTCDE and MTCO2E are used in this section to instead of mtCO2e; all three abbreviations represent "metric tons of carbon dioxide equivalent").

The remaining 50,000 MTCO2e of energy-related GHG emissions are from a combination of natural gas and purchased electricity. To illustrate the effect of transitioning to a renewable (carbon-neutral) fuel source to replace natural gas combustion for steam production instead of implementing combined heat and power as shown above, another scenario was developed:



Again, this scenario does not specify what carbon-neutral fuel might be used, or the technology that would use it. It does, however, show that significant progress towards UNCG's goal of climate neutrality by 2050 can be achieved by transitioning from natural gas to a renewable fuel. As UNCG

implements its Climate Action Plan and tracks its progress towards its goals, it will need to determine the ultimate strategy for eliminating the final remaining GHG emissions – either by purchasing offsets or by implementing a technology that can produce the campus's energy needs with no net carbon emissions.

1. PROJECT BACKGROUND AND GOALS

As a signatory to the American College and University Presidents' Climate Commitment (ACUPCC), the University of North Carolina at Greensboro (UNCG) has voiced its concern over the threat of global warming and committed itself as an institution to achieving climate neutrality as soon as possible. One of the first steps towards achieving this commitment is the production of a Climate Action Plan (CAP) that will set goals and establish the actions necessary to achieve the goal of climate neutrality. Additionally, UNCG has a goal of reducing the energy use intensity of its campus by 30% by 2015 (from a 2002-03 baseline).

This project focuses on the analysis of greenhouse gas (GHG) reduction from the energy-related sources of these emissions on UNCG's campus – primarily natural gas combusted in the University's central plant to produce steam and from electricity purchased from Duke Energy. In 2010, emissions from natural gas combustion accounted for over 20% of UNCG's total GHG inventory. Emissions from purchased electricity were over 45% of UNCG's total GHG emissions. Thus, these energy-related emissions represent nearly 70% of UNCG's GHG inventory – the remainder being a combination of transportation (commuting, fleet, and business travel) and other smaller sources of GHG emissions that are not addressed here. It is expected that those other sources of emissions and UNCG's plans to reduce them as a part of the campus GHG inventory will be addressed in a separate study and combined with the options described by this project into a complete Climate Action Plan for UNCG.

2. BUSINESS-AS-USUAL REFERENCE CASE

The business-as-usual (BAU) reference case is intended to establish the forecast for GHG emissions at UNCG from the baseline year (FYE 2011) through 2050. This is necessary in order to understand not only the current GHG emissions that need to be mitigated, but also the forecasted volume of GHG emissions that need to be addressed as part of this and future GHG mitigation efforts. This section of the document describes the baseline year GHG emissions and the key assumptions used to forecast future emissions.

2.1 2011 GHG Inventory

UNCG, led by its Sustainability Coordinator, conducted a GHG inventory for University operations ending June 2011 (FYE 2011). The University utilized the Clean Air Cool Planet (CA-CP) inventory tool to conduct their analysis. The analysis showed that the FYE 2011 GHG inventory for UNCG was roughly 85,000 metric tons of carbon dioxide equivalent ($MTCO_2e$). The components of the inventory are shown below. These values are the starting values used in the CAP Model BAU GHG

forecast. The "Forecast Drivers" identified in **Table 3.1** below identify the key assumptions that are used in forecasting each type of GHG emission through 2050 for the scopes of emissions that are within the scope of this analysis. The scope of this model includes Scope 1 emissions resulting from steam generation, Scope 2 emissions resulting from purchased electricity and Scope 3 emissions resulting from electricity-related transmission and distribution losses. The key assumptions behind development of the forecast drivers are shown in **Table 3.1**.

Table 3.1: GHG Inventory Summary

GHG INVENTORY SUMMARY ($MTCO_2e$)							
SCOPE	SOURCE	2008-09	2009-10	2010-11	EMISSIONS (%) of '10-'11	In or Out of Scope	Forecast Drivers
SCOPE 1	**Steam Generation**	**17,683**	**18,044**	**19,078**	**22.43%**	**In Scope**	**Building Area (GSF), Energy Use Intensity**
	Directly Financed Travel	624	556	669	0.79%	Out of Scope	Not considered in analysis
	Agriculture	27	25	19	0.02%	Out of Scope	Not considered in analysis
SCOPE 2	**Purchased Electricity**	**37,103**	**37,180**	**38,973**	**45.83%**	**In Scope**	**Building Area (GSF), Energy Use Intensity**
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	Student Commuting	11,662	9,972	9,947	11.70%	Out of Scope	Not considered in analysis
	T&D Losses	**3,670**	**3,677**	**3,854**	**4.53%**	**In Scope**	**Purchased Electricity**
	Direct Transportation	782	825	823	0.97%	Out of Scope	Not considered in analysis
	Solid Waste	451	379	406	0.48%	Out of Scope	Not considered in analysis
	Paper	141	146	INCOMPLETE		Out of Scope	Not considered in analysis
	Wastewater	83	89	69	0.08%	Out of Scope	Not considered in analysis
	Refrigerants & Chemicals	58	766	428	0.50%	Out of Scope	Not considered in analysis
OTHER	Offsets	-65	-72	-79	-0.09%	Out of Scope	Not considered in analysis
TOTAL		83,206	82,457	85,043	100.00%		

2.2 Population Growth

Table 3.2 shows the historical Total Enrollment measured in full-time equivalent (FTE) students[1]. For the purposes of the BAU forecast it is assumed that the projected Total Enrollment grows to 18,250 students by 2020 and to 25,000 2050. The 2020 assumptions reflect the guidance provided by UNCG staff. Specifically, the 2020 value is based on a linear projection based on the historical enrollment (headcount) figures. This linear projection results in a 2020 Total Enrollment Headcount value of 20,055. Applying a 91% conversion for Headcount to FTE to this gives us an estimated Total Enrollment FTE of 18,250 in 2020. Per UNCG staff direction, none of these estimates include enrollment figures for extension courses. This results in an assumed average annual growth rate of 1.5% per annum between 2011 and 2020.

Table 3.2: Enrollment (FTE) – Historical and Projected

	Historical Fiscal Year End												Projected	
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	2020	2050
Total Enrollment (FTE)	11,375	11,250	11,746	12,354	12,708	13,099	13,723	14,219	14,704	15,097	15,670	16,036	18,250	25,000

Beyond 2020 it is assumed that the average annual growth rate is 75% of the 2011 to 2020 growth rate. This results in a Total Enrollment projection of 25,000 FTE students by 2050.

[1] UNCG Strategic Energy Plan, Appendix 2C, column 7, http://www.uncg.edu/ppo/UNCG_Energy_Update.pdf.

2.3 Campus Area Forecast

Campus Area refers to the amount of building space found in the building inventory at the University. The campus area is the primary driver of energy use and subsequently, GHG emissions at the University. As discussed previously, emissions associated with building related energy consumption, i.e. purchased electricity and steam generation account for nearly three quarters of the campus-wide GHG emissions. As illustrated in **Table 3.3**, the campus area grew from nearly 3.8 million gross square feet (GSF) in 2000 to more than 5.5 million GSF by 2011[2], an average annual growth rate of 4.3%.

Table 3.3: Space per Student (GSF/FTE) – Historical and Projected

	Historical Fiscal Year End												Projected	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2020	2050
GSF per Student	333	341	331	346	389	381	377	381	368	359	346	348	389	389
Total Campus (GSF)	3,785,926	3,838,194	3,888,068	4,269,699	4,942,520	4,987,544	5,177,689	5,415,496	5,415,496	5,415,496	5,415,496	5,581,592	7,100,000	9,700,000

Historic Average Annual Growth Rate (2000-2011)	4.3%
Projected Average Annual Growth Rate (2011-2020)	3.0%
Projected Average Annual Growth Rate (2020-2050)	1.2%

For the purposes of the BAU forecast it is assumed that the University will continue to grow, but at a slower rate of 3% per year, on average, through 2020. This results in a total campus area of 7.1 million GSF by 2020. This growth assumption is driven by analyzing historical campus GSF per Student and making assumptions with respect to future GSF required per student.

Since 2000, the GSF per FTE Student at UNCG has ranged from a low of 331 GSF per FTE Student in 2002 to a high of 389 in 2004. The 2011 value is 348 GSF per FTE. The 2007 Campus Master Plan indicated that the campus area per student would continue to grow as more research and other space intensive operations develop on campus. The 2020 GSF assumptions above reflect the assumption that the GSF per student will grow according to the growth rates identified in the 2007 Campus Master Plan, increasing from 348 GSF per FTE in 2011 to 389 GSF per FTE by 2020. Specifically, this increase in GSF/FTE student of 11% between 2011 and 2020 mirrors the projected ASF/FTE Student increase shown in the 2007 Master Plan (85 ASF to 95 ASF).

This ratio is then held constant through 2050 resulting in a total campus area in 2050 of 9.7 million GSF. This results in a projected 1.2% average annual growth rate between 2020 and 2050.

2.4 Utility Demand

According to the information provided in the UNCG Strategic Energy Plan[3], the average campus-wide energy use intensity (EUI) in FYE 2011 was 110,300 BTU per GSF or 110.3 KBTU/GSF. The components of the historical demand are shown in **Table 3.4**, broken down by Purchased Electricity

[2] UNCG Strategic Energy Plan, Appendix 2C, column 5, http://www.uncg.edu/ppo/UNCG_Energy_Update.pdf.

[3] UNCG Strategic Energy Plan, table on page 41, http://www.uncg.edu/ppo/UNCG_Energy_Update.pdf.

and Fuel combusted at the campus. The campus-wide EUI has declined from 124.3 KBTU/GSF in 2000.

Table 3.4: Historical Campus Energy Consumption and Energy Use Intensity (KBTU/GSF)

	Fuel Consumption	NG EUI	Electricity Consumption	Electricity Consumption	Electric EUI	**Total Primary Energy**	**Total EUI**
FYE	MMBTU	KBTU/GSF	MWh	MMBTU	KBTU/GSF	**MMBTU**	**KBTU/GSF**
2000	265,359	70	60,092	205,094	54	470,453	124.3
2001	223,604	58	61,256	209,065	54	432,669	112.7
2002	268,172	69	63,511	216,764	56	484,936	124.7
2003	307,069	72	65,960	225,121	53	532,190	124.6
2004	328,017	66	71,313	243,390	49	571,407	115.6
2005	344,451	69	73,361	250,383	50	594,834	119.3
2006	358,435	69	77,641	264,989	51	623,425	120.4
2007	327,642	61	78,140	266,692	49	594,334	109.7
2008	331,898	61	77,895	265,855	49	597,753	110.4
2009	333,844	62	71,678	244,637	45	578,481	106.8
2010	340,702	63	71,825	245,140	45	585,842	108.2
2011	358,705	64	75,290	256,964	46	615,669	110.3

The BAU utility demand forecast assumes existing space that is not renovated over the forecast period continues to consume utilities at the historical average EUI. **Table 3.5** illustrates the assumptions made regarding the EUI associated with new space added to campus. The future EUI shown in **Table 3.5** indicate that new space added to campus will have an overall EUI (normalized for space type) consistent with the historical NG EUI, but an electricity EUI that is greater than the historical average electricity EUI. This reflects several factors; including the assumption that new space is likely to be more electricity intense as a result of greater cooling facilities, lighting requirements, etc. and that future construction will include a significant amount of laboratory space and a relatively small amount of parking which heavily influences the current campus EUI (i.e., parking decks are included in the GSF data used to calculate the overall campus EUI).

Table 3.5: Projected Types and Energy Use Intensities of Future Buildings

		Future EUI		
	% of Future Growth	NG (kBtu/GSF)	Electric (kBtu/GSF)	Total
Office/Classroom	45%	39	68	107
Lab	15%	200	115	314
Residential	35%	58	49	107
Parking	5%		8	8
Average per New GSF	**100%**	**68**	**65**	**133**

These EUIs are held constant through 2050, per **Table 3.6**:

Table 3.6: Future Construction Estimates and Energy Use Intensities

EUI of Net Additions (BAU)	GSF	NG EUI	Electric EUI	Total EUI
Net Additions Through 2020	1,951,741	68	65	133
Net Additions 2021 Through 2050	2,600,000	68	65	133

These BAU EUI intensity factors multiplied by the BAU campus area growth values described above result in an increase in energy consumption from the 0.616 trillion BTU's experienced in FYE 2011 to 1.16 trillion BTU's by 2050 in the BAU reference scenario, a 90% increase over 39 years. The components of utility demand growth are illustrated in **Table 3.7**.

Table 3.7: Projected Energy Use and Campus EUI

	Fuel Consumption	NG EUI	Electricity Consumption	Electricity Consumption	Electric EUI	**Total Primary Energy**	**Total EUI**
FYE	MMBTU	KBTU/GSF	MWh	MMBTU	KBTU/GSF	**MMBTU**	**KBTU/GSF**
2011	358,705	64	75,290	256,964	46	615,669	110.3
2020	461,810	65	104,361	356,183	50	**817,993**	**115.2**
2030	520,659	65	120,954	412,815	52	**933,474**	**117.2**
2040	579,508	66	137,547	469,446	53	**1,048,955**	**118.7**
2050	638,358	66	154,139	526,078	54	**1,164,435**	**120.0**

2.5 Commodity Price Assumptions

The commodity price assumptions section of the CAP Model includes historical and forecasted prices for natural gas and purchased electricity. The starting values for FYE 2011 purchased energy sources were provided in the UNCG Strategic Energy Plan[4] and are assumed to be $61.20/MWh for purchased electricity. A starting price of $5.83 per MMBTU is used for natural gas.

A variety of approaches can be used to forecast these prices going forward, but to simplify the forecasting process and make the assumptions easily transparent a simple straight-line growth rate of 1.0% per year was used for the BAU forecast period. These same values are used when valuing GHG abatement options and the associated reductions in purchased energy sources. The annual values for the forecast period are available in **Appendix 3A**.

2.6 GHG Emissions Forecast

The GHG emissions are forecasted based on the forecast drivers assumption identified in **Table 3.1**. The purchased utilities and natural gas forecasts have an emission factor that is uses in the forecast calculations. The emission factors used, based on the starting UNCG GHG inventory, are shown in **Table 3.8**.

[4] UNCG Strategic Energy Plan, table on page 41, http://www.uncg.edu/ppo/UNCG_Energy_Update.pdf.

Table 3.8: Emission Factors

Emission Factors for Purchased Commodities ($MTCO_2e$/MMBTU)	
Purchased Electricity	**Natural Gas**
0.1517 (0.5176/MWh)	0.0530

The assumptions outlined above result in a BAU GHG forecast where the UNCG GHG emissions in the scope of this project grow from roughly 62,000 $MTCO_2e$ in 2011 to more than 120,000 $MTCO_2e$ by 2050, a nearly 100% increase (see **Table 3.9**).

Table 3.9: Campus GHG Emissions – Historical and Projected

FYE	SCOPE 1 Steam Generation	TOTAL SCOPE 1	SCOPE 2 Purchased Electricity	SCOPE 3 T&D Losses	TOTAL SCOPE 3	TOTAL GHG EMISSIONS	GHG EMISSIONS PER KGSF
		MTCDE	MTCDE		MTCDE	MTCDE	MTCDE
Row	1		4	7		15	15
2008	17,566	**17,566**	40,321	3,988	**3,988**	**61,875**	**11.4**
2009	17,673	**17,673**	37,103	3,670	**3,670**	**58,445**	**10.8**
2010	18,032	**18,032**	37,179	3,677	**3,677**	**58,889**	**10.9**
2011	19,072	**19,072**	38,973	3,854	**3,854**	**61,899**	**11.1**
2020	24,430	**24,430**	**54,021**	5,343	**5,343**	**83,793**	**11.8**
2030	27,543	**27,543**	**62,610**	6,192	**6,192**	**96,345**	**12.1**
2040	30,656	**30,656**	**71,199**	7,042	**7,042**	**108,897**	**12.3**
2050	33,769	**33,769**	**79,788**	7,891	**7,891**	**121,448**	**12.5**

2.7 Planned GHG Mitigation and an Alternative Reference Case

While the above reference case illustrates the projection of UNCG GHG emissions nearly doubling by 2050, there are a couple of mitigating factors that might be considered as an alternate reference case. First, it is commonly believed that the GHG intensity of purchased electricity will decrease over the next decades as a result of state-level renewable portfolios standards, at least, and possibly more as a result of broader GHG related regulation and legislation.

As an example and illustrated in **Figure 3.4** below, Duke Energy Carolinas is projecting more than a 25% decrease in GHG emissions per MWh between now and 2030. As noted in the company's integrated resource plan (IRP) filed on September 1, 2010 with the Public Utility Commission[5], a major portion of this planned reduction is a result of the planned retirement of a significant amount of currently operating coal-fired facilities. As explained in the IRP, the company "is subject to the

[5] The Duke Energy Carolinas Integrated Resource Plan (Annual Report), September 1, 2010, http://www.energy.sc.gov/publications/2010_Duke_Energy_Carolinas_Integrated_Resource_Plan.pdf

jurisdiction of federal agencies including the Federal Energy Regulatory Commission (FERC), EPA, and the NRC, as well as state commissions and agencies."[6]

While speaking of a different region of the country one industry insider stated that, "The issue at hand here is that we have one final regulation [Mercury and Air Toxics Standards], another final that is stayed [Cross-State Air Pollution Rule] and another two proposed regulations [the Clean Water Act and the Coal Combustion Residuals rule]... From a regulations standpoint, the EPA rules trump all other rules at this time. So the EPA standards and rules trump NERC, trump FERC, and trump DOE. So if you are going to be out of compliance with these rules you are going to be opening yourself up to lawsuits."[7] This tightening regulatory dynamic is a key driver in the GHG emissions trend stated by Duke Energy Carolinas. This tightening of regulations will also likely result in increasing electricity prices, according to prevailing analysis.

Figure 3.4: Duke Energy Carolinas Projected GHG Emissions Profile[8]

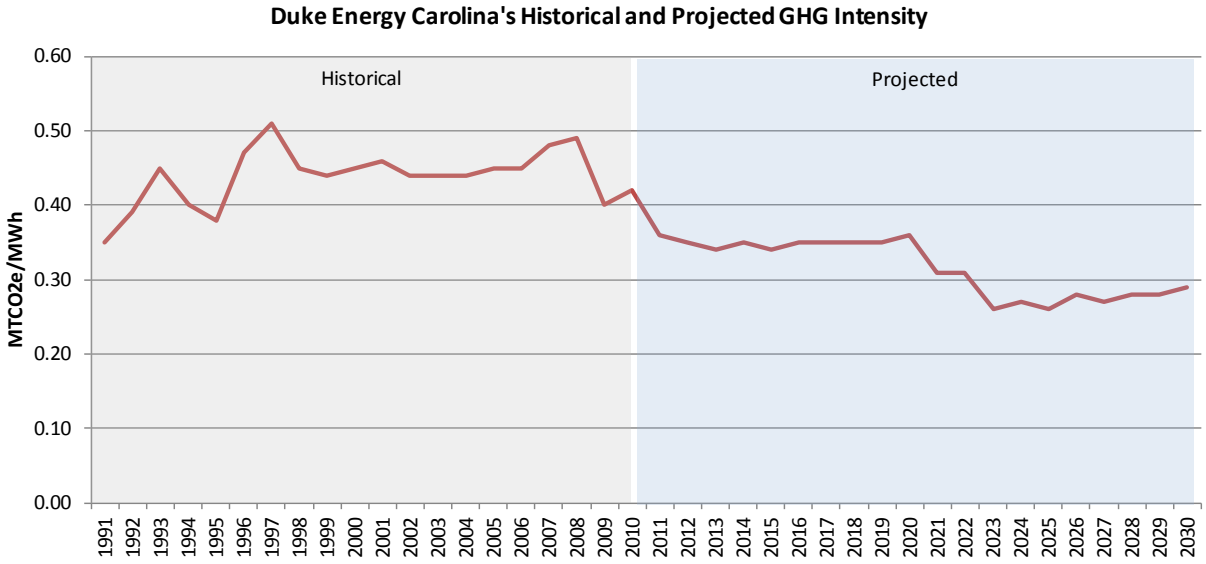


Figure 3.4 illustrates a scenario in which the GHG intensity of purchased electricity is essentially cut in half by 2050 as a result of new technologies responding to regulations. This could reduce 2050 emissions by nearly 44,000 $MTCO_2e$ (see green wedge in **Figure 3.5**).

[6] Ibid., p. 43.

[7] EPA rules seen hiking Midwest ISO power prices significantly in next 5 to 6 years, Peter Marrin, SNL Financial LC, May 1, 2012.

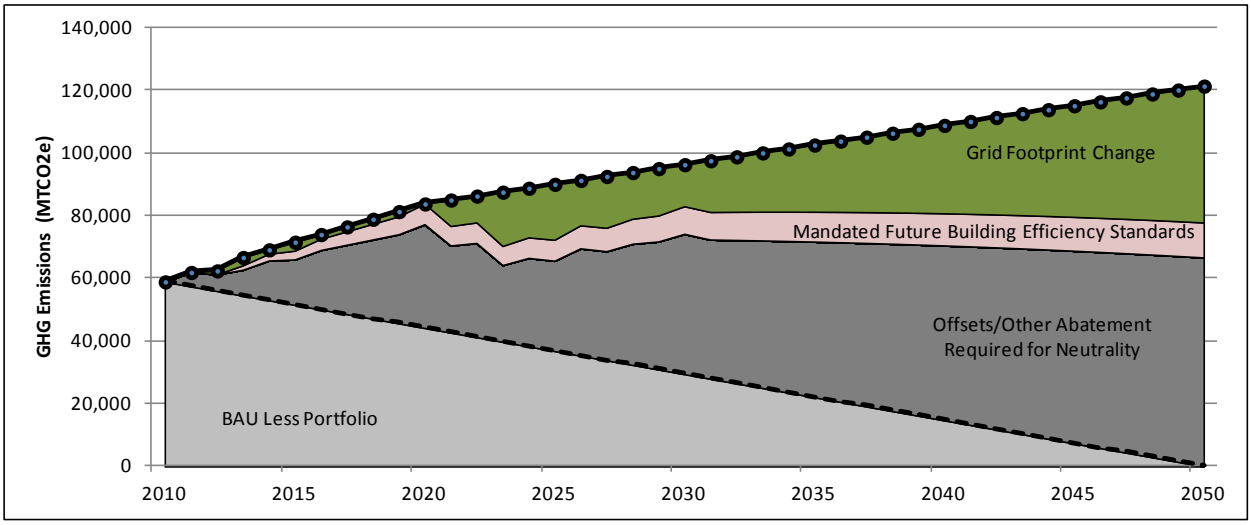
[8] Per Duke Energy Carolinas, the projected GHG emissions reduction per MWh through 2030 is:

1. Based on the results of the Duke Energy Carolinas 2010 IRP filed September 1, 2010
2. Reference case includes:
    a. The retirement of 1,650 MWs of unscrubbed coal and 500 MWs of old fleet Combustion Turbines.
    b. Installation of Cliffside Unit 6, Buck and Dan River Combined Cycle Units, Nuclear uprates, and Combustion Turbines.
    c. Installation of Lee Nuclear Station with the first unit on line in 2021 and the second on line in 2023.
    d. Impacts of Save A Watt and NC Renewable Energy requirements applied to entire service territory.

After 2030 the assumed emission rate reduction is a continuation of the 2011 to 2030 trend, per the AEI Consultant team.

Additionally, state-level energy efficiency standards will require that new space is built to a higher energy standard. The assumptions for how these standards could affect the EUI of future building space are discussed in subsequent section. Based on these assumptions, the state energy efficiency

Figure 3.5: GHG Emissions Over Time – Base Case and Alternative Reference Case



requirements could reduce 2050 emissions by more than 11,000 $MTCO_2e$ (see pink wedge in **Figure 3.5**). This revised reference case illustrates GHG emissions in 2050 of just over 66,000 $MTCO_2e$, a significant reduction from the unmitigated BAU case described above.

2.8 Other Factors

The primary factors highlighted here are inflation and the discount rate used in present value calculations. It should be noted that all dollar values in the model are "real" dollars, meaning they are denominated in 2011 dollars and not inflated. The discount rate used is a "real" discount rate.

First, inflation: The assumed inflation rate is 2.0% and is based on a GDP Chain-type Price Index. The GDP Chain-type Price Index is an index published by the Bureau of Economic Analysis (BEA) and is used to convert between real and nominal dollars. The base year for the index is 2000 where the index is equal to 1.0. The reference used for this information is the 2012 Annual Energy Outlook (AEO) published by the Energy Information Administration. The full AEO can be found at http://www.eia.doe.gov/oiaf/aeo/index.html.

The next topic is the discount rate used in the present value calculations. The real discount rate assumed is 5.0%, consistent with a long-term average tax-exempt cost of capital.

3. ENERGY AND GHG REDUCTION OPPORTUNITIES

There are two areas of focus for the energy-related sources of GHG emissions in UNCG's Inventory. Demand-side opportunities will explore the reduction of energy usage by the campus – primarily, the energy consumed by UNCG's buildings. Supply-side opportunities will examine opportunities for

producing and delivering central utilities (steam and chilled water) more efficiently, with fewer losses and/or with less GHG intensity.

In addition to examining demand- and supply-side energy savings opportunities, this analysis will also look at those opportunities in terms of their recommended implementation timeframe: near-term versus long-term. Near-term options are typically well-proven technologies with a quick payback – opportunities that should be implemented as soon as possible in order to maximize energy savings and emissions reduction over time.

Long-term options for the CAP will be examined in the central steam and chilled water plants and may involve large amounts of capital, delayed implementation to coincide with expected replacement dates of existing equipment, and possibly the use of currently-unproven (or even unknown) technologies that may develop in the coming years. While some basic information about the possible costs or impacts of these long-term technologies is provided, it is outside of the scope of this project to provide detailed information about a specific technology or technologies that may be implemented in the long term to carry UNCG towards its goal of climate neutrality. See Appendix B for an illustration of the opportunities evaluated in this analysis.

3.1 Demand-Side Analysis

3.1.1 Emissions from Purchased Electricity

As discussed in Section 2.7, it is expected that purchased electricity will become less GHG-intense in the coming decades due to state-level renewable energy goals and the possibility of broader GHG regulation and legislation. As such, the indirect (Scope 2) GHG emissions from purchased electricity – the largest source of GHG emissions in UNCG's inventory – are expected to decline in the future independently of any demand reduction initiatives taken by the University. The effect of these reductions has been modeled based on a GHG emissions forecast received directly from Duke Energy that has been scaled to maintain consistency with the basis of UNCG's GHG inventory – specifically, the historical eGRID emission factors contained with the Clean Air Cool Planet GHG inventory model.

3.1.2 Energy Efficient New Construction

For development of the base case, as discussed in Section 2.4, it was assumed future campus buildings would be constructed roughly equivalent to current average energy use intensities in order to show the potential for unmitigated (business as usual) growth of GHG emissions. The Energy Use Intensity (EUI) of buildings in the business as usual case was estimated as shown in **Table 3.10**. Note that the factors shown in the following tables represent the sum of all energy inputs to the building, including steam produced by natural gas combustion at the main heating plant, electricity consumed by the building, and electricity consumed to produce chilled water for the building if the building is connected to the central chilled water plant.

Table 3.10: Estimated Business as Usual EUI by Building Type

	Laboratory (kBTU/GSF)	Housing (kBTU/GSF)	Office/Classroom (kBTU/GSF)
Business as Usual EUI	314	107	107

However, North Carolina energy efficiency standards for new state-owned buildings (G.S. 143-135.40) require that new buildings be constructed to 30% below ASHRAE 90.1-2004 standards. As this is a requirement for new buildings that is mandated by state law, the impact of these new standards was used to create a new reference case for future construction as discussed in Section 2.7. Rather than using historical or BAU EUI factors, AEI has estimated EUI factors for various types of buildings based on building energy modeling experience for compliance with North Carolina's energy efficiency standards for new state-owned buildings. Although these factors could vary significantly for actual buildings based on a myriad of design considerations, the estimated EUI factors used to project the effect of North Carolina's energy efficiency standards.

Table 3.11: Estimated Mandated EUI by Building Type

	Laboratory (kBTU/GSF)	Housing (kBTU/GSF)	Office/Classroom (kBTU/GSF)
State-Mandated EUI	220	75	75

While these mandated energy use targets may be relatively aggressive for certain types of buildings (again, dependent upon the specific design, programming, and construction of future buildings), UNCG may choose to pursue energy use goals that are more aggressive than what the state requires in the buildings they design and construct in the future. Without a specific goal identified, the team considered a couple of options to attempt to quantify what a more aggressive energy efficiency standard might target beyond the mandated level. The possibility of a LEED-related goal was discussed, but LEED goals can be achieved through actions other than energy use reduction. The *minimum* LEED 2009 energy use requirement is 10% below ASHRAE 90.1-2007. This, however, is less aggressive than the current standard of 30% below ASHRAE 90.1-2004 already required by North Carolina.

Instead, the team used a study by the U.S. Department of Energy (USDOE) that compares the relative impact of building energy use as modeled by ASHRAE 90.1-2004 versus the latest modeling standards put forth in ASHRAE 90.1-2010. The USDOE analysis modeled hypothetical prototypes of various building types set in several different climate zones. The modeling showed significantly reduced energy use according to the ASHRAE 90.1-2010 standard compared to the ASHRAE 90.1-2004 standards:

- 26% lower for an office/classroom building;
- 23% lower for hospitals (used as a surrogate for the laboratory building type); and
- 10% lower for an apartment (university housing) building.

In lieu of a specific energy use goal beyond what North Carolina already requires, the energy use reductions shown by the USDOE study comparing ASHRAE 90.1-2004 and ASHRAE 90.1-2010 were applied to the estimated state-mandated EUI factors shown in **Table 3.11**. The resulting factors, shown in **Table 3.12**, then effectively represent a 30% reduction from the more stringent ASHRAE 90.1-2010 baseline and were used as the estimated energy use targets for a "beyond mandate" goal if such a goal is set by UNCG.

Table 3.12: Estimated "Beyond Mandate" EUI Targets by Building Type

	Laboratory (kBTU/GSF)	Housing (kBTU/GSF)	Office/Classroom (kBTU/GSF)
Beyond-Mandate EUI	169	68	56

Although buildings constructed to higher energy efficiency standards will ultimately save significant energy and cost over their lifetimes, these incremental improvements in energy use intensity will also come with a higher initial cost of construction. Those incremental increases in construction costs have been estimated as follows:

Table 3.13: Incremental Cost of Construction by EUI Target and Building Type

Incremental Cost by Building Type	Mandate Cost $/GSF	Beyond Mandate $/GSF
Office/Classroom	$7.50	$10.00
Lab	$10.00	$14.00
Residential	$6.00	$8.00

The incremental cost premiums for the mandated energy use of state buildings are based on a North Carolina study that shows an approximate 3% cost premium for meeting the state standards.[9] The basis costs to which this premium was applied were based on AEI's experience and actual recent building construction costs. The incremental cost premiums for the "beyond mandate" goal assume a 4% premium from AEI's estimated construction costs by building type.

These cost premiums and the estimated energy use reduction beyond what North Carolina currently requires were applied to the projected future construction at UNCG. Modeling results for payback and GHG reduction are shown in **Table 3.14**.

[9] Performance Standards for Sustainable, Energy-Efficient Public Buildings Consolidated Report Required under G.S. 143-135.39(g), September 29, 2011, page 1. http://www.ncleg.net/documentsites/committees/ERC/ERC%20Reports%20Received/2011/Department%20of%20Administration/2011-Oct%20Energy%20Efficient%20Bldgs%20Consolidated%20Report.pdf

Table 3.14: Modeling Results for New Construction Energy Use Beyond the State Mandate

Simple Payback (years)	10
Average Annual Carbon Abatement (MTCO2e)	4,000

Note that the carbon abatement shown in **Table 3.14** is an average over the planning period (though 2050). Since construction is expected to continue throughout the planning period, carbon reduction (and cost savings) from the BAU scenario will continue to grow as more energy efficient buildings are constructed.

3.1.3 Space Planning and Management

By using existing and future space more cooperatively and efficiently, UNCG could avoid the need for the future building that is projected in the Business As Usual scenario. The Office of Space Management (OSM) at UNCG has led efforts in this area. However, effective space utilization on campus must be emphasized and promoted by the administration to change the culture on campus to one of collaborative use of space. One approach is to emphasize the financial and climate benefits of qualitative space management: combined with the existing programs of the OSM, policies to prioritize both space-sharing and more effective programming/usage of space could result in avoiding up to 10% of future construction. This represents a significant reduction in future campus energy use and cost savings, as seen in **Table 3.15.**

Table 3.15: Modeling Results for Space Planning and Management

Simple Payback (years)	0
Average Annual Carbon Abatement (MTCO2e)	3,620

Though expected to be minimal, any costs incurred would be paid for as soon as the need for a building is eliminated due to the more efficient use of existing space.

3.1.4 Energy Conservation in Existing Buildings

UNCG's existing stock of buildings represents an opportunity for energy use reductions through conservation efforts. Although UNCG has already begun to implement energy conservation measures (ECMs) to achieve energy reductions in selected buildings, we estimate the University could save as much as 10% of energy use in existing buildings by implementing relatively low-cost ECMs such as the following:

- Retro-commissioning to retune buildings
- Campus site lighting
- Motion switches and other lighting controls
- Energy management system expansion and optimization
- Lighting upgrades

- Variable Air Volume (VAV) fume hoods
- Demand or occupied/unoccupied ventilation rate reduction
- Air Handling Unit (AHU) supply air static pressure reset
- AHU VAV conversion

The specific ECMs to be included would require study and identification as part of a separate effort – possibly via an ESCO performance contract as has already been done on campus. The assumption here is these relatively low-cost ECMs could capture the "low-hanging fruit" of energy savings. The total capital required for these ECMs is estimated at $8 million. It is also assumed the ECMs would be implemented over a 5-year period campus-wide. Modeling results are presented in **Table 3.16**.

Table 3.16: Modeling Results for Energy Conservation in Existing Buildings

Simple Payback (years)	14
Average Annual Carbon Abatement (MTCO2e)	4,730

Note that additional energy conservation opportunities may exist in UNCG's existing buildings beyond what is estimated here. The initiatives and measures required to realize additional energy savings would likely come at a higher cost and would need more detailed analysis to identify and model.

3.1.5 Behavior Change Initiatives

Another potential source of energy demand reduction is through changes in the behavior of energy users on campus. Studies have shown that outreach and communication efforts to influence or possibly incentivize energy use reduction tied to behavior can reduce energy use on college campuses by as much as 10%[10]. This plan assumes an annual cost for staff to establish and maintain the program, including outreach materials. It assumes a 3% reduction in campus electrical energy use after five years and a 5% reduction after 10 years. Modeling results are presented in **Table 3.17**.

UNCG will build on existing policies and programs focused on energy conservation and efficiency to support the commitment to climate neutrality. Daily decisions such as whether to extinguish unnecessary lights or to leave computers on when not in use directly affect the University's expenses and emissions output. The Office of Sustainability has created some outreach programs to encourage the campus community to reduce energy consumption. For example, the Office has targeted "vampire" energy, the electricity consumed by many electronic devices like televisions, stereos, printers, and computers when operating in standby mode; cell phone chargers and similar

[10] University Business Executive Roundtable, *Managing University Energy Costs, Strategies and Best Practices for Reducing Energy Utilization Across Campus*, Education Advisory Board, 2009, p. 7. This study illustrates that approximately a 2-10% reduction in energy costs can result from consumer focused strategies as opposed to building focused strategies which can account for more than 30% energy cost reductions.

devices continue to draw electricity if they remain plugged in after recharging is complete (Shapley, 2009). Vampire energy accounts for more than 100 billion kilowatt hours (11%) of annual U.S. electricity consumption and more than $10 billion in annual energy costs (United States Environmental Protection Agency, 2008). On a typical college campus vampire energy comprises 10-15% of overall campus electrical use, and this is expected to increase as more electrical components are brought to campuses. As noted earlier, UNCG has created a student-driven campaign called "Vampire Energy Slayers" to make the campus aware of these energy draws and options to reduce them. Broader campaigns can be built from this successful effort.

Targeted social marketing efforts can also instill behavior change. Effective strategies include obtaining commitments from community members via a "green" pledge and then using prompts, incentives, and persuasive communications, and facilitating the desired behavior will foster change (McKenzie-Mohr & Smith, 2008). Educational campaigns will focus on specific audiences:

- The sustainability office will continue to work on student-centered energy conservation campaigns.
  - Energy conservation competitions will be held periodically. Oberlin College pioneered the energy dashboard as a real-time visual feedback tool for campus energy awareness. Oberlin conducted a study to determine the efficacy of these programs and determined that dorm electrical consumption dropped 31-55% during competitions, and continued into a post-competition period (Petersen, Shunturov, Janda, Platt, & Weinberger, 2007). UNCG could purchase an energy dashboard to foster similar savings (NOTE: these costs and savings are not built into the payback model in **Table 3.17**).
  - Housing could establish residence hall sustainability "champions," students who educate their peers about energy conservation and other sustainability issues. Residence hall staff would also receive training on energy efficiency.
  - The Student Government Association should also be engaged in sustainability initiatives.
- To more specifically target employees, the Sustainability Office will work with faculty and staff representatives in various partnerships:
  - Create departmental sustainability champions to serve much as the proposed student sustainability champions
  - Expand, update and promote the existing Green Office certification program
  - Provide marketing and education through the Faculty and Staff Senates.

Table 3.17: Modeling Results for Behavior Change Initiatives

Simple Payback (years)	5
Average Annual Carbon Abatement (MTCO2e)	1,860

3.2 Supply-Side Analysis

3.2.1 Steam Distribution System Improvements

In 2008, Affiliated Engineers completed a Steam Distribution Assessment and Master Plan of UNCG's steam distribution system. That project identified deficiencies and estimated the cost of repair and replacement throughout the system at several million dollars. One of the most prevalent deficiencies identified in the system was damaged or missing insulation on steam lines and valves that result in lost heat. Although parts of the steam distribution system have been repaired or replaced since the study was completed, there are sections where deficiencies still exist resulting in significant heat loss. This was confirmed by a recent inspection of five random manholes in the system.

For the purposes of this study, with a focus on energy use reduction, it is estimated that repairs to and replacement of insulation could be performed at a much lower cost than the larger-scale repairs noted in the Assessment and Master Plan. The potential steam savings from these improvements is estimated at 1% of the total campus steam production on an annual basis. The estimated cost of these improvements is $200,000. Modeling results are shown in **Table 3.18**.

Table 3.18: Modeling Results for Steam Distribution Improvements

Simple Payback (years)	7
Average Annual Carbon Abatement (MTCO2e)	340

3.2.2 Steam Plant Improvements

During a tour/inspection of UNCG's steam plant by AEI's boiler expert and conversations with the boiler plant operators, it was determined that UNCG's boilers are running well. That finding, combined with the fact that UNCG uses natural gas as its primary fuel for steam production (along with minimal amounts of oil as backup) translates to relatively little room for improvement in efficiency or GHG emissions reduction – especially compared to an institution that may be running older, less efficient coal boilers.

Nevertheless, there were some areas of operation that were noted for potential improvement at relatively little cost:

- Reduce number of boilers in hot standby during summer and shoulder seasons
- Replace two damaged economizers
- Add Variable Frequency Drives (VFDs) to boiler forced-draft fans
- Add VFDs to boiler feedwater and transfer pumps
- Replace or repair water treatment system components
- Add insulating blankets to major valves

It is estimated that these repairs/upgrades could result in an improvement of 4 percentage points in plant efficiency – up from the 79% efficiency noted by plant operators to 83% efficiency. It is also estimated that 50,000 kWh per year in electricity could be realized by making these changes. The total cost of these upgrades is estimated at $500,000. Modeling results are shown in **Table 3.19**.

Table 3.19: Modeling Results for Steam Plant Improvements

Simple Payback (years)	11
Average Annual Carbon Abatement (MTCO2e)	1,170

3.2.3 Chiller Plant Improvements

UNCG's Chiller Plant was designed by AEI in 1998. During a recent tour of the facility, the following items were noted as areas of potential improvement in plant operability:

- Incorporate variable flow control on condenser water pumps
- Convert to variable primary pumping and control primary pump flow to match secondary pump flow (NOTE: Although variable flow control was recently installed, it is only being used to control pressure across the chillers. Additional savings could be realized by controlling flow)
- Improve condenser water temperature and tower fan optimization, lowering condenser water supply temp when possible

Note that while this last bullet item has already been implemented by UNCG, system operation during AEI's site visit indicated that additional improvement could be achieved. Thus, implementation cost for these measures is estimated at a relatively minimal $75,000 (new flow meters and control modifications). Savings are estimated to be about 10% of chiller plant electrical consumption, or about 500,000 kWh per year. As one of UNCG's primary energy users, it is worth noting the relatively low estimated cost of the recommended improvements in contrast to the expected reduction in electricity consumption. Modeling results are presented in **Table 3.20**.

Table 3.20: Modeling Results for Chiller Plant Improvements

Simple Payback (years)	2
Average Annual Carbon Abatement (MTCO2e)	310

3.2.4 On-Campus Renewable Energy

Solar Photovoltaics (PV)

Parking decks often offer an ideal location for a solar PV project. The height of the structure reduces the negative impact of shading on the system from other structures or trees and the footprint of parking decks provides an economy of scale that can improve project economics. The downside is

that the PV panels must be raised and supported above the highest level of parking, resulting in additional cost for implementation.

UNCG has three parking decks that could each be used for such a project – the McIver, Walker, and Oakland decks. As each of these structures is roughly similar in size, only one such project was modeled for this effort. The results are expected to be similar at each of the three locations.

Each deck has a footprint of roughly 1 acre. It is estimated that about 1,500 panels could be placed in this area, each producing 210W at peak output. This results in a rated capacity of 315kW for the system. Assuming an average 16% capacity factor for the system on an annual basis, the system is estimated to generate about 440,000 kWh per year. That output is estimated to decline by 1% per year over the expected 25-year life of the system due to degradation of the panels. The installed cost of the system (including structural support to suspend the panels above the deck) is estimated at $2,500,000. Based on these estimates, the results of modeling the system are presented in **Table 3.21**.

Table 3.21: Modeling Results for Solar PV

Simple Payback (years)	No Payback
Average Annual Carbon Abatement (MTCO2e)	170

As indicated in **Table 3.21**, the system does not pay back within the expected 25-year life of the system. As an alternative, it was suggested that because campus demand for parking has decreased over the past five years, the Oakland Parking Deck could allow for installation of panels directly on the top level's parking surface – thus eliminating the need for the additional cost of a structure to raise the panels above the parking surface. The additional structural cost in the original estimate, however, was a relatively small portion of the total. The estimated cost of the PV system with the additional structural cost is $2,175,000 and the system still does not pay back within its expected 25-year life.

Solar Thermal

The use of solar thermal technology for domestic hot water (DHW) production was investigated for implementation at UNCG's residence halls. For the purposes of this study, one of the "Quad" residence halls was used as an example project. The results of this analysis could be repeated for any of the other residence halls, but these are specific to a building the size of Jamison, Coit, Bailey, Hinshaw, Cotton, or Gray.

Each of these buildings offers about 7,000 square feet of roof area and could potentially provide space for about 100 solar thermal panels. Each of these systems could produce up to 450 mmBTU per year in DHW that would displace steam use by the building. The estimated installed cost of such a system (including storage) is $250,000. O&M costs are estimated at 1% of the installed cost.

It should be noted that the actual output can vary greatly depending on the annual usage profile for DHW. These estimates assume near-constant demand for DHW on an annual basis and would not be reflective of a system that is not sufficiently utilized during the summer months (e.g., if the residence hall is unoccupied during the summer). The modeling results based on these assumptions are shown in **Table 3.22**.

Table 3.22: Modeling Results for Solar Thermal

Simple Payback (years)	No Payback
Average Annual Carbon Abatement (MTCO2e)	30

Similar to the Solar PV option, solar thermal does not pay back within the expected life of the system. As an alternative, it may be possible for UNCG to engage in a 3rd party agreement under which a developer would install, own, and operate a solar thermal system at UNCG for 10 years. The 3rd party would be able to take advantage of significant tax credits and incentives not available to UNCG that make the economics of the system viable. After 10 years, UNCG would have the option of buying the system from the developer at 10 percent of the original cost.

At the time of this study, UNCG was still in negotiations with a potential developer of such a system and details of the agreement could not be divulged. Based on the estimates and assumptions described previously and assuming the system could be purchased for 10% of the original cost after 10 years (the estimated useful life of the system is 25 years), financial modeling was performed again. Unfortunately, the system still does not pay back within the (remaining) 15-year life of the system; however, the break-even point is just over 15 years. A more detailed study of a solar thermal installation at UNCG, its costs and expected output may very well make such a 3rd party agreement a viable option. More analysis is recommended.

3.3 Summary of Near-Term Energy Options

All the preceding demand- and supply-side options represent initiatives or technologies which are proven and can be implemented immediately – financing notwithstanding. After modeling each of the alternatives against the base case described previously, the following GHG reduction curve (**Figure 3.6**) is developed:

Figure 3.6: GHG Reductions from Near-Term CAP Portfolio

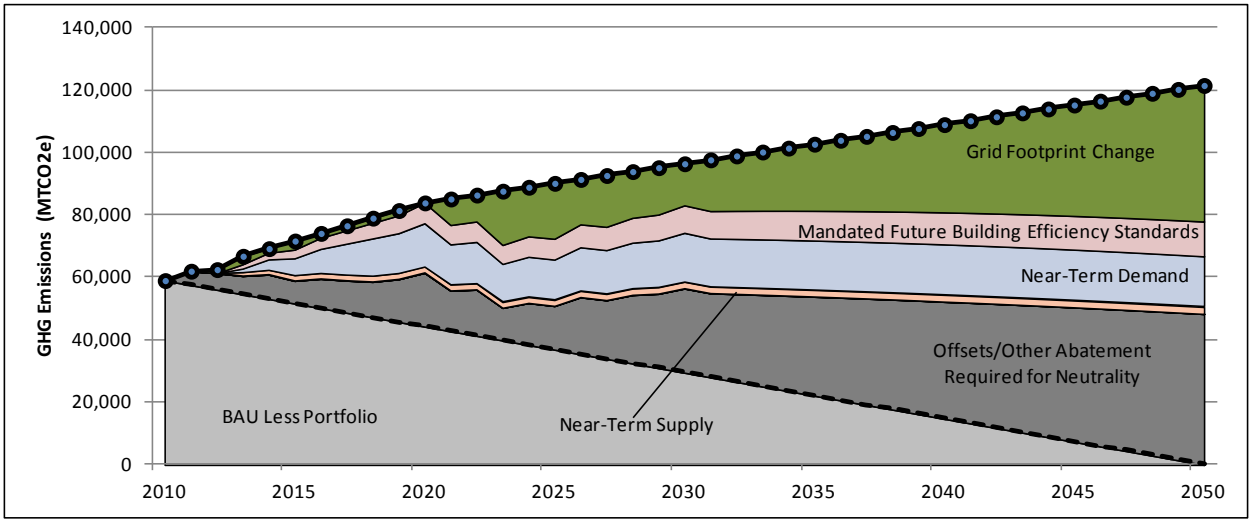
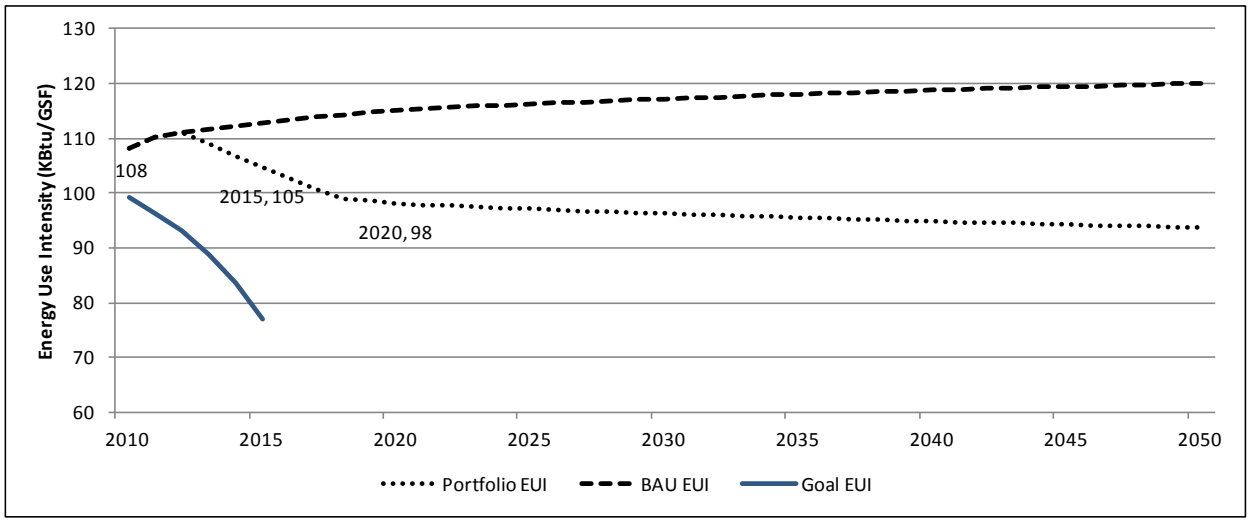


Figure 3.6 shows an unmitigated business as usual projection of energy-related GHG emissions exceeding 120,000 MTCO2e in 2050. The effect of the GHG intensity reduction forecast for purchased electricity and the state-mandated energy efficiency standards for new buildings are expected to reduce the expected emission to nearly half of the business as usual case – to about 66,000 MTCO2e in 2050. The implementation of the near-term options described above will reduce the expected GHG emissions in 2050 by an additional 23% – to about 50,000 MTCO2e in 2050.

In the very near term, implementation of the near term portfolio does not appear to put UNCG on a path to reducing its EUI by 30% by 2015 (2002 baseline). **Figure 3.7** demonstrates this by depicting the business as usual growth in EUI and the projected impact of the near-term portfolio versus the goal set forth by UNCG. Additional reductions or outperformance of the estimated impact of this portfolio will be necessary to meet this goal.

Figure 3.7: Energy Use Intensity (EUI) Projections



3.4 Long Term Energy Supply Options

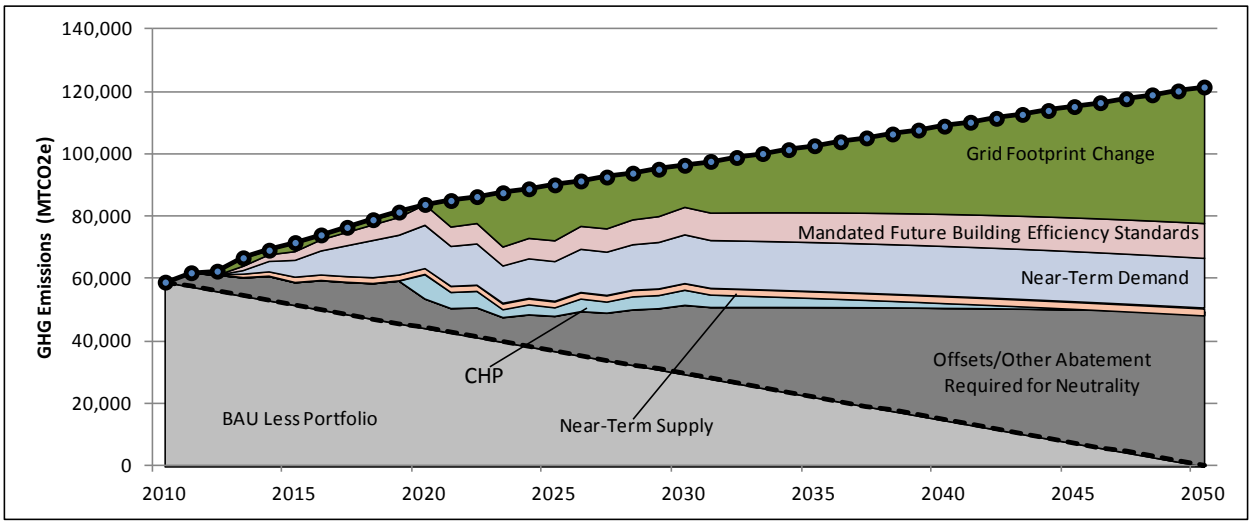
The central steam plant consists of boilers installed in 1989 and 2004. Although several years from the end of their expected life and currently operating without issue, the boilers will be due for replacement within the planning window of this Climate Action Plan. Though this plan is focused primarily on near-term options and is not intended to speculate on the feasibility or economics of technologies capable of producing sufficient thermal energy for a University campus, the following two scenarios have been developed to show the relative impact of these potential options on UNCG's future GHG inventory.

3.4.1 Combined Heat and Power

Combined heat and power (CHP) is the simultaneous production of both thermal and electrical energy instead of the conventional model of producing thermal energy locally and purchasing electricity from the local utility. The CHP system becomes much more efficient than the conventional model and can represent a cost savings over time, depending on utility costs.

Based on UNCG's annual steam load curves, a Solar Centaur 50 combustion turbine system was selected so as to provide the minimum summertime load when operating at 100%. At this operating condition, the system is estimated to generate about 4.3 MW (net system output) – approximately 36,000,000 kWh per year. Additional steam load required by campus buildings during shoulder and winter months would be generated by supplemental (and highly efficient) duct firing. The maximum steam generation capacity of the system with duct firing is roughly equivalent to the maximum peak load seen by UNCG in recent years.

Figure 3.8: GHG Reductions from Combined Near-term Options and Combined Heat and Power (CHP)



Based on the estimated natural gas consumption by the CHP system in general operational profile, an estimated capital cost of $12 million installed, and an estimated O&M cost of $0.01 per kWh, the modeling results are shown in **Table 3.23**.

Table 3.23: Modeling Results for Combined Heat and Power

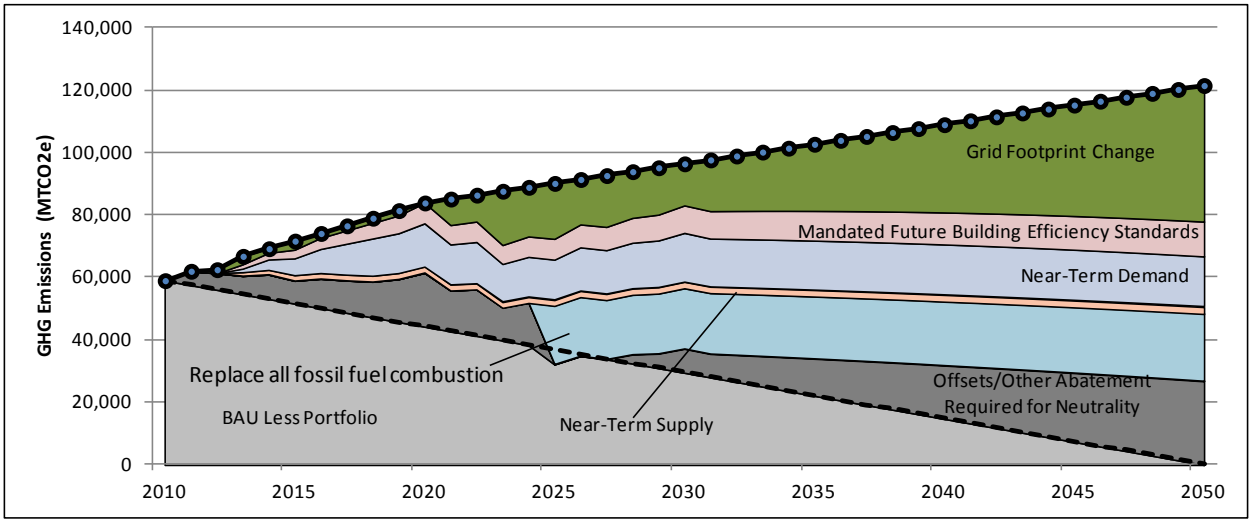
Simple Payback (years)	17
Average Annual Carbon Abatement (MTCO2e)	2,590

While the modeling of the system provided favorable results, it is worth noting that the potential impact of the system on UNCG's GHG inventory is expected to diminish over time. The effect of CHP on campus emissions is to shift them from Scope 2 (purchased electricity) to Scope 1 (on-site natural gas combustion). As the Scope 2 emissions from purchased electricity decrease in the future as described in Section 2.7, they may become lower than the emissions from the natural gas used to fuel the CHP system. If and when this happens, the CHP system would effectively increase UNCG's GHG emissions relative to what would be emitted by producing steam in boilers and purchasing power separately.

3.4.2 Conversion to a Carbon-Neutral Fuel/Technology

Without speculating the exact fuel or technology that might be utilized by UNCG for thermal energy production in the future, this option was modeled to show the relative impact of switching from natural gas to a carbon-neutral fuel in the future. The modeling assumes the fuel switching would be implemented in equipment designed to produce thermal energy only – not in a combined heat and power scenario as described in Section 3.4.1. Implementation of fuel switching was modeled in 2025 – at which point the existing boilers will be 36 and 21 years old, respectively. Of particular note is that even with no on-site use of fossil fuel for steam production, a significant portion of UNCG's projected GHG emissions will remain due to the large amount of purchased electricity and the GHG emissions associated with that energy.

Figure 3.9: GHG Reductions from Combined Near-Term and Conversion to a Carbon-Neutral Fuel/Technology

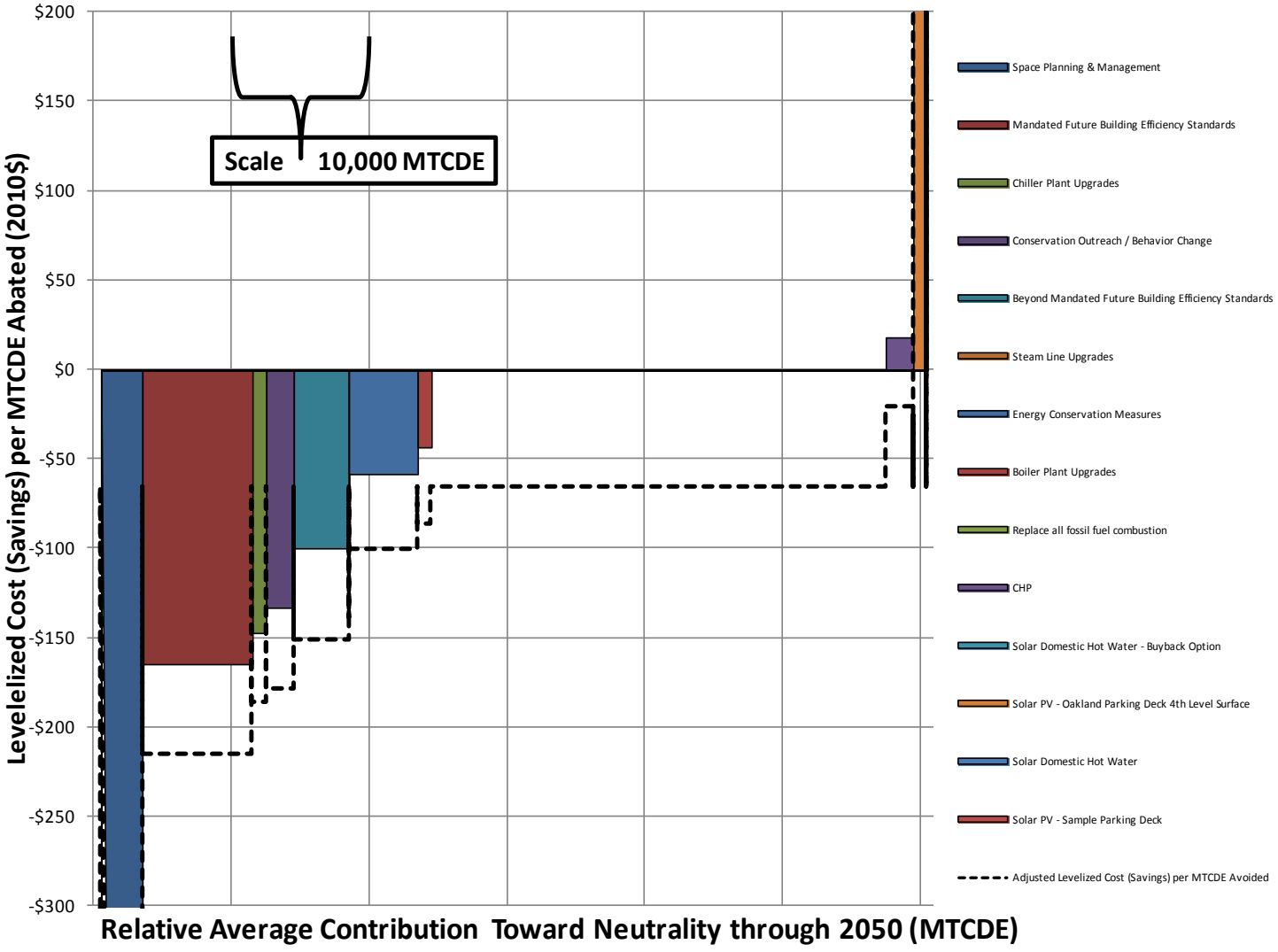


It is recommended that UNCG continue to monitor and evaluate new technologies for both thermal and electrical energy production to identify viable options for implementation on campus in the future.

4. CAP ENERGY PORTFOLIO SUMMARY

Figure 3.10 shows a combination of cost effectiveness and GHG abatement potential for each option in the CAP portfolio. The x-axis displays the average GHG reduction potential of each option from its implementation through 2050. The y-axis shows the levelized cost (or savings) of each option in terms of dollars per MTCO2e abated. Bars below the zero-line represent a cost savings per MTCO2e while bars above the line represent a cost. The data shown in **Figure 3.10** are summarized in **Table 3.25** that follows.

Figure 3.10: Abatement Curve for CAP Portfolio



While this portfolio would require incremental capital investments (not accounting for avoided building capital expenditures as a result of avoided construction), it is possible that net savings could begin to accrue to the University in the near-term and continue to increase over time (see **Table 3.24**).

Table 3.23: Portfolio Cash Flow Summary (2012$)

	2015	2020	2025	2030	2035
FuelSavings	$1,060,000	$3,220,000	$3,910,000	$4,580,000	$5,240,000
Incremental OPEX	($170,000)	($460,000)	($470,000)	($480,000)	($480,000)
Debt Service Net CAPEX	($690,000)	($2,030,000)	($2,100,000)	($2,160,000)	($1,530,000)
Portfolio Cash Flow	$200,000	$720,000	$1,340,000	$1,940,000	$3,230,000

**Values may not add exactly due to rounding*

OPEX = Operating expenditures

CAPEX = Capital expenditures

Table 3.24: CAP Portfolio – Summary of Modeling Results

								w/o Compliance Risk Savings		
Alternative (click on link below to see detailed asssumptions)	Year Implemented	Levelized Cost (Savings) per MTCDE Avoided:	Levelized Avoided Compliance Cost per MTCDE Avoided:	Adjusted Levelized Cost (Savings) per MTCDE Avoided	Contribution toward Neutralilty in 2050	Average Contribution Toward Neutrality (MTCDE)	PV of Incremental Capital ($MM)	Simple Payback	NPV (2012 $MM)	IRR
Space Planning & Management	2013	($2,751)	$52	($2,804)	4.1%	3,615	$109.1	0.0	$114.2	
Mandated Future Building Efficiency Standards	2013	($165)	$51	($215)	9.2%	8,307	$0.0	0.0	$16.1	
Chiller Plant Upgrades	2013	($148)	$38	($186)	0.2%	314	($0.1)	2.3	$0.7	79%
Conservation Outreach / Behavior Change	2013	($133)	$45	($178)	1.4%	1,861	$0.0	5.1	$3.2	48%
Beyond Mandated Future Building Efficiency Standards	2013	($100)	$51	($151)	4.4%	3,996	($3.0)	10.3	$4.7	20%
Steam Line Upgrades	2013	($94)	$45	($138)	0.3%	341	($0.2)	7.3	$0.4	17%
Energy Conservation Measures	2013	($59)	$42	($101)	3.3%	4,728	($6.0)	13.8	$3.8	9%
Boiler Plant Upgrades	2013	($44)	$43	($86)	1.1%	1,173	($0.4)	10.5	$0.7	13%
CHP	2020	$18	$38	($21)	-0.9%	2,591	($8.1)	17.1	($0.6)	
Solar Domestic Hot Water - Buyback Option	2025	$29	$54	($25)	0.0%	18	($0)	No Payback	($0.0)	
Solar PV - Oakland Parking Deck 4th Level Surface	2015	$503	$45	$458	0.1%	171	($2)	No Payback	($1.2)	

BACKGROUND

Automobiles have been the transportation method of choice in the United States since the early 20th Century, at the expense of other forms of transit. Development patterns in the U.S. evolved due to American attitudes about cars, especially the belief that they "provide a degree of personal freedom and flexibility that public transit cannot" (Dreier et al. 2004). Ironically, as Dreier et al. (2004) point out, that promise of freedom and flexibility often disappears during the billions of hours per year that Americans collectively spend in traffic.

Automobile use also damages both human and environmental health. The transportation sector accounts for 70% of U.S. oil consumption; gasoline and diesel fuels alone account for 60% of oil consumption. Burning these fuels for transportation accounts for 67% of carbon monoxide (CO) emissions, 45% of nitrogen oxide (NOX) emissions, and 8% of particulate matter emissions. These pollutants lead to various human health problems including lung and heart disease and higher infant mortality rates (Knittel 2012; Toor and Havlick 2004). Engine combustion also emits both NO_X and volatile organic compounds which create ground-level ozone (smog) when combined with heat and sunlight (Knittel 2012). Most pertinent to this discussion, however, is that the transportation sector contributes significant amounts of GHG emissions. Each gallon of gasoline burned emits approximately 25 pounds of CO_2 into the atmosphere (Knittel 2012); in total, 30% of U.S. greenhouse gas emissions result from the transportation sector. According to the EIA (2012), in 2011 petroleum combustion for transportation was responsible for emitting over 1.8 billion $mtCO_2e$.

Traffic congestion and limited parking are typical of most universities, as are the accompanying health, environmental and economic problems noted above; UNCG is no exception. As the enrollment at UNCG grows these difficulties are expected to grow as well. To achieve climate neutrality, UNCG must address its transportation emissions. "Any university that is attempting to make the transition toward sustainability must confront the issue of transportation. The daily movement of people back and forth to campus in automobiles burning fossil fuels is one of the largest impacts a typical educational institution imposes on the life support systems of the planet" (Toor and Havlick 2004).

CURRENT INITIATIVES

Acknowledging the environmental and health impacts of transportation, as well as the costs needed to provide new parking, UNCG has initiated and promoted multiple alternatives to travel in single-occupant vehicles (SOVs). Led by Parking Operations and Campus Access Management (POCAM), these efforts have resulted in UNCG's recognition as a leader in alternative transportation. In 2010, UNCG was named a Best Workplace for Commuters by the National Center for Transit Research, the first BWC in the state of North Carolina. In 2011, the University earned a bronze-level Bicycle Friendly University designation, the first school in the state recognized by the League of American Bicyclists. UNCG received a gold medal award from the National Center for Transit Research in 2011 and 2012, along with the top honor "Best of" in the university category in 2012. The transportation

demand management (TDM) programs and policies UNCG has implemented to earn these accolades are covered extensively in the 2012 Transportation Master Plan (TMP) Update, but here is a brief review of these programs:

- UNCG offers fare-free **public transit** through the Greensboro Transit Authority (GTA). GTA buses provide service from UNCG to many destinations across the city. In 2006, GTA partnered with the seven colleges and universities in the city to create the HEAT (Higher Education Area transit) lines, an express service specifically for students and employees at those institutions. HEAT buses share stops with GTA's regular service, allowing riders to connect across the city.
- **Campus Shuttles:** The Spartan Chariot is one campus shuttle service. It makes several stops on a campus loop, including at the UNCG transit hub at Walker Circle so riders can connect to GTA and HEAT more easily. For greater convenience, the Chariots can be tracked by riders via an online GPS bus locator map. A Park-and-Ride shuttle is also available for those who park in remote lots.
- To encourage **bicycling** and **walking**, UNCG offers several amenities:
    - Bicycle registration: Beyond increasing the likelihood that lost or stolen bicycles are recovered, registration benefits include discounts at local bike shops, access to free basic bicycle maintenance and tools on campus, free Emergency Ride Home service, and prizes at campus cycling promotional events.
    - Bike/pedestrian infrastructure: The city has provided bicycle lanes along Spring Garden Street within the traditional campus footprint (between Tate and Aycock). UNCG has added many bike racks over the past few years so that there is now parking for over 1000 bicycles. UNCG has also installed Dero Fixit stations with the tools needed for basic bike repairs and maintenance in four convenient campus locations. The entire campus is pedestrian friendly as well, with sidewalks and paths throughout. The TMP Update includes recommendations to improve pedestrian crossing between surrounding neighborhoods and campus.
    - Spartan Cycles Bike Share: Rental bicycles are available through the Spartan Trader store at Spring Garden Apartments.
    - UNCG Pedal Club: Available to all University students and employees, the mission of this group is "to open avenues of communication throughout our cycling community with the goal of creating a greater cycling experience for all involved."
    - GTA and HEAT buses are equipped with bicycle racks to encourage commuters to cycle between home and the transit stations.
- **Carpooling**: UNCG has contracted with Zimride to create and operate a private online network to connect potential carpool members within the UNCG community. Carpoolers may also seek connections via Share the Ride NC. A carpool club incentive program was launched Fall 2012.
- **Car-sharing:** Zipcar allows members to reserve cars by the hour or the day, easing congestion on campus and reducing the need for additional parking. Gas, 180 miles per day, insurance,

reserved parking spots and roadside assistance are included in Zipcar rates. Cars can be reserved for as short as an hour or for up to four days. The annual membership fee is $25 and UNCG applicants receive $35 worth of free driving credit that applies toward their first month of driving. Free annual memberships are offered to departments.

- **Emergency Ride Home Program**: The UNCG Emergency Ride Home program, managed by the Piedmont Authority for Regional Transportation (PART), provides participants (commuters who regularly use alternative transportation) with a reliable ride home in case of emergency on any day the person has used an alternative mode of transportation to get to campus.
- **Annual Campus Transportation Challenge**: in conjunction with the Piedmont Authority for Regional Transportation's Triad Commute Challenge, UNCG encourages and incentivizes students and employees to explore alternative transportation. This three-month targeted effort is intended to improve air quality and traffic congestion by challenging commuters to try a transportation option other than driving alone at least once.
- **Education**: During orientation sessions for new employees and students, information on alternative transportation options is distributed by POCAM. POCAM also holds several outreach events to promote and incentivize their programs. Information is also available on POCAM, Housing and Sustainability Office websites, and all parking permit applicants are urged to consider alternative transportation during the permit purchasing process.
- **LEV Priority Parking:** To encourage the use of hybrid and fuel-efficient vehicles, UNCG has established priority parking spaces specifically for low emissions vehicles (LEV). To park in LEV permit spaces, a vehicle must qualify based on criteria set forth by the American Council for an Energy Efficient Economy and the US Green Building Council.
- **Fleet vehicle operations**: The University owns and operates 229 vehicles, including automobiles, sport utility vehicles, vans, box trucks, and recycling trucks. To reduce fuel consumption and move away from fossil fuel use, UNCG is mandated by the State of North Carolina to create and follow a Transportation Fuel Petroleum Displacement Plan (PDP). This mandate calls for a 20% reduction in petroleum use by campus vehicles based on a 2005 baseline (http://facoperations.uncg.edu/newempfuel.html)

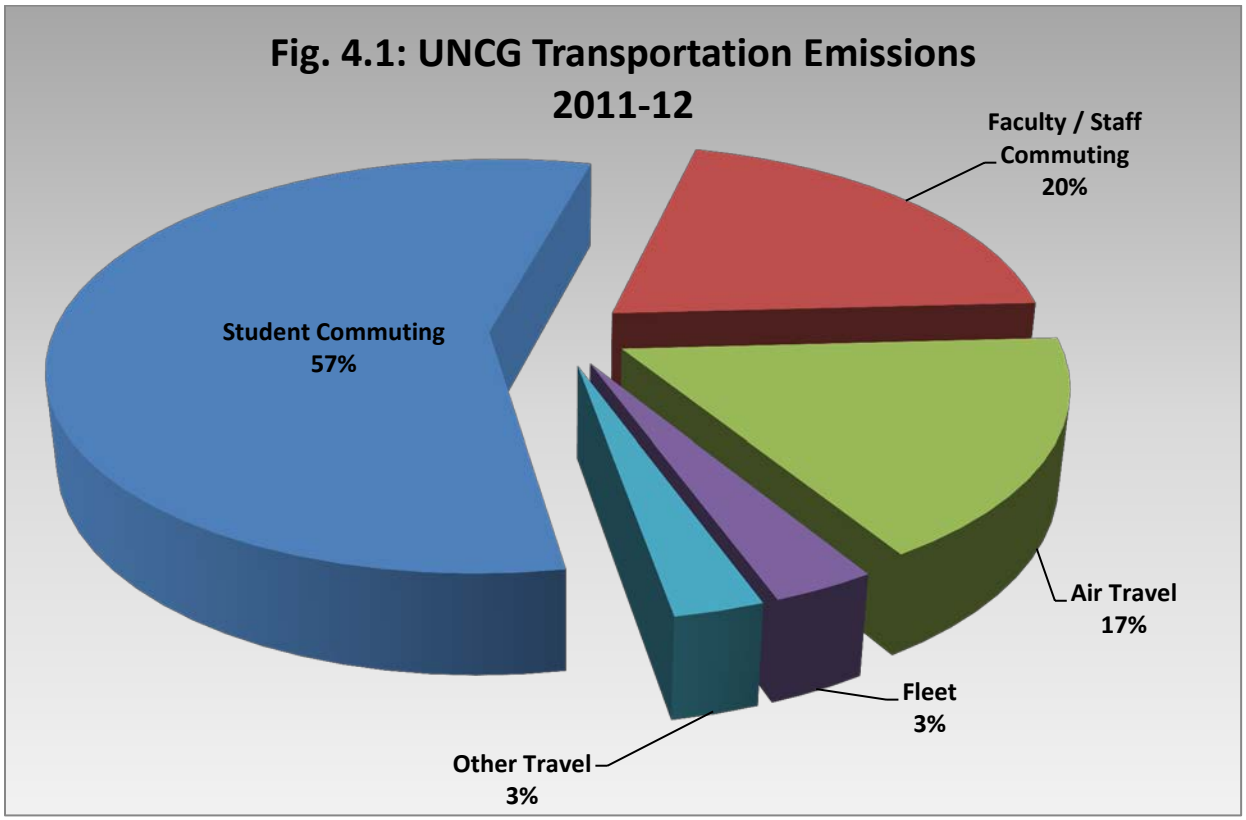
  The PDP has spurred some improvements over the past seven years. Though no campus vehicles are hybrids, shuttle buses and diesel trucks are fueled by B5 or B20 biodiesel blends. The gasoline consumed on campus is an E10 blend. The University also operates 35 electric cars and carts, and some landscape vehicles are propane fueled.

NEXT STEPS

For the purposes of this analysis, "transportation" is comprised of: commutes of employees and students; movement of students and employees between main campus and community-based learning sites; fleet and maintenance vehicle mileage; and University-sponsored travel. To meet its

carbon neutrality mandate and maintain its leadership in the realm of TDM, UNCG must address each of these areas.

In 2011-12, UNCG transportation accounted for 24,210.3 $mtCO_2e$, or 28.4% of the University's carbon emissions. Commuting was responsible for by far the largest portion of the transportation footprint, approximately 18,624 $mtCO_2e$, or 77% of the total transportation contribution (**Figure 4.1**). Travel, including air and ground, was estimated to be 4,810.4 $mtCO_2e$, or 19.9% (note that air travel mileage was calculated by Accounting Services based on a model they constructed to estimate miles from travel costs reported to their office). Finally, the footprint of the University fleet comprised 3.2% or 775.4 $mtCO_2e$. As UNCG progresses towards climate neutrality, it must develop a mechanism to facilitate the collection of travel information in order to better understand the scope of its travel impacts.



By fully implementing the recommendations that follow, UNCG could feasibly eliminate up to 45% of its GHG emissions from transportation over the next 15 years. After that, however, reductions to the University's carbon emissions will depend heavily on policies and practices beyond the control of UNCG: commuter choices, advancements in vehicle technology, public transit improvements in the Piedmont, and more. Therefore planning beyond 2025 is tenuous at best, so this Plan will be limited to those policies and actions that UNCG can take within that time period. However, as UNCG moves toward the 2050 mandate of neutrality, the University will constantly evaluate new policies, programs and technologies to improve its transportation options. Along with the biannual review and update of this CAP, UNCG's transportation practices will be analyzed every 5 years as it revises

its Transportation Master Plan (TMP), which provides a comprehensive review of transportation needs and how they can be met with less reliance on SOVs. To assist in these efforts, UNCG should work with the existing Sustainable Transportation Committee to review transportation policies and protocols annually, including the recommendations proposed as part of this Plan (below), and update as needed with input from the TMP. A logical place for this group to be housed is within the Sustainability Council, which reports directly to the Chancellor.

Commuters

Because the largest portion of UNCG's transportation footprint results from commuting employees and students, reducing their travel in single-occupant vehicles (SOVs) is essential to the success of this plan. UNCG will expand and supplement the successful TDM programs already in place.

The Sustainable Transportation Committee will be asked to **review commuter campus access options** annually and bring recommendations for any modifications to the Sustainability Council as needed to efficiently and effectively manage the supply of and demand for parking and transportation resources. The goal is to shift focus from parking to transportation, focus on moving people not cars.

Encourage sustainable transportation choices to minimize the demand for SOV infrastructure and reduce emissions.

Bicycle and Pedestrian Infrastructure:

The UNCG campus is compact, small (230 acres), and easily managed on foot. However, there are several locations where pedestrian access is difficult, particularly along the campus perimeter. Sites that need sidewalks and crosswalks are identified in the 2012 Transportation Master Plan Update (TMP), with particular focus on Aycock Street access.

To improve safety and convenience for bicyclists, cycling infrastructure improvements and additions are also necessary. Again, the central areas of campus are accessible but some perimeter roads remain inhospitable to bicycle traffic, especially Aycock and Market Streets. As noted in the TMP, UNCG should coordinate with the City of Greensboro to implement the necessary changes along these border streets. These bicycle and pedestrian infrastructure improvements would create amenities for both UNCG and residents of the surrounding neighborhoods, fostering a better "town-gown" relationship. And as more members of the UNCG community cycle for their commutes, more bicycle racks, Dero Fixit stations and shower facilities will be installed.

To support these infrastructure improvements, it is important that bike, pedestrian, and driver laws be rigorously enforced. This will reduce bike/ped/driver conflicts, educate the campus community, and give a sense of safety to those choosing to ride or walk.

Car-Sharing:

Typically, the majority of students residing on-campus do not use their cars daily; instead, they "store" them for weekend trips and occasional errands (Toor and Havlick 2004). UNCG instituted a

car-sharing program with ZipCar in 2010 to take advantage of this behavior pattern, and has seen modest success. In the agreement with ZipCar, UNCG is responsible for marketing the program to the campus community and for providing parking spaces for these cars on campus. Due to the benefits to students (and to a lesser extent, faculty and staff), and potential GHG reductions, UNCG should develop a stronger marketing campaign for its car-share. Or, the University could move to another car-share program such as WeCar. Car-sharing could replace the automobiles of students who may believe they need a vehicle when living on or near campus; ZipCar claims that 20 cars are taken off the road for each of their vehicles in service. Increased participation with the campus car-share could therefore delay or eliminate the need for future parking lots or decks, saving the University money as well.

Carpool:

As discussed earlier, carpooling is promoted and incentivized at UNCG through an agreement with the company Zimride. To increase participation, UNCG must establish more incentives and expand its marketing for carpools. A carpool club incentive program was launched Fall 2012 which includes permit cost sharing and priority parking spaces. Working with surrounding municipalities and regional transportation groups (PART, GTA), UNCG could create satellite Park & Ride lots in locations farther from campus such as Burlington, Reidsville and Winston Salem. To further encourage carpooling, UNCG could also sponsor periodic, unannounced ride share days during which carpoolers will receive rewards. UNCG will also assess other carpool and ride-share programs to determine if any could complement or replace Zimride.

Currently, UNCG estimates that 5% of its commuters carpool. By promoting and rewarding carpools, it is reasonable to expect that carpool participation would increase to 10% of commuters one day per week by 2015, equivalent to a reduction of approximately 186 $mtCO_2e$. Should gas prices continue to climb as expected, another 10% could be captured by 2025 through a combination of more carpool members and increased days of participation by existing carpoolers.

Telecommuting and Flexible Work Weeks:

UNCG has a telecommuting option for faculty and staff whose duties do not require a daily presence on campus. With supervisory approval, participants work from an off-campus location as appropriate for their positions. UNCG also piloted a summer flexible workweek wherein eligible employees could condense the workweek into four (4) days by working ten hours each day. Provided productivity remains the same, no costs would be incurred by UNCG to expand participation. These tactics save 20% of the GHGs produced per week for each day an employee works from home or for every flexible workweek participant, so emissions reductions could be significant. If 10% of UNCG's commuting employees (196 people) participate one day per week, this will reduce emissions approximately 97 $mtCO_2e$. With the advent of better telecommuting technology and expected increases in on-line courses and collaboration, even higher participation can be expected in the long-term.

Commuter Vehicle Incentives:

Regardless of the options presented, commuting in SOVs will remain the primary method of getting to campus for many in the UNCG community. To encourage commuters to drive more efficient vehicles, the University could consider several incentives. POCAM introduced LEV priority parking spaces on campus fall 2012; permit discounts could be offered for drivers of low emission vehicles (LEV) and zero emission vehicles (ZEV) to further encourage their purchase. As more electric vehicles enter the marketplace, UNCG will need to provide recharging stations. These could also be placed in priority parking locations to encourage lower emissions transportation.

Should these approaches prove to be ineffective, the University will have to consider disincentives for single occupancy vehicles. Deterrents are not the University's preferred strategy to reduce campus driving; UNCG favors a focus on education and outreach combined with viable options to automobiles. No disincentives will be implemented if the campus community takes advantage of the alternatives presented above and the concomitant commuter GHG emissions decrease. Should emissions increase, however, the University will consider the following:

Parking fees have discouraged some SOV travel at UNCG, but they do not fully account for the costs affiliated with construction and maintenance of infrastructure or the health and environmental damages from automobile emissions. **Raising permit rates** may further discourage SOV travel; a rate study is currently under consideration.

The increased permit rate can be implemented in a variety of forms. One approach is to assess a **carbon offset fee** for commuter vehicle parking permits. A carbon offset is a financial mechanism to transfer credit for the avoidance of GHG emissions in one location to GHG emissions occurring elsewhere (see **Section 2: Administration**). Here the GHG emissions from vehicles driven by employees and students would be offset by various projects including reforestation efforts, wind power generation, weatherization programs, etc. There are several reputable companies (e.g., Native Energy and Terrapass) that can properly determine the required offsets, ensure additionality, and provide a mechanism to easily purchase them. Or, UNCG could develop its own, local offset projects through the funds raised through this carbon offset.

Increase fines for illegal parking. Unfortunately, some members of the campus community see parking fines as merely another cost to attend or work at UNCG. By making this more costly, drivers may reconsider their SOV trip to campus.

Other ideas for deterrents:

- Eliminate gold reserve parking.
- Eliminate parking spaces and replace with buildings and/or green spaces.
- Create no new parking spaces except as required by the city for new construction projects.
- Consider parking permit restrictions such as no permits for drivers living within a predetermined radius of campus.

- Limit the number of permits issued by department, similar to UNC Chapel Hill.

Planning:

To aid in reducing commute distances, an assortment of retail and entertainment outlets must be available on or near campus. UNCG provides some of these venues at EUC, and there are a limited number along Tate Street, but many more are necessary to encourage students to remain on or near campus. This would also decrease the perception that students need personal vehicles to attend UNCG. Development of such amenities would also be attractive to faculty and staff and may encourage some to move to neighborhoods closer to the University, reducing or eliminating their commutes.

The University could consider encouraging local developers to offer retail and recreation facilities near campus, as currently there are few of these within walking or cycling distance of the campus. The plans for the new Spartan Village in the Glenwood neighborhood include some of these, but as planning evolves more could be facilitated. Such amenities could bolster the relationship between UNCG and its surrounding communities. Walking trails, bike lanes, and sidewalks would facilitate travel to these locations.

Develop a complete streets policy to ensure campus planners design and construct transportation networks with all users in mind – automobile drivers, bicyclists, pedestrians, and transit vehicle operators and riders.

Continue to update the Transportation Master Plan and Bicycle Master Plan and allocate resources to continue implementation of these plans.

Long Term Planning Considerations:

- Outsource campus transportation services if doing so would reduce impacts.
- Encourage development of affordable housing for employees and students with families within walking distance of campus.
- Require all new construction to be high density.
- Work with the City to create bike lanes on Glenwood Avenue between the existing bike lane on Florida Street and the Spartan village along Lee Street.
- Develop a rail stop on campus near the Spartan Village underpass.
- Close the Greenway gap at Chandler Concrete to improve bike connectivity to/from campus.
- Construct no more new parking spaces.
- As parking decks are paid off, replace with academic buildings or other non-parking facilities.
- Consider pedestrian safety zones requiring cyclists to dismount in high traffic areas.
- Develop guidelines and safety protocols for skateboards and other alternative vehicles.

Travel

Travel by University faculty, staff and students to conferences, athletic competitions, and other University -related activities was the second largest contributor to transportation emissions. Air and ground travel accounted for almost 20% of the UNCG transportation footprint, or 5.6% of the total University emissions profile.

As with University vehicles, industry improvements will assist in reducing the University's emissions from air travel. The International Air Transport Association (IATA) reported that the airline industry increased its fuel economy 16% between 2001 and 2011; an additional efficiency gain of 17% is expected by 2020. Assuming this is achieved, by merely keeping University travel to its current level the University's emissions will decrease 703.1 $mtCO_2e$ by 2020.

UNCG must not rely completely on the airline industry for emissions reductions, however; choices the University makes will impact this as well. To that end, the UNCG will consider updating its travel policy to:

- Encourage alternatives to travel, such as teleconferencing, web-conferencing and video conferencing versus physical attendance.
- Recommend that travelers take the most efficient travel available and appropriate for the trip (train or automobile are often more efficient for short (<500 miles) journeys); UNCG will reach out to **Mega Bus** to stop in Greensboro en route between Charlotte and Raleigh, to provide another low-cost, efficient source of travel (http://us.megabus.com);
- Have travelers add the purchase price of carbon offsets to the travel costs. This may necessitate legislation, as current law does not allow UNCG (or any other state school) to reimburse travellers for the costs of offsets. Alternatively, the University could follow the model created at Utah State University, where travellers voluntarily contribute $10 from their reimbursement checks to the USU offset program. These funds are in turn used to finance on-campus projects that reduce the USU carbon footprint.

  Should legislation or guidelines be modified to allow reimbursement, significant reductions could be achieved for a relatively small contribution. Offsets for air travel are relatively inexpensive, ranging from $6-15.00 per credit (or $mtCO_2e$). Offsetting the emissions calculated for UNCG air travel in 2011-12 would cost from $24,816 – $62,041. By purchasing these, the University would offset 4.8% of its total climate footprint; implementing the above policy adding carbon offset fees to travel fees would spread the costs across the entire school and continue annually. However, as airlines become more efficient and University travelers embrace alternatives, the necessary number of credits will decrease.

Education

One key to any alternative transportation effort is how it educates and is marketed to its end users. Therefore this plan emphasizes developing and allocating the necessary resources for campaigns to

educate students and employees about transportation options, the various costs of SOV trips, the benefits of alternatives, and more. Toor and Havlick (2004) reported a 6-14% reduction in automobile driving as a result of strategic marketing to campus communities; because UNCG has marketed its programs in the past, it should only expect to achieve the lower end of that range. Should the University's future marketing efforts realize a 5% reduction, it would still achieve approximately 970 $mtCO_2e$.

Specific campaigns will target carpooling, cycling, walking, and fleet vehicle operations and maintenance. For each of these, a mix of marketing techniques must be employed to engage the diverse audiences at UNCG. Electronic memo boards in the EUC, Campus Weekly, The Carolinian (print and online versions), launch events, signage, "chalking" messages on College Avenue, social media and online videos will all be evaluated as outlets for education campaigns.

To facilitate education and marketing of alternative transportation options at UNCG, the information should be posted on a single source website, likely an update of the existing POCAM Sustainable Transportation page. Other sites could link to this page, including the Office of Sustainability and Housing and Residence Life sites. When it is relaunched, the transportation committee and Sustainability Council can work with University Relations to publicize the website and determine how best to follow-up with site visitors. Promotion of the University's awards as a national leader in providing alternative transportation as well as the planning documents (Bicycle Master Plan, Transportation Master Plan) will be important aspects of the relaunch.

POCAM, HealthyUNCG, the Office of Sustainability, and others can also partner to promote the health, financial and environmental benefits of walking and cycling. The campaigns should incorporate a variety of media, including print, video, electronic, and social. Marketing ideas include:

- Amend campus maps to display bike and pedestrian routes. These could include route times for walking and cycling, and could be conducted as a student project. The information could also be compiled as application software (or "app").
- Create a video illustrating the benefits of walking and cycling versus driving, which could complement the map.
- Post information about the costs of gasoline consumption, including parking tickets, fuel costs and emissions.
- Support HealthyUNCG's "Get Active" and other fitness programs to promote the health benefits of walking. Distances of and potential calories burned along typical walking routes could be incorporated into campus maps and used in conjunction with a pedometer.
- Create signs to identify walking paths.
- Acquire more resources to incentivize and promote the Campus Transportation Challenge.
- Give presentations at residence hall functions and get students to pledge to reduce their on-campus driving.

- Further promote and resource the bike rental and repair services as well as Spartan Cycles.
- Offer bicycle classes and inclusion of sustainable transportation across curriculum.

Fleet Vehicles

To reduce the emissions from the University fleet, the following actions are recommended:

- Expand the existing Facilities Operations Idling Policy (www.uncg.edu/ppo/vehicle.pdf) to become a campus-wide **Vehicle Operations Policy**. This would include not only idling regulations, but also driving conservation strategies to reduce miles driven and increase mileage. Police vehicles could be exempt from this policy due to the unique requirements of those vehicles, particularly if idle-reduction technology is installed. Similarly, a modified policy would be developed for campus fleet buses with consideration for passenger comfort during adverse weather conditions.

  Anyone driving a University vehicle would be required to pass training for "eco-driving" provided by the North Carolina Solar Center (or a similar program). Idling a gas-powered vehicle longer than 10 seconds requires more fuel than to restart it, reduces engine life, and unnecessarily generates harmful emissions and noise pollution. Fleets can save fuel, emissions and money by prohibiting idling. "Jack-rabbiting**"** (fast starting and stopping) should also be discouraged because it not only decreases mileage by 35-40%, it is also potentially unsafe to pedestrians. One study indicates that implementing the policy and educating University drivers in "eco-driving" could increase fleet fuel economy by 5% within five years, and up to 20% in the long term (Midwestern Governors Association 2008); a pilot program at UNCG with the NC Solar Center saw a 27% increase in fuel economy. Initial training would be supplemented with an annual refresher course, and to expedite this, UNCG could develop online training module.

  Enforcement of this policy will be vital to its success and will require the assistance of supervisors and department heads. The University might also place stickers on all fleet vehicles to increase awareness and compliance; for example, each vehicle could have a sticker stating: "How's My Driving? Please call XXX-XXXX if this vehicle idles for more than one minute." To keep drivers familiar with the policy, place a copy in each fleet vehicle. Finally, require fleet vehicle operators to sign a statement acknowledging their understanding of fleet policies and sustainable driving practices with violations subject to disciplinary action.

- Establish a **vehicle maintenance policy**. Proper maintenance of vehicles optimizes their fuel efficiencies and lengthens their operational lives. Replacing vehicles less often and getting greater mileage saves the University money and fewer resources are used to manufacture both fuel and vehicles. Therefore UNCG will develop a policy to ensure proper, timely maintenance of all University vehicles.

- Establish a **vehicle purchasing policy**. Because changes to state purchasing guidelines and motor fleet leasing guidelines may be needed to create such a policy, the administration will have to work with UNCGA to determine the feasibility of creating and implementing it.

The envisioned policy would begin with an assessment of the current fleet with assistance from the North Carolina Solar Center at NC State University and/or or other consultants to examine the total costs and impacts from vehicle use on campus, and generate a plan to reduce costs and impacts. The assessment would involve representatives from all departments with fleet vehicle responsibilities, including Admissions, Athletics, Campus Recreation, Catering, Facilities, Housing, Information Technology Services, Library, POCAM, Police, Post Office, and others. After the assessment, the group will craft a policy that ensures UNCG purchases the most efficient vehicles available for each given duty. Because many UNCG vehicles are service vehicles, it will be difficult to set specifications that will meet all needs. Recommendations may include:

- Investigate alternative fuel, diesel, or hybrid vehicles that would meet the specific needs of the department. Options include compressed natural gas (CNG), electric, hybrid, propane, and/or solar technologies.
- Should these options be unavailable, the most efficient conventionally fueled vehicles available to meet the specific service needs will be specified.
- Right-size the fleet, including replacing petroleum-fueled vehicles with human powered vehicles where feasible (e.g. parking enforcement, police bike patrol, deliveries of small packages, etc.). UNCG Police are encouraging adoption of a Golf Cart, Utility and Low Speed Vehicle Policy that will phase out golf carts. This policy should be adopted to better protect the safety of campus pedestrians and cyclists, but replacements for the carts should operate on alternative fuels.

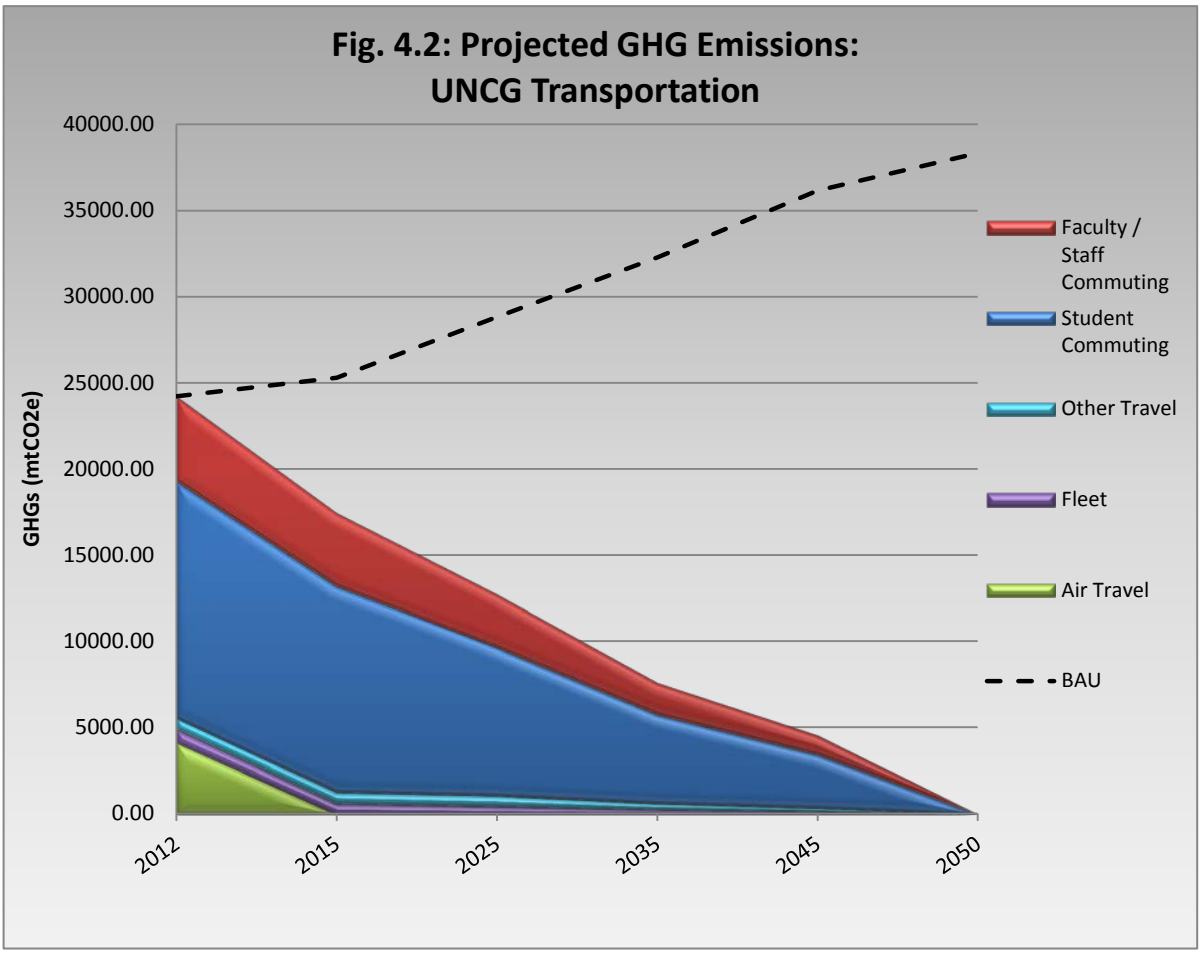
- **Retrofits for idle reduction on diesel vehicles**. A Missouri study of buses (MDNR 2013) revealed that idling wastes approximately 0.5 gal of diesel fuel per hour. Costs for diesel retrofits that allow for engine shut off and quick restarts typically range between $1000 – 3000 and result in a 60-80% reduction of fuel consumption at idle. Assuming each of the University's 23 diesel vehicles idles one (1) hour per day in 180 days of operation, at current diesel prices ($3.64 / gal) these could save approximately 32.8 $mtCO_2e$ and $15,070 annually, resulting in a simple payback time of 1.6 – 4.8 years. Similar technology is available for gasoline vehicles and could be added to police and other automobiles on campus.

Recent changes in Federal law will also help UNCG reach its goals; for example, new Corporate Average Fuel Economy (CAFE) standards from the Obama administration are to improve new vehicle fuel efficiency to 54.5 mpg by 2025, more than doubling the average observed in 2012 (24.1 mpg). Based on the 2011 Petroleum Displacement Plan report, the UNCG gasoline fleet averaged 10.2 miles per gallon, while diesel vehicles averaged 7.6 mpg. UNCG will replace at least 50% of its fleet by 2025, and improved efficiencies in interim years (2013-2025) will have made the fleet more fuel efficient. Therefore, by 2025 it is reasonable to assume that the UNCG fleet will be at least 30% more fuel efficient, with an attendant reduction in GHG emissions (approximately 232.6 $mtCO_2e$). Note that this is a minimum estimate, as the proposed vehicle purchasing policies will push for

vehicles that perform well beyond the expected CAFE standards. Also note that these laws will apply to the vehicles purchased and driven by commuters; applying the same assumption that the average vehicle mileage will have increased 30%, UNCG would see an additional reduction in its transportation emissions of over 6,000 $mtCO_2e$ by 2025.

SUMMARY

Should each of these policies and programs realize its full potential, including the purchase of offsets to account for all air travel, UNCG will reduce GHG emissions from its transportation sector 27.9% by 2015, and 47.3% by 2025 (**Figure 4.2**). However, even if the University delays purchasing offsets until after 2025, the UNCG transportation footprint will still decrease by 11.4% by 2015, and 32.9% by 2025.



5 MATERIALS MANAGEMENT

BACKGROUND

Countless products are used across the UNCG campus, including electronics, construction materials, paper, and much more. Disposition of these materials has financial, social, and environmental costs, including the production of GHG emissions. GHG audits for FY 2008-09 – FY 2011-12 reveal that the solid waste generated by the University contributes an average of 404 metric tons of CO_2e. However, though these Scope 3 emissions are only a small portion of UNCG's emissions profile, the entire climate impact of these materials is not captured in this analysis. Choices of materials for academic programs can also directly impact energy use in buildings. For example, use of art media, chemical compounds and other substances requires much higher supplies of outdoor air to flush buildings where they are housed, air that must be conditioned and exhausted through considerable energy expenditures.

Further, all materials contain "embodied energy," the energy expended to extract resources, then manufacture, transport, and dispose of the resultant products. Therefore, inclusion of life cycle emissions is encouraged by the Climate Commitment. GHG emissions from embodied energy can be significant. A study of life cycle emissions from procured goods at the University of California-Berkeley revealed that these accounted for 39% of their overall GHG emissions, adding over 128,000 $mtCO_2e$ to the campus footprint (Doyle 2012). UNCG does not have the resources to perform life cycle analyses of its purchases; however, even though the University is currently unable to quantify these life cycle emissions, minimizing waste at UNCG could significantly reduce GHG emissions produced beyond the campus. An added benefit is that waste reduction programs are highly visible and are often the first step in building a campus culture of sustainability.

CAMPUS WASTE OVERVIEW

Campus waste is divided into several categories:

- **Municipal Solid Wastes:** Municipal solid waste (MSW), better known as trash or garbage, consists of product packaging, landscape debris, furniture, clothing, containers, food waste, newspapers, and appliances; much of this material is recyclable within conventional programs. MSW *excludes* demolition, construction, and other non-hazardous industrial wastes. The EPA (2011) estimates that in 2010 Americans produced almost 250 million tons of MSW, the equivalent of 1,617 pounds per person per year.
- **E-Waste:** Also known as electronic waste, e-waste includes obsolete or unwanted computers, monitors, classroom multimedia, printers, cell phones, and many more hardware peripherals. Though comprising only about 2% of the total waste stream, this is the fastest-growing type of waste, increasing at a rate more than five times that of other waste sources (Electronic Recyclers International 2007). E-waste also accounts for 70% of toxic landfill wastes (Slade 2007).
- **Household Hazardous Wastes:** This category includes fluorescent lamps, lamp ballasts, fertilizers, herbicides, pesticides, cleaning products, and medical waste. HHWs often contain

toxins that may adversely affect custodial staff, building occupants, and the environment. Therefore, disposal of these items must follow strict protocols to minimize their potential environmental and human health impacts. Other items that fall into this category include motor oil, batteries, paint, and tires. A related category of waste that must be disposed of via similar protocols includes **classroom and laboratory chemicals.**

- **Construction and Demolition Debris.**

WASTE REDUCTION OPTIONS

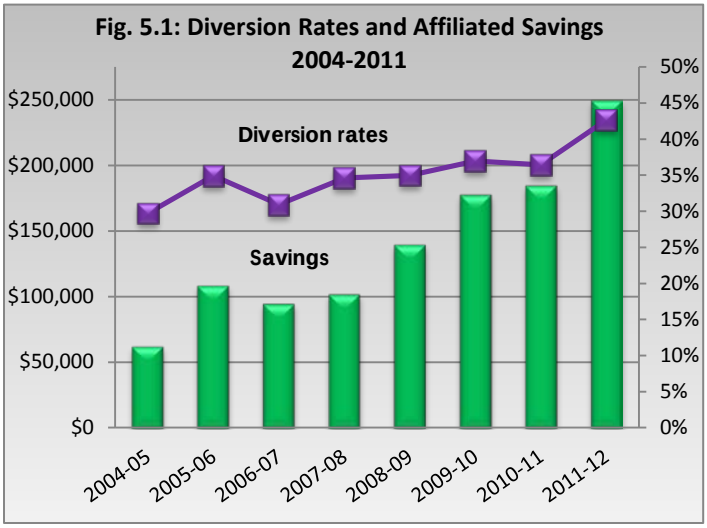
Modern, "sanitary" landfills arose in the US in the 1930s and have served as the primary solution for dealing with waste since. However, landfills still present social and environmental problems. Increasing urban population densities, social justice issues, and less available land have all led to conflicts over the construction of new landfill facilities. Environmental problems resulting from landfills include soil and groundwater pollution and GHG emissions due to the methane produced during the decomposition process. The most effective way to diminish these problems is to reduce disposal in landfills through various means, including source reduction, reuse and recycling.

The National Recycling Coalition defines **source reduction** as "any action that avoids the creation of waste by reducing waste at the source, including redesigning of products or packaging so that less material is used; making voluntary or imposed behavioral changes in the use of materials; or increasing durability or re-usability of materials" (EPA 1995). Source reduction strategies successfully reduced MSW going to landfills by 55 million tons in 2000 (the last year for which data are available). However, as product packaging comprised 30.3% of landfill waste in 2010, there is still considerable progress to be made in this area (EPA 2011).

Reuse (an indirect method of source reduction) and **recycling** are the two other major strategies to reduce waste going to landfills. Reuse is preferable, as it often requires no additional resources. Recycling does consume resources, albeit often less than what is necessary to manufacture a new product. Aluminum recycling uses only 5% of the energy necessary to produce new aluminum, and recycling one ton of paper saves approximately 17 trees from being processed and three cubic yards of landfill space from being filled (Lyle 1994). Recycling has made impacts; 62.5% of paper/paperboard, 19.9% of aluminum, and 48.5% of packaging of all types were recycled in the US in 2010. That same year, however, only 8.2 % of plastics and 19.6% of e-wastes were recycled in the US (EPA 2011).

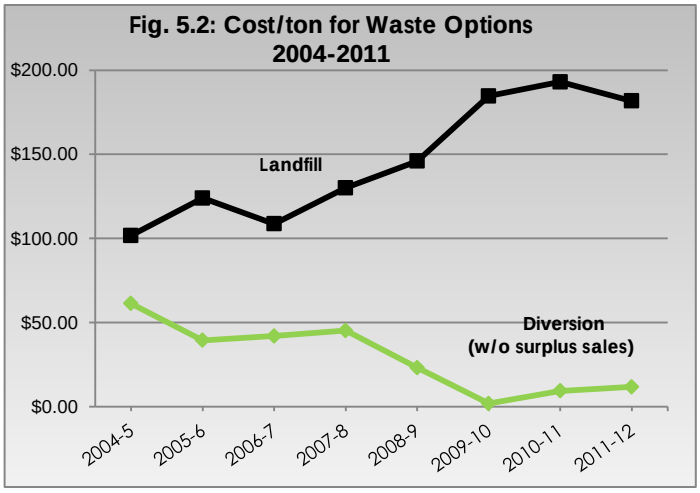
Overall, these strategies have begun to bear fruit. According to the EPA (2011), "over the last few decades, the generation, recycling, composting, and disposal of MSW have changed substantially. While solid waste generation has increased from 3.66 to 4.43 pounds per person per day between 1980 and 2010, the recycling rate has also increased–from less than 10 percent of MSW generated in 1980 to about 34 percent in 2010."

CURRENT INITIATIVES AND ACCOMPLISHMENTS



During 2011-12, UNCG produced 2170.77 tons of waste; 925.53 tons (42.64%) of this were diverted from landfills (excluding construction and demolition waste). This extends the trend of increasing diversion rates observed since FY2004-05 (**Figure 5.1**). This was accomplished through many efforts, including source reduction and reuse programs, education of campus consumers, and recycling.

Not only have these efforts reduced GHG emissions, they have also led to cost savings and avoidance for the University. In 2011-12 revenues from the waste stream were greater than $90,000, and total savings and avoided costs exceeded $250,000 (based on a cost of $181/ ton for landfill disposal). Costs for diverting waste from landfills have dropped 81% since 2004, while costs to send waste to landfills have increased 79% over the same period (**Figure 5.2**). OWRR led programs that have produced these savings include the following:



Recycling

Beginning as a partnership between the Grounds Department and a student group, recycling has been conducted at UNCG since the early 1990s. The program has grown such that UNCG created the Office of Waste Reduction and Recycling to oversee these efforts in the late 1990s. FY 2011-12 highlights include:

- **Municipal Solid Waste:** recycled MSW comprised 28% of the total UNCG waste stream.
- **E-waste:** 29.87 tons of e-wastes were diverted from landfills, saving UNCG both money and GHGs emissions.
- **Household Hazardous Wastes:** The Facilities Department collected and recycled 8.92 tons of light bulbs, ballasts, batteries, tires, and oil used in the University fleet.

- **Special Hazardous Wastes:** the UNCG Office of Chemical Safety collected 5.89 tons of chemical waste in FY 2011-12.
- **Construction and Demolition Waste:** In 2010-11, UNCG diverted over 83% of its C&D waste. It is FDC policy to salvage and recycle demolition and construction waste as defined by LEED credit MR2 for all LEED certified projects. FDC also emphasizes reusing building materials when possible and developing comprehensive plans to divert construction and demolition waste from landfills.
- **Other:** Landscape wastes comprised almost 5% of the UNCG waste stream in 2011-12. 76.25 tons were delivered to the City of Greensboro landfill, while 18 tons of this organic debris was collected from UNCG and deposited at Piney Lake for mulch and soil builder. OWRR also has programs to collect wood pallets and hard plastics.

Finally, Housing and Residence Life entered into an agreement with Mattress-Go-Round, a company that accepts mattresses for recycling and sells new or refurbished mattresses at a lower price. Since the agreement began, UNCG has kept 1350 mattresses from the landfill and been able to replace 600 more mattresses than had a conventional vendor been used.

Reuse

OWRR prioritizes reuse and repurposing of surplus furniture and equipment on campus before other options; the option of "last resort" is to dispose of any in the landfill. Through UNCG's Spartan Swap initiative, in 2011-12 almost 78 tons of goods were sold as surplus and over 6.44 tons of material was reused on campus.

OWRR hosts an annual garage sale on campus called "Cram and Scram" to offer other opportunities for material reuse. Items donated or left by departing students in the spring are sold to the general public. "Cram and Scram" helped direct 4.1 tons of material away from landfills and generated over $1,000 in revenue for OWRR educational programs in 2012.

Food waste

Dining Services has established several practices to reduce food waste sent to the landfill. These include:

- Contracting with a company to collect food waste and compost it at an off-site facility. The composting program kept over 135 tons of food waste from the landfill last fiscal year.
- Promoting waste reduction with customers:
    - **Project Clean Plate**: encourages students to reduce food waste by taking only the amount of food they will eat.
    - **Project Green Thumb** refillable mug program: gives customers a discount on coffee and soda refills while by reducing the number of disposable containers utilized on campus. Mugs are sold in various retail dining locations.

- Selling its used cooking oil to a local biodiesel production facility. This program repurposed 38.51 tons of waste oil in 2011-12 and UNCG made over $5500.
- Adopting cooking practices to minimize oil use with modified frying techniques (usage dropped by almost 500 gallons of oil per semester).

Source Reduction

- **Landscape Chemicals:** Over the past few years, the Grounds Department has emphasized the use of organic fertilizers, and only when necessary. This combination has reduced GHGs from fertilizers by over 50% since 2008-09.
- **Integrated Pest Management**: The UNCG Grounds Department and Facilities Services Department both employ this strategy to minimize the use of potentially toxic chemicals and the production of hazardous waste that the University must handle. UNCG's program places an emphasis on prevention of infestations beginning with landscaping with disease and insect-resistant plants. Should pest control be necessary, the program emphasizes inspection and monitoring protocols and application of least-toxic pesticides.
- **Printing:** To encourage paper-use reduction, all printers in the Libraries are set to duplex printing to reduce waste. Printing in UNCG libraries costs 6 cents per double-sided page. This fee applies to all patrons, including faculty, staff, and guests. However, students are allocated 75 free pages ($3.00) per semester (40 pages for summer) in Information Technology Services-sponsored labs, including the Jackson Library Superlab.

Purchasing

OWRR, Purchasing, the HUB (Historically Underutilized Businesses) Office, and the Sustainability Office have recently joined together to begin research into establishing an Environmentally Preferred Purchasing policy and promoting HUB-qualified vendors. Procurement practices are also governed by various state laws including Executive Order 156, a directive in support of the state's environmental stewardship initiative, NC Project Green. Within this Order is guidance to purchase products containing recycled materials.

Other purchasing initiatives include:

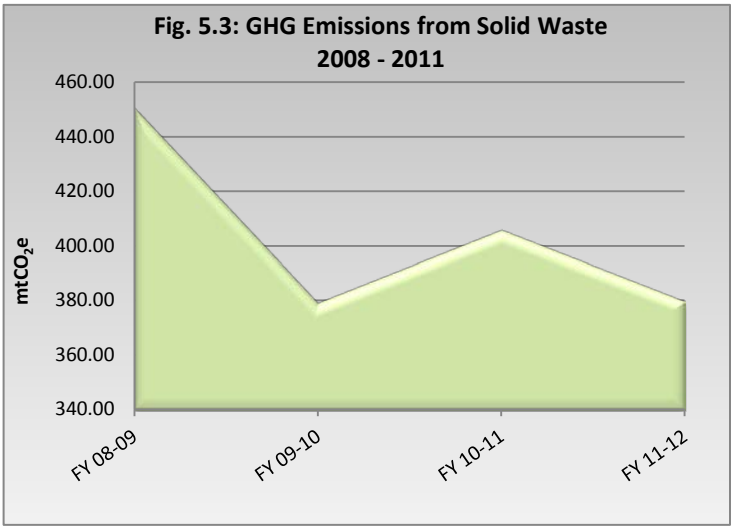
- Third-party sustainability certifications: UNCG encourages that all new motors are Energy Star certified, and some office paper is certified by the Forest Stewardship Council.
- Green Cleaning: Facilities Services has made this a priority over the past decade. UNCG currently purchases Green Seal certified cleaners and hand soaps from Johnson/Diversey, Inc., but will be revisiting this contract in the next fiscal year.

Education

To further engage the University community regarding its waste habits, UNCG participates in RecycleMania. This is an annual competition among U.S. colleges and universities to inform

campuses about recycling and waste reduction. OWRR also conducts periodic waste audits for the public, called "Landfill on the Lawn," to display the portion of campus waste deposited in trash bins that could actually be recycled.

NEXT STEPS



In accordance with its overall goal of climate neutrality, UNCG will become a "zero-waste" campus by 2050. The University will divert 100% of its waste from landfills through the development and expansion of the programs described above that have proven successful in reducing its landfill waste and the related emissions (**Figure 5.3**). These will be supported by education and marketing campaigns and new University policies. UNCG will also employ new strategies in this move toward zero waste, including long and short term (within 5 years) initiatives. The Materials Management team has set an interim target of 50% diversion by 2017.

UNCG cannot achieve "zero-waste" alone, however; the University's business partners must assume more responsibility for the waste created through the manufacture, transport and disposal of their products and packaging. Examples include package "take-back" programs or 100% recyclable packaging. To accomplish its goals, UNCG could leverage its purchasing power to demand more recycled products to "close the loop" of recycling and open more markets for these materials. Further, the campus community must adopt practices that emphasize consuming less, purchasing more responsibly, and proper disposal of goods no longer useful. UNCG has the responsibility to teach the community what these practices are and how to implement them.

SHORT TERM

Education and Marketing:

OWRR has built several successful programs to reduce waste on campus, and this plan builds on these successes. The 2017 target can likely be achieved simply through increased participation in these existing initiatives. In support of these, education and marketing campaigns will be created or expanded to promote waste reduction, including:

- An emphasis on landfill diversion over recycling – recycling is the third "R" in reduce, reuse, recycle because it is the least desirable of the three.
- Promotions to clarify what items can be recycled on campus.

- Create a survey for the campus community on perceived barriers to recycling on campus;
- Continued participation in and improved marketing of Recyclemania.
- Engagement with athletics, SGA, and others to promote waste minimization and recycling initiatives and events.
- A partnership between Purchasing and the Sustainability Office to promote Environmentally Preferred Purchasing once that policy is finalized.
- Campaigns to educate students and employees about the impacts their choices have financially, environmentally and socially. Convenient alternatives to disposables will be presented.
- Create a "Professional Recycler" training program that will formalize commitment and knowledge of UNCG's unique waste reduction programs. This program would be open to all staff but aimed at building contacts and housekeepers.

Source Reduction

- **Printer Paper and Ink:** The default settings for all University printers will be set to print double-sided and to use a font that uses less ink. Examples include Ecofont, Century Gothic, or "draft" settings. This could be implemented for all but the most formal of campus communications, and would result in 10% (draft mode) to 50% (Ecofont) savings of ink. Further, the University will investigate a policy establishing reduced print margins. A 2001 Penn State study revealed that shrinking printer margins 0.25" could save the school over $120,000 annually, as well as preserve 72 acres of forest and eliminate 45 tons of waste.

  Before any policy is implemented, a campaign to educate faculty, staff and students about these changes will be conducted to avoid any potential conflicts with academic requirements or publishing standards. Faculty will be encouraged to adopt the above defaults as their classroom standards. Should special circumstances arise, defaults can be temporarily disabled. Further, UNCG will continue to migrate all its records to electronic format.

- **Campus Communications Paper Use:** Campus activities and events are often promoted through fliers, posters, postcards, and other paper publications. Though at times effective, much paper communication is unnecessary or ineffective given the various electronic communication outlets available. Anecdotal evidence indicates the majority of these mailings and fliers are thrown out or recycled immediately, negating their purpose.

  Unfortunately, UNCG has no central point of communications for announcements and campus events, so those marketing on campus must conduct a "shotgun" approach. The committee recommends that UNCG create a daily email to the campus for announcements. Once established, the University will create guidelines for printed materials promoting University events, as many could be replaced by electronic versions. Printed materials will

abide by the criteria for materials set forth in the proposed purchasing policy (see below). Should this prove undesirable or unworkable, another option is to create an "opt-out" list for campus community members to remove their names from paper distribution lists.

- **Junk Mail:** Junk mail, especially that targeting students, can also be curbed. UNCG cannot legally ban junk mail, but the University can easily encourage students to remove their names from various mail distribution lists. Information for students to remove their names from direct marketing lists is already provided on the sustainability Office webpage, and could be placed in the campus post office as well.
- **Plastic Bags and Beverage Cups:** Discourage plastic bag use on campus by working with vendors to institute a UNCG campus fee for disposable plastic bags and beverage cups. Reusable bags and mugs are already available for purchase at campus retail locations, but adoption of their use has not been widespread. A portion of the fees could be directed to OWRR to offset the costs of disposal.
- **Water Refill Stations:** Provide filtered water refilling stations in more academic buildings and public spaces on campus to reduce plastic waste generated on campus. Several have been installed on campus so far, and reaction has been positive. Each Elkay Bottle Fill Station costs roughly $1500 per unit.

Reuse

UNCG will work to further promote and expand its successful programs to repurpose and reuse surplus goods. Another reuse opportunity exists with local and national charities that collect clothing. Establishing an agreement with one of these reputable groups (e.g., to place donation bins near residence halls and apartments could increase the amount of clothing that is diverted from landfills. These bins are often seen in parking lots of local stores; by making them more convenient to resident students, participation will likely increase.

Recycling Infrastructure

- **Recycling bin labeling and placement:** Effective placement and visibility of bins is vital to growing the recycling program at UNCG. One consideration is to centralize trash and recycling collection in all campus classrooms. Receptacles would be removed from classrooms and users directed to use central hallway bins for greater collection efficiency and recycling availability. This strategy has been successful at other universities, and could be at UNCG. Future buildings must be designed to accommodate code compliant placement of collection bins, however, as current egress codes have hindered implementation in most existing buildings at UNCG. Further investigation with the UNCG Environmental Health and Safety Office will continue.

A second idea that has been successfully implemented at other schools is improved labeling for waste receptacles. Those that are designated for non-recyclable waste would be labeled as "Landfill" instead of "Trash," a strategy that resulted in a 29% increase in recycling rates and a 23% decrease in disposal of recyclables during a pilot study at the University of Pittsburgh (IEI, 2011).

- **Pepsi Dream Machine:** UNCG's current beverage contract is with Pepsi Co. Pepsi has an initiative called the "Dream Machine" to provide incentives for recycling. The committee proposes that UNCG Campus Enterprises collaborate with Pepsi to install "Dream Machines" in high traffic areas of campus to increase bottle and can recycling.
- **E-waste bins:** Increase the number of e-waste collection containers on campus.
- **Construction and Demolition Debris:** Incorporate Construction and Demolition Debris (C&D) tonnages into UNCG's solid waste reporting. Currently data from UNCG is already being reported but kept separate from University generated solid waste. Advances in technology have helped facilitate the recycling of these materials, and more markets for the products are developing. Another idea is to prioritize building deconstruction contractors ahead of demolition contractors to increase building material reuse.

Purchasing

Purchasing practices are vital to achieving the goal of zero waste. UNCG has not established green procurement standards, a situation the University must rectify to take the first step toward a robust Environmentally Preferred Purchasing program. The Materials Management committee has developed guidelines for "green" products and services, which will move UNCG to adopting an Environmentally Preferred Purchasing policy. The guidelines include:

- Energy Star Rated performance
- Is recyclable or reusable
- Contains reduced or eliminated packaging
- Composed of repurposed or recycled materials
- Water efficient operation
- Durable product that will last longer than alternatives, disposable product avoidance
- Paper and wood furniture to be Forest Stewardship Council (FSC) certified
- Low or No VOC in paints and furniture
- Green Seal Certified cleaning chemicals
- Renewable fuels with feedstocks that utilize wastes are preferable to renewable fuels grown on farm land or fossil fuels

As contracts allow, on-campus independent vendors will be required to adopt these standards to avoid potential unfair pricing advantages. Currently, some office paper purchased at UNCG has recycled content and/or FSC certification, but no campus mandate exists for either. Because purchasing for many products is decentralized, for an EPP policy to be most effective the administration should apply it campus-wide. E-Marketplace, the University's online purchasing system, will be part of the efforts to encourage and track purchasing of "green" products and services. In the early stages of rolling this program out, the team recommends that UNCG require EPP alternate bids for common products so the University can determine the potential cost effectiveness of the program.

Food Waste

Elimination of food wastes is another element of the UNCG zero-waste goal, and the composting program has moved UNCG closer to that goal. To complement composting, other ideas for source reduction and recycling have been proposed:

- Establish a reusable food container program (e.g., Eco-clamshell) that Food services customers could use in place of disposable versions. Dining is also moving toward purchasing more foods in dry form rather than wet form to reduce packaging.
- Dining Services will work with Pepsi to incorporate reusable soft drink (Pepsi) syrup boxes for fountain drink supply.
- Build on the participation in the NC 10% program to purchase more local and regional foods.

Grounds Waste

Eliminating the use of yard waste landfills will result in a reduction of almost 5% of the UNCG waste designated for landfills. To accomplish this, all yard waste will be composted. Though some of this already occurs at the University's Piney Lake facility, the majority of landscape waste is taken to a private landfill. The City of Greensboro operates a composting site specific to landscape waste that would accept UNCG's yard debris. However, this option requires more funding than normal landfill disposal; based on 2012 figures, if UNCG diverted its landscape waste to the city compost, it would incur an additional cost of $5,120 and reduce emissions 61.1 $mtCO_2e$.

LONG TERM GOALS

The Materials Management group also began looking toward the long-term goal of zero waste by 2050. Some will require technological breakthroughs, and some will require new UNC System policies or new laws. Ideas for future consideration and implementation include:

- Expand the food waste compost program campus wide to include retail outlets and residence halls that allow cooking. This will require more dumpsters, interior collection bins and staff training.
- The next step beyond centralized trash and recycling collection is to remove trash bins from offices, leaving only recycling bins. Trash would be centrally located only, forcing building occupants to rethink their purchases and coincident waste.
- Building on the fees for plastic bags and beverage cups, create a UNCG container deposit similar to those found in many states. This would provide incentives to recycle cans and bottles on campus and help fund other waste reduction programs. States with container deposits see rates of return at 76%, versus 24% in those without such deposits (Wright 2012).
- Leverage the collective purchasing power of the UNC System to mandate waste reduction strategies with vendors and manufacturers:
    - "Backhaul" packaging from campus to be reused or recycled as part of doing business with UNCG (furniture, computers, bulk/repeated orders).
    - Retrieve their products after their useful lives.
    - Incorporate recycled materials into their products and to institute practices that are socially and environmentally just.
    - Specify packaging used by vendors, must be recyclable on UNCG's campus.
- **"Green" Chemistry and Art:** UNCG will assess the feasibility of replacing toxic chemicals in classes with less harmful or benign substances to teach the same concepts and techniques found in chemistry courses. Similar evaluations of art media will occur as well. The Department of Environmental Health and Safety will be heavily involved in this effort, and work with the Chemistry Department, the Art Department and the Office of Sustainability.

Reuse and recycling of products have their limits; technological improvements will have to play a significant role in the journey toward zero waste. Future goods will require materials that break down and become nutrients for other processes or that can be returned to manufacturers at the ends of their useful lives to be reintegrated into new products. This is echoed in the Sustainability Council principles adopted in April 2013, in which the Council states its commitment to "acknowledging the unity of humanity and nature and emphasizing natural systems as the model of appropriate design. ***Natural systems utilize renewable energy and have no concept of waste.*** They are also characterized by diversity, interdependence, and

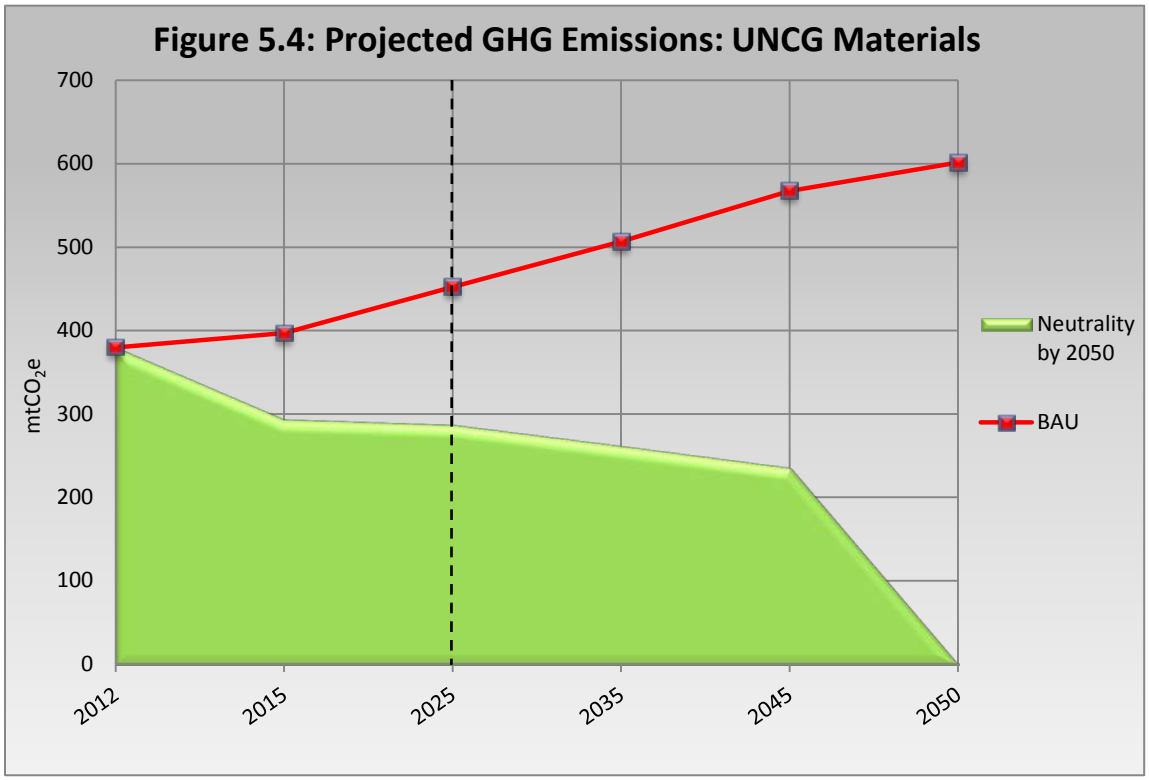
regenerative growth, defining characteristics of healthy academic environments as well. ***The Council will aim to shift University practices toward products and processes that mimic natural systems"*** (emphasis added).

The Sustainability Coordinator will work with Purchasing and other parties to identify these products as they come onto the market. One resource that UNCG can use today is the Cradle-to-Cradle (C2C) program, a third party certification that assesses a product based on its safety to humans and the environment, as well as how its design integrates into future life cycles. Developed by McDonough and Braungart, this system incorporates the values espoused within the Council guidelines above, particularly the concepts of natural design and "no waste." Released in 2005, C2C has certified hundreds of products that are among the most sustainable made today.

Again, cooperation from the campus community, vendors, and manufacturers is vital to the successes of these proposed strategies. Without changes in the purchasing and waste disposal habits of the campus, the University may consider limiting products on campus that are not recyclable, compostable, or otherwise able to be diverted from. Some universities and municipalities have already begun down this path through bans on plastic bags and bottled water. With more awareness and participation, however, the committee believes these measures will be unnecessary and that such products will be phased out due to lack of demand.

SUMMARY

Should the recommendations of this subgroup be fully implemented, UNCG will reduce GHG emissions from its materials sector 22.8% by 2015, and 24.5% by 2025 (**Figure 5.4**).



BACKGROUND

Discussions of climate change mitigation typically center on energy issues such as how fossil fuel-derived energy leads to GHG emissions and how alternatives may reduce those impacts. Other topics involving climate change are often given less attention; the potential scarcity of water resources due to climatic disruptions to the water cycle is one of those topics. Because UNCG is likely to encounter risks to its future water supply, it is prudent to begin planning how the University can more efficiently utilize this resource.

UNCG receives its potable water from the City of Greensboro. Greensboro sits near the top of the Haw River sub-basin of the Cape Fear watershed, and has historically taken its water from three reservoirs on the Reedy Fork tributary of the Haw (Williams 2012). Like so many communities, Greensboro is expected to see an increase in demand for water due to population and industrial growth. A Natural Resources Defense Council (NRDC) study shows that water demand in the United States is projected to be 32.8% higher than 2005 by 2030 and 54.8% by 2050, assuming per capita consumption does not change (Roy et al. 2010). Greensboro estimates that average daily demand in its service area will rise 23.3% beyond 2010 consumption by 2030, and 42.2% by 2050 (City of Greensboro 2010). In part due to these anticipated demands, the City added Randleman Lake as another water source in 2010.

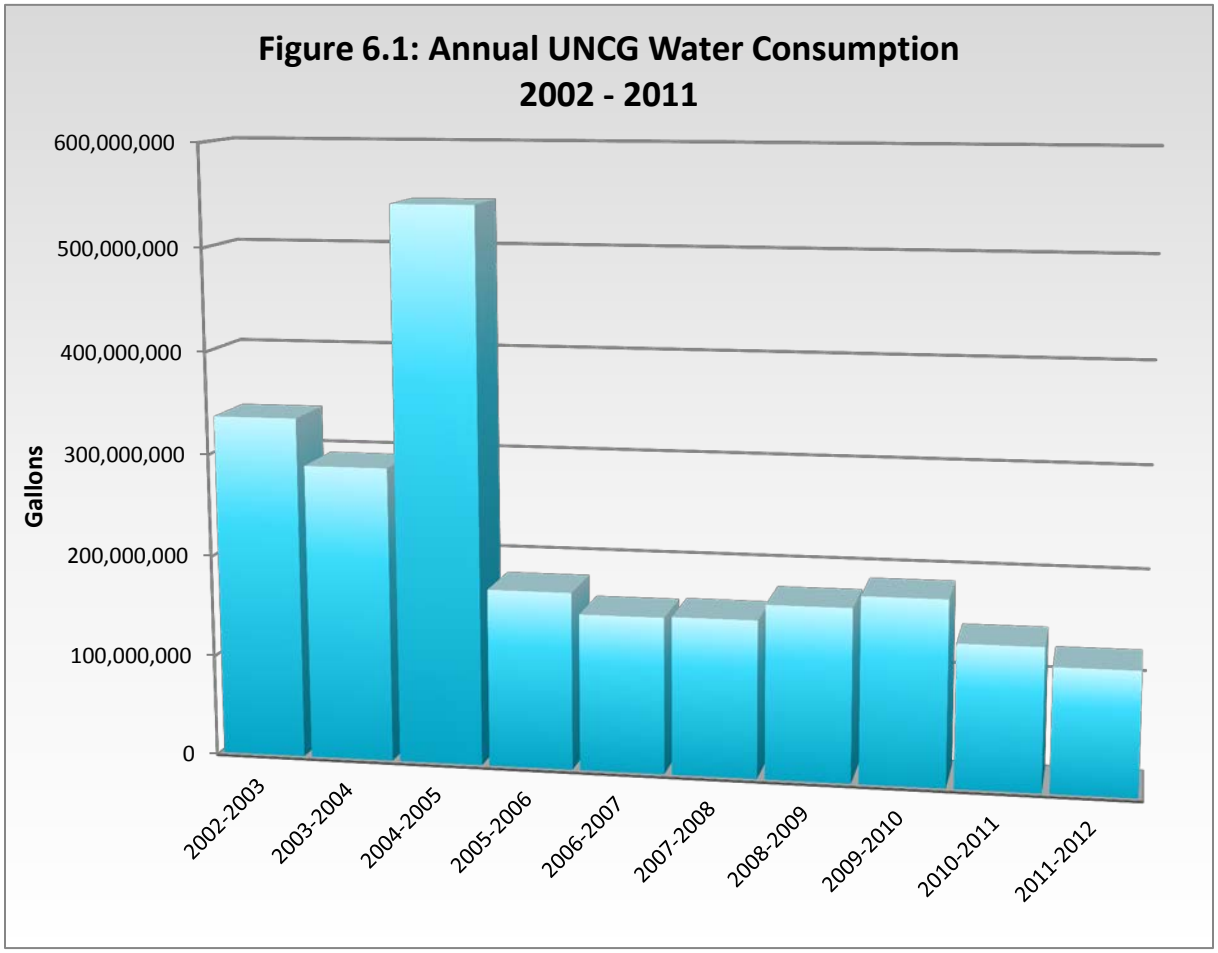
Another issue is the condition of the water infrastructure in the US. Much of this infrastructure is at or beyond its useful life, having been constructed 50 or more years ago; some is well over 100 years. Pipe failures, degraded water quality, and service interruptions have become more commonplace, reducing productivity and quality of life as well as increasing costs due to the emergency nature of repairs. According to a 2012 study by American Water Works Association (AWWA), to update the water infrastructure of the US will require approximately $1.7 trillion between 2010 and 2050.

The combination of regional population growth, impending infrastructure needs and likely climate change affects point to increasing costs and decreasing supply of potable water for Greensboro. The NRDC study identifies the sustainability of Guilford County's water supply as being at "High Risk." This will have significant financial implications to end users, particularly commercial, industrial and institutional consumers such as UNCG. The University is one of the greatest consumers of water in the region, ranking as the second-largest in 2008 according to the City of Greensboro 2010 Water Supply Master Plan. Though no specific projections for Greensboro consumers are available, the AWWA (2012) estimates that annual water bills will likely triple between 2010 and 2050 to cover increases in infrastructure costs alone.

It is important to include water in this Plan not only because of the potential scarcity and financial cost increases, but also because supplying water has its own, albeit small, climate footprint. However, though these Scope 3 emissions are only a small portion of UNCG's emissions profile, the entire climate impact is not captured in this analysis. The measured impact is based on the emissions from water captured and treated within the wastewater treatment system, and assumes

the UNCG consumption figure equals the discharge figure. Not captured are emissions from the fuel needed to power equipment to pump water to campus; the emissions from heating and distributing water across campus are captured in the energy section, however.

CURRENT INITIATIVES AND ACCOMPLISHMENTS



Water consumption at UNCG has decreased 63.5% since 2002-03 (**Figure 6.1**), such that during 2011-12, UNCG consumed 122,794,672 gallons of water. This consumption translated into 59.6 $mtCO_2e$, or only 0.07% of the campus carbon footprint. Water conservation programs led to avoided costs in that time period greater than $11 million. These remarkable results were achieved through a combination of leak detection and repair, demand reduction through education and technology, and use of non-potable water for certain applications. Specific programs include:

- Installation of low-flush toilets or retrofits with low-flow flush valves to reduce flow to 1.5 gallons per flush.
- Retrofit or install automatic flush valves in approximately 85% of toilets across campus.
- Addition of faucet aerators to reduce water flow to 0.5 gallons/minute.
- Retrofit approximately 50% of faucets to automatic.

- Preventive maintenance on all plumbing fixtures on quarterly, semi-annual and annual bases.
- An aggressive steam line leak detection and repair program.
- Monitoring condensate return for boilers to insure rate of return is satisfactory.
- Preventive maintenance scheduled on for steam system valves, traps, pumps and manholes to insure leaks are held to minimum.
- Minimizing leaks in all chilled water systems through a comprehensive preventive maintenance program
- Metering of water use campus wide to monitor consumption.
- Adding preferred plumbing fixture specifications for new construction and renovations in campus construction guidelines through Facilities Design and Construction.
- Outreach efforts to educate the campus community about energy and water issues, long and short term.
- Switching to foam soap in all public and community bathrooms. Because this type of soap tends to rinse off more quickly, its use has led to lower water consumption.
- Retrofit the Dining Hall with more efficient dishwashers.
- Increasing the purchase of pre-prepared and pre-washed produce.

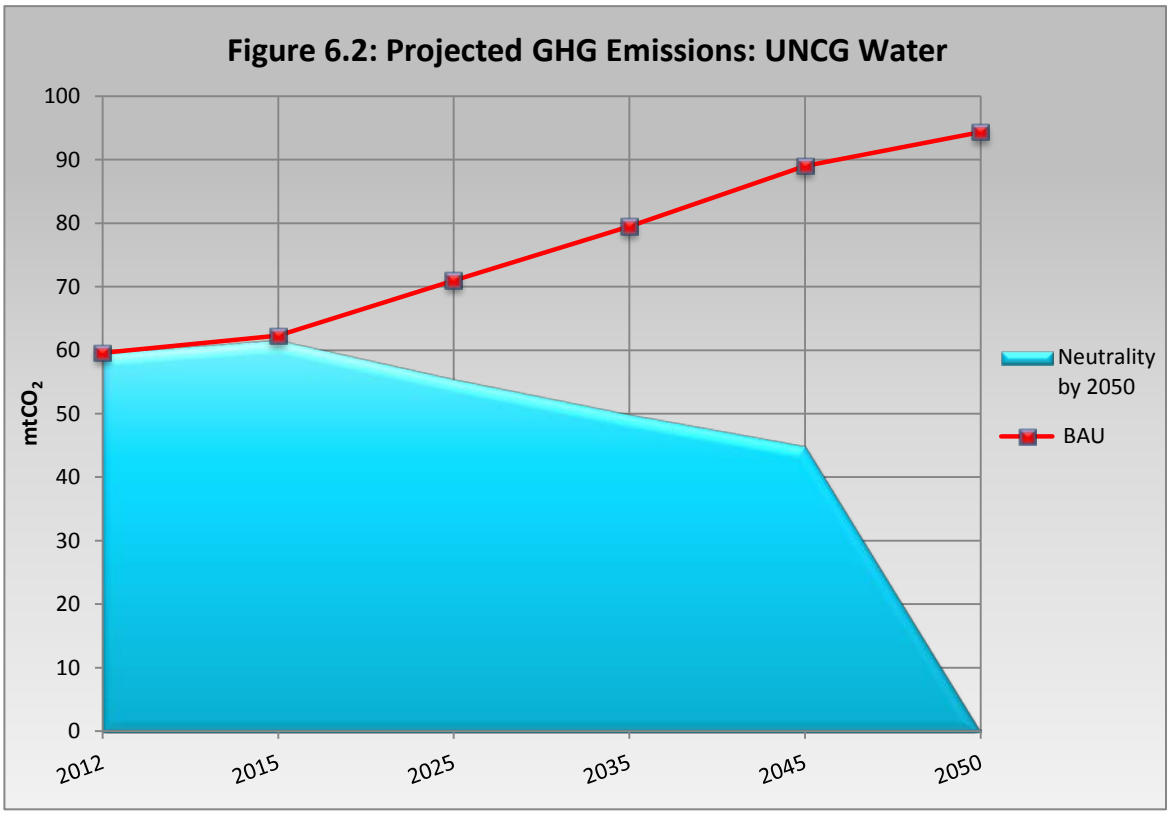
The UNCG Office of Housing and Residence Life (HRL) has utilized many of the same or similar technologies that have been used in academic and administration buildings on campus. HRL has incorporated water efficient practices and technologies into its design guidelines, including low-flow toilets, and low-flow shower and lavatory fixtures. Energy Star rated washing machines have also been installed, resulting in reduced water and energy use. Recent new construction and/or renovations of several residence halls have incorporated water efficient technology. In 2009 and 2010, bathroom renovations occurred in North and South Spencer, Mary Foust, and Guilford residences and included these technologies. Renovations to Weil/Winfield, North and South Spencer, and Ragsdale/Mendenhall residence halls included replacement of hot water storage tanks with instantaneous heaters to conserve water and reduce the load on the UNCG central steam plant. In 2012, the seven buildings of the Quad underwent comprehensive renovations that included all of these technologies. And like Facilities Operations, HRL has made the switch to foam soap in all public and community bathrooms.

Water for landscape irrigation is the purview of the Grounds Department, which has instituted several water-saving practices as well. Recent new construction and renovation projects have been landscaped such that no permanent irrigation is necessary; this also meets the LEED credit for Water Efficient Landscaping. However, there remain many areas where the landscape requires supplemental watering from an irrigation system. To reduce water consumption, this system

incorporates pressure-regulated spray heads that allow better control and more even distribution, and check valves to prevent water from draining out of the system; some drip irrigation has been installed as well. Further, each of the 28 separate controllers (23 for campus, five for sports turf areas) for the irrigation system has a dedicated rain sensor that shuts off irrigation after a predetermined amount of rain has been detected. The Grounds crew conducts periodic review and maintenance of the irrigation systems to inspect and repair leaks or damage. Any sprinkler heads that must be replaced or added are retrofit with pressure-regulated heads that eliminate pressure variations, avoid misting and fogging, and shut off whenever damaged. Finally, the UNCG has three wells to provide non-potable water for vehicle washing and some athletic field irrigation.

NEXT STEPS

UNCG will never be able to eliminate its need for water. However, the University can continue to build on its successful water conservation programs and be even more responsible stewards of this resource. This will be particularly important as water becomes scarcer and more expensive; despite the success of campus conservation programs, water consumption cost the University over $750,000 in 2011-12, and water use rates have increased over 300% since 2002-03.



The short term (2015) goal of this plan is to decrease consumption 1% from 2011-12 (see **Figure 6.2**). Though this does not appear ambitious, reducing UNCG consumption further will be challenging despite the 2002 - 2011 average of reducing water use 6.3% per year. The University expansion known as Spartan Village will add several residence halls and a large recreation center

over the next 3 years. Based on the 2010 usage at Spring Garden apartments, the 800 beds of phase 1 at the Village are expected to add approximately 7.7 million gallons of water annually, a 6.3% increase. However, this will be countered in part by the temporary closing of the high rise dormitories as they undergo renovation. Reynolds will be out of service in 2013-14, and Grogan in 2014-15, resulting in a reduction of 460 beds offline. Regardless, due to funding and time limitations, the short term goal will have to be achieved through a continuation of existing programs.

A mid-term (2025) goal of 10% reduction will also be challenging with the addition of 600 beds in phase 2 – this will add another 5.75 million gallons of water consumption by 2016 and does not include the expected use at the new recreation center or possible new recreation fields. Longer term projects, including water capture and reuse programs will be necessary to make more significant reductions.

Short Term (by 2015)

Existing programs that will be continued and expanded to achieve the short term goals of water conservation begin with completing the retrofits and replacements of toilets and faucets. Currently about 10-15% of these remain to be updated, and completing this project will result in considerable savings.

All new construction and major renovations will include these features as well. The comprehensive Dining Hall renovation will include low-flow toilets with motion sensors, all new plumbing, and a waste pulper that uses recycled grey water to macerate food waste, in turn reducing the amount of compost waste. Several residence hall construction projects will also occur between 2013 – 2016, including the Spartan Village and the renovations of the three high-rise dormitories (Reynolds, Grogan and Cone). Each will have low flow toilets, showers and lavatory faucets; the high-rises will have instantaneous water heaters installed as well. The high rise renovations will result in a 57% reduction in water use from water closet improvements (going from 3.5 gpf to average 1.5 gpf), and 20% reduction with lower-flow showerheads (shifting from 2.5 gpm to 2.0 gpm maximum). Additionally, the Associate Director of Operations for Housing has committed to dedicate a portion of its Repair and Renovation funds to retrofit water fixtures in halls that are not scheduled for renovation.

Facilities Operations will continue to monitor steam and water lines for leaks and quickly repair any observed, as well as continue preventive maintenance efforts on these same systems. To enhance these programs, a steam trap survey is recommended. Steam traps allow condensate to escape from active steam lines, improving the efficiency and safety of the system. In a steam system that is not maintained regularly, it is typical to find a 15-30% failure rate of traps (Seneviratne 2007). Failures can lead to substantial energy, water, and financial losses: assuming a 20% failure rate and 1000 traps, a typical system will lose approximately 11,400 gallons per day, or over 4,000,000 gallons per year (Seneviratne 2007). Based on 2011-12 rates, those water losses would cost UNCG over $24,000 annually. Conducting a steam trap survey will identify all leaking traps so they can be

repaired or replaced. North Carolina State University conducted such a survey and discovered that 14% of its traps were defective; the resulting repairs paid for themselves in six months. Steam system improvements are discussed in more detail in the Energy section.

Though the amount of campus land that must be irrigated is diminishing, there remain several areas that require it. As part of the forthcoming North Practice Field renovation, the Grounds Department has proposed including a more comprehensive weather-informed and centrally-controlled irrigation system. Inclusion of such a system is recommended. These systems automatically respond based on solar radiation, relative humidity, wind, temperature and rainfall, and incorporate sensors to detect soil moisture at the root zone. They also have automated leak detection and notification capability. Installation of such an automated irrigation system will decrease water consumption as well as man-hours devoted to adjusting the current system.

Grounds will also continue to landscape with native and drought tolerant species to remove permanent irrigation systems from more of the campus. Adding rock, mulch, and warm season grasses will reduce watering as well as mowing and other energy-intensive maintenance activities.

Finally, water conservation will continue to be a primary focus in education and outreach programs for the campus. Though important to all campus constituents, the greatest benefits will come from increasing education programs aimed at campus residents. Other audiences that use a greater share of water will be targeted, including patrons of the rec center and athletic facilities.

Mid Term (2015 - 2025)

The goal for 2025 is to achieve a 10% reduction from current consumption. Construction and renovation with water technology that is more efficient than the current low-flow options will be necessary to achieve this target. UNCG must also develop water-capture technologies such as rain water collection and gray water reuse to replace some of the non-potable water needs of the campus even though Greensboro's low water rates extend payback for many of these technologies. Housing has committed to investigate the potential for these in the high rise renovations and later projects, and as the University gains experience with the effectiveness and feasibility of these options on campus, it will implement projects to install them. Eventually these will be added to campus construction design guidelines.

Another idea to capture water is to collect condensate from HVAC systems across campus. Though this water is quite clean, it is still classified as gray water and may not be used for potable purposes. However, it could be directed for use in chiller cooling towers, as make up water for steam/chilled water loops, for toilet flushing, and/or irrigation, including the campus garden. To estimate the potential of this technology at UNCG, a case study of Sullivan Science building was conducted. Calculations reveal that the four air-handling units at Sullivan produce approximately 16,000 gallons per day in the warmest, most humid days of summer. At its peak consumption over the past three years, Sullivan required 8,000 gallons/day, so non-potable water needs could easily be addressed by this supply.

Another, smaller portion of this would be captured for campus irrigation, as the UNCG water trucks distribute an average of 2,000 gallons per week. In-ground storage tanks currently cost approximately $2.00 / gallon; estimates for above ground cisterns are lower. No pricing was developed for the necessary pumps and plumbing to redirect the condensate, labor for installation, or any other affiliated costs, but based on literature from several cistern companies, these would likely triple the estimated budget for a system.

Finally, pint-flush urinals will be installed as replacements for the 1.0 gallon "low-flow" versions that have become the campus standard. These reduce consumption 8-fold and are readily available; a few are already in place on the UNCG campus. However, these ultra-low flow models can cost twice as much as conventional models. To keep costs down, an option is to retrofit the flush valves for existing 1.0 gallon per flush (gpf) urinals with replacement diaphragms that reduce water consumption to 0.5 gpf; though water consumption is only reduced to 50%, the costs of refitting the valves are much less than replacing entire urinals.

Long Term (by 2050)

Beginning in 2025 (or sooner, should the technology become more reliable and affordable), the University will move toward capturing and reusing as much water on campus as it can, such that the UNCG water infrastructure will be a closed system by 2050. In addition to expanding the water capture projects discussed above, on-site water treatment to drinking standards and major water use reduction technologies will form the core of this effort.

Use of composting toilets and waterless urinals would significantly reduce water consumption, as installation of these devices would eliminate flushing. Though these devices are currently available, they are typically more expensive and require higher levels of maintenance than their more conventional counterparts. UNCG piloted waterless urinals and found many problems with them including increased odor and degradation of drain pipes; based on these results, the waterless urinals were removed and have not been pursued for other applications. Manufacturers are refining these products to decrease the needed maintenance increase the user-friendliness of these devices; by 2025 it is expected that these improvements will be in place.

Figure 6.3: Living Machine – North Guilford Middle

A final approach is to conduct wastewater treatment on campus, then reuse the water for campus applications. A promising technology for small-scale (building-level) wastewater is ecological or biological treatment which mimics the processes of natural wetlands. Often referred to as "living machines" (a brand name), these use plants and microorganisms instead of the chemicals that

Figure 6.4: Port of Portland Living Machine

conventional systems do, and the effluent is clean enough to be discharged into the watershed or reused as gray water for various non-potable applications. Ecological treatment has no odors like conventional systems do, and the plants provide an aesthetically pleasing amenity to buildings or grounds (**Figure 6.3**). In fact, some have been placed in conspicuous areas of office buildings and education facilities, including the Port of Portland LEED Platinum building (**Figure 6.4**). Though up-front costs can be significant, particularly if a building is already connected to an existing sewage system, living machines can dramatically reduce water consumption; the installation at the Port of Portland offices has helped decrease water usage by approximately 75% compared to similar-size office buildings.

BACKGROUND

The efforts to move toward sustainability in both the university setting and society at large begin with education. Though educational initiatives have begun to inform campus communities, most people remain unaware of their individual impacts on the environment and have little knowledge of environmental issues in general. For example in a study of students at the three largest universities in Mississippi, scores on the test of ecological literacy were generally low; undergraduate students scored a mean of 52% on the test, while graduate students scored 62% (Hammond and Herron, 2012). These totals were similar to the scores of Michigan State University students who scored only 66% on a state test of environmental knowledge (Kaplowitz & Levine, 2005), and a Penn State University survey of graduating seniors to determine their ecological literacy revealed that "63% were unable to name one federal or state law that protects the environment … 72% had no idea that they were living within the Susquehanna River Basin; and 40% were unable to name even two tree types on campus" (Penn State Green Destiny Council, 2000).

This disconnection with the natural environment is symptomatic of how society has begun to take its relationship with the planet for granted. However, the human impact on our planet is currently unsustainable at multiple levels. Only a vast change in how we view and subsequently interact with the natural environment will bring about a sustaining relationship between humanity and the earth. David Orr, professor of environmental science at Oberlin and noted environmental expert, stated in 2004 that "all education is environmental education… By what is included or excluded, students are taught that they are part of or apart from the natural world." It is clear that environmental education works - in the Mississippi study, number of environment-based courses taken by students related positively to their levels of ecoliteracy, indicating that reemphasizing education on local natural history can improve performance (Hammond and Herron, 2012).

In light of Orr's statement, the findings of Hammond and Herron, and the works of many others, UNCG has the opportunity to improve ecological literacy in its graduates and its community. With a diverse population of thousands of students, faculty, staff, and alumni, UNCG can achieve this in many ways. The University can teach by example via its construction and operating practices. Outreach to the campus and the surrounding community is an integral part of student education, particularly at UNCG, and sustainability can be incorporated into these efforts as well; the University can support student and employee collaboration on environmental outreach programs across the Piedmont. UNCG can expand its support and funding for research groups that study facets of sustainability. Financial and other institutional support for student groups that focus on these issues is another important area for UNCG to consider, particularly as these groups grow (Mital, et al., 2007). However, the most effective approach to influence and educate students regarding sustainability lies within the curriculum taught on campus. By making more courses that inform students about sustainability available and by blending sustainability into core courses and research, sustainability's concepts can reach all students and enhance their academic experience.

ACCOMPLISHMENTS

UNCG has begun to incorporate sustainability throughout its educational programs, including curriculum, research, and outreach.

Leadership

Along with the creation of this Climate Action Plan to recommend practices and policies for UNCG in academics and operations, a new Academic Sustainability Coordinator (ASC) position was created in January 2013 to provide campus leadership in this area. With assistance and collaboration with various campus groups, including the Sustainability Council, the Sustainability Office and the Provost's Office, the ASC will promote, support and implement many programs for sustainability across academic sectors.

Curriculum

Based on a 2011 survey and review of the course catalogs, more than 100 courses focused on sustainability issues have been identified at UNCG (see **Appendix 4** for a complete list). These include courses in Ecology, Biology, Geography, Political Science, Environmental Management/Forestry, Environmental Studies, Business, Tourism and Hospitality, Anthropology, Chemistry, and International Studies. Areas with courses focusing on the social and cultural aspects of the environment include Sociology, Philosophy, Religion, Music, and Theatre. The University has also created a Living Learning Community focused on Sustainable Entrepreneurship. Undergraduate students interested in academic careers focused on sustainability may enroll in the Environmental Studies major or minor, the Environmental Biology program, the Environmental Concentration in Geography, or the newly formed major in Sustainable Tourism and Hospitality. Graduate students interested in sustainability issues may complete the Global Studies M.A. program or the Environmental Health Sciences Ph.D.

Student Groups

The Triad Student Energy Alliance (TSEA) is a campus student organization that addresses sustainability "through energy conservation and efficiency efforts." Members of TSEA also help with the Vampire Energy Slayers project, a student program developed to educate the campus community about energy conservation in a fun and memorable way. Building on the popularity of vampire stories in today's culture, the Vampire Slayers are student volunteers who target energy wasting behaviors in buildings, and engage in "guerilla" marketing to draw attention to vampire energy and energy waste. The UNCG Gardens Student Club promotes sustainable gardening and food production on and off campus. Two other groups have been active in the recent past: UNCGreen and EcoSpartans, the latter focused on sustainability issues for residential students. Students also are contributing members of the Climate Action Plan subgroups, and there are student representatives on the University's Sustainability Council.

Co-curricular Opportunities and Community Engagement

The Office of Sustainability has hosted student projects and on-campus internships focused on sustainability issues; prior to the creation of this office, these were the purview of the Office of Waste Reduction and Recycling.

For off-campus opportunities, the University's Institute for Community and Economic Engagement (ICEE) and Office of Leadership and Service Learning (OLSL) facilitate student involvement with the local community through various programs. They have developed partnerships throughout the region for community-based learning and community service with groups such as the Interactive Resource Center, Equality NC, and the Greensboro Urban Harvest. These organizations and programs provide students with experiential learning as well as opportunities to work for the betterment of the Triad region.

The Greensboro community also has many opportunities to learn about sustainability issues at the campus. Most University events are open to the public; these include Earth Day, Campus Sustainability Day, "Science on Tap," and the Sustainability Film series, as well as seminars, lectures, and research talks pertaining to sustainability.

Faculty Research

A wide range of research into areas under the umbrella of sustainability is conducted by faculty across the campus, often with the assistance of students. Research areas include environmental sociology, environmental movements, urban ecosystems, various other biology and chemistry topics, cycling infrastructure, sustainable tourism, environmental literature, peak oil, social entrepreneurship, underwater sculpture, and ecomusicology. Specific centers conducting research on sustainability issues at UNCG include the Center for New North Carolinians, the Center for Innovation in Interior Architecture, and the Center for Social, Community and Health Research and Evaluation.

Outreach and Other Educational Activities

UNCG has advanced sustainability in many other ways, working to engage all members of the University community. Several sustainability programs and events have been held for the campus over the past few years, including:

Green Office Certification Program: This program educates faculty and staff on how to make the most of the sustainability resources available to their offices/departments, as well as how to make positive sustainability behavior changes. Certification requires an office to complete three progressive levels. The Chancellor's Office was the first to participate and the first to achieve certification. Three additional offices have completed the process, and more than 25 offices are working toward certification.

Energy 101 Course: This lunch and learn class was open to all UNCG employees. Topics of energy conservation, fuel resources, and conservation related to the Piedmont region were covered. Social and environmental impacts of coal burning power plants, and nuclear power plants were also discussed.

Human Resources: A presentation on sustainability at UNCG is included in New Employee Orientation. The Sustainability Office also developed and led a Personal Development Course: titled "*GHG? kWh? CO2e? Zzzzzz….*" This was a conversational workshop to introduce interested employees to the basics of sustainability from economic, social justice and environmental perspectives.

Creative Sustainability Initiative (CSI): This program was developed to engage arts students, who are traditionally not engaged in the sustainability conversation. Three grants of $500 were made to students to carry out their winning proposal ideas. First year winners were two design projects, and one site-specific music/dance performance. The students presented their projects as part of Campus Sustainability Day, and the very first Symposium on Arts and Sustainability.

Lecturers: In the past three years, UNCG has hosted several speakers notable for their work in sustainability, including David Orr, David Owen, Senator George McGovern, and Noam Chomsky.

Earth Day: UNCG's Earth Day celebrations in 2011 and 2012 included a large informational fair along College Avenue and Foust Park with more than 50 "green" vendors and organizations. The events included musicians, artists, alternative health practitioners, and solar power demonstrations. The greater Greensboro community is invited to campus for the event.

Campus Sustainability Day: This national event is sponsored annually by the Society for College and University Planning. It has included the signing of the AUCPCC signing ceremony, an informational street fair and educational webinars.

Class Presentations: When requested, the Office of Sustainability staff gives presentations to classes. These presentations typically include a general overview of operational sustainability efforts and programs offered through the Office of Sustainability. In the past three years, Office staff members have made over 60 presentations to a variety of courses.

NEXT STEPS

The UNCG Strategic Plan, *UNCG Tomorrow*, defines sustainability as "Academics, operations, and outreach… conducted with careful attention to the enduring interconnectedness of social equity, the environment, the economy, and aesthetics." Ensuring that students acquire a basic understanding of the individual elements of sustainability identified in this definition only serves as the *beginning* of sustainability in academics at UNCG, however. The centrality of the natural environment is essential to the entire idea of sustainability; the core of the concept is how the environment shapes, and is shaped by, economic, social and aesthetic factors. Because of this characteristic, imparting a robust understanding of the natural environment to students is vital to any attempt to infuse sustainability into our academic programs.

Infusing sustainability into academics at UNCG will produce graduates who are able to:

- Communicate the basics of sustainability;
- Employ and promote sustainable practices during their time at UNCG; and
- Apply relevant sustainable practices in their career paths.

Other important aspects of this philosophy include conveying current insights and best practices (instruction) and generating new knowledge (research) that explain and enhance the links between the various elements of sustainability. Emphasizing the intentionality of these connections and broadening the scopes in which students think and act are significant outcomes for sustainability in academics. UNCG will provide training and resources to faculty to build the programs needed to achieve these goals.

To successfully institute a culture of sustainability at a university, strategies to "green" the curriculum, research, and co-curricular opportunities must be included. UNCG will ensure that the tenets of sustainability are part of the academic experience of all students, as well as promote the integration of these tenets into the daily lives of its constituency. This is called for in *UNCG Tomorrow*, the University's strategic plan:

> *Improve* health, wellness, and quality of life for children, adults, families, and communities through scientific inquiry and application, workforce development, reduction of disparities, sustainability efforts, and recreational opportunities. (Health and Wellness across the Life Span)… 2.5 Target health, wellness, and safety of the campus community by developing and implementing additional sustainability practices in buildings, outdoor environments, dining services, transportation and campus access, campus maintenance and renewal, energy and climate, and academics and culture. (Sustainability Practices)… 5.2 Promote international investigation of global implications of environmental change that affect shared economic and social systems (Environmental Change).

Issues of global climate change and sustainability are and will increasingly be fundamental to understanding both local and international issues. All students can benefit from acquiring environmental literacy and discovering alternatives to the current, non-sustainable paradigm that dominates our society. The envisioned academic innovations will teach students how their personal choices impact the environment and society, and will offer them accessible, viable options. The broader campus community will be introduced to these concepts via student programs and academic experiences, which in turn will enhance the educational experiences of the students involved. UNCG will build on the successes of the programs and partnerships developed by OLSL and others to promote the concepts of environmental sustainability and social justice throughout Greensboro and the Piedmont Triad.

The vision that all students attain environmental literacy may appear unrelated to certain majors. However, because each student affects the planet and the human communities on it through his/her personal behavior, and because all students will face similar future environmental and

economic challenges, teaching everyone the potential consequences of individual actions is as important as teaching those students that are in disciplines directly related to sustainability. In fact it is likely more important, for most students in the related disciplines begin with or quickly attain some degree of environmental literacy, as observed in the Wheeling (2010) study. Further, as environmental concerns have grown the "green" jobs sector has expanded, and businesses of all types are embracing sustainable practices. Therefore, to better prepare students entering the modern workforce, UNCG must ensure they understand sustainability to compete in the new economy.

Strategies to bolster sustainability within the educational experience at UNCG include the following:

Curricular Changes

To introduce the concepts of sustainability to modern university students, UNCG plans to integrate these concepts into courses across the curriculum and to develop new courses. Ensuring that these efforts do not detract from other academic goals of the University will require input and agreement from faculty and administrators, a responsibility that will fall to the ASC.

One task that is vital to this strategy is to determine a baseline of the existing course offerings. The current inventory of courses is based on a survey that was created in 2011, but had little response, coupled with a review of the online course catalog for key terms and phrases. A more robust and accurate assessment is necessary, and this will also be a goal for the ASC.

Options for curricular changes recommended for consideration include:

Short Term

A phase-in of sustainability throughout the curriculum through one or more of the following:

- Promote and support the successful existing efforts and programs.
- Create and implement a mandatory on-line course on sustainable practices at UNCG, modeled on the AlcoholEDU program. Students would be required to watch the course and pass a follow-up exam before beginning classes.
- Incorporate at least one lecture on sustainability and its relationship to the subject matter into each General Education core course.
- Offer a guest lecture or similar separate teaching module to provide teaching materials on sustainability (e.g. a Powerpoint file, blackboard exercises) that start with the mission and definition, explain the need for sustainability in general, and then describe case studies and solutions. Faculty could include these modules in their courses.

  To overcome potential faculty inertia and implement high-quality content rapidly and widely, the guest lectures could be taught by a designated sustainability instructor. This lecturer would make these presentations in different classes and weave the concepts of sustainability into

the context of the class, making this applicable to almost any course. This idea would have the added benefit of reducing faculty workload.

- Support creation of new Living Learning Communities and Living Communities that center on sustainability, and work to integrate appropriate sustainability concepts into new LLCs and student residential life in general.
- Promote and resource the proposed Introduction to Sustainability course being developed by the new ASC for Environmental Studies.

Medium to Long Term

- As faculty become more familiar with sustainability topics through training (discussed below), each academic department should develop and offer a course focusing on how sustainability issues are applicable to their fields of study. Students would understand the environmental and social implications of the activities in their professions. As an example, the University of Florida's School of Building Construction offers a course titled "International Sustainable Development" that focuses on the environmental impacts of construction worldwide.
- Develop a Sustainability Concentration for appropriate majors. For example, a Green Business concentration or "Green" MBA could be added to Bryan School offerings.
- UNCG could offer a cross-disciplinary Sustainability Certificate or Sustainability Minor. Such a program could be modeled on the successful existing cross-disciplinary programs such as Entrepreneurship, Women's and Gender Studies, and African American Studies.
- Facilitate new faculty hires in relevant areas to strengthen existing academic programs (e.g. Environmental Health Ph.D.) or create new areas of proficiency in departments that have no expertise in sustainability.
- Work across departments to create an annual academic "theme," with sustainability serving as the focus.
- Research the feasibility of a "Sustainability Fellows" program, wherein selected faculty members teach, research, and promote sustainability issues.
- To provide access to subjects beyond what UNCG offers, create an exchange program for sustainability-themed courses akin to that instituted by Tufts, MIT, and Harvard. Several universities in Greensboro and/or the Triad could be involved in this exchange including North Carolina A&T, Guilford College, Wake Forest University, and Elon University. In turn, students from these schools would be able to enroll in courses at UNCG unavailable to them at their respective universities. Because UNCG already has relationships with some of these schools, the program could build on these partnerships.
- Eventually UNCG could require all students pass Introduction to Environmental Studies or a similar course on the basic concepts of sustainability as a prerequisite for graduation.

Optimally this would be taught to first year and transfer students so they might apply their new knowledge toward reducing their personal environmental impacts, which would in turn decrease the climate footprint of UNCG. The course would offer students an alternate view to the current unsustainable practices that dominate modern societies. Students would learn how their personal choices influence the environment and what challenges they will likely encounter due to climate change and diminishing availability of resources.

Any approach to instill sustainability into the various curricula must be interdisciplinary. Not only does this echo the complex interrelationships found within sustainability issues, it also adheres to the definition of sustainability in UNCG Tomorrow. Further, Strategic Area 3 of UNCG Tomorrow states the goal of "offer[ing] transformational undergraduate and graduate education in which students participate in high-impact experiences that develop integrative thinking and prepare collaborative, adaptable graduates with a broad spectrum of transferable skills for life, civic participation, and work in a global society. (Education and Leadership Development)," and sustainability education at UNCG must help accomplish this.

Student Research and Internships

UNCG Tomorrow section 3.6 establishes a goal to "increase participation in initiatives that create meaningful connections between student learning in the classroom and outside of it (Co-Curriculum)." Sustainability education can help meet this objective through student research and internship programs.

As noted above, the OWRR and Office of Sustainability have hosted internships and student research in the past, but on an informal basis. UNCG could develop a formal sustainability internship program through collaboration among the Office of Sustainability, the Academic Sustainability Coordinator, the Environmental Studies Department, and Student Affairs. Topics for internships and research projects are abundant, including expanding recycling, student outreach, and marketing energy conservation habits. These could be offered as options to students to meet individual course research goals or as independent research; it is likely that "pre-packaged" research ideas would better suit the majority of students. Internal funding may be available to support research into areas that would directly help the University achieve its climate neutrality targets. Interested students could also intern with appropriate University departments to work on specific sustainability initiatives including the areas of campus recycling, campus energy use, and behavior change initiatives. Coordination with professional organizations to create internships and other mentoring opportunities could also be promoted.

Student Groups

Interest and participation in sustainability student groups has fluctuated over the years at UNCG. Consistency is vital to keeping these organizations active and their membership engaged. To help maintain this stability, faculty and staff can encourage students in Environmental Studies and related programs to join existing or create new groups to promote sustainability on campus.

Support for student groups that form to promote sustainability within their own professional fields would also be welcome.

To encourage sustainability within existing student groups, the Sustainability Office could work with Campus Activities and Programs. Campus Activities and Programs is better positioned and funded to reach and incentivize students to attend events. They could include sustainable practices in event planning efforts and Greek organization events, and lead an annual student sustainability forum to hear ideas and concerns from all students, building on the first event led by the Sustainability Office in 2012.

Diverse groups should be encouraged to work together on initiatives; as an example, the Triad Student Energy Alliance and the UNCG Gardens Student Club could work together on a project regarding the energy used to produce various foods and how certain diet choices could reduce energy use. Such group dynamics mirror the interdisciplinary nature of sustainability.

Finally, student representatives will continue to be invited to participate on the Sustainability Council and other advisory panels for campus sustainability. As the Climate Action Plan moves into the implementation phase, student representation on the various subgroups will be welcomed as well.

Faculty Research, Hiring, and Training

UNCG support for interdisciplinary research and education to create sustainable solutions for environmental, economic, social, and aesthetic problems will continue through faculty funding, training and hiring prioritization. This is also in keeping with the strategic plan. Another of the values within UNCG Tomorrow is collaboration, such that "Interdisciplinary, intercommunity, inter-institutional, and international collaboration is reflected and rewarded in teaching, research, creative activity, community engagement, and infrastructure." Instruction in sustainability is prioritized in sections 4 and 5.2: "4. Support faculty as they work collaboratively with diverse communities to promote economic transformation, cultural expression, and community development to benefit the residents of the Piedmont region, the state, and beyond (Economic, Cultural, and Community Engagement)…. 5.2 Promote international investigation of global implications of environmental change that affect shared economic and social systems (Environmental Change)."

Training, ongoing consultation and mentorship to guide faculty in their efforts to introduce sustainability into their courses will be vital to achieve success. UNCG could develop a program modeled after those at the University of Maryland ("The Chesapeake Project"), Emory University ("The Piedmont Project"), Tufts University ("The Environmental Literacy Institute") and Northern Arizona University ("The Ponderosa Project") but modified to incorporate a local focus. These programs typically begin with a multi-day faculty development workshop open to faculty in all disciplines to learn about sustainability issues and investigate ways to integrate them into their courses. Participants develop or revise a syllabus or course module that incorporates sustainability concepts as they relate to their prospective discipline. The training cohort then meets again for a

field trip and discussion session, and members share the results of their efforts. Faculty members who take part receive a small stipend once their new or revised syllabi are accepted.

A valuable partner in faculty training for sustainability will be the Faculty Teaching and Learning Commons (FTLC). The primary roles of the FTLC are to bring faculty and professional staff (who teach) together to develop expertise in teaching and learning, and to advance the educational mission of the University. The FTLC offers faculty development opportunities including faculty orientation, mentoring programs, leadership development programs, faculty learning communities, grants and workshops related to teaching and learning. Because of its inherent roles, FTLC is a natural choice to host programs that enhance the ecological and environmental literacies of faculty.

Outreach and Other Educational Activities

A host of strategies will be employed to further educate the campus community. To more effectively market sustainability initiatives and events, the UNCG Office of Sustainability must have the resources to attract and retain audiences. Incentive items that other programs have used to increase the visibility of and participation in their programs include food, t-shirts, and water bottles. However, because the Office is funded through State dollars, it does not receive any discretionary funding to purchase such items. The Office of Sustainability is working with the University Development Office to establish such a fund, and once established UNCG must support fundraising efforts to build this account.

Media & Marketing

The UNCG sustainability website is currently housed within Facilities and is linked to from the main UNCG page. It currently serves as a clearinghouse for information on school sustainability efforts as well as resources for the campus community to use in their lives away from campus. However, this must be expanded into a “landing page,” such as sustainability.uncg.edu, that provides links to all UNCG sustainability groups and programs with an online presence.

Media outreach must go beyond the website, and the Office of Sustainability has attempted to do so with its Facebook page, Twitter feed, and blog. Determining how to increase followers of these resources is vital to successful marketing. Another difficulty for the Sustainability Office as well as many other organizations on campus is the absence of a central communication source that reaches all members of the UNCG community. Because of this, development of specific media campaigns focused on specific populations within the campus community has been the primary outreach strategy to promote resource conservation, recycling, alternative transportation, and other programs with varying degrees of success. This approach can be effective, but it is also extremely time and resource intensive. General campaigns for the entire campus are also necessary to supplement the specific so that everyone at UNCG is reached.

Other ideas include:

- Create a "green tour" of the campus that highlights LEED buildings and other sustainable infrastructure.
- Develop a series of videos on sustainability topics and programs to be made available on the Office of Sustainability website.
- Establish regular features in Campus Weekly, WUAG, and The Carolinian for campus sustainability spotlights and energy data.
- Develop a comprehensive sustainability pledge to be posted on the website that tracks feedback and automatically triggers follow-up e-mails and reminders on a regular basis. In the process, the current energy conservation pledge will be woven into a larger commitment.
- Support awards for leadership and excellence in sustainability for faculty, staff, and students to be awarded by the Sustainability Council.
- Work with University Relations to develop a campus wide awareness effort including high profile activities such as green flags for College Ave and Spring Garden Street.
- Work with the Sustainability Council and Chancellor to establish sustainability as a primary theme for an academic year.
- Develop or purchase a smart-phone/ipad app to encourage sustainable activities. E.g., a "UNCGreen game" in which students self-report sustainable actions to earn points and rankings. Information on sustainability topics tailored to student audiences and local sustainability infrastructure would be a critical part of such an application. This could be a student internship or research project.

Students

Introducing first year and transfer students to the sustainability initiatives is an important step to develop the culture of sustainability at UNCG. Several methods can be used to reach these new students. Inclusion of a presentation within new student orientation ("SOAR") would emphasize the importance of sustainable practices to UNCG. The OOS and OWRR have participated in the Spartan Expo portion of SOAR, a "fair" for campus organizations to promote themselves, but this has not been effective for sustainability programming. To further assist new students, a "green" guide could be distributed with other orientation materials. The Office of Sustainability and a student intern developed such a guide for the Quad residents in Spring 2012, and this could be modified for all students.

A program that has enjoyed success at many colleges and universities is EcoReps, a peer-to-peer residence hall-based education campaign using student sustainability advisors. Two main strategies have been employed: 1.) training residence hall advisors in sustainability, who in turn act as sustainability advisors as part of their RA responsibilities; or 2.) selecting resident students to serve as sustainability advisors and work with the RAs. UNCG piloted a version of

the second strategy in one residence hall in 2011 and saw some success, but resources were extremely limited and the program was not continued. UNCG should fund a robust EcoRep program, as peer-to-peer education is one of the most effective means of influencing behavior.

Other ideas include:

- Work with admissions to include sustainability into recruiting materials.
- Strengthen and expand the Creative Sustainability Initiative. Increase the number of participants, and seek funds to implement winning projects when possible.
- Encourage and fund attendance of UNCG student sustainability leaders at conferences for campus sustainability, including AASHE and the Smart and Sustainable Campuses.
- Continue working with SGA to establish a position within the SGA administration that serves as a liaison to the Office of Sustainability.

To track the effectiveness of these initiatives, a survey will be developed to assess student knowledge of and attitudes toward sustainability efforts. This survey will be given to student cohorts first during freshman orientation and again just prior to graduation.

Faculty and Staff

Much like the sustainability advisor program proposed for students, a peer-to-peer education campaign for faculty and staff will be developed. One successful example comes from the University of British Columbia, whose Office of Sustainability created an education program wherein each academic and operations department has a volunteer sustainability coordinator. These sustainability coordinators work a few hours each month, with supervisory approval, to educate fellow employees in their respective departments about the environmental consequences of their work practices and how these might be made more sustainable.

Human Resources leadership has made “talent sustainability” a core mission, and in doing so has been developing many professional and personal development courses and opportunities. The ASC and Sustainability Office will work with Human Resources (HR) to refine and better promote the professional development class on sustainability that debuted in Fall 2012. An annual award to recognize faculty and staff leaders in sustainability could also be developed in conjunction with HR.

UNCG should also provide the resources needed to expand and revise the successful green office campaign to inform employees about best practices in the workplace environment will be developed. Program revisions and additions will include specific tracks for unique environments such as medical offices, research labs, and athletic facilities, and a “Green Office 2.0” will be created to prevent stagnation and ensure that certified offices continue to practice more sustainable habits in the workplace.

Finally, to reach employees that do not work in office environments, UNCG should resource and implement Green Teams in the Facilities Operations shops. This program allows individual

Facilities units to examine their practices and then revise them to incorporate the tenets of sustainability. This builds sustainability into the daily practices and responsibilities of these staff members and starts a cultural change within these departments. Resources to provide incentives, feedback and measures of progress will be required to make this program successful.

Community Outreach

Building on the successes OLSL and ICEE have made in helping students work on the social aspects of sustainability in the Piedmont community, the University should look to create opportunities for students in all areas of sustainability. Collaboration among the OLSL, the Sustainability Office, the ASC, and the Sustainability Council could lead to beneficial co-curricular and experiential educational programs, including urban ecology or the intersections between public health and the environment. Fostering collaboration with other universities in these efforts would allow students greater breadth of opportunities and create a more cohesive academic community working on sustainability in Greensboro.

APPENDIX 1: FULL TEXT OF THE AMERICAN COLLEGE & UNIVERSITY PRESIDENTS' CLIMATE COMMITMENT:

We, the undersigned presidents and chancellors of colleges and universities, are deeply concerned about the unprecedented scale and speed of global warming and its potential for large-scale, adverse health, social, economic and ecological effects. We recognize the scientific consensus that global warming is real and is largely being caused by humans. We further recognize the need to reduce the global emission of greenhouse gases by 80% by mid-century at the latest, in order to avert the worst impacts of global warming and to reestablish the more stable climatic conditions that have made human progress over the last 10,000 years possible.

While we understand that there might be short-term challenges associated with this effort, we believe that there will be great short-, medium-, and long-term economic, health, social and environmental benefits, including achieving energy independence for the U.S. as quickly as possible.

We believe colleges and universities must exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality. Campuses that address the climate challenge by reducing global warming emissions and by integrating sustainability into their curriculum will better serve their students and meet their social mandate to help create a thriving, ethical and civil society. These colleges and universities will be providing students with the knowledge and skills needed to address the critical, systemic challenges faced by the world in this new century and enable them to benefit from the economic opportunities that will arise as a result of solutions they develop.

We further believe that colleges and universities that exert leadership in addressing climate change 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 and local communities.

Accordingly, we commit our institutions to taking the following steps in pursuit of climate neutrality:

1. Initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible.
    a. Within two months of signing this document, create institutional structures to guide the development and implementation of the plan.
    b. Within one year of signing this document, complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel) and update the inventory every other year thereafter.
    c. Within two years of signing this document, develop an institutional action plan for becoming climate neutral, which will include:
        i. A target date for achieving climate neutrality as soon as possible.

ii. Interim targets for goals and actions that will lead to climate neutrality.
iii. Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students.
iv. Actions to expand research or other efforts necessary to achieve climate neutrality.
v. Mechanisms for tracking progress on goals and actions.

2. Initiate two or more of the following tangible actions to reduce greenhouse gases while the more comprehensive plan is being developed.
    a. Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent.
    b. Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist.
    c. Establish a policy of offsetting all greenhouse gas emissions generated by air travel paid for by our institution.
    d. Encourage use of and provide access to public transportation for all faculty, staff, students and visitors at our institution.
    e. Within one year of signing this document, begin purchasing or producing at least 15% of our institution's electricity consumption from renewable sources.
    f. Establish a policy or a committee that supports climate and sustainability shareholder proposals at companies where our institution's endowment is invested.
    g. Participate in the Waste Minimization component of the national RecycleMania competition, and adopt 3 or more associated measures to reduce waste.

3. Make the action plan, inventory, and periodic progress reports publicly available by submitting them to the ACUPCC Reporting System for posting and dissemination.

In recognition of the need to build support for this effort among college and university administrations across America, we will encourage other presidents to join this effort and become signatories to this commitment.

Signed,

_____
President/ Chancellor Signature

_____
President/ Chancellor Name

_____
College or University

_____
Date

Please send the signed commitment document to:
Presidents' Climate Commitment
c/o Second Nature
18 Tremont St., Suite 308
Boston, MA 02108
or fax to: 320-451-1612
or scan & email to: ACUPCC@secondnature.org

APPENDIX 2: PROPOSED HOME ENERGY EFFICIENCY PROGRAM FOR EMPLOYEES

GOALS:

1. To conduct energy audits and install energy efficiency measures at the homes of UNCG employees.
2. To improve the morale and financial situations of UNCG employees, with a minimal outlay of University funds. The relatively small investment will lead to substantial financial savings over time.
3. To capture "carbon offsets" to assist UNCG in moving toward carbon neutrality.

PROGRAM:

The UNCG Home Energy Assessment Team (**HEAT**) is envisioned as a group of employee volunteers who provide basic home energy audits and home weatherization for UNCG employees. The team will be comprised of campus experts in the building trades, and volunteers who wish to learn more about these areas. Experts from the private sector may be included should interest arise.

Audits: For each home selected, two-to-three team members will conduct a walk-through to identify energy wasting conditions and areas for energy efficiency improvements. The basic energy assessment will include a review of energy usage data (monthly bills) and a visual inspection. Areas to be covered include:

- Insulation
- Lighting
- Weather-stripping and caulking
- Window type/condition
- Window coverings
- Equipment condition/maintenance
- Exterior penetration points
- Appliances
- Faucets & showerheads
- Landscape
- Behaviors

A brief of findings will be presented to the homeowner, with recommendations on areas that could be improved (if any).

Weatherization: Based on the assessment and feedback from the homeowner, the team would then perform basic weatherization of the home. Activities that the team could perform include:

- Inspect heating/cooling equipment and repair as necessary, including filter, duct diagnostics and sealing (return and supply systems)
- Seal major air leaks and bypasses

- Insulate and vent attic
- Adjust refrigerator and water heater settings(if needed)
- Insulate floor
- Insulate ducts and heating pipes
- Install a smart thermostat
- Install compact fluorescent lamps (CFLs)
- General heat-waste prevention measures:
    - Door and window weather-stripping
    - Caulking gaps
    - Water heater insulation
- Install low-flow showerheads
- Install plantings as windscreens and/or shade
- Tutorial and written information on simple energy-saving habits (created by the Office of Sustainability):
    - Thermostat settings
    - Laundry/dishwasher (full loads and cold water setting for laundry)
    - Vampire energy
    - Lights

Services that will NOT be included:

- Repairing broken glass
- Repairing or replacing appliances or light fixtures
- Thermostat change-out
- Insulation of walls and floors

However, if these or similar problems are noted during the audit, the homeowner will be informed during the briefing. Team members will provide information about various incentive programs for professional energy efficiency services and appliance upgrades.

BENEFITS:

Energy use is expected to *decrease 10-30% per home* through this program, and participants should see immediate savings. Their homes will be more comfortable during seasonal extremes.

The average North Carolina home uses approximately 13,500 kWh ($1400) of electricity (EIA, 2010). Depending on its heating system, the home may also use an average of 57,000 cf ($714) of natural gas, 576 gallons ($2217) of fuel oil, or 343 gallons ($1040) of LPG. Participants could therefore be expected to save from *$150 - 1000 annually*; better estimates can be made when specific HVAC information is known.

For the **HEAT** team, providing this necessary service will help boost morale. Hopefully, the program will also lead to greater camaraderie among employees, many who may not typically interact. Team members will acquire new knowledge or share it with other volunteers. All of these will result in a stronger UNCG community.

Beyond the benefits of happier and healthier employees and a strengthened University community, UNCG will be able to claim greenhouse gas offsets of approximately 1-4 $mtCO_2e$ per house per year. This program may also serve as a pilot for a broader effort. The energy audits and weatherization could be expanded to surrounding UNCG neighborhoods to improve relations with those communities and further our carbon offset program.

ELIGIBILITY:

All UNCG employees are eligible to apply for this program. As the funding and manpower resources are expected to be limited, it is likely that not all applicants will be accepted each year. A committee will review the applications to determine priority cases. Priority criteria will include, but not be limited to: current household energy consumption, household size, age and health of household members, total annual household income, and employee longevity of service to UNCG.

ESTIMATED COSTS:

(Note: these are based on retail costs)

- Bulbs: est. 30 per house @ $2.00 bulb ≈ $60.00
- Insulation (attic): $.050-1.00 per $ft.^2$ ≈ _____ (variable)
- Caulk: ≈ $20.00
- Weather-strip: ≈ $50.00
- HVAC Filters: ≈ $5.00 -10.00

OR set a limit of **$500** per home.

Environmentally preferred purchasing will be mandated for available goods.

POTENTIAL FUNDING SOURCES:

- Chancellor's discretionary budget
- Grants
- Affiliate with existing weatherization programs (some question as to whether we can claim the offsets if we don't pay for them).
- Alumni and/or community donations
- Donation of materials from private partners (Lowe's, Duke Energy, etc.)

POTENTIAL PARTNERS – FUNDING, EXPERTISE, VOLUNTEERS, ETC.:

- Local USGBC chapter
- IAR students
- Office of Leadership and Student Learning
- Alternative/renewable energy companies

- Energy efficiency companies
- Non-profits/government agencies doing similar work
- Guilford Technical Community College energy audit students. Additional manpower to reduce demand on UNCG personnel and provide learning opportunity to GTCC students. This could also facilitate getting some of the Facilities Operations or FDC staff certified to assist with energy awareness and assessment on campus.

OFFICE OF SUSTAINABILITY ROLES:

- Help recruit team members
- Serve on application review committee
- Assist with grant-writing
- Request material donations from local businesses
- Provide the educational materials for residents.

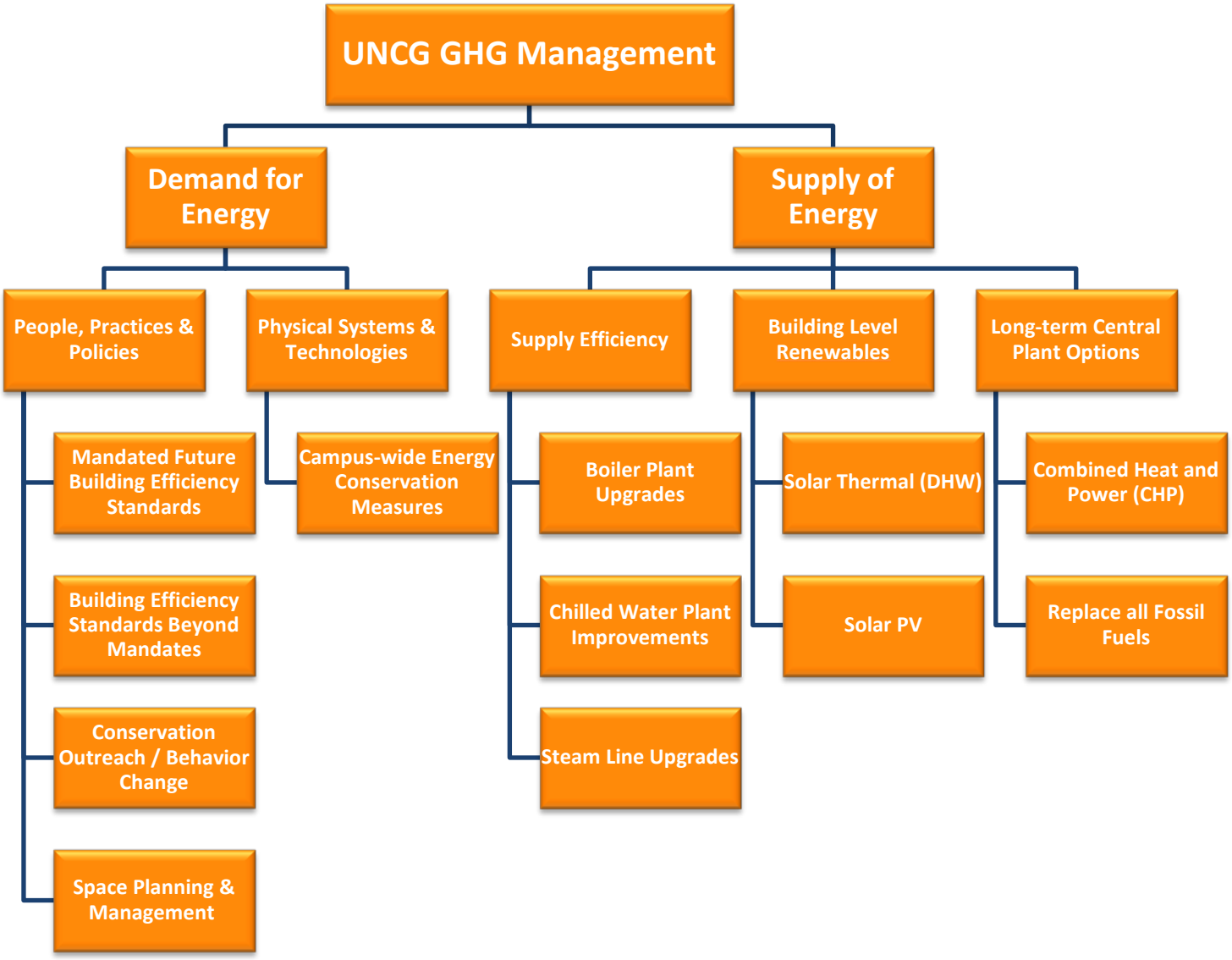
APPENDIX 3A: COMMODITY AND PURCHASED UTILITY PRICE ASSUMPTIONS

	1.0%	1.0%
Energy Type	Natural Gas	Purchased Electricity
Unit	2011$/MMBtu	2011$/MWh
2009	$8.26	$57.30
2010	$6.26	$61.20
2011	$5.83	$61.20
2012	$5.89	$61.81
2013	$5.95	$62.43
2014	$6.01	$63.05
2015	$6.07	$63.68
2016	$6.13	$64.32
2017	$6.19	$64.97
2018	$6.25	$65.61
2019	$6.31	$66.27
2020	$6.38	$66.93
2021	$6.44	$67.60
2022	$6.50	$68.28
2023	$6.57	$68.96
2024	$6.64	$69.65
2025	$6.70	$70.35
2026	$6.77	$71.05
2027	$6.84	$71.76
2028	$6.90	$72.48
2029	$6.97	$73.20
2030	$7.04	$73.94
2031	$7.11	$74.68
2032	$7.18	$75.42
2033	$7.26	$76.18
2034	$7.33	$76.94
2035	$7.40	$77.71
2036	$7.48	$78.48
2037	$7.55	$79.27
2038	$7.63	$80.06
2039	$7.70	$80.86
2040	$7.78	$81.67
2041	$7.86	$82.49
2042	$7.94	$83.31
2043	$8.02	$84.15
2044	$8.10	$84.99
2045	$8.18	$85.84
2046	$8.26	$86.70
2047	$8.34	$87.56
2048	$8.42	$88.44
2049	$8.51	$89.32
2050	$8.59	$90.22

Assumed Real Growth Rate

Source: http://www.uncg.edu/ppo/utilitydatafy1011.pdf

APPENDIX 3B: GHG MITIGATION STRATEGIES



APPENDIX 4: SUSTAINABILITY-FOCUSED COURSES OFFERED AT UNCG (2012-13)

AFS 351 Race, Gender, and Performance: Enactments of Unfreedom. Focus on the history of a relation between race, gender, and performance as it relates to the enactment of and resistance to neocolonial, patriarchal control and captivity.

ATY 100 Contemporary Non-Western Cultures. Survey of contemporary non-Western societies which emphasizes their distinctive cultural characteristics and how these relate to changes taking place in the world today.

ATY 258 Introduction to World Prehistory. Development of culture from its Paleolithic beginnings through the rise of early civilizations.

ATY 450 Anthropology in the Environment: Culture, Environment, and Adaptation. Through an anthropological lens this course examines various theoretical approaches to culture and the environment. Issues of social justice, cultural preservation, and natural resource access will be addressed through case studies.

ATY 520 Economic Anthropology. An analysis of the economic organization of tribal and peasant peoples with special attention given to their participation in a world economy; emphasis is on economic models of social change.

ATY 526 Anthropological Perspectives on Food and Agriculture. Examines the linkages among food producers, marketing strategies, and natural resource use in different cultures, and explores the influence of agriculture on society and the environment.

BIO 105 Major Concepts of Biology. Introduction to major concepts in biology. Topic sections emphasize specific areas including conservation biology, biotechnology, and current issues. Survey sections emphasize basic aspects of biology, including genetics, physiology and ecology.

BIO 105 L (Lab portion of above)

BIO 361 Biology and Conservation of Sea Turtles. Students spend 2 weeks in July/August in Tortuguero, Costa Rica assisting with tagging and collecting data on nesting turtles. Seminar and NC field trip in spring.

BIO 431 The Biosphere. A study of environmental issues in biology, specifically ecosystems, population dynamics, biodiversity and extinction.

BIO 549 Current Topics in Biology. Advanced topics courses in the biological sciences. Topics vary with instructor.

BIO 607 Seminar in Environmental Health Science. Development of critical-thinking and writing skills through discussions and critiques of primary literature in environmental health science and through writing assignments.

BIO 631 Environmental Health Science I: Ecosystems to Individuals. Causes of environmental problems that society faces and the effects on ecosystem and community function and species survival. Implications for environmental and human health are explored.

BIO 632 Environmental Health Science I: Ecosystems to Individuals. Introduction to fundamentals of toxicology with a focus on toxicological consequences of environmental perturbations on physiological and cellular processes, genome structure, and gene function.

BIO 633 Workshops in Environmental Health Science. Individual six-week workshops focusing on analytical tools and experimental approaches used in freshwater/riparian ecosystem analysis, environmental genomics, environmental forensics, and cellular/physiological research.

BIO 641 Stream Ecology. Study of ecology and management of flowing water ecosystems. Topics such as community and ecosystem processes, major paradigms, management of point versus non-point pollutants, and restoration addressed.

BIO 695 Biological Research. Student engages in advanced biological research under the supervision of a member of the Graduate Faculty.

BIO 790 Directed Study in Environmental Health Science. Advanced research in environmental health science under the direction of a graduate faculty advisor. Preparation of doctoral research proposal and planning for dissertation research.

BUS 130 Entrepreneurship in a Sustainable Global Environment. Global forces will restructure the world economy for the foreseeable future. Entrepreneurship, sustainability, and innovation will drive companies and individuals and produce major changes within that environment. (Same as ENT 130)

BUS 340 Social Entrepreneurship. Introduction to social entrepreneurship including identification of social problems and how they are solved through innovation, community impact, sustainability, ethical, scalable, economic value creation, and risk-taking efforts. (Same as ENT 340)

BUS 540 Social Entrepreneurship: Justice and a Green Environment. Interdisciplinary course in social entrepreneurship. Exploration of models for designing and implementing entrepreneurial projects that respond to social, economic, environmental, and justice issues. Introduction to direct action and evaluation. (Same as CST 540, ENT 540, SWK 540, WGS 540)

CED 689 Global Perspectives in Counseling. This course will require travel, cultural immersion, and the provision of services to members of that community, with an overarching goal of improving cultural competence and awareness as a counselor.

CNR 600 Fundamentals of Conflict Resolution and Peace Studies. Introduction to the interdisciplinary theory, research conflict analysis and intervention strategies which form the foundation of peace and conflict studies.

CNR 601 Cultural Dimensions of Conflict Resolution and Peace Studies. Explores multiple dimensions of diversity in creating and resolving conflicts. Students will explore their own culture beliefs and values as well as diverse conflict models and systems around the world.

CNR 610 Conflict Transformation: Reconciliation and Healing. Nonviolent responses to conflict and violence that are oriented to the restoration of relationships damaged by crime, war, community and workplace violence.

CNR 676 Peace Development and Community Building. Approaches to community and peace-building, with emphasis on understanding power and conflict, are taught within a global context. Strategies are developed for building peace and community through civic engagement.

CNR 679 Gender and Peacebuilding. Examines the role of gender, sex, diversity, and power relations in the creation and resolution of conflict and building of peace.

CST 420 Environmental Communication

ECO 100 Economics of a Global Sustainable Society. Sustainable development, with a natural emphasis on non-Western nations; will consider issues around such topics as demographics, development theories, the environment, health and education, the role of institutions, etc.

ECO 300 The International Economy. Examines the history, structure, and institutional foundations of the international trading system. Analyzes the impact of trade on economic growth, employment and living standards with a focus on contemporary issues.

ECO 380 Environmental and Natural Resource Economics. Examination of environmental problems in market economies. Topics include the economic theory of pollution and its control, common-property resources, renewable and other resources, endangered species, population growth, and international problems.

ELC 721 Social and Cultural Change and Education. Consideration of social, cultural, political, and moral challenges facing education in the 21st century. Critical social and educational perspectives on the crises of meaning, democracy, globalization, religion, and identity.

ENG 380 Literature and the Environment. Exploration of some important post-1800 literary texts about "nature," of ecocritical theories, and of affiliated social movements, with particular attention to place-based differences.

ENV 100 Introduction to Environmental Studies. Survey of current environmental issues from ecological, social, cultural, political, and economic perspectives.

ENV 399 Environmental Studies Internship. 150 hours of supervised work in a private, nonprofit, or public environmental agency; five 2-hour seminars to discuss assigned readings and internship experiences; research paper or written field project required.

ENV 401 Individual Study. Reading or research. Available to qualified students upon recommendation of supervising instructor.

ENV 493 Honors Work

GEO 104 World Regional Geography. Geographical criteria that define the major cultural and functional world regions. Emphasis on regional methods of geographical study, with applications to current world events and situations.

GEO 105 Cultural Geography. Introductory project-oriented course concerned with the geographical characteristics of population, political systems, settlement patterns and livelihoods.

GEO 110 Introduction to Geography. Changing interaction of man and his environment and the resultant human and economic patterns in various parts of the world.

GEO 205 Environmental Change: Its Nature and Impact. Environmental changes related to human use of land, water, soils, minerals, and natural amenities. Planning for sustained use or preservation of land-based natural resources.

GEO 301 Urban Geography: Global Patterns. Urbanization processes and the development of mega-cities and urban hierarchies emphasizing the differences between cities from across the world.

GEO 302 Urban Geography: Land Use. Internal structure of cities, including the role of transportation systems, socio-economic development, and the physical environment. Emphasis on differences within cities.

GEO 303 World Population Problems. Major world population problems, trends, and significant policy and action alternatives for the future. Impact of various geographical factors on problems and trends.

GEO 313 Natural Resource Regions of North America. Regional natural resource use and associated human interaction with the natural environment. Instruction takes place during an extended field trip across portions of North America.

GEO 314 Physical Geography: Landscape Processes. Examination of the processes responsible for the development of the earth's varied terrain characteristics. Analysis of environmental problems involving human impact on landscape and river systems.

GEO 314L Physical Geography Laboratory. Laboratory demonstrations and map interpretation exercises to accompany GEO 314, which must be taken concurrently.

GEO 320 Tourism Planning and Development. Geographic distribution of tourist development. Emphasis on the spatial dimension of origin-destination flows, economic geography of the travel industry, socio-economic and environmental impacts. Emphasis on tourism planning issues. (Same as HTM 320 and RPM 320)

GEO 504 Political Geography. A systematic overview of relationships among space, place, and politics at multiple geographic scales. Topics include boundaries, geopolitics, nationalism, resource distribution, means of controlling space, and the spatiality of globalization.

GEO 605 Seminar in Environmental Studies. Selected topics of current interest in environmental studies.

GEO 606 Environmental Planning. Examination and analysis of environmental concepts and their relationship to various planning and management scenarios, including environmental issues, strategies, and plans.

GEO 612 Natural Resource Geography. Application of geographical theory to natural resource use and distribution. Emphasis on resource use and constraints to development.

GEO 641 Earth Surface Processes and Landforms. Advanced systematic study of geomorphology with applications to human responses to natural hazards and environmental management.

GEO 781 Seminar in Earth Science/Natural Resources. Directed readings and research proposal development on selected aspects of natural resource policy and management from the perspective of earth science.

GEO 791 Seminar in Urban Planning/Economic Development. Directed readings on selected aspects of urban planning/economic development focused on theory and policy issues from a geographic perspective.

GRO 632 Communities Responding to an Aging Society. Addresses community responses to an aging society and how those responses may be enhanced through civic engagement, infrastructure development, and public/private initiatives. Emphasizes developing and sustaining innovative programs.

HEA 316 Environmental Health. An analysis of the identification, assessment, and control of environmental health risks. Focus on the effects of specific toxicants and the prevention of their negative impact on health and well-being.

HEA 347 Health Problems of Lower Income Groups. Ramifications of poverty-health complex in United States and social differences in physical and mental illness. Emphasis on identification of specific health problems common among the poor and detailed inspection of characteristics of poverty which contribute to these health conditions.

HEA 608 Environmental Health. Analysis of local, national, and international environmental issues influencing the health of individuals and communities; air and water quality, waste management, disease control, occupational settings, population, and environmental planning.

HIS 625 Preservation Planning and Law. Examination and analysis of the relationship of government programs and policies, community and regional planning strategies, and legal case precedents to the field of historic preservation. (Same as IAR 625)

HTM 251 Multicultural Issues in Hospitality and Tourism. Multicultural and global issues in hospitality and tourism. Historical, socioeconomic, cultural, and linguistic variables impacting tourism and hospitality marketing, operations, and human resources. Study of selected Western and non-Western cultures.

HTM 352 Destination Management. Introduction to the management of tourism destinations. Students will be exposed to the entire destination management process including basic concepts, planning, development, management, and marketing of tourism.

HTM 374 Hospitality Facilities Design and Systems. Focuses on the how and why of matching facility design to operational goals. Students learn to communicate functional goals from an operator's viewpoint to design and engineering professionals.

HTM 463 Sustainable Tourism Development. The study of sustainability and its relationship to the economic, environmental, and social dimensions of tourism development.

IAR 124 Experimental Course: Sustainability 101. Uses conditions and instances of daily life to explore the interconnectedness of four pillars of sustainability: social equity, the environment, economy, and aesthetics.

IAR 302 Interior Architecture II. Design investigations of spaces of increasing scale and complexity articulated by the interaction of individual and place. Special emphasis on social/behavioral aspects of interior architecture and responsibilities of designer to society.

IAR 331 Social and Behavioral Aspects of Interior Architecture. Introduction to literature and methods of environmental design research as it applies to interior environments.

IAR 432 Special Problems in Interior Architecture. Independent study of topics of special interest.

LIS 662 Information Services to Diverse Client Groups. Changing demographic patterns affecting library and information services in all types of libraries. Services, collections and staffing to reflect a variety of cultural/ethnic experiences/needs.

MGT 589 Experimental Course: Business Strategies for Building a Healthy Environment: Competitive Advantage, Sustainability, and Beyond. Business leaders must consider social/environmental

context of practices they employ. Principles of sustainable development will include how human and materials resources are needed for managing a business in today's world.

MTD 667 BioMusic Grounding and Practice. Exploration of the origins of music-making in animals, including humans. Examination of music and natural sounds in contexts of biodiversity, cultural diversity, and complex communication systems.

MUE 631 Selected Topics in Ethnomusicology. Music traditions and current issues in the field of ethnomusicology. Topics may focus on geographical areas or theoretical/methodological issues.

MUS 223 Music and Environment. Consideration of creative works and traditions relating human sound (music, noise, etc.) and the natural environment from artistic, humanistic, and scientific perspectives.

MUS 426 Experimental Course: Introduction to BioMusic. BioMusic is an interdisciplinary field that explores the origins of music-making in animals, including humans. Music and natural sounds are examined in contexts of biodiversity, cultural diversity, and complex communication systems.

MUS 431 Selected Topics in Ethnomusicology. This course with rotating topics will examine particular music traditions and current issues in the field of ethnomusicology beyond the survey level. Topics may focus on geographical areas (Africa, Indonesia, Native American, etc.) or theoretical/methodological issues (Music and Gender, Music and Identity, Popular Music, Fieldwork, etc.).

PHI 361 Ethical Issues in Business. Ethical theory and its application to business: economic justice, corporate responsibility, self-regulation and government regulation, conflict of interest, investment policy, advertising, and environmental responsibility.

PHI 363 Environmental Ethics. The ethics of our relationship to the environment. Traditions in environmentalism; treatment of animals, nature, plants, and species; application of environmental ethical theory to real-world environmental problems.

PSC 313 Natural Resources Law and Policy. Study of state, federal, and international natural resources law and policy: topics include acquisition and management of public lands, wildlife, biodiversity, resource conservation. (Same as ENV 313)

PSC 340 International Political Economy. Recent problems in international politics with emphasis on trade and monetary relations, regional economic integration, transitions to market economies, differing perspectives between the industrialized and developing world, international environmental issues.

RCO 120 Ashby Residential College Seminar in Language and Culture. Focus on the interconnections among regions of the world, interpret and evaluate information on diverse ecologies, human

societies, artistic achievements, or political systems, and gain sensitivity to cultural differences on a global scale.

REL 250 Religious Traditions and Care of the Earth. Examination of the thought, ethics, and practice of major religious traditions and worldviews with regards to the care of the earth. Emphasis on non-Western, indigenous, and eco-feminist traditions.

REL 251 Topics in Religious Social Ethics. Inquiry into the social teachings of diverse religious traditions with respect to such current topics as economic development and social justice, human rights, democracy, freedom, human well-being and the environment.

RPM 626 Tourism Management. Study of the current trends and issues in travel and tourism; examination of ethical and legal issues, marketing and management strategies, and providers of tourism products and services.

SES 200 People with Disabilities in American Society. Exploration of the treatment of people with disabilities in American society from a personal, historical, political, and social perspective, including related legislation, portrayal in popular media, and contemporary issues.

SES 400 Perspectives on the Global Deaf Community. Global perspectives of deaf people in other countries including perspectives on identity, language, human rights issues, education, advocacy, and social and economic self-sufficiency.

SOC 202 Social Problems in Global Context. This course examines causes of and responses to critical social problems in different world regions with a focus on the dimensions and impacts of globalization.

SOC 240 An Introduction to Cultural Sociology. An introduction to cultural sociology and exploration of cultural products and practices, the relationship between culture and society, and issues pertaining to meaning, interpretation, and representation.

SOC 323 Global Deviance. Explores and examines contemporary meaning and forms of deviant behavior using cross cultural and international perspectives.

SOC 326 The Community. Recent changes and current structure of communities, with special attention to urbanization, bureaucratization, industrialization, social class systems, land use, inter-organizational relationships, urban life styles, and community power.

SOC 327 Race and Ethnic Relations. Interaction between peoples of differing racial, ethnic, and cultural backgrounds, with comparison of American relationships to those in other parts of the world.

SOC 328 Social Movements. Systematic study of such forms of collective social behavior as social movements and revolutions with a strong international and comparative focus.

SOC 330 Urban Society. Analysis of emergence of urban society including formation and growth of urban centers and problems associated with ecological, social, and cultural differentiation within urban settlements.

SOC 342 Global Inequalities. Examination of social stratification systems and theories, economic prestige, power inequalities, social mobility, and class consciousness.

SOC 344 Global Society. Examines the interdependent development of formal organizations, communities, and societies as large scale social systems. Special attention is given to inter-societal relationships and the world system. Application to contemporary social issues is stressed.

SOC 345 Social Change. Examination of nature, process, and consequences of social change with consideration of its control in all types of societies.

SOC 346 Population Problems. Sociological study of basic population processes of fertility, migration, and mortality, including examination of problems associated with changing population size, composition, and distribution.

SOC 370 Environmental Sociology. Introduction to major sociological theories, perspectives and research useful for understanding environmental issues and environmentalism. Primary focus on the U.S., with some attention to Europe and developing countries.

SOC 522 Seminar in Population and Urban Studies. Advanced study of population processes and urban concepts from an interdisciplinary viewpoint. Emphasis on accessing and interpreting data from the U.S. census and other sources.

SOC 533 Political Sociology. Influence of social values and social forces upon government policy and of government policy upon society. Examination of conflicting political sociological theories.

SOC 628 Social Movements. Sociological approaches to social movements and social conflict emphasizing their genesis, structure, resources, and consequences for simple and complex societies.

SOC 636 Seminar in Social Inequalities: Theory and Research. Basic systems of social inequality, including social class, race, and gender. Trends in theory and research.

SOC 640 Cultural Sociology. Graduate seminar in cultural sociology; an exploration of cultural products and practices, the relationship between culture and society, theories of culture, and issues pertaining to meaning, interpretation, and representation.

SOC 644 Sociology of Globalization. Sociological perspectives on globalization and its effects. Trends in theory and research.

SWK 215 Introduction to Social Work. Introduction to social welfare programs and social work practice. Topics include: social problems confronting society; societal and community helping resources; social work practice in a changing society. Field observation required.

SWK 311 Human Behavior and Social Environment. Emphasis on theories relevant to understanding and influencing change on the societal, organizational, group, and individual levels.

SWK 315 Social Work, Diversity, and Vulnerable Populations. Examination and understanding of cultural and human diversity with focus on oppressed groups. Students will have the opportunity to learn about broad differences and likenesses among diverse populations and cultures.

SWK 620 Human Behavior and Social Functioning I. Theories of human behavior and intervention with people in a variety of systems viewed from biological, sociological, and psychological perspectives.

SWK 624 Social Work Practice and Human Diversity. Examines cultural and social diversity; addresses theoretical and practical dimensions of social work practice with oppressed people of color, women, the aged, the sexually diverse, and the physically disabled.

TED 445 Human Diversity, Teaching, and Learning. Examines how the multiple identities of race, ethnicity, socioeconomic status, gender, and religion affect the teaching and learning environment. Issues of classroom management for maximum instructional delivery are also included.

TED 555 Multicultural Education . Philosophical and sociocultural perspectives on pluralism and diversity. Emphases include interdependent individual, cultural, and institutional behaviors related to race, religion, class, cultural/ethnic heritage, and gender.

TED 646 Introduction to Equity Education. Designed to introduce concept of equity education (culture, race, ethnicity, socioeconomic status, language, gender, and exceptionality). Students acquire knowledge, skills, and dispositions necessary to create equitable environments in K-12 educational settings.

TED 765 Research in Equity Education. Examines the research knowledgebase in equity education and facilitates the design of culturally sensitive studies. Particular emphasis on race/ethnicity, gender, and class issues related to the design of research studies that affirm equity and perpetuate social justice.

WGS 250 An Introduction to Women's and Gender Studies. An interdisciplinary introduction to the study of gender through images, roles, and status in U.S. history and culture. Special attention given to developing critical frameworks for understanding gender in society.

WGS 270 Sexuality and Culture. An introduction to the academic study of lesbian, gay, bisexual, transgender, and intersex histories, experiences, and cultures. (Alt Years)

WGS 333 Gendered Worlds. Explores social problems, movements, and change related to gender in specific cultural, historical, political contexts. Advances a questioning of one's position in gendered relations of power in a constantly changing world.

WGS 650 Feminist Theory: Intersections of Gender, Race and Class. Core class introduces feminist social movements across historical and global contexts. Relies on interdisciplinary lenses and epistemologies, particularly as contested identity politics intersect with other systems of power and relationships.

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