University of Richmond
Climate Action Plan

Executive Summary

The Climate Action Plan for the University of Richmond establishes the framework for achieving the University's climate action goals under the American College and University Presidents Climate Commitment. The University of Richmond's goal is to reduce greenhouse gas emissions 30% by 2020 and 100% by 2050. In addition to emissions reduction, the Climate Action Plan articulates goals for embedding sustainability into the curricular and co-curricular aspects of a Richmond education. The plan has been developed under the leadership of the Sustainability Working Group and the University's Sustainability Coordinator. Climate Action Plan subgroups, with representation of staff, faculty, and students, drafted sections of the plan establishing the time frame and action items associated with the ambitious goals of carbon neutrality and sustainability education. A draft of the Climate Action Plan was published online and input from the entire University of Richmond community was sought and incorporated as appropriate into the final draft.

The University completed its first greenhouse gas (GHG) audit in 2009, and the findings of that audit provide the baseline data that the University will use to measure progress regarding emissions reductions. That initial audit provided a baseline emissions number of 43,709 metric tons of carbon dioxide equivalents per year. The University of Richmond's target for 2020, based on a 30% reduction from the 2009 GHG audit, is 30,596 $mtCO_2e$. Due to the limitations in data available at the time as well as the recent completion of several new facilities, the initial audit may underestimate the University's current carbon footprint. Through improved data tracking and gathering and improvements to the Carbon Calculator created by Clean Air Cool Planet, subsequent audits promise to become increasingly accurate. Semi-annual GHG audits and the use of the Building Dashboard energy monitoring system will provide the ability to track progress.

The University's Climate Action Plan is divided into five subsections which outline key areas of focus as the University works to reduce its carbon footprint. These sections are Administration, Infrastructure Energy Use, Transportation, Materials Management, and Education. The administrative policy objectives include developing and implementing an overarching environmental policy as well as purchasing and operating policies designed to support the University's sustainability goals. Other administrative responsibilities in support of the Climate Action Plan include effective planning, financial evaluation, and support of institutional environmental priorities.

Infrastructure energy use is obviously a central area of the Plan's focus. The onsite steam plant and our purchased electricity account for about 84% of campus GHG emissions. The University will be conducting a campus-wide energy audit in fiscal year 2011 and will use that data to prioritize the next steps for improving campus energy efficiency. The University also plans to develop a formal energy policy to guide building occupant behavior that will support this commitment. Finally, campus

sustainability and energy use goals are being integrated into the new campus master plan currently being developed.

Transportation and materials-management-related emissions comprise 16% of the University's GHG emissions. An independent transportation study recently resulted in a comprehensive transportation plan for the University. This plan covers a variety of methods to better integrate the University community into the city and to support commuting and student activities transportation. An early achievement of this plan will be the conversion of the University's public transportation fleet to propane-operated buses and shuttles. To facilitate environmentally responsible on-campus mobility, the University will support alternatives to single-occupancy vehicles presented in the study and develop initiatives to promote car-free travel on campus by improving walking and cycling infrastructure, financially supporting walking and cycling events, and establishing and enforcing appropriate parking restrictions such as limiting employees to a single parking lot and having car free sections of campus. Additionally, the Plan calls for campus fleet vehicle purchasing, maintenance, and operating policies designed to support the University's sustainability goals.

Landfilled waste releases methane gas, a highly potent greenhouse gas. Decreasing the waste sent to landfills through overall waste reduction and improved recycling efforts will move the University toward the goal of carbon neutrality. The University plans to expand compost efforts from a student-sponsored small-scale system to a campus-wide system. The University will investigate expanded recycling options and enhance the recycling program as appropriate.

The final section of the Climate Action Plan addresses Education. The use of community-based campaigns designed around all the preceding goals combined with classroom experiences, on campus events, and community involvement will increase awareness among students, faculty, staff, and community members about sustainability and environmental issues.

Through the adoption of these suggested actions, the University is set to make great strides toward achieving the Climate Action goals. This plan is designed to be flexible and will be reviewed and updated regularly to ensure it remains a living document. Members of the University of Richmond community are invited to submit ideas and provide feedback on current sustainability initiatives and our future plans.

As a signatory to the President's Climate Commitment, the University of Richmond is committed to achieving carbon neutrality. This 2010 Climate Action Plan represents the University's initial plans for honoring that commitment. Some of the initiatives identified in this plan are already being integrated into the University's budgeting and planning processes, as the University moves aggressively toward its 30% reduction target. In other areas, and especially as the University considers the initiatives for 2020 and beyond, plans will necessarily be adjusted to reflect the effects of emerging technologies, new opportunities, and advantageous strategies that cannot be foreseen. This plan is designed to be flexible and will be reviewed and updated regularly to ensure it continues to reflect the most effective strategies for the University to achieve its sustainability goals.

List of Figures

Figure 1: 2008-09 University of Richmond GHG Profile 4
Figure 2: Projected UR GHG Emissions, 2010-2020 5
Figure 3: GHG Emissions from UR Energy Use, 2007-08 12
Figure 4: GHG Emissions from UR Infrastructure, 2010-2050 21
Figure 5: GHG Emissions from UR Transportation, 2008-09 24
Figure 6: Projected Emissions from UR Transportation, 2010-2050 33

Table of Contents

Executive Summary i
List of Figures iv
Table of Contents v
Introduction to Climate Change and the Climate Commitment 1
Process 2
Greenhouse Gas Emissions Inventory 4
Tracking Progress 5
Administration 6
Accomplishments 6
Next Steps 7
Financing Plan 8
Infrastructure Energy Use 12
Background 12
Next Steps 14
Transportation 22
Background 22
Current Initiatives 22
Next Steps 23
Implications 33
Materials Management 34
Background 34
Campus Waste Overview 34
Waste Reduction Options 35
Current Initiatives and Accomplishments 36
Materials Management Goals 39
Implications 44
Education 45
Background 45
Accomplishments 45

Next Steps 47
Implications 53
Acknowledgments 54
Bibliography 55
Appendix A-1: University Temperature Guidelines and Energy Policies 58
Appendix A-2: Assumptions for Building Energy Use Reductions 60
Appendix A-3: Financial Model 61
Appendix B-1: Transportation Emissions Calculation Data and Assumptions 63
Appendix B-2: Commuter and Campus Shuttle Information 64
Appendix B-3: Proposed Vehicle Maintenance and Operating Policies 66
Appendix C-1: Sustainability Courses at University of Richmond 67
Appendix D-1: Sustainability Action Items 69

Introduction to Climate Change and the Climate Commitment

Global climate disruption is anticipated to have far reaching impacts, but it is possible to mitigate and limit the disruptions by adopting environmentally responsible policies and utilizing resources in a sustainable manner. Carbon dioxide is the most prevalent anthropogenic greenhouse gas. Released into the atmosphere through the use of fossil fuels, agricultural practices, and deforestation, CO_2 atmospheric concentrations have risen from pre-industrial levels of 280ppm to 387ppm in 2009 (National Oceanic & Atmospheric Administration, 2010; IPCC Working Group 3, 2007). Current scientific consensus is that in order to minimize the effects of global climate change and keep global mean temperatures from rising more than 2.4 degrees Celsius, the concentration of atmospheric carbon dioxide must be stabilized at no more than 350ppm by 2050 with peak emissions occurring prior to 2015 (IPCC Working Group 1, 2007).

The continued release of greenhouse gases and the subsequent increases in global atmospheric concentrations will result in significant climatic changes around the world. Observational evidence of the impacts of global climate change is already evident in the form of earlier springtime events such as bird migration, enlarged glacial lakes, shifts in both aquatic and terrestrial species' ranges, and increased frequency of extreme events such as flooding and droughts. Within North America, projections include increased pest and fire damage in forests, increased frequency and strength of heat waves, and an increase in coastal ecosystem stressors (IPCC Working Group 2, 2007). If the global population continues with business as usual, these consequences will become increasingly evident. However, appropriate policy implementations, behavior changes, infrastructure changes, land use changes, and other mitigation strategies will serve to stabilize greenhouse gas concentrations and minimize the consequences that will require significant adaptations (IPCC Working Group 3, 2007).

In acceptance and recognition of the valid science behind anthropogenic greenhouse gases, the relationship to climate disruption, and the unique role of higher education institutions in the world, twelve college and university presidents became founding members of the American College and University Presidents Climate Commitment in December 2006. Signatory institutions agree to dramatically decrease their own emissions while increasing environmental and sustainability related educational and research endeavors. Today over 650 institutions, including the University of Richmond (UR), have signed the aggressive and ambitious commitment. By signing, the University of Richmond accepted the following responsibilities:

- Complete an emissions inventory;
- Take immediate tangible steps to reduce GHG emissions by choosing from a list of short-term actions;
- Set a target date and interim milestones for becoming climate neutral within two years of signing the commitment;

- Integrate sustainability into the curriculum and infuse its concepts into the educational experience; and
- Make the action plan, inventory, and progress reports publicly available.

This Climate Action Plan includes not only the University's plan to achieve climate neutrality, the educational goals for sustainability, and the emissions inventory results, but also documents the university's process for completing these tasks, tracking progress, and remaining flexible as we face the future.

Process

University of Richmond president, Dr. Edward L. Ayers signed the Climate Commitment in 2007, and the university quickly selected four of the immediate tangible action items on the ACUPCC's list for implementation during the writing of the Climate Action Plan. The selected tangible actions are (Implemetation Profile for University of Richmond, 2010):

- 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.

  "In recent years, all of the University's new construction has been LEED certified, and the University's major renovations have also focused on green design elements. As part of the President's Climate Commitment, the University will commit to a goal that all new campus construction will be built to at least LEED Silver standard or its equivalent."

- Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist.

  "In practice, the University has already been purchasing Energy Star appliances for many areas in which such criteria exist. We are also working towards using only vendors that meet the Life Cycle Assessment by using sound environmental practices for procurement of raw materials, production methods, packaging and transportation methods and, where applicable, use Forest Stewardship Council Certified Wood. As we move forward with PCC implementation, a subcommittee of the Green Working Group will develop a University-wide, energy-efficient appliance procurement policy, develop communication methods and create a process that encompasses University purchase-card transactions."

- Encourage use of and provide access to public transportation for all faculty, staff, students and visitors at our institution.

  "The University has completed a study for designing and implementing a comprehensive transportation plan. Under this plan to be launched in early 2011, the entire public transportation fleet, buses, and shuttles, will operate on propane. We have also worked on carpooling to campus and made public transportation more affordable for all

employees. To encourage the use of public transportation, we provide free swipe cards for bus fare to and from work for all employees who use public transportation."

- Participate in the Waste Minimization component of the national Recyclemania competition, and adopt three or more associated measures to reduce waste.

  "Since 2009, we have participated in Recyclemania; with the support of the student organization, GreenUR, we will enroll in Recyclemania in February of 2011. We will register in the per capita classic and waste minimization competitions. Targeted materials will be paper, cardboard, bottles, and cans. The University already has a campus recycling program for traditional recyclables as well as used carpeting, fluorescent lamps, computing equipment, and other University waste. Whenever possible, printers in the library and computer labs have duplex printing as the default setting. In cooperation with campus chapters of Sierra Club and Habitat for Humanity, the University collects and re-sells tens of thousands of pounds of surplus student property at the end of each school year."

Following the adoption of these immediate steps, the Sustainability Working Group (SWG) was formed and a sustainability coordinator was hired to facilitate the completion of the Climate Action Plan. The SWG includes faculty, students, and staff to ensure representation from throughout the University. The Climate Action Plan guidelines specify that the following items must be included in the plan:

- A target date for achieving climate neutrality as soon as possible;
- Interim targets for goals and actions that will lead to climate neutrality;
- Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students;
- Actions to expand research or other efforts necessary to achieve climate neutrality; and
- Mechanisms for tracking progress on goals and actions.

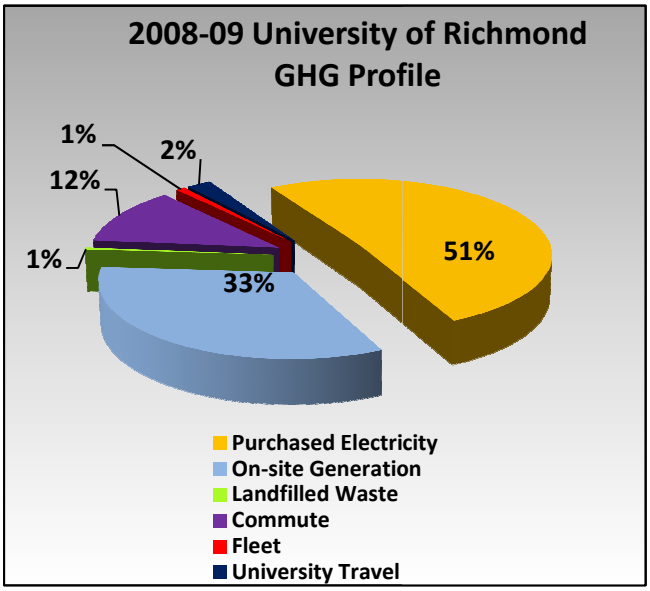
The SWG and the sustainability coordinator created five subsections in the report under which to establish specific action items. Subgroups were created to be responsible for reviewing an assigned section. These five subgroups comprised the Climate Action Planning Team. Each section details several initiatives, including mitigation strategies and educational goals, which the Climate Action Planning Team has proposed. The subgroups addressed sustainability concerns in the following areas: University Administration, Infrastructure Energy Use, Transportation, Materials Management, and Education. After completion of the first draft, the sustainability coordinator published the first draft online in January 2010 and invited comments and suggestions from the community. These comments have been reviewed by the Climate Action Planning Team and the sustainability coordinator and appropriately incorporated into the plan.

It is important to note that this climate action plan is a fluid document. It will be revisited and modified periodically to reflect progress, improved technologies, economic conditions, and advances in climate science. There is no one solution to greenhouse gas reduction. The University of Richmond's multi-pronged approach will include a combination of demand-side behavior and technological changes as

well as supply-side changes. Achievement of the University's goal to attain climate neutrality will require a combination of many of the strategies listed in this plan and additional strategies that have yet to be added. Adoption of these strategies should follow appropriate approval.

Greenhouse Gas Emissions Inventory

UR completed its first emissions inventory in 2008, using the Clean Air Cool Planet carbon calculator version 6.4, and already has taken several steps to reduce GHG emissions. In 2007-08, available data indicated that the University was responsible for the equivalent of 36,247 metric tons of carbon dioxide ($mtCO_2e$ – 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 commuting and University-related air travel that year. Those data were accessible for 2008-09, so assuming energy use and fleet data were unchanged in 2008-09, UR produced approximately 43,709 $mtCO_2e$ over that year (Figure 1). This number is likely an underestimate due to numerous assumptions made in the calculation; future planning will provide for improved methods of data tracking to facilitate more accurate calculations. Annual greenhouse gas audits will play a critical role in tracking the progress of and success of all campus sustainability efforts. The second audit will be completed in January 2011.



ıd GHG Profile

Using 2011 as the year that the implementation will begin, UR aims to reduce its GHG emissions by 30% by 2020, and has established 2050 as its target year for neutrality (Figure 2). Achieving neutrality by 2050 follows the recommendations of the United Nation's Intergovernmental Panel on Climate Change, which has targeted a GHG emission reduction of 80-95% (from 1990 levels) by 2050. The University plans to achieve these reductions through a combination of technological and infrastructure improvements, policy changes, campus community behavioral changes, and offset purchases where appropriate. A "business as usual" scenario, based on a 0.5% annual increase in energy consumption, is also presented in Figure 2.

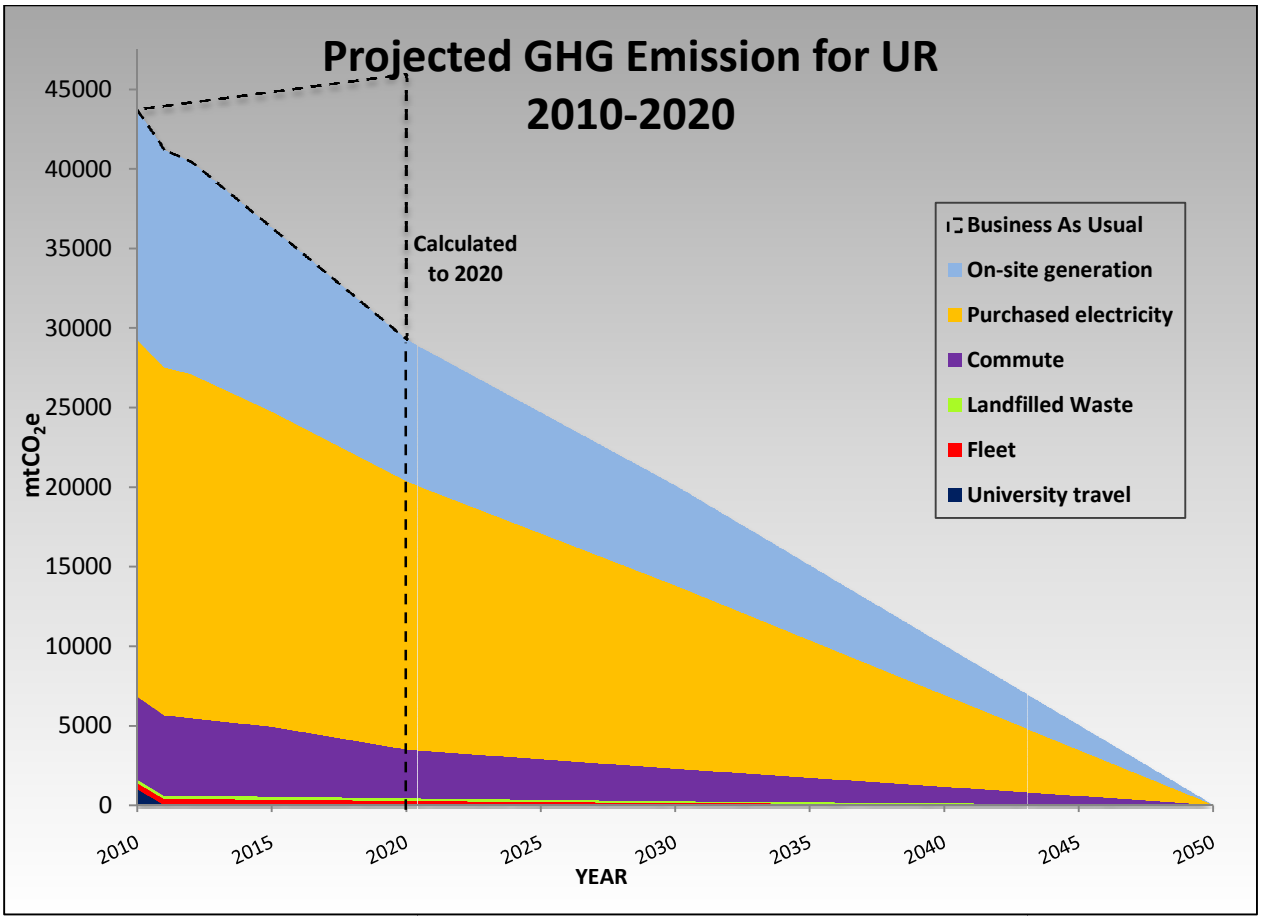


Figure 2: Projected UR GHG Emissions, 2010-2020

Tracking Progress

Completing a greenhouse gas audit on an annual basis will allow the University to continuously monitor progress. This process will provide the data needed to drive decision making over the next decade to ensure that the initial goals of the action plan are achieved. Additionally, the Sustainability Coordinator will review the Climate Action Plan on a biannual basis to determine the level of progress achieved and direct next steps. This review will provide the opportunity to create the next version of the Climate Action Plan and incorporate the results of recent GHG audits. Periodic reviews of the plan will ensure progress is being made and the objectives are being fulfilled. The revisions will ensure that the plan remains relevant throughout its intended longevity. An actionable items list will also be used to track progress and ensure adherence to the plan (Appendix D-1).

Administration

Top-down support from University administration is essential for the success of this bold and aggressive commitment. While faculty, staff, and student initiatives will continue to play an important role in providing new, creative, and innovative strategies for sustainability, the administration's continued support is vital. The leadership support for the sustainability initiatives that are financially viable and in line with the climate action goals can make a major difference in the success of the plan. The leadership's assistance in promoting and communicating the importance of sustainability sends clear and powerful messages about the institution's commitment to sustainability. In turn, these messages focus the campus community on achieving those goals.

Accomplishments

Recycling began at UR in 1991 as an effort between the facilities department and interested students. Ensuing years saw the creation of several initiatives within various departments and by student groups. Unfortunately, little comprehensive oversight of these programs left many campus constituents unaware of sustainability efforts. These silos of activity occasionally led to redundant projects, resulting in wasted time, energy, and monetary resources.

In recent years, UR took steps to clearly define its commitment to sustainability and to educate the campus about environmental initiatives. In 2003, then-President William Cooper signed the Talloires Declaration, a ten-point action plan for incorporating sustainability strategies and environmental education across the University. Later that year, the Provost's Office created the Environmental Awareness Group, bringing faculty, student, and staff representatives together to discuss campus sustainability and environmental issues. However, it was not until after President Ayers signed the ACUPCC in November 2007 that sustainability became a strategic focus of the University. This action led to the establishment of the Sustainability Working Group, an advisory board to the President, and the creation of the UR Sustainability webpage. In April 2009, the University hired its first sustainability coordinator. These efforts, bolstered by programs instituted by various departments, led to the University's recognition in 2009 as a "Campus Sustainability Leader" by the Sustainable Endowments Institute.

In May 2009, UR became the 100th school to sign the Talloires Declaration on the Civic Roles and Social Responsibilities of Higher Education, a companion to the original Talloires Declaration. By entering into this agreement, Dr. Ayers committed UR to create institutional structures to support and encourage civic engagement, social responsibility, diversity, and community partnerships in its academics, practices, and policies. By fostering these societal aspects of sustainability and emphasizing an interdisciplinary approach to curricula, UR demonstrates its commitment to these principles.

The University of Richmond has provided practical support for sustainability as well, including considerable financial and personnel assistance for initiatives. Faculty and staff received a grant from Dominion Virginia Power to install an online electricity monitoring system for the 14 residence halls on campus. This system is used to conduct energy conservation competitions, and University Facilities incorporates it to track energy consumption in these buildings. Alumni have acted as well; the University received a $500,000 donation to expand the Queally Hall sustainability efforts.

Next Steps

To achieve climate neutrality, the administration will continue to embrace sustainable practices such that the concepts become institutionalized within the University. UR will develop the financial models and resources necessary to support approved, viable strategies to attain climate neutrality, and will maintain a framework to ensure continuity over time.

Communication and Outreach

A vital component for reaching climate neutrality is the participation of the campus community in sustainability initiatives. To optimize the cooperation and involvement of the various campus constituencies, UR will develop a comprehensive campaign program to educate and encourage community ownership of the sustainability efforts.

A first step in this arena will be a voluntary "green pledge" that campus community members will be encouraged to sign demonstrating their commitment to helping UR achieve climate neutrality. UR community members will pledge to incorporate specific sustainable actions into their daily lives. The pledge and supporting educational information on the impact of sustainable actions will be developed on the sustainability website and supported by an internal communications campaign.

The Sustainability Coordinator will establish a green office certification program to guide campus offices to make sustainable choices. A review of purchasing habits, printer use, computer energy settings, and business processes will all be part of this program. Additional specific communications, outreach, and education efforts are discussed in subsequent sections of this Climate Action Plan.

Campus Policies

Environmental Policy

To further formalize the University's commitment to sustainability, the University should adopt and distribute a formal environmental sustainability policy statement to serve as the philosophical basis for its environmental strategy. Though UR has already instituted several programs to reduce the effects of

its operations on the environment, a formal declaration outlining its principles and goals in this arena will signal that sustainability is a core value and will provide guidance to departments for incorporating the University's sustainability goals into their departmental actions. The statement will include commitments to incorporate sustainability into decision-making processes and espouse further collaboration to explore opportunities for sustainable solutions across the campus.

Departmental Policies

Specific policies have been or are currently being developed by particular departments to target activities that will reduce UR's climate impacts. To strengthen the effects of and adherence to these policies, the University's leadership officials should endorse these as UR practice after appropriate review and discussion. Proposed policies include the following:

- University Energy Operations Policy (Appendix A-1) developed by University Facilities;
- University Vehicle Purchasing Policy from Procurement and Strategic Sourcing;
- University Vehicle Maintenance Policy (Appendix B-3) from University Facilities;
- University Vehicle Operating Policy (Appendix B-3) from University Facilities; and
- University Purchasing Policy from Procurement and Strategic Sourcing and Campus Services.

Financing Plan

Certain action items will require financial commitment by the University. Individual projects will be evaluated based on a combination of financial, environmental, and educational impacts. Although the investment return objectives are a major consideration, not all sustainability projects would be judged solely on financial payback. In order to truly capture the financial costs of projects, external costs for business as usual also will be considered. Creative approaches for financing also will be sought for projects that align with other short- and long-term University goals.

Due to a large variance in project scales, a variety of funding mechanisms will be considered for each project. Small-scale proposals and large capital investments will be evaluated and funded using separate mechanisms. Potential funding mechanisms include designing a revolving loan program where capital projects receive funding from a pool that they contribute back to using savings from the project. This mechanism allows savings from sustainability projects to be reinvested back into new projects. The University has committed to a campus-wide energy audit during the 2011 fiscal year which will identify practical measures and capital improvements that will reduce energy use on campus. These types of energy-saving projects will be ideal for incorporation into this potential funding model. The model will help the University overcome the disconnect between construction and operations budgets by incentivizing those on the planning and construction side to reduce operational costs. Under this model, the savings generated by the project initially go toward repayment of the loan; with the remainder used to offset the individual department's operating costs. Both construction and operations are incentivized to implement the project. An example of this type of funding scheme is Harvard's Green Loan Fund. In

2005 their capital projects generated a return on investment (ROI) of 30% (compared to a 2005 ROI of 19.2% for the Harvard endowment), and as of June 2007, loan fund initiatives were projected to save $3.8 million per year in energy and maintenance costs and reduce greenhouse gas emissions by 22,000 $mtCO_2e$.

For small scale-projects, a green student fee could fund sustainability-related projects and community-driven projects or other initiatives as deemed appropriate by the student body and the sustainability coordinator. The sustainability coordinator and student representatives would be responsible for managing these funds.

For larger infrastructure projects, UR will investigate operating a green endowment. Using private donations and targeted fundraising efforts, a green endowment could be a long-term source of funding for large campus sustainability projects, such as large-scale renewable energy.

Another option for large projects is Energy Performance Contracting, an arrangement wherein energy cost savings are used to repay the costs of the infrastructure improvements. An Energy Performance Contract is administered through an Energy Management Services Agreement (EMSA) between a university and a private energy management firm (MCW Custom Energy Solutions, Inc, 2002). The university contracts the firm to design, install and fund energy-saving technology, and the EMSA is worded such that the payments to the firm depend on the performance of the system upgrades; the firm guarantees a specific amount of energy savings and will reimburse any shortfall (MCW Custom Energy Solutions, Inc, 2002). This method has been successful at other universities and UR will investigate the value of EPCs for energy efficiency and renewable energy projects.

Offsets

Acquisition of offsets is less desirable than direct action to reduce GHG production because offsets fund renewable energy or carbon sequestration projects but have no impact on GHG production by the purchaser. The credit for these offsets is often sold as a commodity so that individuals, businesses, and institutions can neutralize a portion of their emissions. As part of the strategy to reach climate neutrality, the University may purchase offsets to compensate for emissions that cannot be reduced through other means. One type of offset is a carbon credit, such as those listed on the Chicago Climate Exchange or available for purchase through bilateral contracts, based on projects undertaken in the U.S. or other countries. The University will have to weigh several factors in the decision to buy carbon credits, including type, location, permanence of the offsets, impacts to indigenous peoples, and project additionality. When considering offset projects, local projects are preferred because the University could have more oversight of projects. A key to the recognition of carbon credits is additionality, the assurance that the project would not have proceeded had it not been for the purchaser's investment. The University will conduct due diligence in researching options before purchase, including reviews of

additionality. A financial shortcoming of offsets is that without a clearinghouse, regional REC prices are volatile, which makes future financial planning difficult.

Another common type of offset is the Renewable Energy Certificate (REC), which is available through many outlets, including Dominion Virginian Power, UR's electricity supplier. RECs are not carbon sequestration projects, but rather help fund alternative and renewable energy.

To overcome many of the drawbacks of purchased offsets, the University can create its own. One option the University can investigate is the designation or purchase of land for the purpose of protecting and restoring natural habitat. By designating or acquiring land locally and restoring its native ecosystems, UR would accrue several benefits. The sequestration of CO_2 by the restored lands will compensate for some of UR's emissions. Over an 80-year period, one acre of reforested Virginia agricultural land can sequester approximately 64 metric tons of carbon (Galang, Zipper, Prisley, Galbraith, & Donovan, 2006). While the sequestration impacts would be relatively small and recognition of carbon credits unlikely without meeting the additionality requirement, the University will also have the option to incorporate these habitat restoration efforts into its academics, particularly environmental sciences, biology, chemistry, and geography.

Financial Modeling

When evaluating sustainability initiatives, attention must focus on striking a proper balance between its three key elements: social, environment, and economical. Serious discussion between social, environmental, and economic stakeholders must be encouraged in order to meet the highly aggressive goals set forth by the President's Climate Commitment. The University sustainability managers and administrators must have a managerial tool to answer the critical question: how much is too much?

Balancing Sustainability

A few conclusions were presented before proposing solutions to the problem of how much is too much:

- Environmental externalities are real and an important decision-making factor;
- Real financial costs of projects must be considered closely, with opportunity costs weighed; and
- Each project should have significant impact on GHG reduction and move the University closer to its carbon neutrality goal.

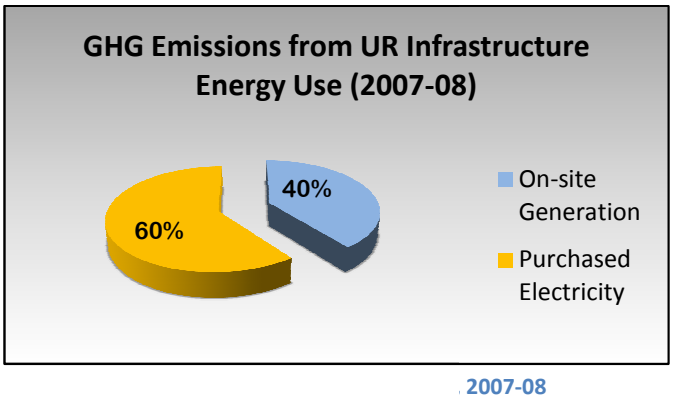
How other university managers accepted sustainability projects, particularly costly supply-side projects, was considered. Findings showed that most universities have used payback and total-project GHG reduction to determine project acceptance. Unfortunately, using payback to make sustainability decisions fails to provide relevant managerial data on many levels, especially for costly supply-side projects. Payback thresholds for demand-side conservation projects, such as more efficient light bulbs,

may be quite low, around 3-5 years. Most supply-side projects have payback between 20-60 years, requiring a separate threshold and decision-making criteria than conservation projects.
A baseline cost must be established for supply-side infrastructure projects in order to balance project externalities, cost, and GHG reduction. A working paper, authored by a UR MBA candidate, with detailed project information will be provided to the sustainability coordinator for analysis of projects prior to decision making. Please see Appendix A-3 for a detailed discussion of the model.

Infrastructure Energy Use

Background

The GHG emissions for which UR is responsible come primarily from the purchase of electricity and on-campus generation of steam. According to the initial GHG emissions inventory, in 2007-08, purchased electricity produced 21,482 $mtCO_2e$, while the steam plant created 14,318 $mtCO_2e$ (Figure 3). Combined, these accounted for 84.4% of the University's carbon footprint.



Energy Use Profile

Electrical use on the campus is about 7 MW with the completion of recently added new construction. The University purchases electricity from Dominion Virginia Power, which uses a combination of coal, natural gas, nuclear, oil, and hydroelectric. This purchased electricity is used primarily for lighting, running electronic equipment, and powering some of the campus chiller units.

UR 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. Two of the boilers are coal-fired only, but the other two are tri-fuel and capable of running on coal, oil, or natural gas. This flexibility has allowed UR to adjust to the volatile fuel markets over recent years. Though the primary fuel is typically coal, in 2008-09 the fuel mix was 22% coal, 76% natural gas, and 2% oil. This mixture reduced GHG emissions for that year because natural gas burns cleaner than oil or coal.

Existing Energy Efficiency Programs

Though data are currently unavailable to quantify the amounts, UR has saved money and reduced emissions through various energy efficiency measures over the past few decades. Some of the existing programs, technologies, and policies implemented by UR include the following:

- Installation and operation of an energy management system which incorporates:
    - Time-of-day scheduling and optimum start cycles and temperature setback/setup

    - Economizer cooling
    - Outside air reset for heating and chilled water systems and CO_2-based demand ventilation;
- High-efficiency heat pumps for the University Forest Apartments;
- 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 50% of applicable space (92% of classrooms)
    - Energy-efficient lamps (compact fluorescent across 75% of campus, LED exit signage on 100% of the campus, and efficient fluorescent lamps and ballasts) also have been incorporated;
- Automated exterior lighting (time clock/photocell control) across 98% of campus;
- Vending Misers across campus (occupancy sensors for vending machines, save 1 $mtCO_2e$ per machine per year);
- High SEER heat pumps in seven buildings;
- High efficiency chillers: 24 buildings with 76% of applicable space;
- Steam plant upgrades: the addition of ancillary equipment improved efficiency by 7-8%, also included during the plant upgrade was the installation of a bag house at which brought the steam plant up to the upgraded EPA standards for mercury and significantly reduced (>98%) particulate emissions.

Energy Conservation Campaigns

Beyond technological advances, UR encourages students, faculty, and staff to do their parts in conserving energy on campus. Using email alerts, the UR sustainability web page, social media, electronic and traditional signage, and other communication avenues the community is educated and reminded of its role in energy conservation. Members of the Environmental Studies Senior Seminar course helped stage the first AltURnative Energy Festival in the spring of 2009. Further, the University sought and won a grant from Dominion Virginia Power to implement a web-based energy monitoring system for all campus residence halls. The Associated Colleges of the South Faculty Fellow, a chemistry professor, incorporated this monitoring system in an energy conservation research project as part of the Environmental Studies Senior Seminar. In October 2009 GreenUR, the student environmental and sustainability group, also used the monitoring system in its energy conservation competition among the residence halls. This contest was part of the UR Environmental Awareness Week, during which GreenUR led initiatives to improve campus energy savings, with particular focus on phantom energy. In November 2010, UR used this system to participate in a 40-school national contest called Campus Conservation Nationals.

Campus Construction

When President Ayers signed the Climate Commitment in 2007, the University pledged to construct all new buildings to LEED Silver standards. UR had already completed two buildings prior to 2007 that qualified for LEED certification. Weinstein Hall, completed in 2005, was the first LEED Certified building in central Virginia, and the second in the state. The addition to Heilman Dining Center was completed in 2006, and received certification in 2009. In 2010, the Weinstein Center for Recreation and Wellness became the first building on campus to earn a LEED Gold certification. Six campus buildings are in various stages of the LEED certification process or will be certified upon completion. UR also leases a portion of a 47,300 sq. ft. building renovated to LEED Core & Shell Gold standards in the downtown area of Richmond. This former savings and loan facility houses UR Downtown, a community outreach program. The building has been registered with USGBC for certification, and the interior spaces UR leases were finished to meet LEED Commercial Interiors criteria.

Next Steps

Though UR has made considerable strides in reducing its building energy use and the accompanying GHG emissions, this sector remains by far the largest contributor to the University's carbon footprint. To further reduce its emissions, UR will employ strategies to instill conservation behavior, improve energy efficiency, better utilize existing space, and incorporate alternative energy sources. These tactics will contribute to the success of UR's goal of 30% GHG emission reductions by 2020.

After 2020, strategies for reductions become more speculative. To meet the goal of climate neutrality by 2050, UR will depend on technological breakthroughs, reductions in prices and increased availability of alternative energy, and improved conservation behavior by the campus community.

Conservation Measures

Education

The University administration plans to adopt several policies and programs to support the climate neutrality commitment. One area where UR will upgrade its efforts and achieve energy savings is in improving campus community education about energy conservation. President Ayers signed the PCC because of a grassroots campaign from the campus community. Further efforts from students, faculty, and staff will be necessary to implement the plan and meet the commitment, especially efforts to incorporate energy saving behaviors into their daily lives. UR will utilize targeted campaigns to help educate its constituents about behavioral changes that will lead to decreased energy costs and a smaller carbon footprint for the University.

The primary goal of the education program will be to create a culture of sustainability. Student, faculty, and staff behaviors directly influence the University's climate footprint. Daily behavioral decisions, such as whether to turn out lights or keep computers on when not in use, directly affect the University's emissions output. Creating outreach programs to encourage the campus community to eliminate energy waste could save significant financial and natural resources. Even when electronics are turned off, many consume vampire or phantom energy. Some electronic devices, like televisions, stereos, printers, and computers operate in a standby mode that consumes electricity constantly. Cell phone chargers and similar devices continue to draw electricity if they remain plugged in after recharging is complete (Shapley, 2009). On a national basis, this standby power 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). Phantom energy is estimated to account for 10-15% of overall campus electrical use, and is expected to increase as more electrical components are brought to campus. Therefore UR will create campaigns to make the campus aware of these energy draws and options to reduce them.

Community based social marketing efforts can effectively instill behavior change; obtaining commitments from community members via a green pledge and then using prompts, incentives, persuasive communications, and ensuring convenience will foster behavior change (McKenzie-Mohr & Smith, 2008). Educational campaigns will focus on specific audiences:

- The sustainability coordinator will continue to work with GreenUR on student-centered energy conservation campaigns, building on the success of those presented during Environmental Awareness Week. The communications office at UR also can provide valuable input for many of these education and outreach initiatives:
    - 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). UR will utilize our energy dashboard to obtain similar results.
    - Creative marketing and prompts will remind the campus to save energy.
    - The UR sustainability website and social media will be leveraged to reach out to the community.
    - The University will establish residence hall sustainability "champions," students who will educate other students on their halls about energy conservation and other sustainability issues. Resident advisors and residence hall staff will receive training on energy efficiency.
    - The student senates will assist in disseminating information on sustainability initiatives.
- To more specifically target faculty and staff, the sustainability coordinator will work with faculty and staff representatives in a partnership similar to the one established with GreenUR. The involvement of the communications office will again be paramount.

- Departmental sustainability champions for academic and operations departments will act much as the proposed student sustainability champions.
- An office sustainability certificate will be created to provide guidance and incentives to offices wishing to decrease the environmental impacts of current practices.
- The University Faculty Council, University Staff Advisory Council and other governing bodies will be conduits for energy saving and other sustainability information.

Infrastructure Improvements

Carbon emissions from current buildings on campus can be reduced through operating procedure changes and infrastructure upgrades and improvements. The University already has conducted a space utilization analysis in conjunction with the campus master plan that will be used to ensure that all space is being fully utilized before any new construction in planned. During FY2011, the university will conduct a full energy audit of the campus in order to determine a complete list of options and establish priorities. UR anticipates a 15% energy use reduction following implementation of the energy audit suggestions. In addition to the energy audit and subsequent efficiency projects, the University will undertake the following initiatives:

- Create an Energy Policy: The Campus Energy Policy will address seasonal building temperature set-points and operating ranges (see policy draft in Appendix A-1). University Facilities anticipates a reduction in annual energy use of 3% the first full year it is adopted.
- Steam Plant Fuel Switch: UR will commit to switch from coal to cleaner-burning natural gas to fuel the steam plant. The phase out of coal will occur over 20 years, so that by 2030 the maximum amount of coal burned in the plant will be a maintenance load of 500 tons. Assuming the plant burns 7,500 tons per year, this equates to a yearly decrease of 350 tons of coal. Because natural gas produces approximately 57% of the GHG emissions that coal does, the expected emissions reduction by 2030 will be 5802 $mtCO_2e$, or 290.1 $mtCO_2e$ per year.
- Install Individual Building Meters: To further direct energy conservation measures, individual utility meters will be installed on every major campus building. Most campus buildings are connected only to a campus-wide meter for utilities, but 14 residence halls already have these as part of the energy monitoring system grant from Dominion Virginia Power. Installation of these meters also would facilitate energy audits, retrocommissioning activities, and other energy efficiency measures.
- Promote Information Technology Efficiency: The UR Information Services Department has implemented purchasing standards and equipment repurposing/recycling programs that have saved the University considerable energy use and GHG emissions. The department has also tried to instill behavioral changes, encouraging users to turn off computers when finished. However, as UR owns over 4,000 computers, and students often have personal computers in their residences, any strategy to save energy in computer usage has the potential to reap considerable rewards. Students in the 2009 Environmental Senior Seminar conducted preliminary analyses of potential strategies the University could employ to save energy and reduce its carbon footprint. Recommendations from this research include switching log-off

default settings for appropriate computers from restart to shutdown, auto sleep/hibernate modes for computers not being used, thin client computing to replace standard computers, and installation of a centralized energy management system for the University's network. Where appropriate, Information Services will enact these recommendations.

- Expand University Purchasing Sustainability: Procurement and Strategic Sourcing will build on its existing Energy Star purchasing policy to ensure that all appliances are the most energy efficient possible. Procurement and Strategic Sourcing also will look to take advantage of any opportunities that could make these purchases more affordable.

As the University reviews the findings of the energy audit and prepares to perform major updates on campus buildings, building renovations, retrofits, and retrocommissioning are all options for the UR campus. An adage in sustainable design circles is that the greenest building is the one that is never built. Renovations, major and minor, have less impact on the environment and budgets than a new building. On a campus as historic as UR's, preserving buildings addresses social and cultural aspects of sustainability as well.

The University of British Columbia (UBC) began both types of programs between 2003 and 2007 and is an example of the potential for success. The UBC Renew program is a renovation initiative to upgrade older buildings on campus before they deteriorate, saving materials and money that would have been used for new construction (University of British Columbia, 2007). The plan aims to extend the useful lives of older buildings by 40 years or more (University of British Columbia, 2007). As of April 2009, seven buildings had completed the process. Estimates are that refurbishing these as opposed to replacing these structures has so far saved UBC $53.7 million (University of British Columbia, 2007).

UR has successfully renovated and retrofitted buildings, including Gottwald Science Center, Freeman Residence Hall, and the Heilman Dining Center. Building on the lessons from these successful projects, UR will utilize these strategies where appropriate according to the energy audit. One potential strategy is to employ the LEED for Existing Buildings criteria as the guideline for retrofits.

As part of building renovations and retrofits, the University will also institute a retrocommissioning protocol. Retrocommissioning is a systematic process to improve an existing building's performance. By taking a "whole-building" approach, retrocommissioning methods determine operational improvements that can both increase occupant comfort and save energy. Energy savings typically range from 5–20%, according to Portland Energy Conservation Inc. (PECI), and paybacks are often less than one year (Building Operating Management, 2006). The first two buildings to undergo this process at the University of Florida displayed a 20-28% decrease in electrical consumption and a 14% drop in chilled water use.

Additionally, UR will complete the replacement of all T-12 fluorescent lighting on campus with T-8 and T-5 versions. Although 95% of T-12s on campus have been replaced, new lower wattage T-8 bulbs have come to market that could replace older T-8s and generate further cost and energy savings for the school. Some lighting retrofits at UR occurred several years ago and also will be revisited. UR will

complete the installation of occupancy sensors in appropriate spaces throughout campus, and also will continue to research and install daylight sensors, LEDs, and other lighting technologies as the performance and financial feasibility are proven.

Renewable Energy Sources

Though UR will reduce its GHG emissions considerably through education, energy conservation campaigns, and energy efficiency technologies, policies and practices, these will not be enough to achieve climate neutrality. To accomplish this goal, the University will have to shift its use of fossil fuels to renewable sources of energy. These technologies will be phased in to replace the power produced from fossil fuels by both the on-campus steam plant and UR's electricity provider.

On-campus

The incorporation of renewable energy sources on the UR campus will be phased in during the implementation of the Climate Action Plan. Realistic targets for UR are 1% of the total electric use of the campus by 2015 and 5% by 2020. Though these seem like modest goals, many schools that have implemented solar and other technologies began quite small; as of 2009 the University of Oregon had installed solar panels to meet only 2% of its electrical needs.

Prior to large-scale adoption of these technologies on-site, a priority should be placed on improving the envelopes of campus buildings so that the energy required to power them is reduced. This allows for any on-campus renewable energy installations to be "right-sized," thus keeping costs down further.

UR will begin implementation of these technologies through the use of pilot programs. Bringing renewable energy to campus in stages will also give the University time to determine which alternative energy source, or combination of sources, is best for the campus. Pilot studies will be conducted for solar photovoltaic (PV), solar hot water, and small wind turbines to determine their respective efficacies at UR. Additionally, even small versions of these technologies will provide significant educational opportunities for the community.

The University is considering the following renewable technologies for on-campus implementation:

- Biofuel: The Facilities Department has investigated renewable energy options for the campus already, solid biomass has so far not proven feasible at UR due to the vast amounts that would be required, amounts far beyond the coal tonnage because biomass is less energy dense than coal. Therefore, any GHG emission savings from switching from coal would be countered by the GHGs produced from transporting the necessary quantities of biomass. However, as new local suppliers are coming into the market, UR will continue to evaluate biomass as a replacement for coal or as a co-fuel. As a mid-term (5-10 year) possibility, biodiesel could be incorporated to

substitute for some coal and fuel oil. Locating a reliable local source and supplier for biodiesel is again the primary challenge, so UR will continue to research this option.

- Solar Photovoltaic (PV): The University has also investigated the feasibility of solar PV for individual new building projects. Currently, even with incentives and prices for solar cells falling, the calculated financial payback period for solar PV at the University makes this option economically unattractive (note that this payback estimate does not account for the negative external costs associated with fossil fuels). Roughly 25% of these costs are for installation, however. Therefore, to make the economics more viable, should solar PV prove to be a realistic option for UR, the University will create an in-house "solar team" to install the equipment. UR Facilities has long performed as many duties in-house as possible, so this idea reflects that philosophy.
- Solar Power Purchase Agreement: Another alternative to overcome the financial obstacles associated with PV is the Solar Power Purchase Agreement (SPPA). A solar electricity generating company pays the up-front costs of a solar power project in exchange for a contract obligating the customer (here, UR) to buy the generated electricity at specific rates and over a certain time frame (typically 15-20 years). Upon the end of the contract, the company removes the solar equipment from the customer's property or can sell or donate the system to the customer. The primary drawback from the standpoint of achieving the goals of the Climate Commitment is that to make the financial numbers work for investors, the company usually sells the Renewable Energy Certificates (RECs) attributed to the solar power. Therefore, the University could not claim the GHG reductions from the solar energy. However, the University could enter into a shorter-term (10-year) agreement, and then acquire the already-installed PV system from the generating company at a reduced (pro-rated) cost. Funding for the purchase of the system could be accrued over the term of the SPPA.

Purchased Electricity

UR's provider, Dominion Virginia Power, has a renewable power goal of 15% of its total production by 2025; if achieved, this will result in a GHG reduction for UR of approximately 2608.7 $mtCO_2e$ by that year.

As noted earlier, the University may purchase some amount of Renewable Energy Certificates (RECs) to meet its obligation. Dominion offers the Virginia Green Power program through which customers have the opportunity to offset their emissions via the purchase of RECs. A REC is a guarantee that one megawatt hour (MWh) of renewable energy is generated and sent to the power grid. Dominion's RECs are certified through Green-e, a third-party certification and verification system for renewable energy projects. For every REC purchased through the Virginia Green Power program, UR could offset 8.5 $mtCO_2e$. The current cost of this program is $15.00 per MWh. Costs from other REC providers will be reviewed as well.

Campus Growth

Although enrollment has remained fairly constant over the past 5 years, UR launched several new building projects in that time period. Four buildings are not included in the 2007-08 GHG audit, (the Westhampton Center, Queally Hall, the Carole Weinstein International Center, and the E. Claiborne Robins Stadium). Combined, these contribute almost 139,000 square feet of new spaces that require energy. While all four will meet or exceed LEED Silver standards, they will still increase the UR carbon footprint.

The University will have to account for the emissions of future campus growth, but growth is not always necessary. To assist in determining its future construction plans, UR is creating a campus master plan. In preparation for this plan, UR conducted a space allocation analysis that will evaluate the need for new buildings. Using this information, UR can ensure current space is utilized efficiently and effectively before beginning new construction projects.

Possible causes of future increased energy demand include additional structures, student lifestyles that incorporate more electronic devices, and more energy-intensive equipment demands from throughout the campus community. Schools such as the University of Buffalo that plan large numbers of new buildings and significant increases in enrollment estimate a 2-3% annual rise in their GHG emissions. As UR's size and plans for expansion are considerably more modest, this analysis assumes a 0.5% annual average increase in GHGs assuming business as usual. Based on this estimated increase and the GHG information from 2007-08, UR is expected to add approximately 1,790 $mtCO_2e$ to its profile annually should the University not take action.

New Building Standards

To proactively address the need to manage this anticipated increased energy demand, the University will create an energy efficiency policy for all new buildings. Options UR will consider for this policy include:

- Apply Increased LEED Standards: LEED Platinum is the highest rating within the LEED system, and UR could adapt LEED Platinum construction standards for all new building projects. Though it would ensure that all new buildings at UR would be even more sustainable, this measure would not guarantee a specific reduction in energy use. If LEED is to be employed, a more effective idea would be to require that new construction achieve all 19 points within the "Optimize Energy Efficiency" section of LEED. Meeting this standard would require new buildings to be at minimum 48% more energy efficient than baseline.
- Construct Net-Zero Energy Buildings: An ambitious and sustainable option is to adopt the guidelines established under the 2030 Challenge, a set of energy-consumption targets established by the nonprofit group Architecture 2030. The 2030 Challenge targets begin at 60% more efficient by 2010 and increase 10% every five years. By 2030, all new structures would

then be Net-Zero Energy Buildings (NZEBs), structures that produce as much energy as they use over a year. The US Department of Energy echoes these calls for NZEBs and has set a goal of 2025 for these to be on the market through its Net-Zero Commercial Building Initiative.

Implications

Data to quantify the GHG emission reductions possible from each strategy discussed above are not available. However, using the assumptions listed in Appendix A-2, the University estimates that if the strategies above are implemented, it will decrease its carbon footprint from building energy use 15.1% by 2015 and 30.2% by 2020 (Figure 4). These reduction targets are met without the purchase of RECs or offsets.

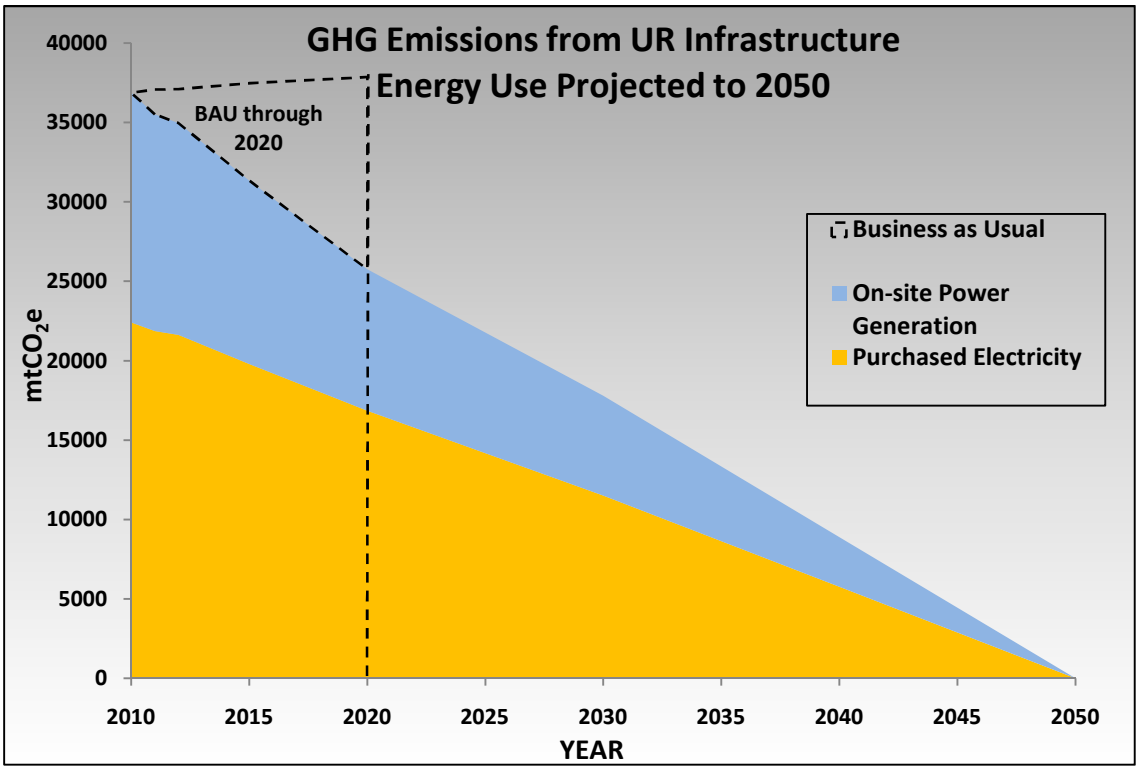


Figure 4: GHG Emissions from UR Infrastructure, 2010-2050

Transportation

Background

Automobiles became the primary source of transportation in the United States in the early 20th Century at the expense of other forms of transit. In 2004, Toor and Havlick reported that transportation accounted for approximately 66% of U.S. petroleum consumption; 50% of that was used in personal vehicles. Further, vehicles contributed 26% of volatile organic compounds (VOCs), 32% of nitrogen oxides (NO_x), and 60% of carbon monoxide (CO) pollution to the atmosphere, leading to various human health problems including lung and heart disease. Most pressing to this Climate Action Plan, however, is that the transportation sector contributes significant amounts of GHG emissions. According to the U.S. Energy Information Association (EIA) (2009), in 2007, transportation was responsible for emitting over two billion $mtCO_2e$.

Most university campuses face automobile traffic and parking problems, and UR is no exception. Until the recent economic downturn, the number of students with cars rose annually, paralleling the United States as a whole. That trend has increased traffic and parking difficulties, as well as the negative environmental effects on university communities and beyond (Toor & Havlick, 2004). Therefore, "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 & Havlick, 2004).

Current Initiatives

Recognizing the environmental impacts of transportation, UR has promoted multiple alternatives to single-occupant vehicles and has been acknowledged as a leader in this area. The Sustainable Endowments Institute recently recognized the programs UR has instituted by awarding the University a grade of "A" for transportation in its 2010 and 2011 Sustainability Report Card.

UR has collaborated with the Greater Richmond Transportation Company (GRTC), the local public transportation organization, to offer free bus passes to all students, faculty, and staff as an option for commuters and campus residents. The passes were first distributed in 2008, and 650 were distributed for 2009-10.

To facilitate bicycling on campus, UR created an on-campus bike-share program called Green Bikes. This program provides 35 bikes to the University community to be used on an honor system, along with several new bike racks. Also, the GRTC buses are equipped with bicycle racks to encourage commuters to cycle between home and the transit stations.

Carpooling is promoted at UR, and carpool participants receive preferred parking spaces. UR works with GRTC to promote Ridefinders, a service to connect potential carpool members. To further the carpooling effort, the school's social networking site, UR Groups (a Ning application) established a group for interested parties to coordinate rides.

UR offers preferred parking spaces for hybrids and other vehicles that are more fuel-efficient and produce low levels of emissions. Also, in preparation for the predicted use of electric vehicles for commutes, the University has installed recharging stations.

The University owns 49 utility carts and three Segway electric personal transporters. Twenty of the carts are powered by alternate fuels: six are propane-fueled, while 14 are electric. To encourage optimal operating efficiency, the grounds and landscaping department holds a quarterly tire inflation competition.

Currently, UR has a fleet of vans/minibuses (12-passenger) that serve distinct shuttling functions:

- To make up for the reduced service of GRTC bus lines to campus during off-peak hours;
- To provide access for students to shopping and entertainment venues off campus (Thurs. – Sat.);
- To transport clubs, classes, etc. to destinations off campus (reserved on a first come/first serve basis);
- To carry Bonner Center for Civic Engagement volunteers and students to various locations off campus, including UR Downtown (Mon. – Fri.); and
- To serve as a Safety Shuttle run by the UR Police Department (daily during evening hours).

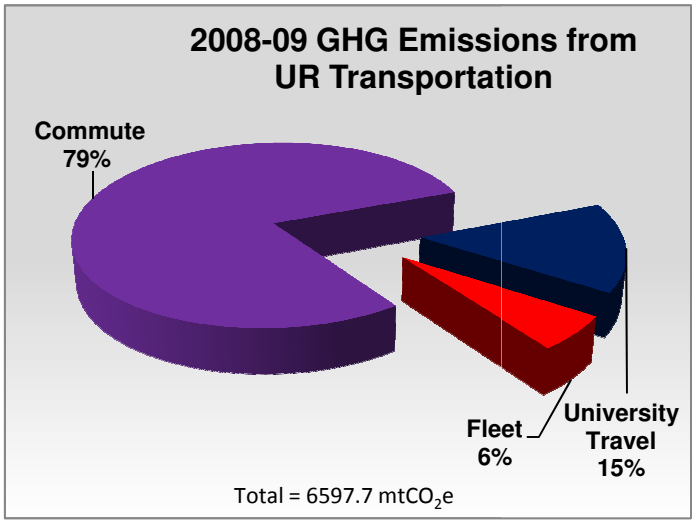
Most recently, UR initiated a "To the Bottom and Back" (2BNB) shuttle to provide students with transportation to the nearby communities of Shockhoe Bottom and Carytown for entertainment.

Next Steps

The transportation portion of UR's climate footprint for 2007-08 was determined to be 382 $mtCO_2e$. However, this result did not include emissions created via University travel (conferences, study abroad, etc.), commuting, or driving by students on campus. Data for these sectors of transportation were not available when the audit was conducted. Recent data (2009) have been gathered to create a minimal estimate of GHG emissions from University travel, and a rough estimate from commuting. These data, using several assumptions (see Appendix B-1 for details), were input into the Clean Air-Cool Planet Calculator (version 6.4) to approximate these emissions. University travel emissions were estimated at 989.2 $mtCO_2e$, based on flights booked through the University's travel agent and the Athletic

Department; commuting was responsible for approximately 5226.5 $mtCO_2e$ (Figure 5). Assuming the fleet footprint remained constant, these figures bring the 2009 total to 6597.7 $mtCO_2e$.

As UR advances in the campaign to reduce its impacts on the climate, mechanisms will be created to facilitate the collection of travel information so that the University can accurately track travel and refine its mitigation efforts. UR will continue to develop and implement plans to address these areas of its transportation footprint while that system is established.



2008-09

Though the ultimate goal is to achieve zero emissions from campus-affiliated transportation, as in other sections of this plan, UR is focusing on its objectives for the next 10 years. Recent changes in Federal law will assist UR in achieving its goals; for example, new Corporate Average Fuel Economy (CAFE) standards from the Obama administration are expected to improve vehicle fuel efficiency by 40% by 2016.

UR can feasibly reduce GHG emissions from its transportation sector 45-50% by 2020. It is assumed that new technologies, government guidelines, and other influences will continue to increase transportation efficiencies after 2020, and UR will constantly be researching and reviewing these for implementation.

The University recently completed a mobility study which primarily evaluated the options for travel between UR and the surrounding areas. The study provided several recommendations for next steps. The action items recommended will help the University meet the CAP targets and continue its success in offering alternative transportation to the campus. The University must address the GHGs produced from the commutes of employees and students to campus, additional transportation from main campus to volunteer and community-based learning sites, all fleet and maintenance vehicles, University travel, and the travel of students and employees on campus.

Educational Initiatives

Key to any alternative transportation effort is how it is marketed to its end users. Toor and Havlick (2004) reported a 6-14% reduction in automobile driving as a result of strong marketing to campus communities. Therefore, the University will fund campaigns to educate students and employees about transportation options, costs of driving, and benefits of alternatives. Specific campaigns will target

carpooling, cycling, walking, using shuttles, and fleet vehicle operations and maintenance. For each of these, a mix of marketing techniques can be employed depending on the topic and audience. Using the available communications modes available on campus in conjunction with competitions, incentives, and other marketing tools, the sustainability coordinator will work with the campus sustainability champions to promote these alternative transportation options.

To promote alternative transit, UR will launch educational campaigns touting the health, financial, and environmental benefits of these alternatives. The campaigns will incorporate a variety of media, from print to video to web-based. Marketing ideas include a promotion to encourage students and employees to avoid driving around campus to get from one location to another ("UR by Foot," "UR Without a Car," or other title). This campaign will include some or all of the following elements:

- Maps showing bike and pedestrian routes on campus. Route times for walking and cycling will be compared to those for driving to display how little time (if indeed any) is actually saved by driving. This could be a student project within a GIS class, and will be updated as campus improvements and additions are made.
- Creation of signage to identify walking and cycling paths.
- Videos about the health and environmental benefits of alternative transportation on campus.
- Information about gas consumption, costs (including parking tickets), and emissions generated by driving.
- A partnership with Recreation and Wellness to support their pedometer program and to promote the health benefits of walking. Distances of and potential calories burned along typical walking routes could be incorporated into maps used in conjunction with the pedometer.
- A launch event that includes give-aways (t-shirts, buttons, pedometers, etc.) and a pledge to eliminate driving on campus one day a week.
- Give presentations at residence hall functions and get students to pledge to reduce their on-campus driving. This pledge could also be a part of the proposed student sustainability orientation program.

Bicycling and Pedestrian Initiatives

Infrastructure

At 350 acres, UR's campus is small and easy to manage on foot in most areas. Some walkways would benefit from improvements and there also remain some locations where pedestrian access is difficult, particularly at the campus perimeter. Areas that need sidewalks and crosswalks include: Westhampton Way from UR Drive to Gateway Road/Richmond Way; along Gateway Road; and along the roads that border the neighboring communities, including Campus Road, College /Boatwright Drive, and River Road.

To ensure safety and convenience for bicyclists, cycling road infrastructure improvements and additions are also necessary across the campus. Though the central areas are accessible, the perimeter remains inhospitable to bicycle traffic, and limited options exist for crossing or bypassing Westhampton Lake. The new Master Plan for the campus, which is being created with sustainability goals in mind, should address these needs. Coordination and planning among UR, the City of Richmond, Henrico County, and other relevant agencies will be necessary to address the improvements along campus border streets. Adding sidewalks and crossings would create an amenity not only for the UR community but also for the surrounding neighborhoods, thus fostering a better relationship between the city and University.

A final infrastructure change that will be carefully studied and considered for implementation is the creation of a "walking campus." This idea is supported by the administration and the campus police department, and is in practice at many universities. To achieve this, interior campus roads would be closed to motorized vehicles between 8:00 a.m. and 5:00 p.m., with access granted only to those with permits in interior lots and those who acquire special permission. UR drivers will be issued a parking decal that provides them with a space in a particular lot. This policy would not only reduce driving on campus, but it would also alleviate concerns that parking regulations are enforced arbitrarily by clearly defining where drivers would park. Further, a walking campus would be safer (reducing automobile-pedestrian encounters) and could lead to some parking areas within the interior of campus being closed.

Green Bikes

The Green Bikes program, initiated in September 2009, is widely successful, despite some damaged and lost bicycles. The program continues in 2010, bolstered by additional, sturdier bicycles to replace damaged and lost bikes. In addition, the program includes bike repairs, distribution of recycled bikes, and an off-campus bike rental program:

- Bike Repair – The visibility of the Green Bike program brought attention to the ongoing bicycle repair program taking place in the Weinstein Center. Several students who owned bikes requested help with repairs to their personal bikes. Recognizing the demand, the Recreation and Wellness staff responsible for bike repairs is making every effort to assist students with repairs to their bikes.
- Bike Rental – As well received and popular as the Green Bike program has been, no option has existed for students seeking to use bikes for an extended period of time or to travel off-campus. To address this, three mountain bikes have been purchased as part of a pilot program for students to check-out for a nominal fee.
- Bike Recycle – The media exposure of the Green Bike program raised awareness in the community and several offers to donate bikes to the program were received. GreenUR and the Recreation and Wellness Department collect and refit donated bikes and distribute the bikes to interested students.
- UR will add more bike racks at strategic locations across campus to further encourage riding and support the Green Bikes program. The University also will review alternatives to the current bike rack system to ensure that the bikes are returned and treated well.

IRS Bicycle Incentive

In January 2009, the Internal Revenue Service instituted an incentive program to help offset the costs of commuting by bicycle. An institution may exclude the value of any de minimis transportation benefit provided to an employee from the employee's wages. Acceptable expenses include the purchase of a bicycle, as well as bicycle improvements, repair, and storage; these are considered reasonable expenses as long as the employee uses the bicycle as the primary mode of travel between the employee's residence and place of employment. Not only does this plan reduce the campus GHG production, it provides a host of financial savings. Employers can provide up to $20 per month ($240 per year) under this program, and both employees and employers save all income and payroll taxes on these commuting benefits (Nixa, 2009).

Car Sharing

Students and staff who do not have a car on campus can benefit from a car sharing program where a car can be obtained as needed for specific off campus trips. In a typical car-share agreement, a private company (such as ZipCar) provides vehicles to a university (or other group) for use by customers who pay a membership fee and a rate for the use of the car on an hourly or daily basis. Contract language usually obligates the university to guarantee a set amount of revenue per car, or the university makes up the difference. Further, the university is responsible for marketing the program to the campus community and for providing parking spaces for these cars on campus. This program would benefit UR resident students in particular, offering them options for weekend travel or trips to local venues. Car-sharing could also replace the automobiles of students who might otherwise feel they “need” a vehicle on campus; ZipCar claims that 20 cars are taken off the road for each of their vehicles in service. However, the possible financial obligation will make such an agreement untenable if the campus cannot provide enough participants in the program. Before pursuing a contract with a car-share provider, UR will research potential campus participation in a car-share to ensure the University would meet its financial commitment. This program is recommended in the UR mobility study.

Shuttle System

One advantage UR has is that over 90% of its student body lives on campus, thus reducing the GHG emissions created by commuting. However, because of UR’s location and lack of sidewalks and bike paths leading to campus, it is difficult for resident students to get to stores or entertainment locales without a personal vehicle. If the University is to encourage students to drive less and perhaps even to do without a vehicle, it must provide viable options for resident students to access off-campus venues. Further, although not included in the greenhouse gas emissions report, personal driving by students and employees while on campus contributes to the UR climate footprint. By addressing this issue, UR will

maintain its leadership role in providing transportation alternatives and bring awareness to general climate issues across the campus.

UR will utilize the findings presented in its mobility study to make further decisions regarding the shuttle system. Following the recommendations, UR has already implemented the 2BNB free shuttle on weekend nights for students to use to get downtown.

Other recommendations from the study include:

- Move the GRTC bus stop from the campus perimeter to the centrally located commons;
- Modify the Spider Shuttle schedule to better accommodate students' shopping needs; and
- Provide bicycle accommodations on University run shuttles.

An additional future option for shuttle services is to create a commuter shuttle. By using campus shuttles as commuter shuttles, UR could further reduce the number of cars on campus. If the existing 12-passenger vans and buses were employed in this program by 2015, approximately 81 cars would be removed from the road (by operating three suburban commuter shuttle routes three times in the morning and again in the afternoon, assuming nine passengers with the driver). This represents a reduction of approximately 153.9 $mtCO_2e$ (cars removed represent 218.7 $mtCO_2e$ per year, while the shuttles would produce 64.8 $mtCO_2e$). If the shuttle program is successful, the University will invest in more vans or larger (26-passenger) buses, that could grow to 234 cars, or 542.7 $mtCO_2e$ (cars removed = 631.8 $mtCO_2e$, while the shuttles would produce 89.1 $mtCO_2e$) by or before 2020. See Appendix B-2 for preliminary logistical and financial details.

University Village

To reduce the need for resident students to drive, a variety of retail and entertainment outlets must be available on or near campus. The University provides some of these amenities at The Cellar, ETC, and The Commons, but a campus "town" or "village" that offers more of these services would better address the difficulties faced by resident students without personal vehicles. The village concept has proven popular with many campus constituents, especially the idea to replace the existing University Forest Apartments with a new village-style development on the south campus. Creation of such a village will be considered during the update of the UR master plan. Beyond student housing, entertainment venues, and shops, to be a true campus village it could also include some housing for faculty and staff as well as recreational and green spaces.

The University will also coordinate with and encourage local developers to offer student-oriented retail and recreation facilities near campus, particularly the proprietors of the River Road Shopping Center. Walking trails, bike lanes, and sidewalks to the shopping center would facilitate travel to these locations. These near-campus facilities, combined with the on-campus ones, will further reduce the need for many

students to have a personal vehicle and will help promote the relationship between UR and its surrounding community. The village concept will be further expanded.

Telecommuting and Flex Work Weeks

To reduce employee travel to campus, UR will review the possibility of a telecommuting option for faculty and staff whose duties do not require a daily presence on campus. Participants will be allowed to work from home as often as would be appropriate for their positions. Similarly, UR will investigate a flexible work week option. Again, if appropriate for the position, an employee will be able to condense the work week into four days. This option could be an amenity for employees allowing for an improved work life balance, who would receive an extra day at home, while also reducing the GHG emissions from commuting.

These tactics will save 20% of the GHGs produced per week for every day an employee works from home or for every flexible work week participant. Through these programs, UR expects that approximately 10% of its commuters (191 people) will be off the road one day per week by 2015, equivalent to a reduction of 104.5 $mtCO_2e$. A further 10% reduction is anticipated by 2020, through a combination of more flex work participation and increased opportunities to work from home via improved communication technologies.

Carpooling

As noted above, carpooling has long been promoted and incentivized at UR. GRTC's Ridefinders and the carpooling group within UR Groups have been able to link some commuters to share rides. However, to increase participation, UR will establish more incentives and marketing for carpools. First, parking permit fees for carpooling students who live off-campus will be reviewed.

As an introduction to carpooling, UR will sponsor special ride share days. The first will serve as a launch event, with coverage by various University media with small rewards given to carpoolers. Similar promotional days will occur periodically throughout the year to maintain campus awareness of carpooling and provide further incentives.

In 2007, GRTC and the Human Resources Department at UR teamed to create a map of where UR commuters live to determine carpooling hubs. With permission from the employees, this map will be updated and made available to those interested in carpool options. The University mobility study recommends promoting student government ridesharing initiatives utilizing a service such as Zimrides to incentivize and promote ridesharing.

Through these various promotions the University expects that carpool participation will increase to 10% of commuters one day per week by 2015, equivalent to a reduction of 104.5 $mtCO_2e$. Another 10% reduction is likely by 2020, through a combination of more carpool members and increased days of participation by existing carpoolers.

Fees and Parking Fines

Low parking fees at UR do little to discourage single-occupant vehicle travel and do not account for the costs affiliated with campus driving, including construction and maintenance of lots and roads, as well as the environmental damages from automobile emissions. To more accurately address the impacts of vehicles on their campuses, several schools have increased their parking permit fees. UR's current student permit cost is $100 per year and employees are not charged. The UR Mobility Study recommends increasing student fees and instituting an employee fee both to fund and encourage participation in the alternative transportation options. Additionally, to deter illegal parking the University will consider an increase in parking fines.

University Fleet

The University owns 106 registered vehicles: 11 automobiles (five assigned to individuals, six used by departments), seven sport utility service vehicles, and 88 other service vehicles including vans, trucks, trailers and motorcycles. The University shuttle fleet will be the first alternative fuel vehicles used on campus, the eleven shuttle fleet will use propane fuel. A policy for vehicle purchasing will be developed to increase the overall fuel economy of the campus fleet.

Vehicle Purchasing Policy

Procurement and Strategic Sourcing currently purchases, administers, and maintains an inventory of all registered vehicles. Because 90% of UR vehicles are service vehicles, it will be difficult to set specifications that will meet all needs. This policy will govern all vehicle purchases to ensure the University acquires the most efficient vehicle available for a given duty. A thorough vehicle procurement policy should stipulate the following:

- Each department will conduct periodic audits to determine vehicle condition.
- Once a vehicle is deemed unsatisfactory, the requesting department representative will consult with the procurement office and the fleet manager to investigate alternative fuel, diesel, or hybrid vehicles that would meet the specific needs of the department.
- Should alternative fuel vehicles be unavailable, the most efficient conventional vehicles available to meet the specific service needs will be specified.

A similar policy will be enacted such that unregistered vehicles (carts, Segways, etc.) be purchased through the Procurement and Strategic Sourcing office. University Facilities is responsible for maintaining all UR vehicles and operates the largest number of service vehicles on campus. Using the fleet manager's experience with various cart and vehicle alternatives, Procurement will collaborate with the requesting department to identify vehicles best suited for the specific tasks, mindful of efficiency, durability, and fuel efficiency. These guidelines will facilitate keeping an inventory of carts and other unregistered vehicles.

The newly adopted CAFE standards will also help the University to decrease emissions from transportation. The average fuel economy of new vehicles in 2016 is expected to be 40% higher than today. Based on the median age of UR vehicles (approximately seven years), by 2020 about 60% of the fleet will have been replaced and be achieving this higher fuel economy. Further, improved efficiencies in interim years (2010-2016), will have made the fleet more fuel efficient. Therefore, by 2020 the UR fleet is expected to be at least 30% more fuel efficient, with a concomitant decrease in GHG emissions (approximately 114.6 $mtCO_2e$). This is a minimum reduction over that time period, as UR's purchasing policies will direct the fleet to vehicles that perform well beyond the average expected fuel economy of the national fleet.

This expected reduction assumes that University vehicles will be driven and maintained to optimize their fuel efficiency. To help ensure that this goal is met, UR will also establish vehicle maintenance and operating policies. To increase buy-in from drivers and to improve the chance of success, UR will develop educational campaigns to explain the policies and best practices.

Vehicle Maintenance Policy

Maintaining vehicles properly optimizes their fuel efficiency and extends their operational lives. If vehicles are replaced less often, UR will save money and fewer resources will be used to manufacture new vehicles. Therefore, the University will develop a written policy for maintenance of UR vehicles to ensure all are operated efficiently (see Appendix B-3).

Vehicle Operating Policy

UR will also establish a policy governing the operations of all vehicles within its fleet. Because idling of a gas-powered vehicle longer than 10 seconds requires more fuel than to restart it, fleets can save considerable fuel and money by instituting a policy prohibiting drivers from idling vehicles on campus. Idling not only wastes fuel, it reduces engine life and unnecessarily generates harmful emissions and noise pollution. Further fast acceleration and stopping will also be discouraged because it not only decreases mileage by 35-40% it is also potentially unsafe to pedestrians. Adoption of these policies and concomitant education of University drivers to institute "eco-driving" is expected to increase fleet mileage by 5% within five years, and up to 20% in the long term (Midwestern Governors Association, 2008). Therefore, the policy will include anti-idling and other driving standards (see Appendix B-3).

Vehicle Operator Education

Anyone who drives a University vehicle will be informed of the operations and maintenance policies. The tenets of these policies and the reasons for adopting them will be taught to all drivers, either within the existing driver safety education program or as an independent course. Further, UR will develop an educational plan to encourage the University community to adopt these practices in their personal vehicles. The operations and maintenance policies will be available to the campus as part of this education and outreach.

University Travel

Air travel by UR faculty, staff and students to conferences, athletic competitions, study-abroad programs, and other University-related activities accounted for an estimated 989.2 $mtCO_2e$ in 2008-09. This represents 2.3% of UR's total climate footprint and 15% of the emissions from UR transportation. However, as no central mechanism is in place to account for all UR travel, this figure is certain to be an underestimation. As the University moves forward in its CAP implementation, it must establish a travel tracking system to ensure accurate data and benchmarks for progress.

According to the International Air Transport Association (IATA), the airline industry improved its fuel economy 20% between 1995 and 2005, and has set a goal of a further 25% by 2020. Assuming this is achieved, by merely keeping university travel to its current level, UR's footprint would decrease 181.4 $mtCO_2e$ (18.4%) by 2020. However, UR must not be wholly reliant on the airlines for their reduction efforts. The University will institute a policy that:

- Encourages the use of travel alternatives, such as teleconferencing, web-conferencing and video conferencing over physical attendance when appropriate;
- Encourages travelers to take the most efficient travel available and appropriate for the activity (train or automobile are often more efficient for short (<500 miles) trips); and
- Adds the purchase price of carbon offsets to University-related travel costs
    - Offsets for air travel are relatively inexpensive, ranging from $5-15.00 per credit (or $mtCO_2e$). Therefore, to offset the emissions calculated for UR travel in 2008-09 would cost from $4,946 – $14,835.00. By purchasing these, the University will offset 2.3% of the total UR climate footprint. By implementing the above policy adding carbon offset fees to travel fees, the costs will be spread across the entire school. As airplane and flight operations become more efficient and University travelers embrace alternatives, the number of credits will decrease; however, offset prices will likely rise as demand for these grow.

Implications

Should each of these policies and programs realize its full potential, including the purchase of offsets to account for all air travel, UR will reduce GHG emissions from its transportation sector 28.4% by 2015, and 49.8% by 2020 (Figure 7). However, even if the University delays purchasing offsets until after 2020, the UR transportation footprint will still decrease by 15% by 2015, and 37.5% by 2020.

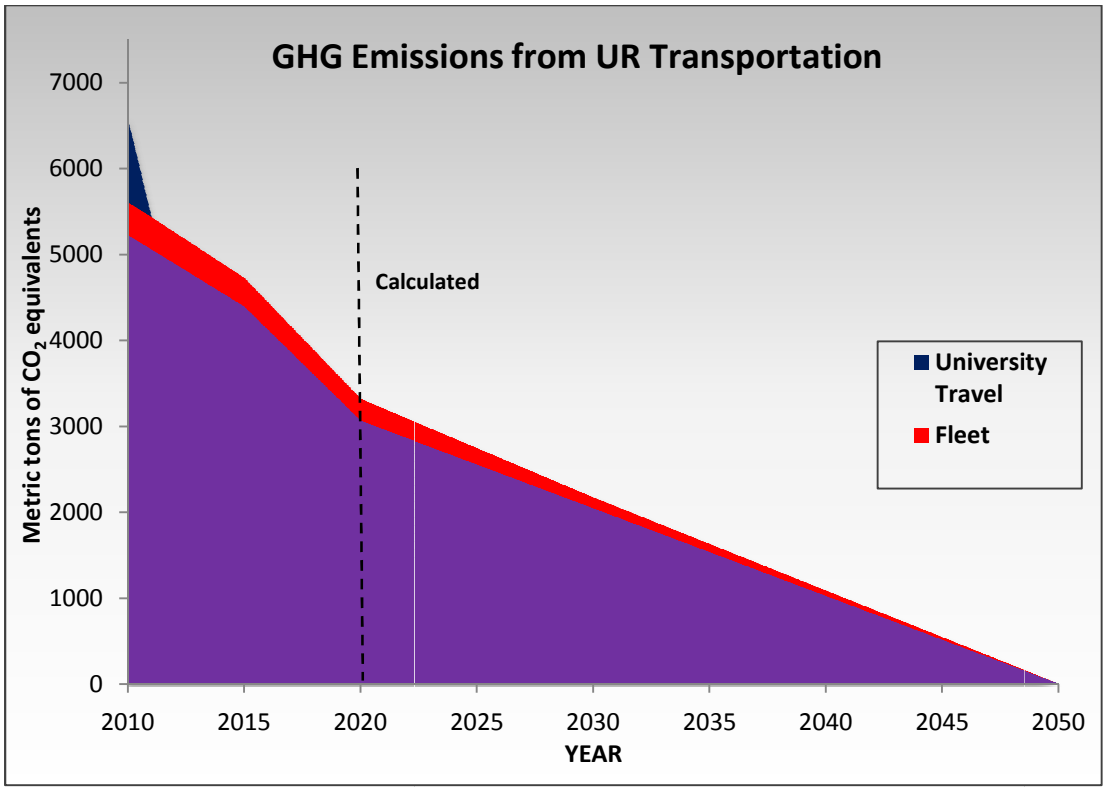


Figure 6: Projected Emissions from UR Transportation, 2010-2050

Materials Management

Background

A wide variety of materials and products are used throughout the UR campus, including construction materials, electronics, office supplies and many others. Disposing of these materials after they are no longer useful has environmental costs, including the release of green house gas emissions. The 2008 GHG audit revealed that the solid waste generated by UR contributed 215 $mtCO_2e$ to the atmosphere. Though these indirect emissions represent a small fraction of the overall carbon footprint of UR as currently calculated, the GHGs emitted over the life cycles of these materials are not incorporated in the estimate.

At present, inclusion of life cycle costs is encouraged within the Climate Commitment guidelines; however, no mechanism exists to accurately and quickly conduct a life cycle analysis of most materials. All materials have life cycle costs, or "embodied energy," the energy expended to extract resources, then manufacture, transport, and dispose of the resultant products. Embodied energy also creates GHG emissions, and studies indicate these can be significant. In 2007, the University of California-Berkeley estimated that life cycle emissions from campus procurement comprised 28% of their overall GHG emissions. Therefore, strategies to minimize campus waste will significantly reduce GHG emissions beyond the campus. Further, because they are often highly visible, these programs contribute to environmental awareness across the campus.

Campus Waste Overview

Campus wastes include municipal solid wastes, electronic waste, household hazardous waste, and laboratory chemicals. Each of these categories is composed of a specific set of University refuse:

Municipal Solid Waste: Municipal solid waste include all general household wastes, including mixed paper, glass, cardboard, aluminum and plastic – the items often labeled as "conventional" recyclables. According to the EPA, in 2007 over 254 million tons of municipal solid wastes (MSW) were produced in the United States. This is the equivalent of 1,686.3 pounds per American per year, and excludes demolition and construction wastes, household hazardous wastes, and other nonhazardous industrial wastes.

E-Waste: With technological components ubiquitous across college campuses, of particular concern to universities is "e-waste." E-waste, or electronic waste, is the fastest-growing constituent of refuse, increasing at a rate five times that of all other waste sources (Electronic Recyclers International, 2007). E-waste includes obsolete or unwanted computers, monitors, classroom multimedia, printers, cell

phones, and many more hardware peripherals. Due to the hazardous compounds used to create these products, e-waste comprises only 2% of the trash in landfills, but it accounts for 70% of toxic landfill wastes (Slade, 2007).

Household Hazardous Waste: Cleaning products, fertilizers, herbicides, and pesticides often contain toxins that may adversely affect custodial staff, building occupants, and the environment. Household hazardous waste is commonly found at universities and must be disposed of properly to minimize their potential environmental impacts. Other items that fall into this category include motor oil, batteries, paint, and tires. Americans generate approximately 1.6 million tons of household hazardous waste (paints, cleaning chemicals, oils, batteries, pesticides, etc.) annually (United States Environmental Protection Agency, 2007).

Classroom and Laboratory Chemicals: These substances are used in research and teaching and, much like HHWs, disposal of these must follow strict protocols.

Waste Reduction Options

The primary solution for dealing with solid waste in the United States has been disposal of refuse in landfills. However, landfills present several environmental problems including soil and groundwater pollution from leaching and GHG emissions due to the methane produced during the anaerobic decomposition process. These environmental concerns, as well as increasing urban population densities, public health impacts, social justice issues, and less available land, have led to conflicts over the construction of new landfill facilities (Sener, Süzen, & Doyuran, 2006).

Many options exist to reduce disposal in landfills and the associated GHG emissions. The most effective method is source reduction, as it prevents creation of waste from the outset. Source reduction involves "designing, producing, purchasing, or using materials in ways that reduce the amount or toxicity" of any waste created (United States Environmental Protection Agency, 2007). Product packaging alone accounted for 30.9% of landfill waste in 2007 (United States Environmental Protection Agency, 2007). According to EPA data, source reduction strategies successfully decreased MSW disposal by 55 million tons in 2000 (the last year for which data are available). One specific example of successful source reduction of packaging is plastic soft-drink bottles. Beginning in 1977, manufacturers decreased the amount of plastic used to create these from 68 grams per bottle to 51 g/bottle, leading to an annual reduction in the waste stream of 125,000 tons (United States Environmental Protection Agency, 2007).

Direct reuse of products (an indirect method of source reduction) and recycling are two other strategies to shrink the waste stream. Both processes help to minimize the need for virgin natural resources to create a product, reduce necessary landfill space, and decrease energy use. Reuse is preferable, as it has the added benefit of no product processing energy. Lyle (1994) notes that recycling one ton of paper saves approximately 17 trees from being processed and three cubic yards of landfill space from

being filled. Further, aluminum recycling uses only 5% of the energy necessary to produce new aluminum (Lyle, 1994). Recycling has made impacts; 54.5% of paper/paperboard, 21.8% of aluminum, and 42.7% of packaging of all types were recycled in the U.S. in 2007 (United States Environmental Protection Agency, 2007). However, in 2006-07 only 18% of e-waste was recycled in the U.S. (United States Environmental Protection Agency, 2007).

Current Initiatives and Accomplishments

In 2009, UR produced 2,038.73 tons of waste, of which 700.39 tons (34.35%) were diverted from landfills through a variety of UR programs, including recycling and reuse.

Recycling

Recycling has been in place at UR since 1991, beginning as a coordinated effort between the University's Environmental Services Department and interested students. That program has grown such that UR now has two dedicated recycling technicians working in facilities and an extensive recycling program for a variety of materials:

Municipal Solid Waste: In 2009, recycled MSW comprised 9.88% of the total UR waste stream. The primary components were mixed paper, cardboard, plastic, glass, and aluminum.

E-waste: UR Information Services has a partnership with Redemtech Inc. to divert e-waste from landfills via repurposing, recycling, and sales of electronic equipment. Older computers are "rotated down" to secondary users to extend equipment life; Information Services has a computer inventory that includes over 1,500 computer systems and peripherals that are in their second life cycles here at UR. Equipment that is still functional but too old for UR purposes is either donated to charity or released to Redemtech for remarketing or recycling. Any equipment at the end of its useful life is broken down to its component parts and recycled. All e-waste is tracked to ensure that none is deposited in landfills or sent overseas. During the first full year of the partnership, 47,000 lbs. of e-waste was diverted from landfills, saving UR both money and GHG emissions.

Household Hazardous Waste: The Facilities Department collected and recycled 1.20 tons of light bulbs, ballasts, and household rechargeable batteries in 2009, and recycled the tires and oil used in the University fleet.

Construction Waste: The Facilities Department has worked diligently to incorporate recycling of construction-related waste. In smaller renovation projects, ceiling tiles are collected and shipped to the manufacturer for recycling. In 2008, 30.13 tons of ceiling tiles were returned to manufacturer. Seven of the most-recently completed or current major building projects have exceeded or are on track to exceed

75% diversion of construction and demolition debris from landfills. This diversion not only prevents many tons of material from landfills, but also contributes two points under LEED New Construction criteria.

Other: Scrap metal is collected for recycling. Landscape wastes make up a large portion of the overall waste stream. In 2009, 336 tons (16.48% total waste) of this organic debris was collected from UR and mulched for use on campus and beyond.

Purchasing Initiatives

Third-party sustainability certifications are used whenever possible for product and services specifications. Verifying programs employed at UR include Green Seal, GreenGuard, Energy Star, and the Forest Stewardship Council. Materials that are certified through one or more of these organizations have been used across campus.

Recent contracts have included specifications for recycled content for custodial, office, and food service paper products. Eighty percent of these paper commodities contain 30% recycled content.

The University also initiated carpet recycling in 1997, and this continues under the coordination of Environmental Services. Three years ago, modular carpet tiles became the University standard whenever feasible. In FY 2009, 92% of the carpet installed was modular tile, and all of the old carpet (6.25 tons) was returned to manufacturer.

Reuse

UR has established a hierarchy of options for disposal of surplus furniture and equipment:

Repurpose on campus → Sell → Donate to a nonprofit organization → Recycle → Landfill

In 2009, over 840 pieces of furniture were sold or donated, and the majority of furnishings in three campus buildings were sourced from surplus furniture.

To further facilitate the reuse of items, Facilities (Environmental Services), GreenUR, and the local Sierra Club chapter have partnered to host an annual garage sale on campus. Some surplus furniture as well as goods donated or left by departing students are sold to the general public. This effort successfully routed 22.5 tons of material away from landfills in 2009. University Facilities also collects cinder blocks and wood pallets for reuse.

Food Waste

Dining Services donates its used cooking grease to a local biodiesel production facility. This program repurposed 2.85 tons of waste grease in 2009. To further minimize waste sent to landfills, the Dining Center employs two pulpers, machines that grind food scraps, cardboard and paper with water and then extracts the water to produce a dry pulp waste. This process reduces the weight of waste products up to 85%, resulting in many fewer trips to the landfill. The dining hall also began composting kitchen scraps in Fall 2010.

Source Reduction

Green Cleaning: Green Seal certified all-purpose cleaners and bathroom cleaners are purchased from Johnson/Diversey Inc. Environmental Services and Campus Services also are conducting a bid for campus cleaning chemicals, and green products are specified in the bid documents. When completed, this contract will considerably increase the Green Seal certified products in use across the campus.

Integrated Pest Management: This pest control strategy is practiced across campus in an effort to minimize the exposure of campus community members to potentially noxious chemicals and to reduce the hazardous waste that the University must dispose. The program places an emphasis on prevention of infestations using inspection and monitoring protocols and application of least-toxic pesticides.

Landscape chemicals: The UR campus is currently considered a Nutrient Management Site under the auspices of the Virginia Department of Conservation and Recreation. This voluntary status imposes strict standards on the use of herbicides, pesticides and fertilizers, and has resulted in significantly reduced application of chemicals to the grounds. To administer this program properly, the University landscape manager is a certified Virginia Nutrient Management Planner.

Lug-a-Mug and Eco-Clamshell: These two initiatives by Dining Services go hand-in-hand to reduce the packaging of carry-out food items. Dining Services funds the Lug-A-Mug program for carry out beverages. Students enjoy beverages to go and discount beverage prices by using the mugs in place of disposable cups. Similarly, for a small one-time fee, reusable food containers can be purchased in the "HDC to Go!" program. Dining Services will accept these food carriers after use in exchange for a clean one, and then wash the used ones for later distribution.

Printers: In an effort to continue program changes focused on a reduction of paper waste, the default settings for all new university printers with duplex capability will be to print double-sided. In addition, an evaluation of existing print devices on campus will be conducted, and changes to default settings will be implemented where possible.

Education

The University held a Vendor Fair in January 2009 to educate departments and to highlight the sustainable products available from six vendors. To further educate the entire campus community about its waste habits, UR participates in Recyclemania. This is an annual competition among U.S. colleges and universities to inform campuses about recycling and waste reduction. Environmental Services also conducts periodic waste audits on the Forum to shed light on the amount of campus waste that is sent to landfills that could actually be recycled.

Materials Management Goals

To meet the overall goal of climate neutrality, UR must commit to creating a "zero-waste" campus. The University will divert all waste from landfills through improved recycling, reuse and source reduction measures, all bolstered by education and marketing campaigns and new policies. As the 2009 diversion rate was 34.4%, to achieve this goal by 2030, an average increase in waste diversion of 3.3% per year is needed.

Like other areas within this plan, UR will not be pursuing this objective alone. Achievement of this goal will depend in part on manufacturers taking more responsibility for the waste generated by their products and the attendant packaging, as well as expanding markets for recycled products. Manufacturer programs that could enable success include agreements to accept packaging and products at the ends of their useful lives, to phase in 100% recyclable packaging, and to reduce or eliminate packaging.

UR will continue to develop the programs that have proven successful in reducing its landfill waste. The University will also employ new strategies in this move toward zero waste.

Education and Campaigns

First, UR will build upon the success it has already achieved through its existing waste minimization programs. Additional reductions can be accomplished simply through increased participation in these initiatives. To achieve this, education and marketing campaigns will be created or expanded to promote recycling and reuse programs on the campus. Programs will include:

- Establishing a campaign to clarify what items can be recycled on campus;
- Continuing participation in and improving the marketing for Recyclemania;
- Creating partnerships between the Sustainability Working Group and various departments such as athletics and dining services to promote waste minimization and recycling; and

- Promoting information to educate students and employees about the impacts of their shopping habits. Near-term programs will target disposable plastic shopping bags and disposable plastic water bottles. More permanent replacements for these, including cloth bags and refillable containers, are widely available and impose no hardship on consumers.

How best to approach these education and marketing initiatives will be determined through research into the attitudes and behaviors of the campus constituency regarding waste minimization programs. Some of this research has begun as surveys are being developed to determine how UR might improve its existing recycling program, particularly within the resident student community. Research in the form of targeted waste audits will continue as well.

Recycling Infrastructure

Common Area Refuse Bins

UR is investigating improvements to the placement and visibility of recycling bins located across campus. To avoid confusion between recycling containers and trash receptacles, one promising option is to replace or augment outdoor trash cans with three-bin receptacles. Bins or their labels would be color-coded: for example the bottles/cans receptacle would be blue, the paper receptacle yellow, and the "Trash for Landfill" receptacle red. The bright colors would draw attention to the differences in the bins. A similar color-coding and labeling system would be employed for interior receptacles; this redundancy will serve to minimize confusion. Each bin also would have a lid, forcing users to make conscious decisions when disposing of their waste. Any new receptacles will complement the UR campus aesthetic. A pilot program to determine the efficacy of these receptacles and an accompanying financial analysis will be the next step.

Individual Residence Hall Room Recycling Bins

To further increase student participation in recycling, another proposal is to place small collection bins in individual dorm rooms and apartments. Though this would require a significant up-front cost, as well as more time and vigilance from custodial staff, the convenience for students is expected to greatly increase recycling rates on campus. The resultant drop in tipping fees may eventually repay the initial costs of the bins. A study will be conducted to determine actual costs, return on investment, expected participation, and estimated changes to recycling rates before this is considered for campus-wide implementation. The pilot for this program began in October 2010.

Fraternity Lodges

Some students have sought to improve recycling at the fraternity lodges. For safety reasons, the current set-up for social events at the lodges requires that beverages be poured from cans and served in plastic cups. Though there are specific containers for cans, there is often contamination (mixing) of the recyclables with non-recyclable materials, causing many recyclable materials to be sent to the landfill.

The sustainability coordinator and Environmental Services will work with fraternity representatives to improve the recycling tactics at the lodges and to encourage replacement of the nonrecyclable plastic cups with reusable or compostable alternatives.

Alkaline Batteries

Due to statutory reductions in their mercury levels, the EPA does not require alkaline batteries (typical household batteries) to be treated as hazardous waste or to be recycled. As such, UR does not offer a recycling program for these. However, alkaline batteries contain cadmium, manganese, and other potential pollutants, and they contribute to UR's waste stream. Therefore, as part of its effort to become a zero-waste campus, the University will investigate options to recycle household batteries, including a pilot study in one dorm to estimate potential costs and participation in such a program.

Purchasing

As noted above, an important component of waste management is purchasing, and green procurement standards for some products have been established at UR. To achieve the goal of zero waste, however, these standards must be expanded. UR will institute a policy to govern the standards for all products, including recycled content, packaging, and recyclability/reusability. Products will be longer lasting, composed of recycled materials (to generate a market for recyclable products), and recyclable or reusable. Due to the decentralized nature of most campus purchasing, to be most effective, the administration will apply this policy campus-wide.

The policy will encompass, but not be limited to the following:

- Require the highest environmental standards for as many products as possible, based on the most stringent third party certification systems. Criteria will include:
    - Recycled content (e.g. 100% recycled office paper)
    - Social justice criteria (e.g. fair trade products)
    - Reduced packaging specifications, including pallet reuse
- Specifications for University-owned vehicles.
- Delivery consolidation – reduce to weekly or even monthly. This will minimize truck trips to campus, thus reducing GHG emissions.
- On-campus independent vendors will be required to adopt these standards to avoid potential unfair pricing advantages.

Reuse

UR will build on its successful programs to repurpose, sell, and otherwise divert its surplus goods from landfills. To take advantage of the success of the Lug-a-Mug program, UR will expand the program by

stocking reusable water bottles for purchase and investigating the placement of water bottle refill stations across campus to discourage use of disposable water bottles. Paired with the education program to reduce purchasing of bottled water, this could have significant reductions in UR's waste stream. Another potential option to expand reuse opportunities is to work with a local charity to place donation bins near residence halls and apartments. These bins often are seen in parking lots of local stores; by making them more convenient to resident students, participation will likely increase.

Food Waste

Institutional Composting

Elimination of food waste is another element of the UR zero-waste goal. Current discussions are underway regarding the composting of campus food waste. Options are being explored to have an off-campus group collect food wastes and compost them off-site. A small project to begin composting dining hall kitchen scraps began in Fall 2010. Figures are not yet available for the amount of food waste generated annually, as organic and inorganic wastes were previously mixed in the dining hall dumpsters. Therefore, the amount of GHG emissions that could be averted through composting cannot be calculated. However, in 2009, the Heilman Dining Center compactor processed 301 tons of waste, of which a considerable amount would have been compostable.

On-campus Composting

Some resident students in the University Forest Apartments elect to buy and cook their own food. Waste food is obviously generated here as well, though much like at the dining hall this is not measured independently. To address much of this food waste, a student group is working with Backyard Farmer, a local community compost and gardening group, to run an on-campus composting spot. The resultant product is to be used at the campus community garden.

Source Reduction

Printer Paper Use

To reduce paper waste, the default settings for all printers with duplex capability will be set to print double-sided. Reduced print margins also may be adopted, as this could save paper, GHG emissions, and money. Penn State conducted a study in 2001 that concluded that decreasing campus printer margins 0.25" could save the school over $120,000 annually, as well as preserves 72 acres of forest and eliminate 45 tons of waste. Faculty will be encouraged to adopt the above defaults as their classroom standards. Should special circumstances arise, defaults can be temporarily disabled. Further, UR will continue to migrate toward electronic record keeping.

Paper Use in Advertising and Promoting Campus Events

Several members of the UR community have noted an overabundance of printed materials publicizing University events. Paper communications to promote campus activities often are unnecessary or redundant given the various electronic communication outlets available. The majority of these mailings and fliers are thrown out or recycled immediately. Therefore, the University will consider establishing guidelines for printed materials promoting University events. Many could be replaced by electronic versions. Printed materials will abide by the criteria set forth for materials in the proposed purchasing policy. 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. Adding this option to the proposed "green pledge" page would provide an opportunity for those who sign the pledge to immediately act on their concerns.

Junk Mail

Another area of concern is junk mail, particularly that targeting students. UR cannot legally place a blanket ban on junk mail, but the University will provide contact information for the direct marketing companies on the sustainability webpage as well as in the campus post office.

Green Chemistry

Using Oregon's Green Chemistry Program as a model, UR will investigate replacing toxic chemicals in classes with less harmful or benign substances to teach the same concepts and techniques found in traditional chemistry courses. The Safety Services & Risk Management Department, working in conjunction with the Chemistry Department, will continuously update this program to minimize the use of harmful chemicals in the laboratory and classroom.

Other

In addition to recycling and product reuse, purchasing compostable materials and recyclable products is necessary to meet the goals of the Climate Action Plan. The sustainability coordinator will work with Procurement and Campus Services to research products that meet these characteristics. Currently, the Cradle-to-Cradle (C2C) rating system developed by McDonough and Braungart evaluates and certifies products based on their life-cycle impacts. Though relatively new, products that meet C2C criteria are among the most sustainable products available today.

Finally, all these strategies are based on the expectation that the campus community, vendors, and manufacturers will take part in these various initiatives. Once voluntary participation levels off, it is possible that bans will be placed on the purchase or sale of products on campus that cannot be recycled, composted, or reused. This is not without precedent, as some universities and municipalities have successfully introduced bans on plastic bags and bottled water. However, the hope is that these products will be phased out due to a lack of demand as the UR campus changes its purchasing habits.

Implications

Cumulatively, these efforts will help the university meet its goal of an additional 33% reduction in waste by 2020. This accomplishment will reduce the GHGs associated with materials management from 215 $mtCO_2e$ to 106.8 $mtCO_2e$.

Education

Background

The efforts to move toward sustainability at universities, and in turn society, 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. A Penn State University survey of 150 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 lack of knowledge is a symptom of how society has forgotten its relationship with the planet, and only a vast change in how humans view and subsequently interact with the natural environment will bring about a sustaining relationship between humanity and the earth. As the Penn State Green Destiny Council (2000) noted, "Members of sustainable communities have the capacity to see themselves as part of, rather than separate from, the environment in which they dwell (e.g., they understand where their water comes from and where their waste goes)."

With the ability to reach thousands of students, faculty, staff, and alumni, the University of Richmond has the opportunity to influence and educate a sizeable population about sustainability. UR can accomplish this goal by serving as an example via its building and operating practices, as well as through outreach programs into the Richmond community. One of the most direct and important ways to influence and educate is to address sustainability within the curricula taught on campus. By expanding the numbers of courses available that teach students about sustainability, as well as blending sustainability into core courses and research, these lessons can begin to permeate and enhance student academic experiences. But, at UR and other universities, education extends beyond the classroom. Outreach to the campus and the surrounding community is an integral part of student education, particularly at UR, and sustainability can be incorporated into these efforts as well.

Another area to be addressed within academia is the research conducted, funded, and championed by the University. UR will continue to develop and support research groups that directly or indirectly study facets of sustainability. Financial and other institutional support for student groups that focus on these issues is also important, particularly as these groups grow (Mital, et al., 2007).

Accomplishments

The University of Richmond has already begun to incorporate sustainability into a variety of its educational programs.

Curriculum

An Environmental Studies major has been developed, and a similar minor is available as well. Both within this program and beyond it, more than 80 courses addressing sustainability issues have been developed (see Appendix C-1 for a complete list). These include courses in Geography, Political Science, Environmental Management/Forestry, Environmental Studies, Biology, Business, Anthropology, Chemistry, and International Studies. Areas with courses focusing on the social and cultural aspects of environment include Sociology, Philosophy, Religion, and Theatre. In the realm of post-graduate studies, the Law School offers courses specializing in environmental law and is home to the Robert R. Merhige Jr. Center for Environmental Studies, and the Business School offers research opportunities for MBA students.

Student Groups

GreenUR is the leading student voice for sustainability at UR. Habitat for Humanity also has a student chapter, the Law School hosts the Environmental Law Society, and the Richmond College Student Government Association has an ad hoc sustainability committee. Students also are contributing members of the Climate Action Plan subgroups, and there are student representatives on both the University's Sustainability Working Group and the Environmental Awareness Group.

Co-curricular Opportunities and Community Outreach

In September 2009, the Facilities Department created its first student internship, a position to conduct research on the strengths and weaknesses of its recycling program. This internship is an outgrowth of the Environmental Studies interns program funded by the Class of 1992 Environmental Awareness Gift.

The Bonner Center for Civic Engagement (CCE) facilitates student involvement with the local community through various programs. The CCE has developed partnerships throughout the region for community-based learning and community service, including programs such as UR Downtown and the "Build It" Initiative. And UR has partnered with other universities: the Family Law Clinic at UR Downtown is a collaborative endeavor between UR law students and VCU graduate students in social work and psychology. These programs give students the opportunity for experiential learning, while simultaneously working for the betterment of the greater Richmond area.

Through the Civic Fellows program, the CCE has awarded fellowships for students to complete academically grounded summer internships. Over the past three years, two fellows have completed internships at the Chesapeake Climate Action Network in Richmond and at Growing Power in Chicago.

Both students incorporated the knowledge they gained about sustainability through their internships into their co-curricular and curricular activities at the University.

The broader Richmond community also is afforded many opportunities to learn about sustainability issues at the UR campus. Most University events, including seminars, lectures, and research talks pertaining to sustainability, are open to the public.

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 undergraduate students. Research areas include how psychology affects environmental and public policy; forestry, sustainable development and carbon markets in Latin America; improving field chemical analysis of water bodies; political ecology of the Amazonian borderlands; landscape ecology; and social entrepreneurship.

Other Educational Activities

The Lora Robins Gallery of Design from Nature is the natural sciences and decorative arts museum for UR. This museum hosts collections and exhibits of artwork that focus on the natural world, provoke thought about human impacts on the planet, and celebrate a variety of cultures. Exhibits have included Ansel Adams: The Man Who Captured the Earth's Beauty; Oceanic Art from the Sepik River Region of Papua New Guinea; and Eating Wonderland: Recent Works by Sue Johnson.

Next Steps

Any successful strategy to institute true sustainability at a university must include "greening" curricula, research, and community outreach. The University of Richmond plans to not only include the tenets of sustainability throughout the academic experience of all students, but also to integrate these tenets into the daily lives of the members of the campus community. This concept is reflected in the UR strategic plan, the Richmond Promise. One action step within the Richmond Promise is to "revise the general education and graduation requirements to include attention to our local and international contexts." Issues of global climate change and sustainability are and will increasingly be fundamental to understanding both local and international issues, and consequently are appropriately to address in this plan.

All students should attain environmental literacy, learning alternatives to the current, non-sustainable paradigm that permeates society. The academic program envisioned will teach students how their personal choices influence the environment and society, and will introduce them to accessible, viable

alternatives. The campus community also will be introduced to these concepts via student programs and academic experiences, which will in turn enhance the educational experiences of the students involved. UR will continue to partner with the people of Richmond, building on the successes of the programs of the CCE and others to bring the concepts of environmental sustainability and social justice to the community.

The goal that all students attain environmental literacy may appear to be unrelated to certain majors (e.g. music, dance, foreign language, etc.). However, because each student affects the planet through his/her personal behavior and each will face the same future environmental and economic challenges, teaching them the potential consequences of their actions is as important as teaching those in disciplines more directly related to sustainability. In fact, it is likely more important, as most students in the related disciplines begin with or quickly attain some degree of environmental literacy. Further, as environmental concerns have grown the "green" jobs sector has expanded, and businesses of all types are embracing sustainable practices. Therefore, students entering the modern workforce will need to understand sustainability not only to help achieve University and national GHG reduction goals, but also to compete in the new economy.

Strategies to bolster sustainability within the educational experience at UR include the following.

Curricular Changes

To introduce the concepts of sustainability to modern university students, UR plans to integrate these concepts into courses across curricula. Ensuring that this integration does not detract from the other academic goals of the University will require considerable discussion and cooperation among faculty, students, administrators, and the Sustainability Working Group. A committee composed of representatives of these constituencies, such as the Environmental Awareness Group, will be formed to create appropriate plans to incorporate sustainability into classes. Options that are recommended for consideration in these discussions include:

- A phase-in of sustainability throughout the curriculum:
    - First, individual survey-level courses could incorporate one lecture on sustainability and how it relates to the subject.
    - As faculty become more familiar with these issues, each academic department could offer a course within each major concentrating on the environmental, social, and economic issues associated with the major subject. Students would learn about the environmental implications of the activities in the profession. 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.

    - Eventually, a course on the concepts of sustainability could be taught as a prerequisite for graduation. Ideally this would be taught during the first year so that students could apply their new knowledge toward reducing their own climate footprints, which would concomitantly decrease the climate footprint of UR. This course would be designed to offer students an alternative view to the unsustainable practices that are the current norm in Western society. Students would learn how their personal choices influence the environment and would explore accessible, viable alternatives to conventional practices. Students would also discover the challenges they will likely encounter due to both the effects of climate change and the diminishing availability of cheap fossil fuels.
- Development of sustainability-themed electives.
- Similar to the Interdisciplinary Concentration in Neuroscience for Biology and Psychology majors or the Interdisciplinary Concentration in Comparative Literature for English majors, create a Sustainability Concentration for appropriate majors. For example, a Green Business concentration could be added to the Robins School curricula.
- Because a wellness course is already required for graduation, develop one that delves into the links between health and environmental sustainability. Indoor environmental quality and green space preservation are two topics that lend themselves easily to these discussions.
- Work across departments to create an annual academic "theme," with sustainability periodically serving as the focus.
- Investigate the possibility of a "Sustainability Fellows" program, wherein selected faculty members teach, research, and promote sustainability issues.
- Develop an exchange program for sustainability-themed courses similar to the one instituted by Tufts, MIT, and Harvard, to provide access to courses beyond what UR offers, particularly in technical arenas. Several universities in the Richmond area could participate in this exchange including Virginia Commonwealth University, Randolph-Macon College, and Virginia Union University. In turn, students from these schools would have the opportunity to enroll in courses at UR unavailable to them at their respective universities.

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 Principle 1 of the Richmond Promise, "Integrated Academic Enterprise." The first goal within Principle 1 is to "capitalize on interdisciplinary and cross-school connections to provide students a distinctive education," and sustainability education at UR will reflect this.

Student Research and Internships

Beyond the classroom, sustainability education can be enhanced through student research. Topics in sustainability issues can 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, particularly those interested in sustainability. Internal funding may be available to support

research into areas that would directly help the University achieve its climate neutrality targets. Interested students will also receive the opportunity to intern with appropriate departments to work on specific sustainability initiatives. Potential internship opportunities exist in the areas of campus recycling, campus energy use, and behavior change initiatives.

Student Groups

Diverse groups should be encouraged to work together on initiatives; this group dynamic will mirror the interdisciplinary nature of sustainability. Students will continue to be given the opportunity to participate with the Sustainability Working Group and other advisory panels for campus sustainability. As the Climate Action Plan moves into the implementation phase, student representation on the various subgroups will continue.

Faculty Research, Hiring, and Training

UR's strong support for interdisciplinary research and education to create sustainable solutions for environmental, economic, and social problems will continue through faculty funding and hiring prioritization. This is also in keeping with the Richmond Promise. Another of the Integrated Academic Enterprise goals is to "enrich faculty intellectual lives, including increased support for interdisciplinary teaching and scholarship, so as to make the University of Richmond the destination of choice for the highest quality faculty."

To assist faculty in the efforts to introduce sustainability into their courses, training workshops similar to those created by Furman University would be organized. The Furman Center for Sustainability conducted a seminar titled "Infusing Sustainability into the Existing Curriculum," attended by several professors from 15 different departments. This training could be housed in the faculty development center proposed in the Richmond Promise. The purpose of the center is "to enhance teaching skills, support scholarship, foster collegiality, and provide expertise on course design and pedagogical strategies for interdisciplinary, international, and innovative approaches to teaching, learning, and scholarship."

Campus Community Education

A host of strategies will be employed to further educate the campus community.

General

The UR sustainability website will serve 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, marketing and education must go beyond the website. One difficulty in reaching the UR community is the absence of a single primary communication source. Therefore, specific media campaigns that focus on each of the populations within the campus community (faculty, staff, and students) will be created to promote energy conservation, recycling, and alternative transportation. Representatives from each of the target groups will be solicited for help in creating these campaigns. New media outlets, including social media (Facebook, Twitter, etc.), show promise in connecting with the student population in particular, so campaigns will take advantage of these resources as well. An open "green tour" of the campus focusing on LEED buildings is also in development.

Students

Development of an orientation presentation designed to introduce freshmen to the sustainability initiatives at UR would minimize the learning curve for new students to campus. To assist new students in locating green resources, a "green" guide or "move-in" guide could be created with the assistance of current students and included with orientation materials. 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.

A program that has met with success at Columbia, the University of British Columbia, and other schools is the creation of sustainability advisors for residence halls. Two primary strategies have been employed: training residence hall advisors in sustainability initiatives or creating independent sustainability advisors. UR will create some form of peer-to-peer residence hall-based education campaign, based on ideas from other schools but tailored to the specific interests and needs of UR students. Regardless of the approach, this voluntary peer-to-peer education is an opportunity for student leaders to model sustainable behavior, to teach and learn from fellow students, and to create novel solutions to issues in the residence halls and beyond. An additional peer-to-peer option is the creation of a presentation by student advocates for campus sustainability (similar to the Eco Reps at Columbia) for presentation to student groups.

Another idea for increasing student awareness is to create a living and learning community on campus located within the current on-campus apartments. The idea behind the community will be to empower students to sustainably develop and personalize a space on the campus.

Faculty and Staff

An orientation presentation for new hires similar to the one proposed for entering students will be created. And much like the sustainability advisor program proposed for students, a peer-to-peer education campaign for faculty and staff will be developed as well. 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. UR will develop a similar Green Team program where each office can establish a recognized team responsible for managing sustainability initiatives within the office.

Finally, a green office campaign to inform employees about best practices in the workplace environment will be developed. This green education initiative will inform employees about UR sustainability policies and provide guidance for creating a green office. This Green Office program will be created through a partnership between the Sustainability Office and the University Staff Advisory Council.

Community Outreach

Bonner Center for Community Engagement (CCE)

Since its inception in 2004, the CCE has led the efforts to connect UR students to the greater Richmond community, working primarily in the social aspects of sustainability. CCE has also fostered interdisciplinary study throughout its endeavors. To further expand opportunities for students in sustainability, CCE and the Environmental Sciences program could develop educational programs that concentrate on urban health, including urban forestry and ecology and the intersections between public health and sustainability. Further collaboration with other universities similar to the efforts between UR and VCU at UR Downtown also could be fostered through the CCE.

Student Groups

GreenUR is the primary undergraduate student organization at UR that engages in sustainability issues. This group focuses on campus projects, but is considering partnerships with area neighbors and organizations. This work will be encouraged and expanded. Also, the UR chapter of Habitat for Humanity already works within the community, and with the funding of the Energy Efficiency and Conservation Block Grant (EECBG) Program, under the American Recovery and Reinvestment Act of 2009, opportunities for this group to be more involved in community energy conservation efforts through home weatherization will likely increase. These student organizations also will be encouraged to reach out to their parent groups (Sierra Club & Habitat), other local nonprofits (e.g., the Chesapeake Bay Foundation and the James River Association) and local governments. Coordination with professional organizations to create internships and other mentoring opportunities will also be promoted.

For law students, the Environmental Law Society (ELS) could work with UR Downtown to expand its pro bono opportunities to include environmental justice issues. ELS could also promote and lend its services

to proposed environmental ordinances. To promote cross-disciplinary cooperation and mentoring, ELS and GreenUR will be encouraged to work together on projects as well.

Implications

Establishing and promoting structured educational activities on campus will aid the University in meeting the educational requirements of the Climate Action Plan, and an educated and empowered community also will help the University reach its greenhouse gas reduction goals.

Acknowledgments

The University thanks President Edward Ayers for his commitment to sustainability. The University also gratefully acknowledges the following individuals for their contributions to the Climate Action Plan:

Authors:
Megan Litke
Trey McDonald

Campus Contributors
Betsy Andress
Laura Barry
Wendy Burchard
Brian Cherry
David Dean
Joel Eisen
Don Forsyth
Steve Glass
Natalia Green
Andy Gurka
Dee Hardy
Travis Henschen
John Hoogakker
Amy Howard
David Kitchen
Al Lane
Katybeth Lee
Alex Lescroart
Jordan Lyons
Andrew McBride
Gray McDermid
Dave Merchan
Lisa Miles
Neah Monteiro
Cathy Moran
Van Nail
Asha Phadke
Elaine Pierpont
Chelsea Prue
Sally Roberts
Hossein Sadid
Lori Schuyler
Peter Smallwood
Carl Sorensen
George Souleret
Zach Sussman
Max Vest
Doug West
Italicized: Sustainability Working Group Members

Bibliography

Alsema, E., Wild-Scholten, M., & Fthenakis, &. V. (2006). *Environmental Impacts of PV Electricity Generation - A Critical Comparison of Energy Supply Options.* Energy Research Centre of the Netherlands, Dresden, Germany.

American College and University Presidents Climate Commitment (ACUPCC). (2009). *Implementation Guide: Information and Resources for Participating Institutions, v 1.1.* Retrieved November 12, 2009, from http://www2.presidentsclimatecommitment.org/pdf/ACUPCC_IG_Final.pdf

Building Operating Management. (2006). *Retrocomissioning for Better Performance*. Retrieved October 21, 2009, from www.facilitiesnet.com/green/article/Retrocommissioning-for-Better-Performance-409

Dreier, P., Mollenkopf, J., & Swanstrom, T. (2004). *Place Matters: Metropolitics for the Twenty-first Century.* Lawrence, KS: University Press of Kansas.

Edge, C., & Vachon, E. (2003). *An Assessment of Campus Sustainability at the University of Kentucky.* Retrieved September 28, 2009, from www.uky.edu/Ag/Forestry/student_work/Report03.pdf

Electronic Recyclers International. (2007). *Current E-Waste Trends*. Retrieved January 12, 2007, from www.electronicrecylclers.com/historyofewaste_currenttrends.aspx

Energy Information Administration (EIA). (2009). *U.S. Carbon Dioxide Emissions from Energy Sources: 2008 Flash Estimate*. Retrieved October 19, 2009, from www.eia.doe.gov/oiaf/1605/flash/flash.html

Energy Information Administration (EIA). (n.d.). *World Energy Overview: 1995 - 2005*. Retrieved January 12, 2008, from http://www.eia.doe.gov/iea/overview.html

Galang, J. S., Zipper, C. E., Prisley, S. P., Galbraith, J. M., & Donovan, P. F. (2006). Evaluating Terrestrial Carbon Sequestration Options for Virginia. *Environmental Management , Volume 39* (Number 2), 139-150.

Implemetation Profile for University of Richmond. (2010, November 10). Retrieved November 10, 2010, from ACUPCC Reporting System: http://acupcc.aashe.org/ip/735/

IPCC Working Group 1. (2007). *Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom and New York, NY USA: Cambridge University Press.

IPCC Working Group 2. (2007). *Summary for Policymakers. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani,J.P. Palutikof, P.J. van.*

IPCC Working Group 3. (2007). *Summary for Policymakers. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on*

Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)]. Cambridge, United Kingdom and New York City, NY USA: Cambridge University Press.

Lyle, J. T. (1994). *Regenerative Deisgn for Sustainabile Development.* New York.: John Wiley and Sons.

McKenzie-Mohr, D., & Smith, W. (2008). *Fostering Sustainabile Behavior.* Gabriola Island, BC, Canada: New Society Publishers.

MCW Custom Energy Solutions, Inc. (2002). *Ecotrek Universal Energy Performance: What is EPC?* Retrieved September 22, 2007, from www.ecotrekenergyinfo.com/01_01/01_01_01.asp

Midwestern Governors Association. (2008). *Eco Driver Program*. Retrieved October 4, 2009, from http://www.midwesterngovernors.org/MGA%20Energy% 20Initative/Bioeconomy%20and

Mital, S., Barry, C., Briggs, R., Doeffinger, B., Fischetti, D., Murphy, M., et al. (2007). *Campus Sustainability Assessment: University of Oregon.* Retrieved August 24, 2007, from http://sustainability.uoregon.edu/indicators/UO%20Sustainability%20Report.pdf

National Oceanic & Atmospheric Administration. (2010, September). *Trends in Carbon Dioxide*. Retrieved September 2010, 2010, from Earth System Research Laboratory: http://www.esrl.noaa.gov/gmd/ccgg/trends/#mlo

Nixa, J. (2009). *New IRS Bicycle Commuter Benefit in Effect*. Retrieved September 2009, from http://bikemichiana.org/2009/02/12/new-irs-bicycle-commuter-benefit-in-effect/

Penn State Green Destiny Council. (2000). *Penn State Indicators Report.* Retrieved September 12, 2007, from www.bio.psu.edu/greendestiny/publications/gdcindicators_2000.pdf

Petersen, J., Shunturov, V., Janda, K., Platt, G., & Weinberger, K. (2007). Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives. *International Journal of Sustainability in Higher Education , 8* (1), 16-33.

Sener, B., Süzen, M., & Doyuran, V. (2006). Landfill site selection by using geographic information systems. *Environmental Geology* (49), 376-388.

Shapley, D. (2009). *3 Steps to Slay Energy Vampires and Save $100.* Retrieved October 20, 2009, from www.thedailygreen.com/green-homes/eco-friendly/energy-vampires-47102803#ixzz0Un19sSTI

Slade, G. (2007, March/April). *iWaste*. Retrieved February 12, 2008, from Mother Jones: www.motherjone.com/commentary/columns/2007/03/iwaste.html

Toor, W., & Havlick, S. (2004). *Transportation and Sustainable Campus Communities: Issues, Examples, and Solutions.* Washington, DC: Island Press.

United States Department of Energy. (2009). *Energy Savers: Lighting*. Retrieved March 2, 2010, from http://www.1.eere.energy.gov/consumer/tips/lighting.html

United States Department of Environmental Protection (EPA). (n.d.). *Climate Change: Basic Information*. Retrieved January 24, 2008, from http://www.epa.gov/climatechange/basicinfo.html

United States Environmental Protection Agency (EPA). (2004). *Buildings and the Environment: A Statistical Summary.* Retrieved December 28, 2007, from USEPA Green Building Workshop: www.epa.gov/greenbuilding/pubs/gbstats.pdf

United States Environmental Protection Agency. (2008). *Is Your Energy Bill Scary? Slaying Energy Vampires Can Save Americans Millions*. Retrieved October 20, 2009, from http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/a9f83e777a975e6d852574ef004e3ca7

United States Environmental Protection Agency. (2007). *Municipal Solid Waste in the United States: 2007 Facts and Figures*. Retrieved September 23, 2009, from www.epa.gov/epawaste/nonhaz/municipal/pubs/msw07-rpt.pdf

United States Green Building Council (USGBC). (2009). *Green Building Research.* Retrieved October 19, 2009, from www.usgbc.org/DisplayPage.aspx?CMSPageID=1718

United States Green Building Council (USGBC). (2007). *Why Build Green?* Retrieved January 20, 2007, from www.usgbc.org/DisplayPage.aspx?CMSPageID=291&

University of British Columbia. (2006). *2005 - 2006 Annual Report: Progress Towards a Sustainable Campus*. Retrieved October 4, 2007, from http://www.sustain.ubc.ca/pdfs/ar/2006_ar.pdf

University of British Columbia. (2006). *Ecotrek Project Complete*. Retrieved September 22, 2007, from http://www.ecotrek.ubc.ca/index.htm

University of British Columbia. (2007). *The UBC Sustainability Report, 2006-2007.* Retrieved October 2, 2007, from www.sustain.ubc.ca/pdfs/ar/URCSustainability_Report_2006-2007.pdf

University of British Columbia. (2007). *UBC Renews Iconic Buchanan Buildings for Future Generations, Saving Taxpayers Millions*. Retrieved February 10, 2007, from www.publicaffairs.ubc.ca/media/releases/2007/mr-07-041.html

University of British Columbia. (2007). *UBC Renews Iconic Buchanan Buildings for Future Generations, Saving Taxpayers Millions.* Retrieved February 10, 2008, from UBC Public Affairs: www.publicaffairs.ubc.ca/media/releases/2007/mr-07-041.html

University of Oregon. (2007). *University of Oregon Sustainability: Introduction and History*. Retrieved August 24, 2007, from http://sustainability.uoregon.edu

Appendix A-1: University Temperature Guidelines and Energy Policies

The University of Richmond is committed to energy conservation wherever possible. The campus energy management system monitors campus buildings and is designed to optimize energy consumption and expenditures where possible. University Facilities will utilize night, weekend, and holiday temperature setbacks to optimize energy consumption. Buildings not generally open to the public during nights, weekends, or holidays will be monitored closely to determine if HVAC systems need to be running. Thermostats in buildings will be raised or lowered by the Energy Management System to the appropriate setback to achieve energy savings. Temperature set points of 68-70 degrees in the winter and 74-76 degrees in the summer will be utilized campus-wide as a general rule.

University Facilities will strive to comply with the following goals:

- All facilities will be operated utilizing the most energy-efficient methods and provisions;
- Efforts will be made to reduce energy consumption in all areas of the University where practical;
- University Facilities will educate students, faculty and staff of the need to reduce energy consumption where possible; and
- University Facilities will cooperate with all federal, state, and local regulatory bodies in accomplishing energy conservation throughout the campus.

Space temperature settings will be set by University Facilities in centrally controlled systems. Occupants who control their own thermostats are required to adhere to these settings.

Occupied times for building spaces will be determined by either class schedules from the registrar or event schedules as listed in Resource 25. The Campus Energy Management System will use “Optimized Start” programs to minimize equipment run times.

Heating and cooling are not allowed simultaneously in the same space for the sole purpose of achieving comfort. Excessive cooling of a space on campus below the summertime University Temperature Guidelines should be reported to University Facilities so that air-conditioning levels can be adjusted.

Consideration will be made for sensitive research laboratories and other areas with environmentally or temperature-sensitive equipment or objects such as computer labs.

Spaces such as research facilities requiring critical temperature settings will be more tightly controlled.

Cooling temperatures only apply where air conditioning equipment currently exists.

Space Heaters — the use of personal (space) heaters is prohibited for many reasons:

- Space heaters are a very costly means of heating;
- Because of the way areas are zoned, use of space heaters in one area may actually cause others to be even colder since your area will tell the system there is enough warm air and it can stop heating all areas in that zone;

- Use of space heaters can mask problems with the central heating system that need to be addressed by a technician. This is especially true if a space heater is used during the summer due to high air conditioning; and
- Space heaters can pose serious fire and safety hazards.

For these reasons, use of space heaters is prohibited.

Building Management — Windows and doors of conditioned spaces should be kept closed. Personal computers, other office equipment and lights should be turned off when not in use and power management features of personal computers should be enabled. Schedulers of classes, meetings, and other campus activities should endeavor to minimize energy use by concentrating meetings in the fewest buildings possible and, where appropriate, specifically those buildings that already have late night temperature setback (see Nighttime Setbacks below). Additionally, every faculty/staff member is asked to turn out the lights whenever they are the last person leaving a room.

Appendix A-2: Assumptions for Building Energy Use Reductions

Assumptions for building energy use reductions:

- Solar or other renewable are installed on site to meet 1% of electrical demand by 2015 and 5% by 2020;
- Behavioral changes resulting from educational initiatives will produce an annual incremental 0.5% energy savings, reaching 5% by 2020;
- Upon adoption, the Energy Policy will decrease energy use by 3%;
- The steam plant fuel switch will result in 290.1 mtCO2e reduction in GHG annually, and increase by that same amount annually through 2030;
- Retrofits will achieve a 20% reduction in energy use across the campus by 2020;
- Dominion will meet its 12.5% renewable goal by 2020;
- Vending Misers will be installed on all 134 vending machines by 2011;
- Linear phase in of Dominion's renewables;
- Using 2010 as start - assume no change between 2008 GHG audit and 2010 other than new buildings.

Appendix A-3: Financial Model

ABM Sustainability Model

The ABM Sustainability Model (named for creators Dr. Tom Arnold, Dr. Harold Babb, and A. Gray McDermid) was developed by University Professors and graduate students to give University of Richmond managers a decision-making tool for supply-side sustainability projects. While the model provides a baseline from which managers can compare projects, it does not provide standard yes/no project acceptance.

The baseline using the ABM model is developed by capturing the cost to the University of complying with the President's Climate Commitment without engaging in any on-site projects (i.e. cost of compliance without action). While this model is not intended to justify the purchase of renewable energy credits (RECs), the baseline shows that the University can buy into sustainability targets with no qualitative benefit to the campus community by purchasing RECs. A net present value (NPV) of REC purchases into perpetuity is calculated to determine the baseline.

Once the baseline is determined, individual project costs and GHG reductions are compared against the baseline cost and GHG reductions. A multiple is established associated with each project. Projects that cost more, on a GHG reduction basis, than the baseline, have multiples greater than one (i.e. paying more for the same level of GHG reduction received through RECs). Rather than suggesting that projects that cost more than the baseline should not be considered, it suggests that qualitative benefits should be articulated and discussed. If qualitative benefits are determined to outweigh the additional cost of the project, a project will be accepted, if not, it will be rejected.

AMB Sustainability Model Example

Creating a baseline: (not actual UR figures)

- NPV of RECs are $1,000,000
- 10,000 metric tons of CO2 (MTCO2e) are emitted each year
- $100 NPV for a project should now offset 1 MTCO2e
- Any project that has a NPV of $100 that offsets less than 1 MTCO2e each year has a higher cost multiple (i.e. $200 for 1 MTCO2e = multiple of 2)
- Projects with higher cost multiples should have additional qualitative benefits above and beyond RECs

Example: Solar Photovoltaic Project

- NPV of $100,000
- Offsets 100 MTCO2e each year
- Project carries an ABM multiple of 10
    - $1,000 for each MTCO2 compared to $100 for RECs. 1,000/100=10
- Qualitative benefits are considered. Some may be:

    - On-campus education opportunity for students/faculty
    - Sustainable marketing and branding opportunity for the University. Could positively affect applications
    - Fundraising efforts for sustainability supported by on-site solar project
- Administrators weigh qualitative benefits and determine if those warrant 10X the cost of other options

The solar project ABM multiple of 10 is compared to a group of other projects for opportunity cost (i.e. biomass ABM multiple of .5 or solar hot water ABM multiple of 5).

Appendix B-1: Transportation Emissions Calculation Data and Assumptions

Calculation data and assumptions:

- 1,680 employee commuters;
- 229 student commuters;
- 100% of commuters drive each day;
- Number of days per year for commute
  = 226 (45.2 work weeks)
  = 365-139 (104 weekend, 15 holiday, 10 vacation, 10 misc, [sick, extra vacation, conferences, etc.]);
- U.S. automobile fleet is 9.4 years old (DOT);
- The average U.S. one-way commute (2005-07 – from 2009 Census Bureau info) is 25.1 minutes and 16 miles. Henrico County is approximately 21 minutes, but other employees come from counties farther away; therefore, 15 miles is used as an average;
- Education for "eco-driving" and anti-idling will reduce GHG emissions 5% by 2015, 20% by 2020; and
- Increases in airline fuel efficiency and automobiles will be linear in nature. This will not likely occur, but will suffice for graphical purposes.

Appendix B-2: Commuter and Campus Shuttle Information

Commuter and Campus Shuttle Information:

- Two bus routes were reviewed that could be tied to a campus shuttle and thus encourage higher bus ridership:
    - Route 2 to/from the Village Shopping Center from/to the Upper Fan District, VCU, Downtown, transfer to other GRTC routes, and Church Hill. This currently works well for commuting and some evening service for shopping and entertainment/dining. To be more amenable to students, later service would be necessary, particularly on weekends.
    - Route 13 was reviewed, but GRTC has taken it out of service.
- Sites that would serve as hubs for the commuter shuttles are:
    - Chesterfield Town Center: Midlothian Route
    - Tuckahoe Village Shopping Center: Tuckahoe Route
    - Short Pump Town Center: Short Pump Route
- A summary of the logistics:
    - The vans/mini-buses will run the three suburban commuter routes from 07:00 to 08:30, and again from 16:30 – 18:30, Monday – Friday.
    - One van/mini-bus will operate on a circuit from River Road Shopping Center to UR, then to the Village Shopping Center and back to pick up bus riders from 06:30 to 08:30, and then drop riders off between 16:30 to 18:30, seven days a week.
    - Two vans or one large shuttle will run from 08:30 to 16:30 to transport CCE volunteers Monday – Friday.
    - One van will travel the circuit around campus up to the Village Shopping Center and back from 18:30 to 01:00. This will act as the safety shuttle around campus and provide access to both the Village Shopping Center and GRTC's Route 2.
    - Two shuttles will operate two different circuits (UR to Short Pump and UR to Cary Town & the Slip/Bottom) Thursday – Saturday from 18:30 to 01:00.
    - Two shuttles will run on campus to link the UFAs, Westhampton College and Richmond College. These will operate from 07:00 until 22:00, Monday - Friday.
    - The van pool available for trips will need to remain separate since it can be gone for several days.
- The estimated costs are as follows:
    - Fuel and maintenance: Estimated fuel use of one gallon/hour, combined with periodic maintenance will cost roughly $1,500 - $2000 per shuttle per year. Should the shuttles be retrofit to operate on alternative fuels (biodiesel, E85 ethanol), this cost will likely increase.
    - Of the total 391.5 hours/week needed to operate the shuttles, 164.5 hours are already being funded by different departments during the school year. UR Police run the Safety Shuttle; Student Activities oversees the Short Pump shuttles and the 2BNB bus Thursday – Saturday, and the CCE operates two vans during the day. In order to run the

commuter and campus shuttles year round, approximately six full-time employees will be needed. Because it will operate 15 hours a day, four drivers will be necessary to operate the on-campus shuttle. For the other positions, driving would be only a portion of the responsibilities. For example, a person would work as a driver for the morning first thing in the morning for 1.5 hours and then as a landscaper for the remaining 6.5 hours.

There may be no need to purchase more vehicles if the Spider Shuttle, the Safety Shuttle, and the Student Activities Van are combined with the two CCE vans. Should ridership warrant it, however, 26 passenger buses are available at a cost of $84,000, and the investment could be spread across several programs. These buses can come with either diesel or gasoline engines, but could be run on biodiesel or ethanol, respectively, further reducing the climate footprint. The logistics of the future transportation services are further evaluated in the University's transportation study.

Appendix B-3: Proposed Vehicle Maintenance and Operating Policies

Proposed maintenance policy items:

- To meet the requirements of the safety office, quarterly or 3,000-mile scheduled maintenance for all vehicles that travel campus or transport passengers will continue.
- Schedule all other vehicles, including carts, for annual inspection and semi-annual maintenance. The Auto Shop will assign two numbers per vehicle, corresponding to the service months. The department responsible for the vehicle will receive stickers to install on the windshield indicating when the department is responsible for scheduling maintenance with the auto shop. Departments may be disciplined if a vehicle inspection lapses.
- All vehicles users would be required to maintain a vehicle log to record the following on a monthly basis at minimum:
    - Miles driven or hours operated;
    - Tire pressure;
    - Oil and other fluid levels;
    - Water levels in electric cart batteries; and
    - Any problems noted.
- The auto shop will check the log entries when the vehicle is serviced.

Proposed University vehicle operating policy items:

- No non-diesel powered University vehicle or piece of equipment will be idled in a nonemergency situation. The operator of the vehicle/equipment will turn off the unit and the keys are to be removed from the ignition.
- No vehicle should be left unattended or idling at a loading dock, delivery stop, or at other locations where exhaust emissions may enter an occupied building such as near building air intakes, entrances, or open windows, etc. Engines should be left running only as long as it takes to unload or load passenger.
- Idling of diesel powered vehicles is generally unnecessary, except at cold start-up. According to the EPA, engine manufacturers typically recommend a warm up time for diesel engines of less than five minutes. Further, idling causes significantly more wear on engine parts than driving at regular speeds. Therefore, idling of these vehicles will not be allowed with the exception of cold starts.
- Avoid hard acceleration and braking to prevent excessive wear on vehicles. This also saves fuel and reduces potential conflicts with pedestrian, bicycle, and other vehicle traffic.

Appendix C-1: Sustainability Courses at University of Richmond

COURSE NUMBER	COURSE TITLE
ANTH 101	Introduction to Cultural Anthropology
ANTH 328	Anthropology of Human Rights
ARTS 220	Drawing From Nature
ARTS 279 / PHIL 280	Land Art and Landscape: Aesthetics, Design, Practice
BIOL 100	Biology of Plants
BIOL 108	Environmental Biology
BIOL 109	Introduction to Ecology
BIOL 111	Marine Biology of the Chesapeake Bay
BIOL 207	Ecology
BIOL 309	Invertebrate Zoology
BIOL 328	Vertebrate Zoology
BIOL 332	Tropical Marine Biology
BIOL 333	Microbial Ecology
BIOL 334	Oceanography
BIOL 360 / GEO 360 / ENVR 360	Environmental Remote Sensing
BIOL 383	Tropical Biology and Conservation
BUAD 392	Ethical, Social, and Legal Responsibilities of Business
CHEM 110	Pollutants in the Environment
CHEM 316	Environmental Chemistry
ECON 105	Introduction to Global Economics
ECON 230/ENVR 230	Environmental Economics
ECON 330 / ENVR 330	Environmental and Resource Economic Theory
ENGL 336	Literatures of Globalization
ENVR 201	Introduction to Environmental Studies
ENVR 250	Introduction to Earth Systems and Physical Geography
ENVR 260	Introduction to Geographic Information Systems
ENVR 300	Special Topics – Environmental Studies
ENVR 320	Directed Research – Environmental Studies
ENVR 388	Individual Internship – Environmental Studies
ENVR 391	Environmental Senior Seminar
GEOG 210	Geographic Dimensions of Human Development
GEOG 250	Introduction to Earth Systems and Physical Geography
GEOG 320	Power, Space and Territory: Geographies of Political Change
GEOG 333	Geographies of Amazonia
GEOG 345 / ENVR 345	Society, Economy, and Nature: Global Perspectives on Sustainable Development
GEOG 365/ ENVR 365	Advanced Spatial Analysis
GEOG 370	Geographies of Economic Development and Globalization
GEOG 380	Ecotourism
GEOG 401	Geography Capstone
HIST 216	American Cultural and Intellectual History Since 1865
HIST 391	Transnational Social Reform

JOUR 304	Environmental Reporting
LAWE620	Environmental Law
LAWE645	Land Use Planning
LAWE691	Indian Law
LAWE692	Environmental Law: Solid Waste and Toxic Material
LAWE699	Special Topic: Animal Law
LAWE699	Special Topic: Law of Global Warming
LAWE729	International Environmental Law
LAWE777	Labor Law in a Global Economy
LDST 325	Leading Socially Active Businesses
LDST 386	Leadership in a Diverse Society
MATH 119	Statistics for Social and Life Sciences
MBA 508	Social, Ethical and Legal Issues in Business
MBA 545	Strategic Resource Management
MGMT 348	Environmental Management
MLC 260	Nature, Nurture, Neurons: Science and Society in 20th Century East European Literature
MUS 116	Music Scenes
MUS 124	Asian Music and Globalization
MUS 203	Global Hip Hop
MUS 230	Music in Culture: Introduction to World Music
PHIL 220	Contemporary Moral Issues
PHIL 299	Philosophy of Science
PHYS 134	Biological Physics
PLSC 260	Introduction to Public Policy
PLSC 351	Globalization
PLSC 360	International Development Policy
PLSC 361	The Politics of Social Welfare
PLSC 362 / ENVR 362	Environmental Law and Policy
PLSC 363	Global Health Infectious Disease and Human Rights
RELG 265	Religion and Moral Decisions
RELG 269/ ENVR 269	Ethics Religion and the Environment/ Environmental Ethics
RELG 369	Problems in Social Ethics
RELG 374	Religion and the American Environment
SOC 101	Foundations of Society: Introduction to Sociological Analysis
SOC 209	Social Problems
SOC 216	Social Inequalities
SOC 306	Social Change in a Global Perspective
THTR 210	Performing Diversity: A Cultural Odyssey
THTR 313	Theatre for Social Change I
THTR 314	Theatre for Social Change II

Appendix D-1: Sustainability Action Items

University of Richmond Sustainability Action Item List

Category	Action	Comment
Administration	Green Pledge	Online pledge for campus community to commit to specific actions
Administration	Green Office Program	Sustainable office certification
Administration	Environmental Policy	Summarize the University's environmental position and provide a tool to guide departments in doing their part
Administration	Energy Operations Policy	See Appendix A-1
Administration	Vehicle Purchasing Policy	Ensure employees are aware of preferred, sustainable vendors
Administration	Vehicle Maintenance Policy	See Appendix B-3
Administration	Vehicle Operating Policy	See Appendix B-3
Financing	Green Fund	Provide small grants to those on campus with an idea
Financing	Revolving Fund	Provide money for capital projects
Financing	Student Fee	Green fee that students will pay to fund sustainability projects, green power, etc.
Energy	Campaigns/Competitions	Building occupant education, student and staff campaigns, competitions, certifications, incentives to encourage behavior change
Energy	Building Dashboard	Real time online energy data available from 14 residence halls
Energy	Individual Building Metering	Expanded energy and water monitoring
Energy	Building Occupant Education	Ensure that employees know how to use equipment efficiently
Energy	Energy Star and EPEAT Standards	Continued use of purchasing guidelines for new electronic equipment
Energy	Lighting Upgrades	Continued expansion
Energy	High SEER Heat Pumps	Continued expansion, in seven buildings so far
Energy	Occupancy Sensors	Reduces reliance on behavior change
Energy	High Efficiency Chillers	Improved building energy efficiency
Energy	Building Energy Audits	Provide data needed to prioritize next steps
Energy	Transition from Coal	Review options including natural gas, biomass, etc.
Energy	Renewable Energy	Begin with solar pilots and then expand
Energy	LEED Building Standards	All construction must be LEED Silver or higher
Energy	Building Retrofits, Recommissioning, LEED EB	Achieve improved building energy efficiency
Transportation	Flex Work Weeks	

Transportation	Telecommuting	
Transportation	Parking Restrictions	Limit driving within campus, increase parking fines
Transportation	Green Bikes	Continued expansion and refinement
Transportation	Carpooling	Incentivize and publicize
Transportation	Car sharing	Zimrides, Zipcar
Transportation	Preferred Parking	For Hybrids, etc.
Transportation	EV Recharging Stations	Two on campus
Transportation	Free Public Transit	GRTC bus pass available
Transportation	Shuttles (propane fleet)	Run from campus to a variety of locations
Transportation	Improved Sidewalks	Help to encourage a walking campus
Transportation	Partner with Recreation and Wellness	Encourage healthy activities while discouraging driving
Transportation	Campaigns/Competitions	Provide information and incentives to encourage
Transportation	Tracking System for University Travel	To improve the accuracy of the greenhouse gas audit
Waste Mgmt	Recycling Education	Increase awareness of dual bin system - plastic #1&2, glass, metal, and mixed paper and cardboard
Waste Mgmt	E-waste	Campus e-waste handled by Redemtech
Waste Mgmt	Purchasing Policy	Use vendors/products with Green Seal, GreenGuard, Energy Star, FSC; high recycled content
Waste Mgmt	Repurpose >Sell > Donate >Recycle > Landfill process	Ensure that all offices can participate
Waste Mgmt	Food Waste -- Pulper	Two pulpers on campus
Waste Mgmt	Food Waste -- Compost	Students have, dining services is starting
Waste Mgmt	Green Cleaning	Green Seal used in most of campus
Waste Mgmt	Integrated Pest Management	Decrease in landscape-related and housekeeping chemicals
Waste Mgmt	Nutrient Mgmt Site	Voluntary status with strict chemical use standards
Waste Mgmt	Social Marketing/Competitions	Use incentives, competitions, etc. to encourage behavior change
Waste Mgmt	Bin Audit	Ensure proper availability of bins
Waste Mgmt	Eco Clamshells	Reusable dining hall take-out containers
Waste Mgmt	Lug-a-mug	Reusable mug
Waste Mgmt	Printers	Eliminate personal printers, proper energy settings
Waste Mgmt	Recyclemania	Continued and improved participation in 10-week campus-wide competition
Waste Mgmt	Plastic Bags	Reduction needed
Waste Mgmt	Water Bottles	Reduction needed

Waste Mgmt	Recycling Expansion	Library currently recycling batteries, review other expansion options
Waste Mgmt	Publications	Need to reduce frequency/volume
Waste Mgmt	HazMat Waste	Green chemistry options will reduce need
Education	On campus groups	Form partnerships to facilitate education
Education	Research Opportunities	Enhanced student involvement/education
Education	Internships	Enhanced student involvement/education
Education	Classes	Concentration in environmental subjects and environmental classes across majors
Education	Curriculum	Incorporate sustainability in all majors
Education	Events	Green Speaker Series, campaign kick-offs
Education	Green Tour	Tour of LEED buildings and sustainable features on campus
Education	Sustainability Orientation	Targeted for all new community members
Education	Community Outreach	Partner with Bonner Center for Civic Engagement and student groups and other local schools