Virginia Tech Climate Action Commitment and Sustainability Plan

Energy & Sustainability Committee

April 22, 2009

ACKNOWLEDGEMENTS

VIRGINIA TECH CLIMATE ACTION COMMITMENT & SUSTAINABILITY PLAN
Developed by the Members of the VTCAC&SP Subcommittee
(Members with an * are also current members of the Energy and Sustainability Committee)

John Randolph (Chair)*	Professor and Chair, Urban Affairs & Planning
Denny Cochrane *	Sustainability Program Manager, Facilities Services
Michael Coleman *	Associate Vice President for Facilities Services
Jack Davis*	Dean, College of Architecture & Urban Studies
Angella De Soto *	Undergraduate Student Sustainability Intern, Environmental Policy & Planning
Michael Ermann	Associate Professor, Architecture Program Chairman
Bruce Ferguson *	Associate Director, University Planning, Design & Construction
Richard Hirsh	Professor, History
Scott Hurst *	University Architect
Rick Johnson*	Director, Housing and Dining Services
Rob Lowe *	Environmental Engineer, Environmental Health & Safety Services
Steve Mouras	Director, Transportation & Campus Services
Erik Olsen	Transportation Planner, Blacksburg Transit
Brian Perkins *	Graduate Student, Wood Science & Forest Products
Scott Reed	Senior Associate Director, Operations and Services, UUSA
Mary Seyler	Buyer Senior, Purchasing Department
Lylah Shelor	Facilities Manager, Information Technology
James Torgersen	Facilities Manager, Athletic Department
Tom Tucker*	Architectural Planner, Facilities Information Systems, and President of the Staff Senate

Assisted by the Following Additional Current and Former Members of the Energy and Sustainability Committee

Mike Cutlip	Post Award Administrator, Sponsored Programs
Natalya Hallanan	Undergraduate Student, Environmental Policy & Planning
Kristina Hartman	Undergraduate Student, Biological Sciences
Jack Lesko	Professor, Engineering Science & Mechanics and Special Assistant to the VP for Research for Energy Initiatives
Sean McGinnis	Senior Research Scientist, Green Engineering Program
Sara Murrill	Graduate Student, Forestry
Ben Myers	Director, Utilities and Building Systems, Facilities Services
Annie Pearce	Assistant Professor, Department of Building Construction
Madeline Schreiber	Associate Professor, Geosciences
M. Dwight Shelton	Vice President for Finance and Chief Financial Officer
Sherwood Wilson	Vice President for Administrative Services

Additional Assistance and Support Provided by the Following University Employees

John Beach	Director of Strategic Initiatives, Facilities Services
Larry Bechtel	Virginia Tech Recycling Coordinator, Facilities Services
Keith Boyd	Director, Mechanical Utilities, Virginia Tech Electric Services
Kim Briele	Electrical Engineer Senior, Utilities & Building Services
Chris Compton	Chief Engineer and Director of Property Operations, The Inn at VT and Skelton Conference Center
Debby Freed	Alternate Transportation Manager, Transportation & Campus Svcs
Matt Gart	Campus Landscape Architect, Office of the University Architect
Jennifer Tatum Harris	Public Relations Specialist, Undergraduate Admissions
Mark Helms	Director, Buildings, Grounds and Housekeeping, Facilities Services
Lucinda Jennings	Programming Director, Office of the University Architect
Don Leo	Associate Dean for Research & Graduate Studies, College of Engr, Special Assistant to the VP for Research for Energy Initiatives
Leon McClinton	Director of Residence Life
Richard McCoy	Parking Manager, Transportation and Campus Services
Sandra Mullins	Executive Secretary, Office of the Associate VP for Facilities Svcs
Byron Nichols	Power Plant Superintendent, Facilities Services
Gene Reed	Director of Fleet Services, Transportation & Campus Services
Andy Sarjahani	Sustainability Coordinator-Dining Services
Larry Smith	Mechanical Engineer Senior, Utilities & Building Services
Melinda West	Assistant to the Vice President for Finance
Linda Woodard	Assistant VP for Administrative Services and Chief of Staff

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Cover Photos (left to right): Campus Tree Tour planting 100 trees on campus, October 21, 2008; Environmental Coalition student leaders with President Steger, December 10, 2007; Virginia Tech students at Power Shift 2007 in Washington; Virginia Tech Steam Power Plant

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Virginia Tech Climate Action Commitment & Sustainability Plan

Executive Summary

On April 25, 2008, President Charles W. Steger charged the Energy and Sustainability Committee with the task of developing the Virginia Tech Climate Action Commitment and Sustainability Plan (VTCAC&SP). To develop a draft plan, the Committee established a 20-member subcommittee representing all facets of the university, from facilities to campus life, from to academic faculty to students.

The plan incorporates three objectives:

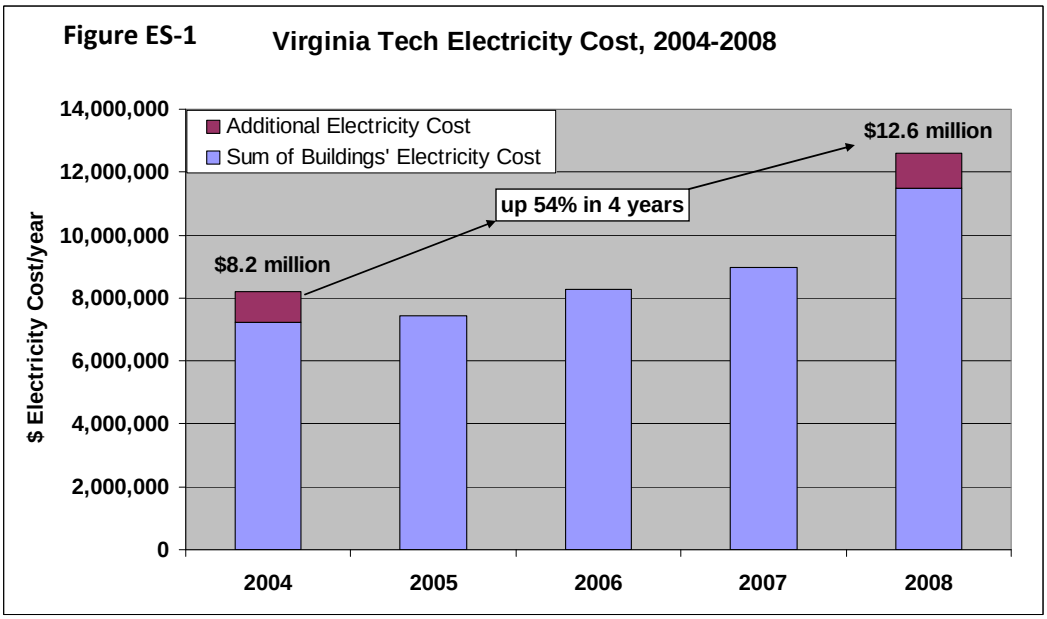
1. A statement of Virginia Tech's Climate Action Commitment more specific to the university than the American Colleges and Universities Presidents Climate Commitment (PCC)
2. An action plan to achieve the goals of that commitment
3. A plan to enhance Virginia Tech's sustainability programs and culture

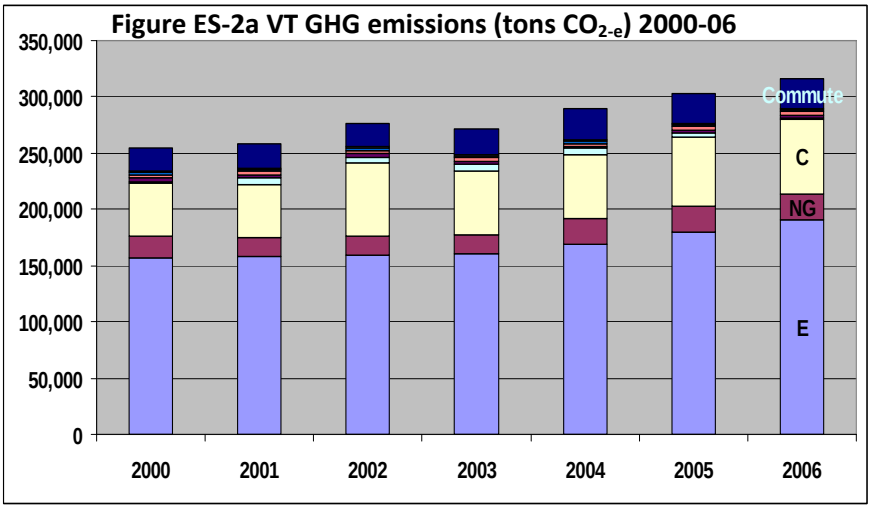
By its nature, the plan has a long time horizon, perhaps 40-50 years, since climate action and sustainability are long-term issues that will not be solved overnight. The plan is divided into several sections. After an introduction and background section, a presentation of constraints and guiding principles and a summary of the university greenhouse gas (GHG) emission inventory completed in 2008, the plan presents the current status and action options for six topical areas: administrative structure and governance, facilities infrastructure, facilities operations, transportation, behavior and campus life, and academic programs. Finally, the plan presents future sustainability scenarios for Virginia Tech, the Virginia Tech Climate Action Commitment, and an assessment of plan measures to meet the commitment targets.

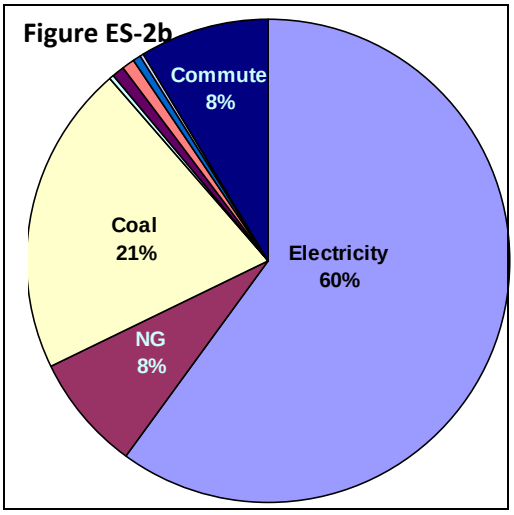
While this commitment and plan was conceived as a means to advance the university's efforts to join the growing number of universities, communities, states, and nations in addressing climate change and environmental sustainability, it has turned more immediately to addressing the university's dramatically increasing energy costs in this time of budget challenge. In the short term, strategies to reduce energy costs are compatible with those to reduce carbon emissions. With a concerted effort to operate the university more efficiently, we can save millions of dollars in the short term and doing so will also reduce carbon emissions and set us on a course for greater campus sustainability.

As shown in **Figure ES-1**, from FY2004 to FY2008, the university's electricity costs increased from $8.2 million to $12.6 million, a 54% increase. Prices for coal tripled and natural gas also increased. This growing financial burden on the university is not sustainable. Although coal and gas prices have begun to come down as a result of the economic recession, electricity prices and costs continue to increase. As shown in **Figures ES-2a** and **ES-2b**, two-thirds of our carbon emissions are tied to our use of electricity. **Figure ES-2a** gives emission sources for 2000-06 and **Figure ES-2b** shows the 2006 breakdown.

The VTCAC&SP calls to arrest this growth of electricity and cost and turn this growth into a decline within three years. This will not be easy and will take a concerted effort by the entire university community in campus operations and behavior. The plan identifies a number of no- and low-cost modifications of campus operations, including air handling schedules, temperature settings, and relamping, that can be accomplished in the immediate term (2009-2012) ,and that will have substantial savings. But these will not be sufficient without a concerted campus effort by students,



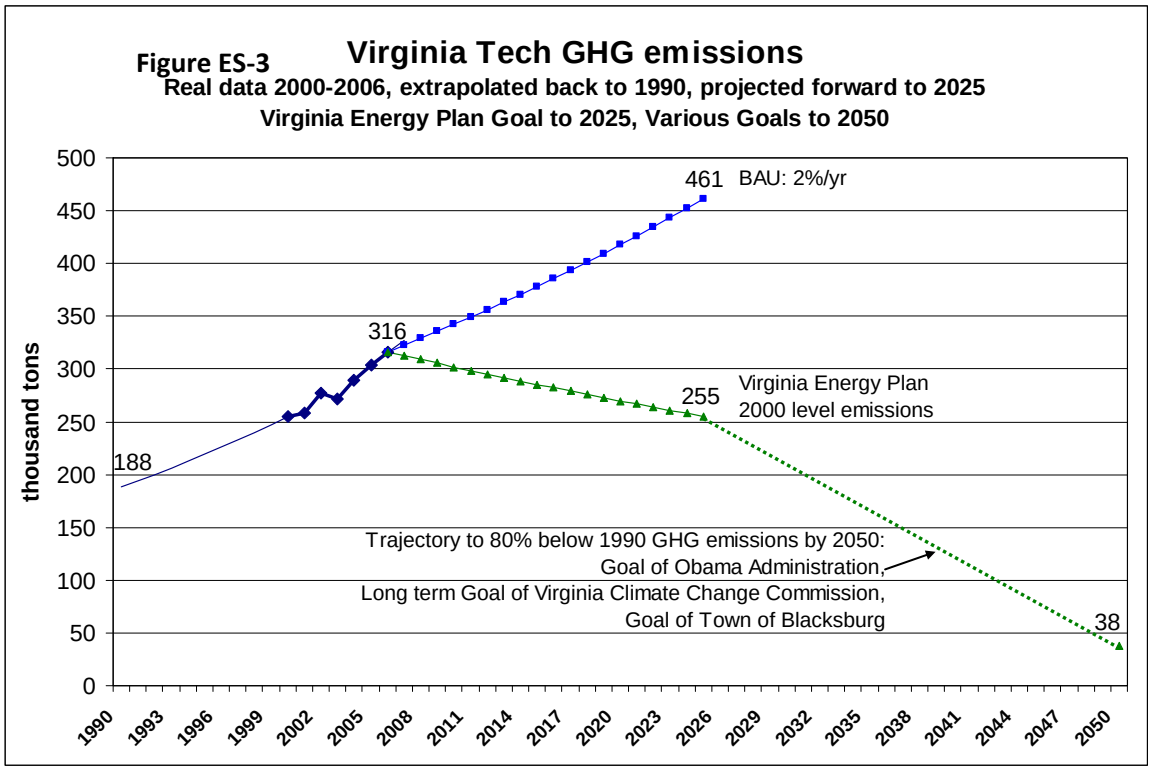




faculty and staff to join the movement to reduce unneeded electricity by turning off computers, peripherals and lights when not in use and other conservation behavior.

This will take a campus movement, and the plan calls for an extensive education effort through the Coalition for Campus Sustainability (now with 18 member student organizations), the Staff and Faculty Senates, Dining and Housing and Residence Life Services, and other campus units. Everyone can see the need for this action to temper expenditures in light of budget cuts. Those concerned about the university's impact on the environment and climate change also see this as a first step toward long-term sustainability: "Save the University, Save the Planet."

The commitment and plan looks beyond three years and identifies mid-term (until 2025) and long term (until 2050) goals and strategies, as shown in **Figure ES-3**. The business as usual (BAU) projection is 2% per year. Here the plan references the changing world expected during those periods as represented by goals established by the Virginia Energy Plan, Governor Kaine, the Governor's Commission on Climate Change, the Town of Blacksburg, pending federal legislative initiatives introduced by Congressman Boucher and others, and the Obama administration. While we have identified mid- and long-term strategies for campus planning, new buildings, scheduled upgrades and replacement of



campus energy infrastructure, and other means, we expect also to ride the wave of the changing world around us to lower our carbon emissions and achieve greater sustainability.

The Virginia Tech Climate Action Commitment and Sustainability Plan focuses on six action categories and several subareas that are explored in separate sections of this report. They include the following:

VTCAC&SP Action Categories

1. **Administrative structure and governance**
2. **Facilities infrastructure**
   - **a.** The Central Steam and Power Plant and steam distribution system
   - **b.** Virginia Tech Utilities, VT Electric Services
   - **c.** The chiller system
   - **d.** New and renovated buildings
   - **e.** Existing buildings
   - **f.** Campus planning, landscape, grounds
3. **Facilities operations**
   - **a.** Thermostat settings
   - **b.** VT Recycling
   - **c.** Procurement policies
4. **Transportation**
   - **a.** Alternative transportation
   - **b.** Telecommuting and Flexible Work Schedules
   - **c.** Local Regional Transit
   - **d.** Parking Services
   - **e.** Fleet Services
5. **Behavior and campus life**
   - a. Student Culture and Engagement
   - **b.** Faculty and Staff Engagement
   - **c.** Housing Services and Residence Life
   - **d.** Dining Services
   - **e.** University Unions and Student Activities (UUSA)
   - **f.** The Inn and Conference Center
   - **g.** Athletic Department
6. **Academic programs**
   - **a.** Instruction and Learning
   - **b.** Research and Discovery
   - **c.** Outreach and Engagement

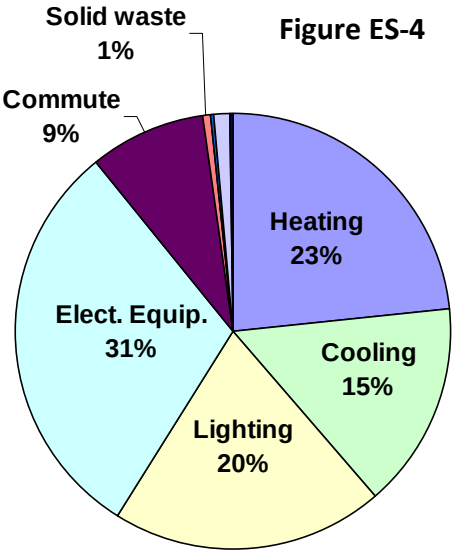
Assessing Impact of Action Strategies

The plan report assesses the measures contained in the plan to see how well they contribute to energy and emission targets of the commitment. The first step in this process is to review the GHG emission inventory and estimate emissions from end use sectors addressed by the prospective actions. **Table ES-1** gives an estimated breakdown of GHG emissions for different end uses and some notes indicating how they were derived. Figure ES-4 shows the distribution of emissions in a pie chart.

Table ES-1. Virginia Tech 2006 GHG Emissions by End Use

2006 GHG emission by end use		
End use	**GHG emissions, 1000 tons**	**%**
Heating	74	23%
Cooling	48	15%
Lighting	64	20%
Elect. Equip.	96	30%
Commuting	27	9%
Solid waste	2	1%
Water, WW	1	0%
Fleet	3	1%
Aviation	1	0%
TOTAL	316	100%

Figure ES-4



Using estimates of savings related to these end uses from the specific actions and the timing of those actions (immediate, mid-term, and long-term), solution wedge diagrams were developed in a large spreadsheet model based on ICLEI-Local Government for Sustainability climate action planning software. Those diagrams are given in **Figures ES-5-6**. **Figure ES-5** focuses in the short-term immediate period of 2009-2012. It shows the 2000-2006 emissions, the 2%/year business-as-usual (BAU) projection, and the target for 2012, as given in **Figure ES-3**. Various prospective actions related to the facilities infrastructure and operations (heating, cooling, lighting, on-site generation, new and existing buildings), behavior of building occupants (lighting, equipment), alternative transportation (transport), and recycling (solid waste), set us on a path to the 2012 target. The biggest wedge comes from savings in lighting energy due to relamping with more efficient lights and a campaign to turn off lights when not in use.

Figure ES-6 shows the full impact to 2050. This assessment is conservative since it assumes continued 1%/year growth from 2012 and 0.5% growth from 2025. The biggest savings to 2025 come from cooling, equipment, new and existing buildings, on-site generation, transportation, and campus tree canopy. Major savings to 2050 are estimated from on-site generation, existing building renovation, and heating system changes. But these measures fall well short of the needed reductions to achieve the 2025 and 2050 targets, and as a result, the largest wedge to meet the target is “unknown.” It is assumed that external forces and new technologies can fill this wedge.

Figure ES-5

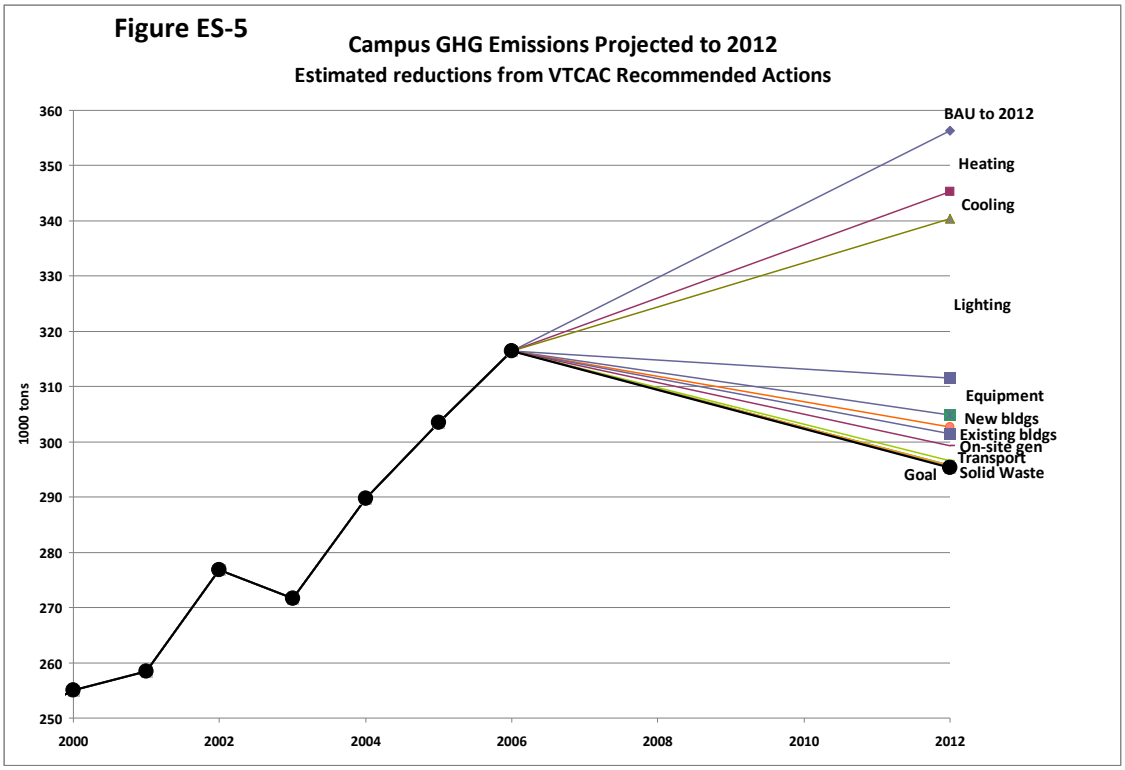
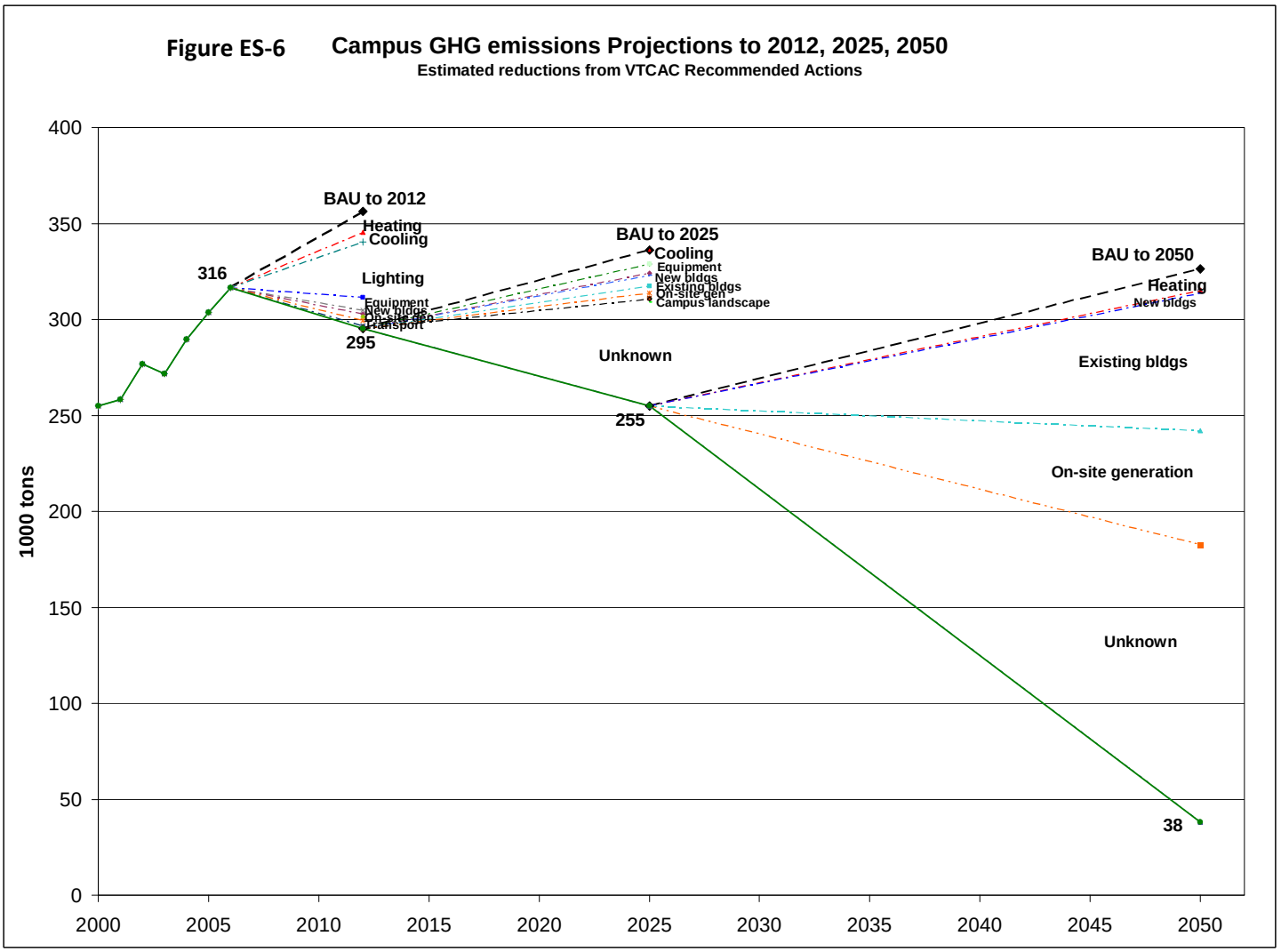


Figure ES-6



Future Energy and GHG Emission Scenarios for Virginia Tech

The plan's wide array of measures illustrates the opportunity not only to improve the design and operation of Virginia Tech's physical infrastructure toward greater efficiency and less reliance on carbon-based energy, but also to change the culture of the institution toward greater awareness of the impacts of our actions on the fiscal health of the university and the environmental health of our community and our planet.

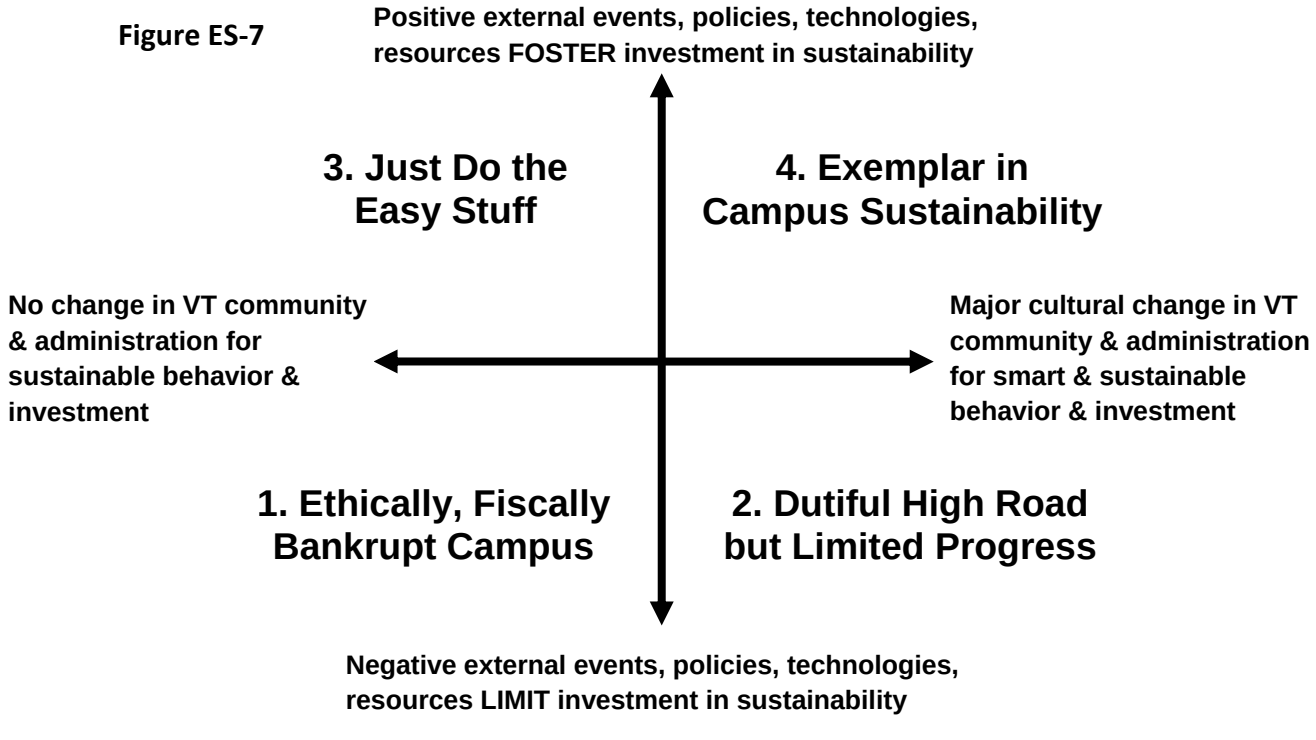
What will the future of the Virginia Tech look like in terms of sustainability?
It depends on many things that can be boiled down to two driving forces:

1. the internal will of the university community and administration
2. the external events, policies, technology, and available resources for sustainability

Placing these driving forces on a two-by-two matrix defines four future scenarios shown in **Figure ES-7**:

1. **Ethically, Fiscally Bankrupt Campus**: a combination of negative external forces and no change in campus culture for sustainability lead to a future on dramatically increasing energy and carbon costs and a campus community that follows rather than leads.
2. **Dutiful High Road but Limited Progress**: if campus culture changes but external forces, especially resources, are limited, the community will do what it can but will be frustrated about its limited progress.
3. **Just Do the Easy Stuff**: with positive external forces, the campus will invest in easy fixes but without a culture change affecting community behavior and administrative policy, the easy stuff will have limited impact.
4. **Exemplar in Campus Sustainability**: a combination of positive internal change and external forces would position Virginia Tech to be a campus sustainability leader for the Commonwealth and the nation, driving down energy use and emissions and creating a more livable and enjoyable campus environment.

Figure ES-7



The Virginia Tech Climate Action Commitment (VTCAC)

The targets recommended for the commitment are illustrated in **Figure ES-3**. VTCAC adopts the 2007 Virginia Energy Plan and 2008 Governor's Commission on Climate Charge target for 2025. For Virginia Tech, that is 255,000 tons CO_2, or about 19% less than 2006 emissions as estimated by the GHG Emission Inventory. The VTCAC also has an interim short-term target for 2012 of 295,000 tons, or about 7% less than 2006. This target follows the straight-line path toward the 2025 target.

The VTCAC adopts the emission reduction target of 80% below 1990 levels by 2050, the target recommended by the Intergovernmental Panel on Climate Change (IPCC), and adopted or endorsed by the Obama administration, the Governor's Commission on Climate Change (GCCC), the Town of Blacksburg and many other communities. For Virginia Tech that would be 38,000 tons of CO_2.

This level of emissions reduction by 2050 would make possible the achievement of climate neutrality or zero net emissions of carbon through further reductions or purchase of carbon offsets.

Are these targets achievable? The intent of this plan is to show that we can move on the path toward these targets, but that it will be difficult to achieve them without fundamental changes in the patterns of energy use locally and nationally. Beyond what we can achieve from the measures provided in this plan, achieving these targets requires aggressive federal and state efficiency mandates for vehicles, buildings and equipments; improved cost-effective efficiency and renewable energy technologies; changes in the energy sources both on campus and from utility providers; a cost on carbon that will drive investments toward efficiency and renewable energy; and other changes we cannot imagine.

This study estimates the emission reductions from many of the actions recommended by this plan (**Figures ES-5** and **ES-6**) and identifies gaps in achieving the targets that must be filled with currently unknown measures. These gaps are expected since we cannot today envision all of the possibilities 10-40 years from now. The analysis does show that the actions of this plan can help meet our interim 2012 target which is on the straight-line path to the 2025 target.

This VTCAC&SP provides the following resolution to the university governance system and to President Steger for consideration as the Virginia Tech Climate Action Commitment.

The Virginia Tech Climate Action Commitment Resolution

Whereas, in December 2007 President Steger met with students about the Presidents Climate Commitment, and in April 2008, he charged the Energy & Sustainability Committee with drafting a Virginia Tech Climate Commitment and sustainability plan;

Whereas, Virginia Tech's electricity bill increased 54% from $8.2 to $12.6 million from 2004 to 2008 at a time of major state budget reductions, and electricity rates are expected to increase;

Whereas, efforts to reduce electricity and energy use and related greenhouse gas (GHG) emissions also reduce the rising costs of energy;

Whereas, the 2007 Virginia Energy Plan and 2008 report of the Governor's Commission on Climate Change call on the Commonwealth to reduce its GHG emissions to 2000 levels by 2025;

Whereas, the Governor's Commission, Governor Kaine, the Town of Blacksburg, the Obama administration, and countless states, cities, and campuses across the country, have endorsed a long term target for GHG emissions of 80% below 1990 levels by 2050;

Whereas, the Virginia Division of Engineering and Buildings issued new rules in December 2008 requiring all new state buildings and major renovations to achieve either LEED certification or a 30% improvement in energy performance over ASHRAE 90.1 2004 and other requirements;

Whereas, the Governor's Commission calls on the state agencies to lead the Commonwealth to lower emissions by example, and Virginia Energy Plan also calls on the state's universities to "lead by example by implementing energy-efficiency actions across their campuses. These actions will not only reduce energy use and lower energy bills but will also help educate our next generation of leaders on how to manage energy wisely in their lives;"

Whereas, many colleges and universities throughout the country have joined this "lead by example" challenge and joined a national movement to "green" university campuses; 606 have signed the American Colleges and Universities Presidents Climate Commitment, including 7 ACC schools, 15 Virginia colleges, 16 top 50 research universities, and 26 land grant institutions;

Whereas, Virginia Tech is the premier technical and design university in the Commonwealth and should take on this leadership role, exceed minimum state standards, and demonstrate emerging technologies and management approaches to reduce energy consumption and costs and reduce GHG emissions;

Whereas, Virginia Tech has adopted Campus Energy and Water Policy 5505 that establishes a foundation for this commitment regarding efficient use of energy on campus; and

Whereas, 18 Virginia Tech student organizations are members of the Campus Coalition for Sustainability and student, staff, and faculty interest in sustainability issues is at an all-time high;

Let it be resolved that the university shall adopt the following Virginia Tech Climate Action Commitment:

1. Virginia Tech will be a Leader in Campus Sustainability.

2. The university will represent the VTCAC&SP in the Virginia Tech Strategic Plan.
3. Virginia Tech will establish a target for reduction of campus GHG emissions to 80% below 1990 emission level by 2050, and interim targets from 2006 emissions of 316,000 tons consistent with the Virginia Energy Plan, the Governor's Commission on Climate Change, the Town of Blacksburg, and the federal administration: for 2012, 295,000 tons (on path to 2025 target); for 2025, 255,000 tons (2000 emission level); and for 2050, 38,000 tons (80% below 1990 emission level).
4. Virginia Tech will work toward these emission reduction targets through improved energy efficiency, reduction of energy waste, replacement of high-carbon fuels, and other measures identified in the VTCAC&SP.
5. Virginia Tech will establish an Office of Sustainability to
    a. Coordinate programs for campus sustainability,
    b. Oversee implementation of the VTCAC&SP,
    c. Monitor annual electricity and other energy use and GHG emissions, and
    d. Working with faculty and departments, manage a campus-wide student internship and undergraduate research program using the campus as a sustainability laboratory
6. Virginia Tech will pursue LEED Silver certification or better and exceed ASHRAE 90.1 2004 energy performance by 35% (ASHRAE 90.1 2007 by 30%) for all new buildings and major renovations. Capital budgets should account for future energy price, cost of building operation, return on investment, and environmental benefits of achieving this level of performance.
7. Virginia Tech will improve electricity and heating efficiency of campus facilities and their operations, including the heating and cooling infrastructure and operation, lighting efficiency, controls and operation, and equipment efficiency and controls.
8. The university will adopt at least 4 reduction measures in the Waste Minimization component of the national RecycleMania competition. Virginia Tech Recycling will adopt a goal of 35% recycle rate by 2012 and 50% by 2025.
9. Virginia Tech will require purchase of Energy Star rated equipment, maximum practicable recycled-content paper, and other low life-cycle cost products, with exceptions for special uses.
10. Virginia Tech will engage students, faculty and staff through education and involvement to reduce consumption of energy, water, and materials in academic and research buildings, dining and residence halls, and other facilities.
11. Virginia Tech will improve transportation energy efficiency on campus through parking, fleet, and alternative transportation policies. Alternative transportation use will increase from the current level of 45%, to a goal of 52% in 2015, and 60% in 2020.
12. The university will create and support a virtual Virginia Tech School of Sustainability or similar mechanism to coordinate, develop, and communicate related instructional, research, and outreach academic programs.
13. The university will monitor energy use and GHG emissions as well as changing internal and external conditions, prepare an annual 'report card' showing progress towards targets, and periodically re-evaluate targets, making adjustments to targets as appropriate based on changing internal and external conditions and evolving technologies.
14. With regard to all the items in this resolution, major personnel and investment decisions, including capital projects, associated with implementing the VTCAC&SP will be based on a joint review of costs and benefits by university financial and facilities staff and be subject to availability of funds. Virginia Tech will provide funding to support sustainability programs through a variety of sources, which might include savings from reduced electricity and energy fuels, E&G funds, loans, a Green Development Fund from private sources, and a student Green Fee.

I. Introduction and Background

This Virginia Tech Climate Action Commitment and Sustainability Plan was commissioned by President Charles W. Steger to the Energy and Sustainability Committee on April 25, 2008, (see **Appendix A**). It incorporates three objectives:

1. A statement of Virginia Tech's Climate Action Commitment more specific to the university than the American Colleges and Universities Presidents Climate Commitment;
2. An action plan to achieve the goals of that commitment
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By its nature, the plan has a long time horizon, perhaps 40-50 years, since climate action and sustainability are long term issues that will not be solved overnight. This report is divided into several sections. After an introduction and background section, a presentation of constraints and guiding principles, and a summary of the university greenhouse gas (GHG) emission inventory, the plan presents current status and action options for six topical areas: (1) administrative structure and governance (2) facilities infrastructure (3) facilities operations (4) transportation (5) behavior and campus life, and (6) academic programs. Finally, the plan presents future sustainability scenarios for Virginia Tech, the Virginia Tech Climate Action Commitment and the Sustainability Plan, and Action Strategies.

A. The Problem

Climate change has been characterized as the defining environmental issue of the century. The Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report completed in 2007 stated that the evidence of climate change caused by human generated greenhouse gas (GHG) emissions is "unequivocal." The chief concern is that even if we were to stop emissions of GHG today, the effects of those gases already in the atmosphere, especially long-lived carbon dioxide (CO_2), would continue the warming process for decades if not a century or more. But we have not stopped them. Indeed, CO_2 emissions continue to rise as we continue to be dependent on fossil fuels for 85% of global energy. Atmospheric CO_2 concentrations have risen from 280 parts per million (ppm) in 1850 to 385 ppm today. Global surface temperatures are now about 0.6^{o}C higher than the 1950-1980 average, and fourteen of the warmest years since 1880 have occurred in the past 18 years since 1990.

Our current dependence on fossil fuels for energy means that CO_2 concentrations will continue to rise. At our current rate, concentrations will reach double pre-industrial levels to 560 ppm by 2050. The IPCC's consensus indicates that a level of 450 ppm would be enough to raise global average temperature 2-4^{o}C, enough to trigger catastrophic impacts including sea level rise, widespread drought, extreme weather patterns, and ecological changes. To achieve this concentration, the IPCC consensus is that emissions must decline by 20-40% by 2020 and near zero by 2050. Many IPCC scientists believe these projections are conservative, and the problem is even more severe.

B. The Response

Clearly, the reduction of emissions of CO_2 and other GHG is essential to mitigate the impacts of climate change. The Bush administration has been reluctant to propose such emission reductions arguing that they would be too costly to the U.S. economy. But as 64 California economists,

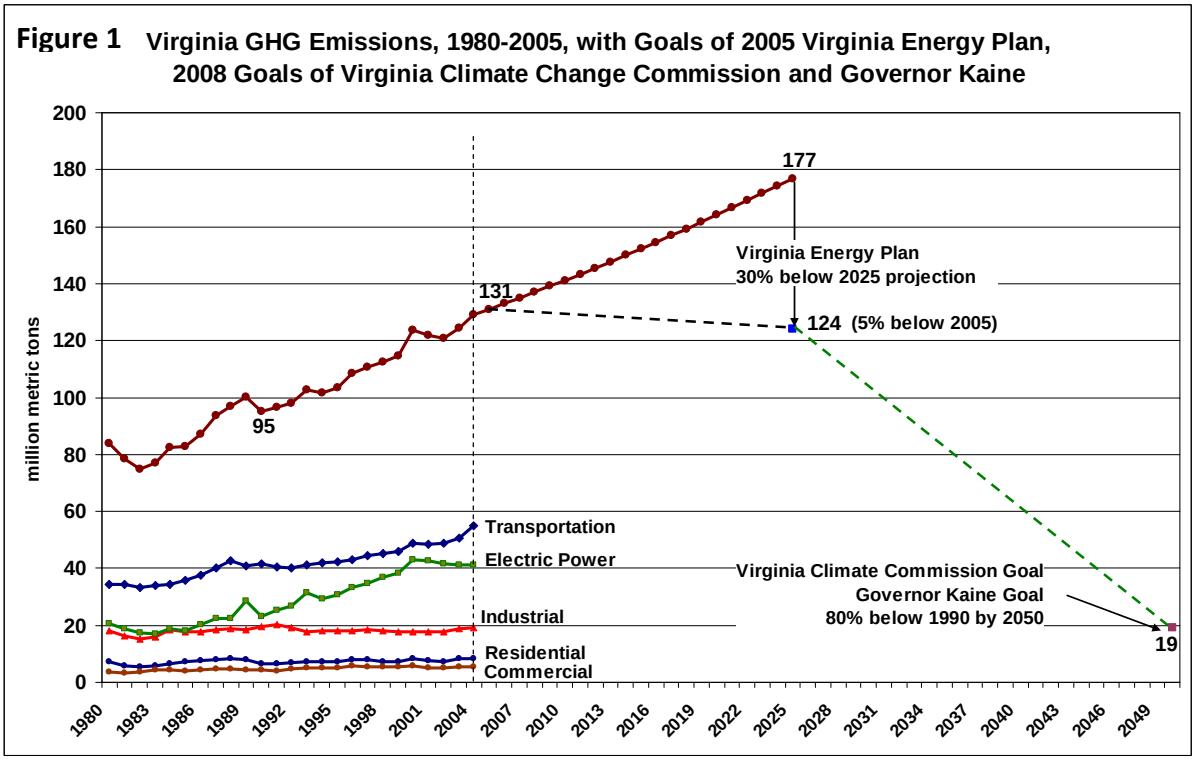
including three Nobel Prize winners, wrote to the California governor and legislature in 2005, "The most expensive thing we can do is nothing." They argued we need to invest in emissions reductions today to avoid catastrophic economic, social, and environmental costs later.

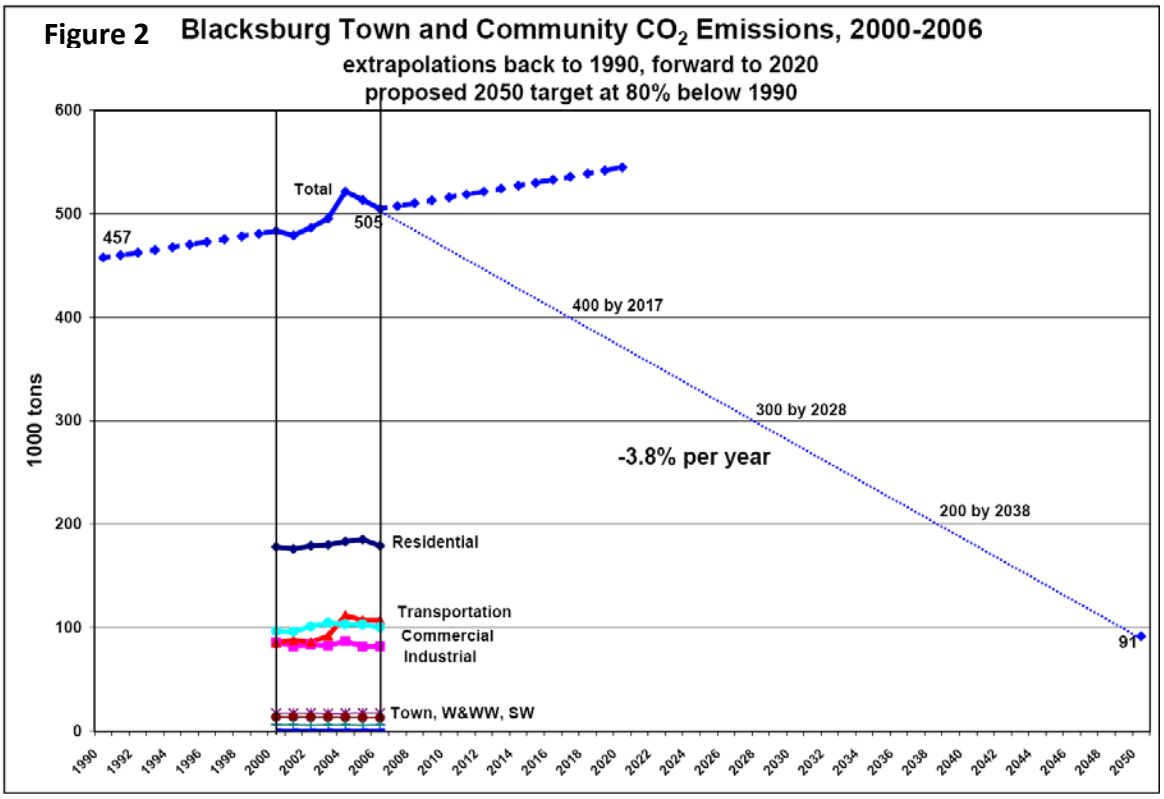
Although the U.S. federal government has not yet to join the international community in addressing this issue through established mechanisms such as the Kyoto Protocol, this is likely to change with the Obama administration and bipartisan support for action. But many states, localities and universities in the U.S. have not waited for federal leadership and have forged ahead with GHG emission reduction plans of their own. Thirty-two states have developed climate action plans and five more (including Virginia) are developing them.

About 600 U.S. universities have signed the American Colleges and Universities Presidents Climate Commitment (PCC) to develop climate action plan to achieve climate neutrality (see **Appendix B**). About 1000 local governments, including the Town of Blacksburg, have signed the U.S. Mayors Climate Action Agreement and/or joined ICLEI—Local Government for Sustainability to develop plans to reduce emissions to below 1990 levels.

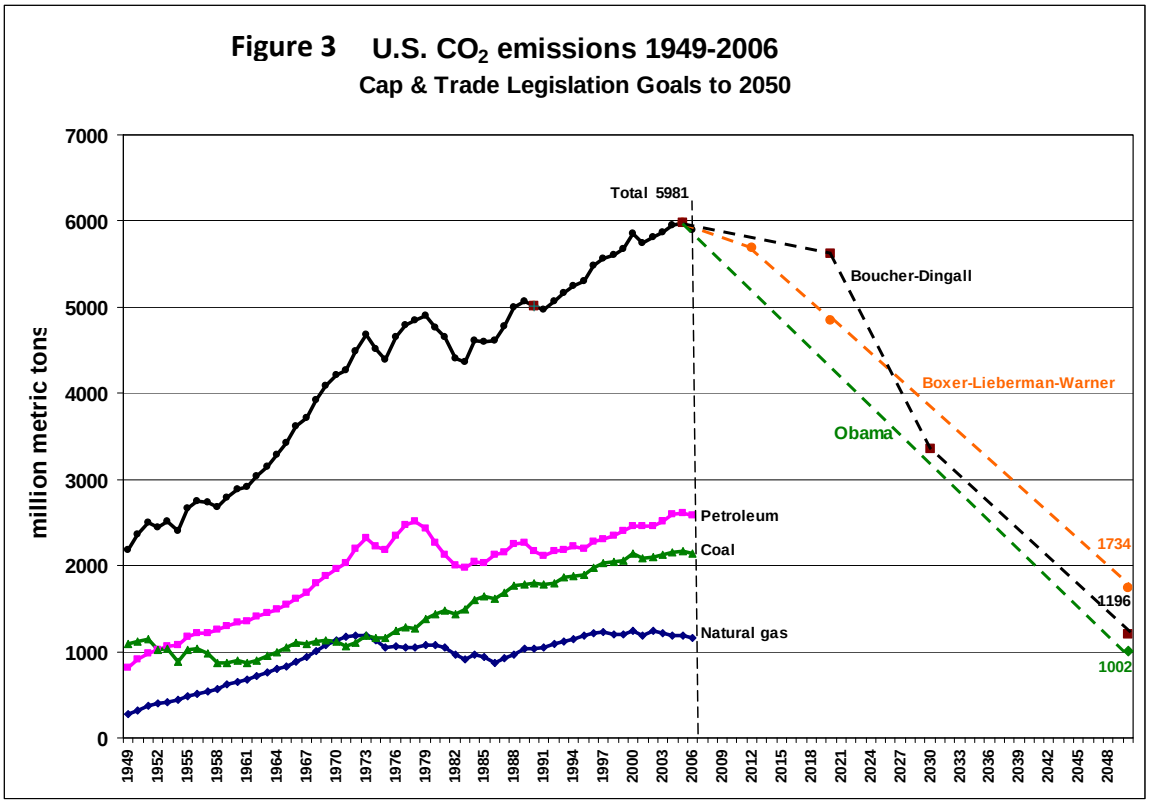
In the Commonwealth of Virginia, the Governor's Executive Order 48 (2007) requires that state agencies reduce their non-renewable energy costs by 20% of 2006 costs by 2010 (see Appendix C). The Virginia Energy Plan adopted in 2007 has a goal of achieving a 30% reduction of GHG emissions from projected 2025 levels, which amounts to maintaining about 2005 emissions through 2025. In December 2008 the Virginia Governor's Commission on Climate Change finalized 100 recommendations to meet that target, but it also adopted a goal of 80% of GHG emissions below 1990 levels by 2050. Governor Kaine has adopted this 80% goal. This target is common for states and communities which have adopted climate action plans. See **Figure 1**.

Figure 1 **Virginia GHG Emissions, 1980-2005, with Goals of 2005 Virginia Energy Plan, 2008 Goals of Virginia Climate Change Commission and Governor Kaine**





The Town of Blacksburg has adopted the 80% goal for town operations and the community not including the university (see **Figure 2**). At the federal level, there are several proposed climate change bills, including the Boucher-Dingell bill which includes that same goal of 80% reduction below 1990 levels by 2050. President Obama's campaign energy plan includes mandatory reduction to that level. National and state policies to achieve these goals will likely increase the costs of carbon-based energy significantly (see **Figure 3**).



C. The Solutions

Achieving these goals will require fundamental changes in our patterns of energy use. For communities and universities, these changes include reducing and replacing carbon-based fuels through:

1. Energy efficiency improvements, including investments in buildings (high-efficiency heating and cooling systems, lighting, and equipment), efficient vehicles and transportation systems, and compact and infill development patterns to enhance non-motorized transport and transit.
2. Energy conservation to reduce energy waste, including heating and cooling system operations and energy conserving behavior.
3. Transition from carbon-based to low and non-carbon energy sources, such as converting from coal to natural gas, from fossil fuels to renewable sources, from centralized coal electricity to local distributed efficient and renewable electricity systems.
4. Measures to procure low life-cycle cost products, to recycle materials, and to reduce water, wastewater, and landfill waste, all of which save energy and GHG emissions.
5. Expanding tree canopy and soil conservation since vegetation and soils absorb and hold CO_2 and thus can offset carbon emissions.

For universities, these solutions also include:

1. Educating students and the public for a future of climate change.
2. Developing new knowledge and technologies to mitigate and adapt to climate change.

With the cost of energy increasing, these smart efficiency investments and conservation practices can also save considerable money and create additional social and environmental benefits. Developing capacity for instruction and learning, outreach and engagement, and research and discovery in energy and environmental technologies can also position the university to compete for expected federal and foundation funding of green technology and workforce training.

D. The university as a model for society and the campus sustainability movement

Universities have long served as a source of new knowledge and a testing ground for progressive change in society, including, for example, free speech, racial integration, multiculturalism, and social tolerance. With regard to sustainability and climate change, universities are an appropriate source of new ideas and approaches to create sustainable campuses that serve as models for society and a source of cultural change.

More than 600 universities agree and have signed the American Colleges and Universities Presidents Climate Commitment (PCC). By signing the PCC, each university president commits to developing climate action plans to achieve “climate neutrality” by a target date determined by the university. The PCC is given in **Appendix B** and **Table 1**.

E. President Steger’s charge to the University

On December 10, 2007, President Steger met with members of the Environmental Coalition (EC), a student group heavily involved in campus sustainability. The EC strongly urged the President to sign the American Colleges and Universities Presidents Climate Commitment (PCC).

After considerable deliberation, President Steger wrote the EC on April 23, 2008 with his decision not to sign the PCC, but rather to develop a Virginia Tech Climate Commitment specific to the conditions of the university. On April 25, 2008, he charged the Virginia Tech Energy and Sustainability Committee (ESC) to develop the VT Climate Commitment and a sustainability plan to achieve it. He asked that the commitment and plan be drafted by the end of fall semester 2008 and that it be advanced through university governance during spring semester 2009 to ensure full consideration and buy-in by the university community. His letters to the Environmental Coalition and ESC are shown in **Appendix A**.

F. Process for developing the Virginia Tech Climate Action Commitment and Sustainability Plan

The Energy and Sustainability Committee (ESC) was established in April 2007 and the current membership is shown in **Appendix D**. The ESC further established a subcommittee to develop the Virginia Tech Climate Action Commitment and Sustainability Plan (VTCAC&SP). The current membership is shown in **Appendix E**. The VTCAC Subcommittee has broad campus representation and met nine times from May 2008 through the 2008 Fall Semester. Five work groups were established to address priority topics and recommend action measures for the plan. The five groups addressed facilities, campus planning, LEED certification, transportation, and renewable energy. The subcommittee also addressed campus life, including dining and residence halls, and academic programs. In addition, a fall semester environmental planning studio in Urban Affairs and Planning provided independent assessments for the campus climate action plan and conducted a campus workshop to get input from students, staff and faculty during Sustainability Week 2008. That workshop and the results are described in **Appendix F**.

The Committee intends to shepherd the acceptance of the plan through governance during spring 2009. As most university plans, it will not constitute policy, although it is likely to prompt specific resolutions and policies that will be addressed in university governance procedures.

II. Constraints and Obstacles to achieving Climate Neutrality

A point of departure for the Virginia Tech Climate Action Commitment (VTCAC) is the Presidents Climate Commitment (PCC) shown in **Appendix B**. It is useful at the outset to describe the latter commitment, assess Virginia Tech's progress toward the PCC, and identify constraints and obstacles to achieving the requirements of the PCC. **Table 1** lists the requirements of the PCC and the related measures already taken at Virginia Tech, as well as those measures proposed by the VTCAC.

Existing programs and measures and simple proposals from the VTCAC place the university in compliance with the PCC with the exception of the commitment to *climate neutrality* by a specific date. One goal of the VTCAC is to reconcile this issue for Virginia Tech. However, there are several obstacles and constraints that stand in the way of doing so.

A. Physical plant infrastructure, electricity and fuels

Like many campuses, Virginia Tech is blessed with several **old buildings** that define the character and culture of the university but are energy hogs. Many lack operational controls.

These old buildings would be costly to retrofit. Some buildings, including housing, dining, The Inn, and athletics, are managed outside of the control of central Facilities Services and energy improvement would require full engagement of those units.

Table 1. Comparing PCC requirements to VTCAC

Presidents Climate Commitment	Virginia Tech Climate Action Commitment
Setting up a mechanism (committee, task force, office, etc.) within 2 months to guide the process.	**Yes:** *existing* E&SC and VTCAC Subcommittee set up in formal university governance. (VTCAC *proposes* Office of Sustainability)
Completing an inventory of greenhouse gas emissions within 1 year.	**Yes:** *completed* March 2008
Creating and implementing a climate neutral plan (that includes a target date and interim milestones for achieving campus climate neutrality) within 2 years.	**No:** VTCAC plan *completed* by 5/2009: goal of reduction of GHG emissions to 80% below 1990 levels by 2050. Carbon neutrality goal awaits assessment of progress.
The plan should include actions to expand research or other efforts necessary to achieve climate neutrality.	**Yes:** *existing* progress: Off. for Research Special Asst. Energy, and Deans Forums on Energy and Environment
The plan should include actions to Integrate sustainability into the curriculum and making it part of the educational experience.	**Yes:** significant progress and VTCAC *proposed* OVPUS and Grad School Special Asst. for Sustainability Curricula
The plan should include mechanisms for tracking progress on goals and actions.	**Yes*:** *proposed* annual progress report, systematic data inventory through Facilities
The action plan, inventory and periodic progress reports should be publicly available through AASHE	**Yes*:** *proposed* posting plan and inventory with AASHE
Taking 2 of the following 7 immediate steps specified in the commitment to reduce greenhouse gas emissions while the more comprehensive plan is being developed.	**Virginia Tech has accomplished or would with this VTCAC&SP**
1. 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.	**Yes*:** *existing* goal for LEED silver <u>equivalent</u> for new buildings. (VTCAC *proposed* LEED silver <u>requirement</u>.)
2. Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist.	**Yes:** University practice to purchase ENERGY STAR equipment. (VTCAC *proposed* requirement for ENERGY STAR.)
3. Establish a policy of offsetting all greenhouse gas emissions generated by air travel paid for by our institution.	**No**
4. Encourage use of and provide access to public transportation for all faculty, staff, students and visitors at our institution.	**Yes:** *existing* Alternative Transportation Program provides incentives and access
5. Within one year of signing this document, begin purchasing or producing at least 15% of our institution's electricity consumption from renewable sources.	**No**
6. Establish a policy or a committee that supports climate and sustainability shareholder proposals at companies where our institution's endowment is invested.	**No**
7. Participate in the Waste Minimization component of the national RecycleMania competition, and adopt 3 or more associated measures to reduce waste.	**Yes:** *existing* participation in RecycleMania. (VTCAC *proposed* adoption of 4 or more waste reduction measures.)

* with adoption of policy recommendations in this VTCAC

The university has an **old coal boiler infrastructure** dictated by economics (historically low coal prices) and policy (state mandates). Through the years, the boilers have been upgraded to improve efficiency and meet air pollution emission requirements. The boilers feed an **old steam distribution system** that also has undergone periodic upgrades to improve efficiency and extensions to serve the expanding campus. Fundamental changes to switch fuels and increase efficiency are very costly.

Campus air conditioning provided by the **chiller system** is a haphazard combination of central and distributed units brought about by incremental growth of the campus and building-specific capital funding. Retrofit measures to improve the chiller infrastructure are more costly than planning for central and interconnected systems up front.

Virginia Tech is served by Virginia Tech Electric Service (VTES) which also serves the older part of Blacksburg. Although the campus coal and gas boilers have cogeneration units that provide about 6% of VTES's distributed electricity to campus and the Town, VTES purchases the remainder from American Electric Power (AEP) through its regional subsidiary Appalachian Power Company (APCo). AEP depends on its coal-fired generating units in Ohio, West Virginia, and Virginia for 85-90% of its electricity. As we will see in the campus GHG inventory in section IV, this **coal-based electricity** accounts for 2/3 of Virginia Tech GHG emissions. The university's dependence on this electricity source is a major barrier to achieving climate neutrality.

B. User behavior

While much of the energy use and carbon emissions on campus are fixed by its physical infrastructure, discretionary behavior by the users of that infrastructure also affects energy consumption, recycling rates, and paper and material consumption. Users include students living and dining on campus, commuting students, and faculty and staff commuting to and working on campus. Education campaigns can affect user behavior but the effectiveness of these efforts is difficult to assess.

C. Institutional constraints

Limited operating and capital budgets in this period of state budget reductions are significant barriers to investments in efficiency and carbon emission reduction. Even those investments with a very high economic return will be difficult to fund with all university units facing budget cuts.

Even with sufficient funds, **budgetary procedures** constrain effective life-cycle cost decisions related to major efficiency investments in new and renovated buildings and infrastructure systems.

1. Capital budgets are generally separate from operating costs, so even when a small initial investment will save considerable long term operating expenses, it is hard to justify under limited capital budgets especially with competing amenity demands and cost overruns.
2. Capital budgets are often so project specific that they do not allow allocations for more efficient centralized utilities like chillers that serve multiple projects, and thus promote less efficient self-contained units.

Contractual arrangements with energy providers including AEP may inhibit new opportunities for both efficiency and load management improvements and lower carbon energy sources. For example, in 2007, the University and APCo agreed to a 20-year contract that stipulates that VT generation facilities will not be operated "in a manner designed primarily to reduce its peak demand or load…no adjustment will be made to metered values to determine…Billing Demand or Billing Energy."

Finally, **State rules** on procurement of materials and equipment (e.g. U.S. auto-maker vehicles only) and accounting procedures often inhibit least-cost life-cycle decisions.

III. Guiding Principles and Assumptions

It is useful to cite some of the guiding principles and assumptions used in developing the plan.

A. Future Energy: The world of energy around us is likely to change

Count on higher energy prices. We have seen volatile energy prices in the past two years, including petroleum fuels, coal, natural gas, and electricity. The university's price for coal has tripled in price, gasoline has been up and down, and in November 2008, the State Corporation Commission approved a 17% increase in APCo electricity rates. Even before this rate increase, the university's electricity costs increased 59% from $7.2 in FY2004 to $11.5 million in FY2008.

This pattern of rapidly increasing energy prices is expected for the future. The Obama administration and Congress are likely to enact a carbon cap and trade system designed to reduce carbon emissions (see **Figure 3**), and this will further increase coal prices and coal-based electricity.

Shift to low- and non-carbon energy. Higher energy prices will increase the return on investments made in energy efficiency: every kilowatt-hour (kWh) and every ton of coal saved will save more money. This higher rate of return will justify more investment in efficiency. And these higher energy prices, combined with increased government incentives for non-carbon energy, will make renewable energy like solar and wind energy more competitive.

Other proposed government policies, including higher efficiency vehicles, building efficiency standards, carbon capture and storage from coal power plants, and renewable portfolio standards (RPS) (that will push utilities like APCo to increase their proportional generation from wind, solar, and hydro), will act to reduce Virginia Tech carbon emissions no matter what we do.

For example, Governor Kaine and his Commission on Climate Change have endorsed a reduction of state GHG emissions to 80% below 1900 levels by 2050. In December 2008, the Virginia Division of Engineering and Buildings issued new requirements for new state buildings and major renovations of existing buildings. The directive requires LEED certification and a 30% energy efficiency improvement over existing standards (see part IV).

The Obama energy plan also calls for mandatory reduction of GHG emissions to 80% below 1990 levels by 2050; incentives for solar, wind and plug-in vehicles; and a 25% renewable portfolio standard. We can build on these changing energy conditions around us and make further gains.

B. We should build on current actions and successes

In the sections that follow we describe not only recommendations for future actions but also actions already taken. We build the plan on the substantial efforts and momentum for enhanced sustainability of our campus provided by student organizations, facilities management, and academic units. For example:

- We have improved our Sustainable Endowments Institute Campus Sustainability Report Card grade from a *C*- in 2008 to a *B*- in 2009 (one of 33 universities out of 200 evaluated to increase their overall grade by at least one full letter). Transportation and Student Involvement received grades of *A* (see **Appendix G**).
- Eighteen student organizations are now part of the Coalition for Campus Sustainability.
- Facilities management is making a number of initiatives for smart investments and modifications of operations to save money, energy, and carbon emissions.
- Housing and dining services, central purchasing, and campus planning are integrating sustainability criteria in their programs.
- Virginia Tech has very strong academic and research programs in energy and environment, as demonstrated by the Deans Forums on energy and environment.

C. The Plan focuses on six action categories

The Virginia Tech Climate Action Commitment and Sustainability Plan focuses on six action categories that are explored in separate sections of this report. They include:

1. **Administrative Structure and Governance**
2. **Facilities Infrastructure**
    - **a.** The Central Steam and Power Plant and Steam Distribution System
    - **b.** Virginia Tech Utilities, Virginia Tech Electric Services (VTES)
    - **c.** The Chiller System
    - **d.** New and Renovated Buildings
    - **e.** Existing Buildings
    - **f.** Campus Planning, Landscaping and Grounds.
3. **Facilities operations**
    - **a.** Thermostat settings, Air Handling, and Chiller Operations
    - **b.** VT Recycling
    - **c.** Smart Procurement
4. **Transportation**
    - **a.** Alternative Transportation Program
    - **b.** Telecommuting and Flexible Work Schedules
    - **c.** Local and Regional Transit
    - **d.** Parking Services
    - **e.** Fleet Services
5. **Behavior and campus life**
    - a. Student Culture and Engagement
    - **b.** Faculty and Staff Engagement
    - **c.** Housing Services and Residence Life
    - **d.** Dining Services
    - **e.** University Unions and Student Activities (UUSA)
    - **f.** The Inn at Virginia Tech and Skelton Conference Center
    - **g.** Athletic Department

6. **Academic programs**
    - **a.** Instruction and Learning
    - **b.** Research and Discovery
    - **c.** Outreach and Engagement

D. Action strategies should develop and rely on internal expertise

Developing expertise for sustainability and climate protection among university staff, faculty, and students will build experience and contribute to a culture of sustainability on campus. Such expertise can help lower implementation costs and enhance return on investment. The campus can serve as a living laboratory for energy and climate protection research.

E. Action strategies should include immediate as well as long term measures

By its nature, the plan has a long time horizon since climate action and sustainability are long term issues that will not be addressed overnight. The plan includes prospective actions in three times periods:

1. Immediate: 0-3 years (2009-2012)
2. Midterm: 4-16 years (2013-2025)
3. Long term: 17-41 years (2026-2050)

F. Action strategies should be categorized by level of university control

Some action measures, such as facilities operation, are controlled by the university, but others have more limited university control because of constraints discussed in the previous section (e.g., behavior, infrastructure, state rules and policies). Still other actions and factors outside of university control (e.g., AEP energy sources, federal energy policy) may have significant impact on university carbon emissions. It is useful to focus on those actions the university controls, but also consider the effects of changing external conditions it does not control.

G. Action strategies should be evaluated based on measurable outcomes

As much as possible, proposed action strategies should be judged on their measurable impacts, including economic return on investment, impacts on productivity and learning, energy and emissions reduction, and university reputation and visibility, among other criteria. The plan should **package action measures** to maximize net benefits based on a range of outcome criteria. For example, measures with zero- and low-cost/high economic return should be packaged with moderate cost/moderate economic return actions that have significant benefits in other criteria to achieve positive economic return overall, justify moderate cost options, and achieve non-economic benefits.

IV. Virginia Tech Greenhouse Gas Emission Inventory

A. Blacksburg and Virginia Tech GHG inventory 2000-2006

In 2007, students in Urban Affairs & Planning at Virginia Tech conducted an energy and greenhouse gas (GHG) inventory for the Town of Blacksburg and Virginia Tech (Pitt and Randolph, 2008). The inventory was based on data provided by energy suppliers and energy use data from the university and the Town. Transportation energy and emissions data were derived from vehicle miles travelled data based on vehicle counts within the Town limits using ICLEI software designed for that purpose. **Figure 4** gives the 2006 end-use energy sources and consuming sectors for Blacksburg as a whole. Of the 5 trillion BTUs used, 36% was electricity and 34% was used by Virginia Tech. We get 88% of our electricity from coal-fired steam generation which is not only inherently inefficient but also the most carbon-intensive fuel. As a result when we convert the end-use energy to CO_2 emissions, electricity becomes the source of 68% of the Town's emissions and the university contributes 281 kilotons or 35% as shown in **Figure 5**.

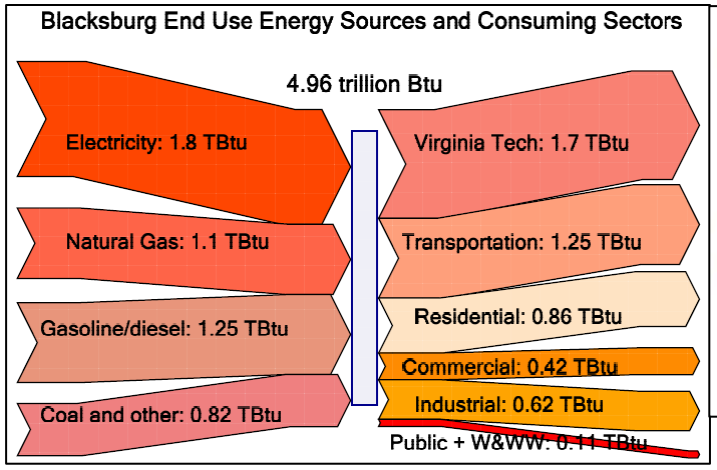


Figure 4. End use energy sources and sectors, 2006

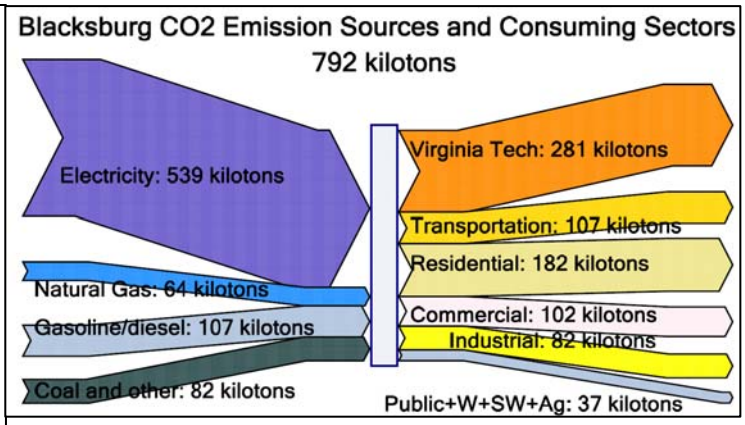


Figure 5. CO_2 emission sources and sectors, 2006

Figure 6 gives the emissions data by consuming sector from 2000 to 2006. Virginia Tech's emissions have grown by 24% since 2000 (3.7% per year), while all other sectors in Town have been flat.

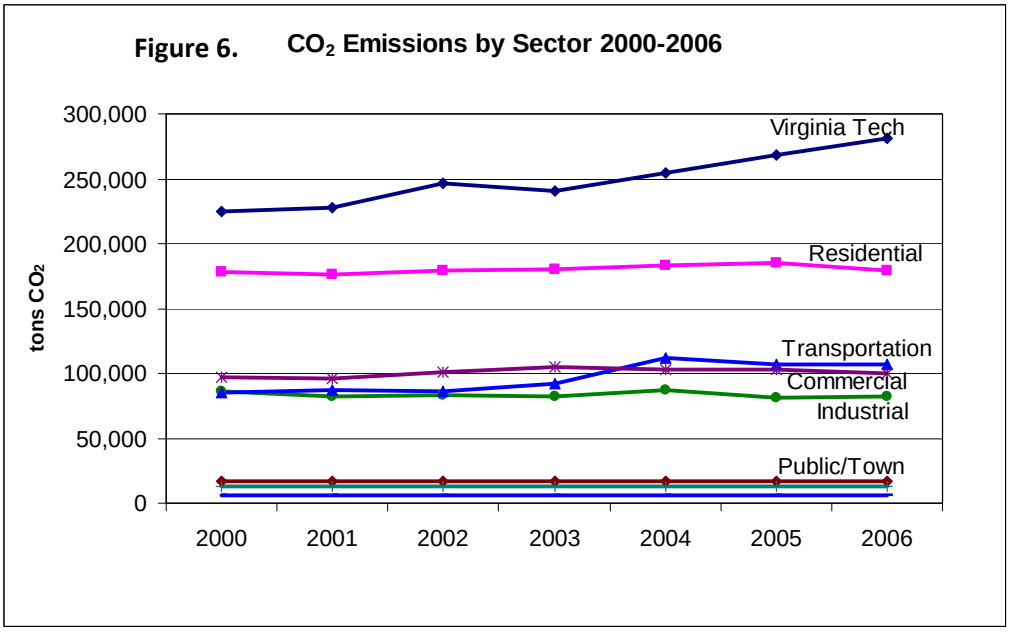


Figure 7 gives a flow diagram of campus energy use by Virginia Tech from source on the left to end use on the right. Included in this energy is the electricity purchased by the university from AEP/APCo and sold by Virginia Tech Electric Service (VTES) to customers in the Town. VTES essentially operates as a municipal utility for about half of the Town's electric customers. About 1/3 of all energy used on campus comes each from electricity, natural gas and coal. But as shown in **Figure 9**, the proportion of GHG emissions is far different. **Figure 8** shows the growth of emissions by energy source from 2000 to 2006.

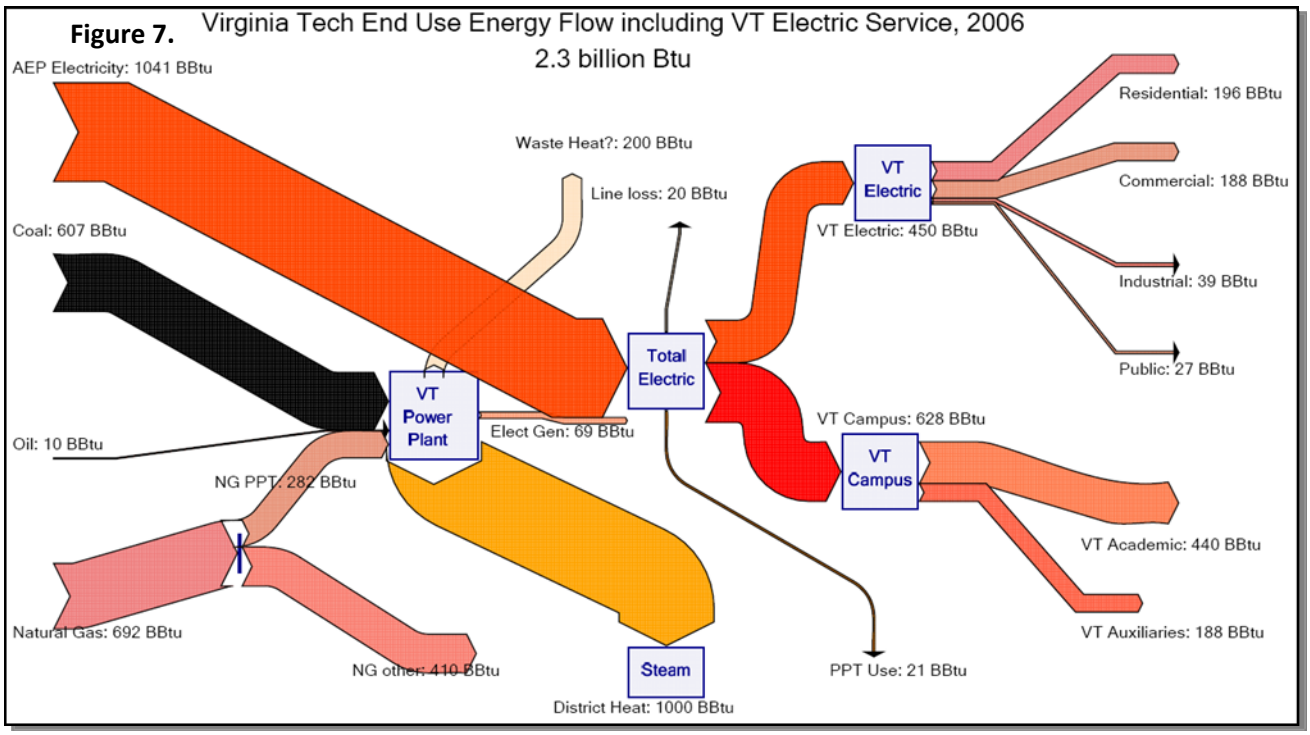


Figure 9 breaks down the university's 2006 GHG emissions by energy source including transportation and employee/student commuting (assumed at 25% of all Blacksburg VMT). Although coal, natural gas and electricity each made up about 1/3 of campus end-use energy, electricity contributed 60%, coal 21%, natural gas 8%, and commuting 8% of the total **316,000 tons** of CO_2 emissions. The rest came from solid waste (1%), water/wastewater (0.9%), VT fleet (0.6%), and VT aviation (0.3%).

Figure 8. Virginia Tech campus GHG emissions, 2000-2006

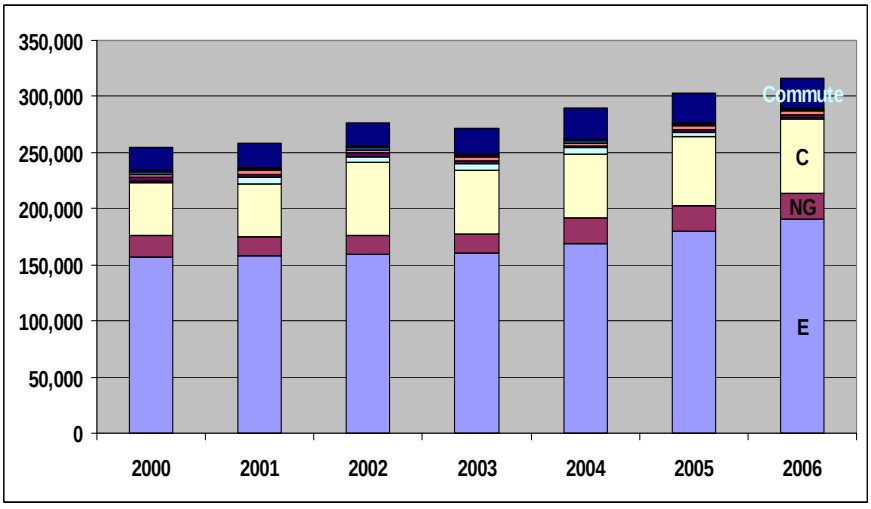
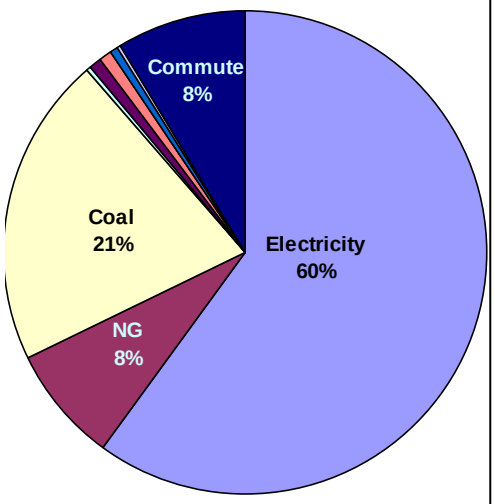


Figure 9. 2006 VT campus GHG emissions



The Virginia Tech central power plant is a cogeneration system that produces steam for the campus district heating system and also generates electricity. However, as shown in **Figure 10**, the amount generated is only a small amount of the total VTES electricity (about 6%) and of campus electricity (11%). Any additional on-campus generation is a good thing because it offsets more costly AEP/APCo purchases per kWh and reduces overall emissions. **Figure 10** also shows the steady growth in VTES electricity from 1990 to 2006, a 50% increase in that period.

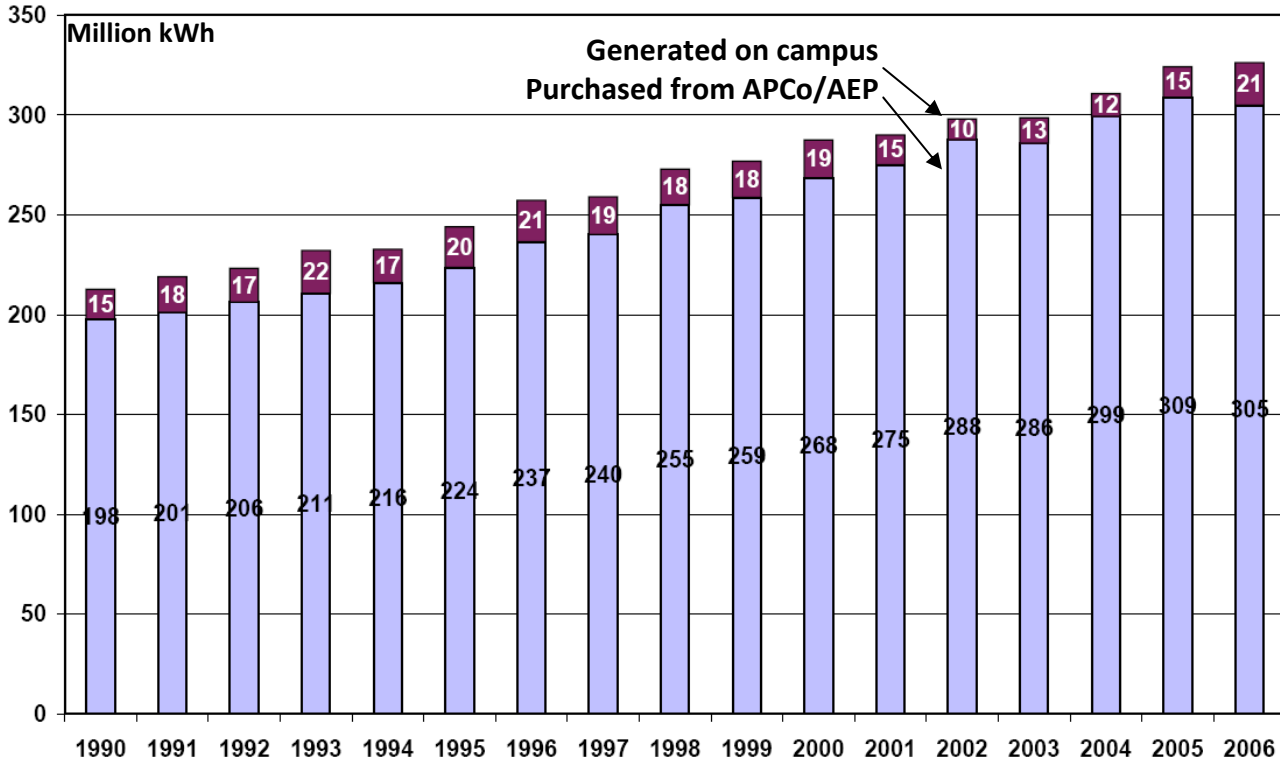


Figure 10. Virginia Tech Electric Service electricity sales to Campus & Town, 1990-2006

The distribution of electricity to campus functions is highlighted in **Figures 11 and 12**. Campus E&G buildings (including chillers) use about 2/3 of all electricity, primary auxiliaries residence (9%) and dining (6%) halls and athletic facilities (5%) use about 20%, and the power plant uses about 3%. Note the three-fold growth in athletic facilities electricity from 2000 to 2006.

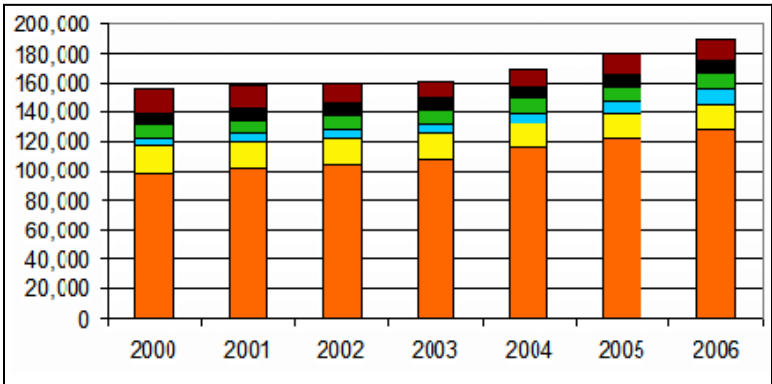


Figure 11. Campus Electricity Use, 2000-2006

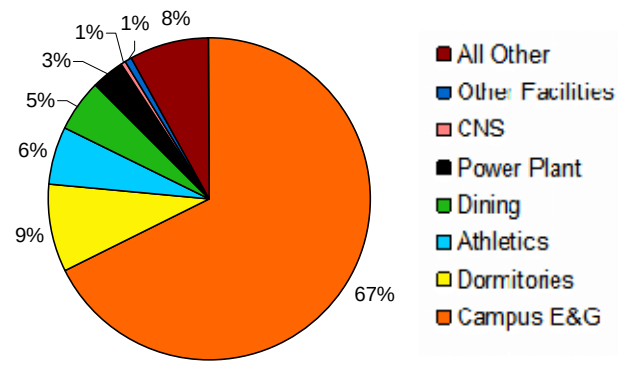
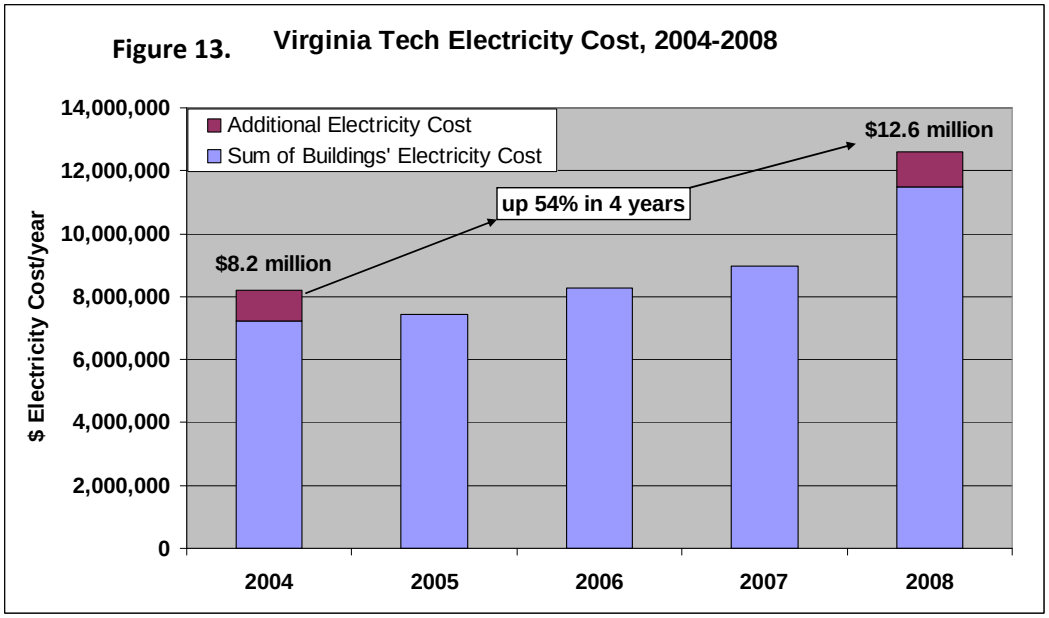
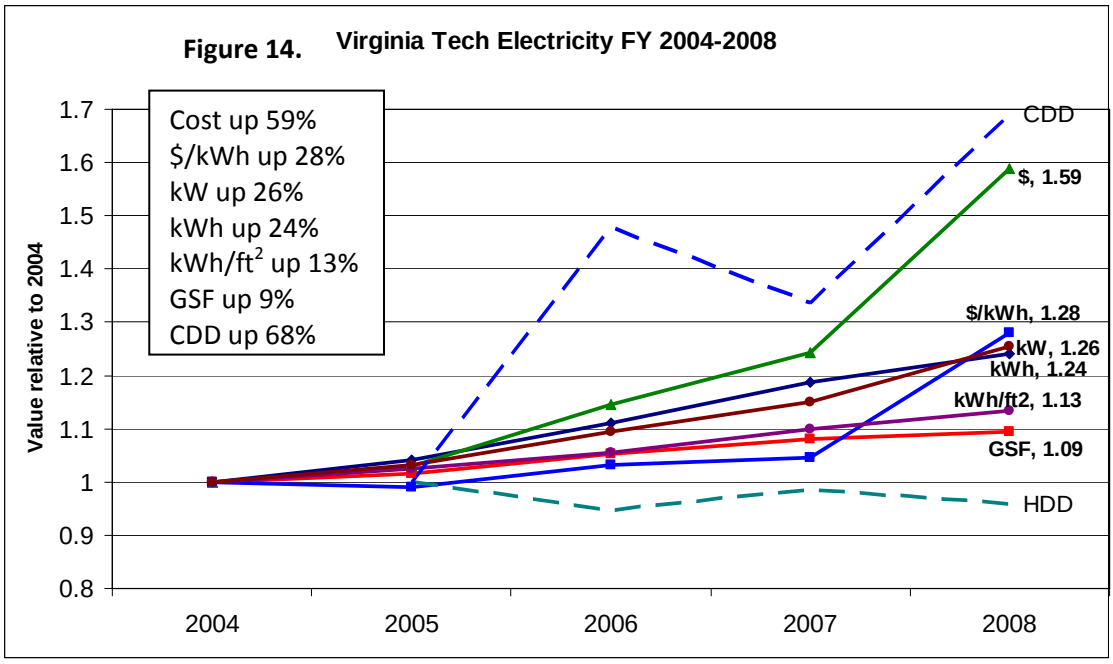


Figure 12. Campus Electricity, 2006

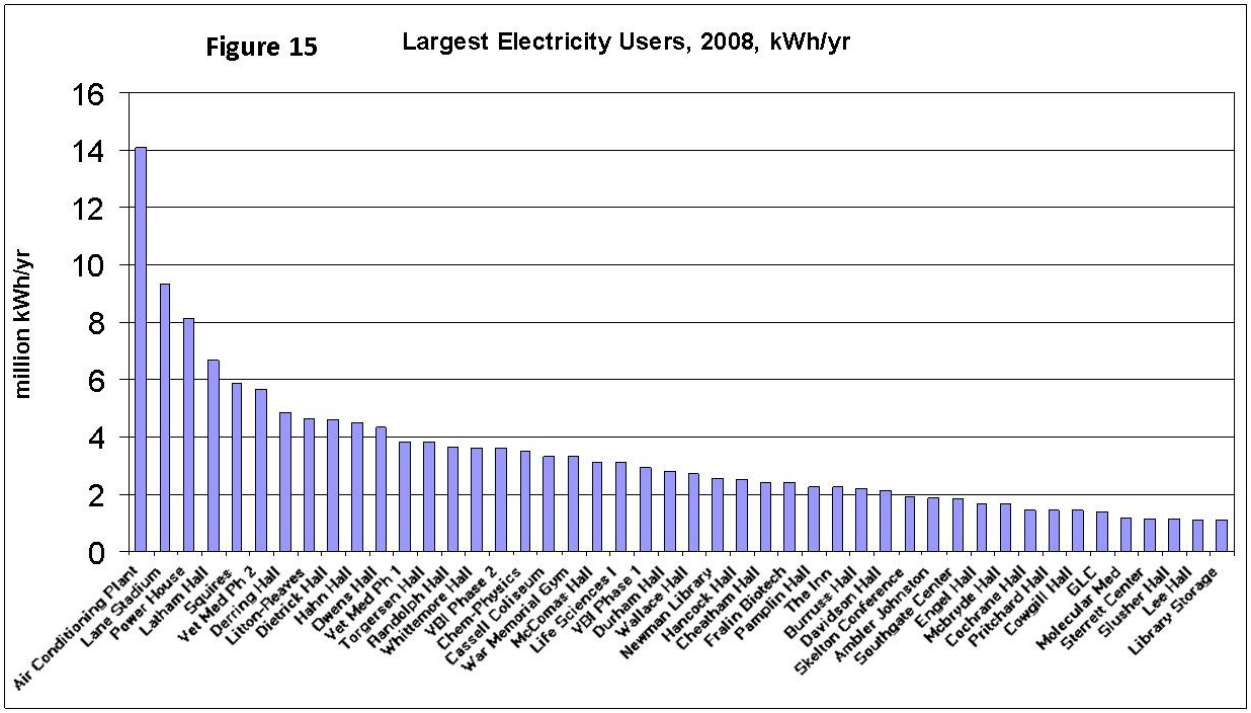
B. Virginia Tech electricity use, 2004-2008

The GHG inventory made clear that electricity use is the source of 2/3 of the GHG emissions on campus and that any effort to reduce emissions should probably start there. This section reviews facilities data on electricity use in buildings from FY2004 to FY2008. **Figure 13** shows the growth of total electricity cost in that period from $8.2 million in 2004 to $12.6 million in 2008, an increase of $4.4 million or 54**%! The imperative for the university to improve energy efficiency and reduce electricity use is more financial than environmental.** But the two imperatives are mutually beneficial. Several factors contributed to this increase: higher rates, more buildings, higher use per ft^2, and hotter weather. These are shown in **Figure 14** which uses the sum of all individual buildings data (for which costs rose from $7.2 to 11.5 million) and plots normalized values relative to 2004 for cost (up 59%), $/kWh (including demand charges) (up 28%), peak kW (up 26%), total kWh (up 24%), kWh/ft^2 (up 13%), gross ft^2 of building space (up 9%), as well as heating and cooling degree days (CDD). It should be noted that GHG emissions are driven by kWh but costs are driven by both kWh energy and KW peak power demand. About 45% of the campus electricity bill is from peak demand charges.

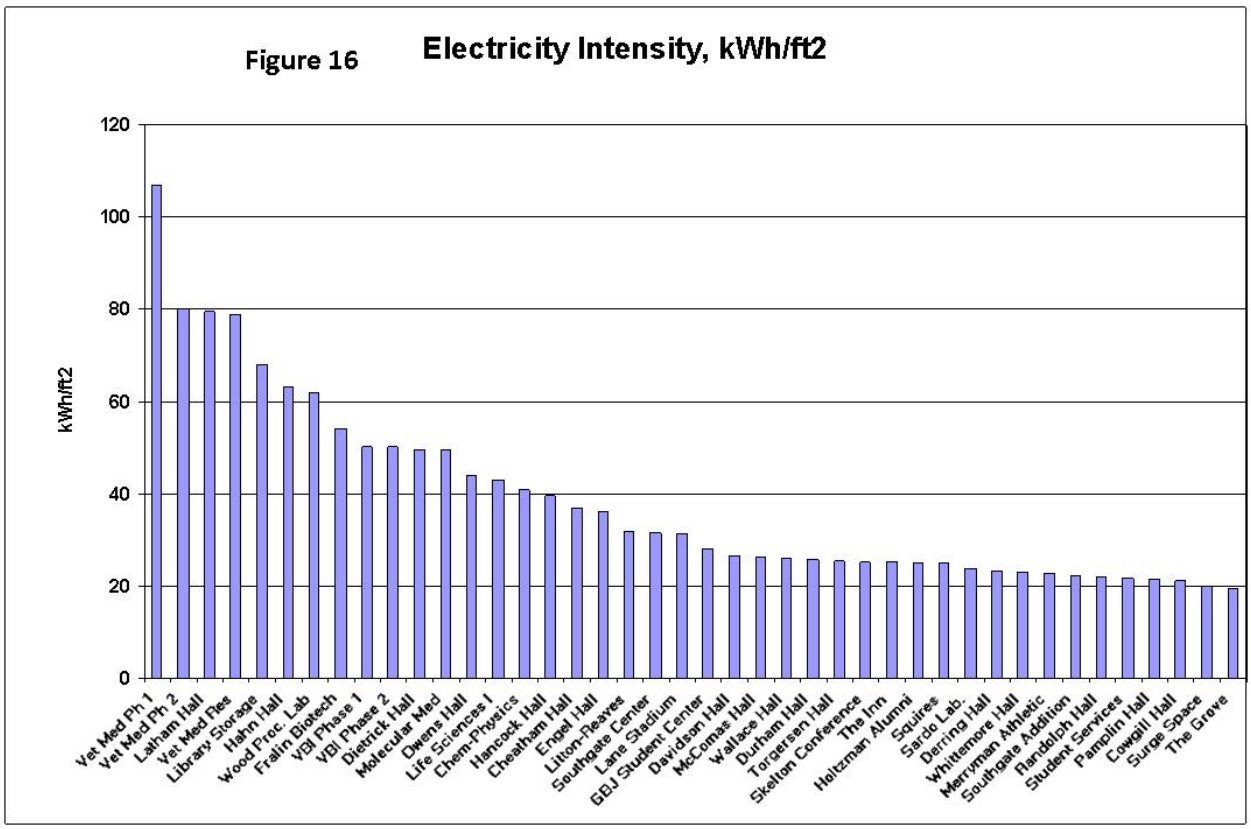




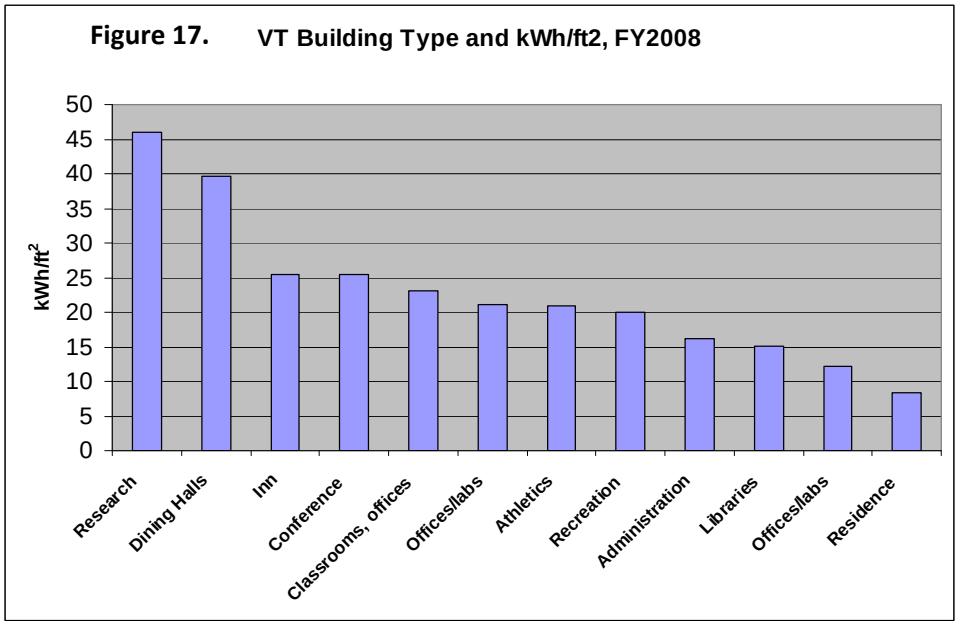
Figures 15-16 compare electricity use in specific buildings for FY2008. **Figure 15** gives the largest electricity users on campus. The central chiller air conditioning plant and power house rank first and third, and Lane Stadium ranks second. One of our newest buildings Latham Hall ranks fourth.



But a better comparison is electricity use intensity or kWh/ft2 of floor area. **Figure 16** shows that life and physical science buildings including the Vet School, Latham Hall, Hahn Hall, Fralin Biotech Center, VBI 1&2, Molecular Med, Life Sciences 1, and Chem-Physics constitute 11 of the 14 most electricity intensive buildings on campus. Dietrick and Owens dining halls rank 11 and 13.

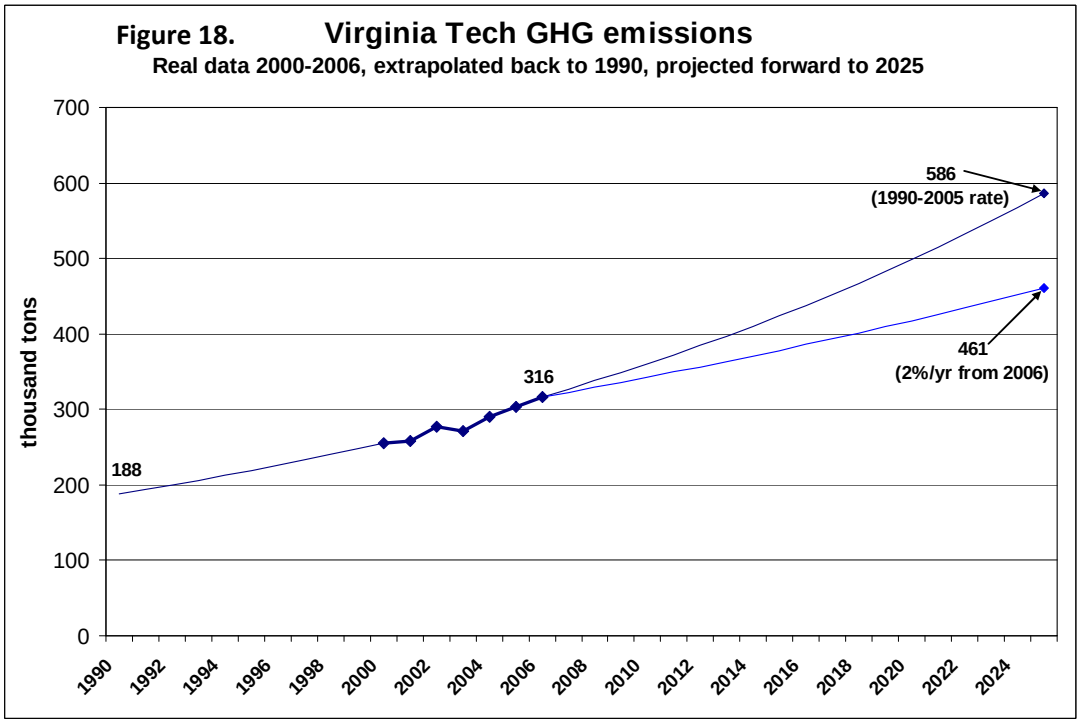


Some of these high use buildings have self-contained chillers. Their electricity use includes air conditioning load, so they would be expected to have greater electricity demand than buildings served by the central chiller. **Figure 17** plots electricity intensity for different catagories of buildings. Given **Figure 16**, it is not surprising that research and dining halls are very high relative to classrooms, offices and other buildings on campus. Residence halls have the lowest kWh use per ft^2.



C. Trends and Business-As-Usual Scenario

Recent growth in Virginia Tech energy and electricity use and related GHG emissions does not bode well for the future. If we project this growth trend into the future we would get two "business-as-usual" scenarios shown in **Figure 18**. These represent a 45-85% increase in GHG emissions by 2025 that would not only pose a poor environmental image of the university, but the financial energy costs associated with this scenario would have significant impacts on the university's budget and its programs.



V. Administrative Structure and Governance

A. History and current status

During the past two decades, the university has made attempts to better coordinate its environmental programs. Most of these efforts have focused on instructional and research programs, and few resulted in any substantive centralized direction of sustainability-related university activities until very recently.

An exception was in the early 1990s, when President James McComas, Provost Fred Carlisle, and Engineering Dean Wayne Clough provided leadership to enhance VT's environmental programs:

1. President McComas took the Talloires Declaration to the Virginia University Presidents' Council and got them to sign collectively. The declaration is a ten-point action plan for incorporating sustainability and environmental literacy in teaching, research, operations and outreach at colleges and universities. It has been signed by over 350 university presidents and chancellors in over 40 countries[1]. The Declaration is given in **Appendix H**.
2. Carlisle established the position of special assistant to the Provost for environmental programs. Under this position, David Conn formed several committees on degrees and minors, environmental literacy, research, and campus as an environmental model. This latter committee was not very successful in advancing campus sustainability due to other priorities. When Carlisle stepped down as Provost, so did the commitment to this initiative.
3. Clough established the Green Engineering program and provided faculty development support for faculty to integrate environmental considerations into the curriculum. Support for the program diminished after Clough's departure, but the program continues as a university minor and student interest has increased substantially in 2008.

Commitment to these initiatives waned in the late 1990s as a result of changed leadership, other priorities, and budget cuts after 2000. But by 2006, conditions changed and a new campus push to address sustainability issues has emerged. Prompted by a growing national movement for sustainability, increased student activism and a 2006 student proposal for a "green fee" paid by students to fund campus sustainability programs, rising energy costs, and greater attention to the role of universities in addressing climate change, several initiatives have occurred.

1. The Alternative Transportation Manager became a full-time position under the Director of Transportation and Campus Services, Office of the Associate Vice President for Facilities Services.
2. In April 2007, the Energy and Sustainability Committee was established within the university governance system. The Committee reports to the Commission on University Support which further reports to the University Council.
3. In September 2007, the Energy and Sustainability Coordinator position was created under the Associate Vice President for Facilities Services. The position was subsequently renamed Sustainability Program Manager.
4. Budget cuts in 2002 eliminated funding for much of the Virginia Tech Recycling (VTR) Program. But in FY2007-08, funding was reinstated, and three additional full-time recycling positions were established to include an Operations Manager, a crew chief and worker.

[1] Curiously, the Talliores Declaration website shows that 22 of the 144 U.S. university signatories are Virginia institutions, including UVA, William & Mary, Old Dominion, VCU, GMU, JMU, Virginia State, Radford, and others, but Virginia Tech is **not** listed.

5. In February 2008, a new Associate Vice President for Facilities Services with a strong energy background was hired to oversee all energy matters, with reporting line to the Vice President for Administrative Services.
6. In 2008, Virginia Tech became a member of the American Association for Sustainability in Higher Education (AASHE).
7. In August 2008, a Dining Services Sustainability Coordinator position was created under the Director of Housing and Dining Services.
8. During 2007-08, student Intern part-time positions have worked for the Associate Vice President for Facilities Services, the Virginia Tech Recycling Coordinator, the Director of Transportation and Campus Services, and the Sustainability Program Manager.
9. The university has collaborated with Town of Blacksburg and Sustainable Blacksburg, a community organization, in a "Green Partnership" sponsoring Sustainability Week in October 2007 and 2008 and other community programs.

Some of these new positions are discussed further in later sections of this plan. Although these recent initiatives have helped position the university to better coordinate sustainability and climate issues, additional actions are recommended in this plan. Two foci of activity and coordination are needed: the first related to campus sustainability, the second related to academic programs.

B. Prospective Actions: Immediate (2009-12)

1. Create the Virginia Tech Office of Campus Sustainability

The Office of Campus Sustainability would serve as an information clearing-house, coordinating continuous discussion between the various administrative units, administrators, facility infrastructure and operational groups, and students. Campus sustainability must be holistic in nature and thus it must include academic units; student, faculty, and staff behaviors; and the facilities infrastructure and its operations. The Office of Sustainability should reflect these diverse interests and provide a clear path for these various interests to coordinate in the greater purpose of sustainability, and more specifically, the implementation of the *Virginia Tech Climate Action Commitment and Sustainability Plan*.

The formation of the Office of Sustainability would not result in a change in the chain of command for any and all administrative groups. The director of the Office of Sustainability would report to the Associate Vice President for Facilities Services because of the importance of facilities management in the implementation of the VTCAC plan, but he/she would also coordinate other university activities related to sustainability. This would create an efficient, centralized resource base to develop a continuous university-wide discussion and evaluation of Virginia's Tech climate action and sustainability programs. The director would channel policy initiatives through the Energy and Sustainability Committee.

Several direct benefits would result from the creation of the Office of Campus Sustainability (Office):

- The Office would assure a more effective implementation of the VTCAC, including overseeing the monitoring data and evaluating progress, and updating and revising the plan as new obstacles and advantages present themselves.
- The Office would promote Virginia Tech's sustainability efforts. This has begun with Virginia Tech's improving its grade in the *Sustainability Report Card*. This plan recommends that the university work to further **improve its current grade to A- within three years**. It also

recommends that the university become an **active member of the Association for Advancement of Sustainability in Higher Education (AASHE)** and play a more substantive role within the national movement toward greater campus sustainability.

- The Office would provide a centralized resource and discussion forum for all sustainability-related campus activities and help coordinate activities of various positions created and proposed in different university units, including Environmental Health & Safety, the Virginia Tech Recycling Coordinator, the Dining Services Sustainability Coordinator, the Alternative Transportation Manager, and Facilities Services personnel. Designated faculty and student groups would also participate in discussion forums and coordination directed by the Office.
- The Office would spearhead efforts to save energy and money through behavior of the campus community. While Facilities Services personnel will manage the technical improvements in infrastructure and operations, these will not be sufficient to achieve the goals of the plan. Energy use behavior will be a necessary component and this Office would provide the leadership for these initiatives.
- The Office would manage the **monitoring of campus energy use and GHG emissions** called for in implementing the *Virginia Tech Climate Action Commitment and Sustainability Plan*. This data and information are needed to assess progress and to implement various behavior programs. Student interns could be employed to work with Facilities Services personnel to gather this information.
- Working with academic departments and campus departments, the Office would coordinate a **student internship program** that would provide student service learning in various campus operations. Work could be arranged for academic internship, research credit or for pay.
- The Office would position the university for funding opportunities related to sustainable campus development.

Costs for the Office of Sustainability would not be significant since there is already funding for the University Sustainability Program Manager which would be folded into the Office. Other costs include staff support and support of student interns who would play an important role in working with various sustainability-related campus programs. Several funding options exist to cover the cost of this office. A student Green Fee, earmarked development funds, and the savings from energy efficient facilities are possible funding strategies. These are discussed below.

2. Assure that Virginia Tech is a signatory to the Talloires Declaration

Given James McComas legacy to the university and commitment to sustainability among Virginia universities, make sure Virginia Tech is included along with the 22 other Virginia universities that have signed the Talloires Declaration that promotes a ten point plan for building sustainability into instruction, research, outreach, and campus life.

3. Establish a Senior Fellow for Sustainability Programs or comparable position to develop and coordinate academic instruction, research, and outreach sustainability programs.

Virginia Tech has an impressive array of academic programs related to sustainability, but it continues to lack sufficient coordination to take advantage of growing instruction, research, and outreach opportunities in the sustainability field. A Senior Fellow reporting to the Provost or President could provide leadership for coordination, collaboration, fundraising, and new initiatives. This position could help establish coordinate the virtual Virginia Tech School of Sustainability

proposed in section X and work closely with academic colleges and departments, related research and outreach centers, and the offices of the vice presidents for undergraduate and graduate education, research, and outreach and international affairs.

4. Establish a *Sustainable Development Coordinator* in Office of Outreach

The Sustainable Development Coordinator would be drawn from existing faculty and would have a partial appointment to work with the Office of Outreach and International Affairs to coordinate sustainability outreach initiatives, professional education, and green workforce training programs. The position would be similar to the Energy Research Coordinators in the Office of Research. The position would work across the university coordinating and adding visibility to the large array of existing related outreach efforts and identify opportunities for new initiatives and grant prospects for funding them. Costs of the coordinator would include one course teaching release and a partial summer salary. This recommendation is discussed further in Section X, Academic Programs.

5. Funding mechanisms for Virginia Tech sustainability programs

It is difficult to envision large discretionary funds in this period of budget constraints. Therefore, it is necessary to seek new sources of revenues to support sustainability initiatives on campus. Under the Facilities sections, we discuss state incentive funding, energy service company investments, and other sources to invest in improving the efficiency of new and existing buildings and the physical plant to arrest skyrocketing energy costs and save the university substantial future operating expenditures. Here we add to these two potential sources of funding for ongoing initiatives beyond facilities improvements.

a. Establish a student "Green Fee"

In 2006, student organizations proposed establishing a small "Green Fee" to be added to students' semester fees to build a fund to support campus sustainability initiatives. In particular, student groups wanted to use the fee to reestablish funding for the campus recycling program. University administration wished to avoid raising student fees for this purpose and acted to reinstate the paper recycling program and took steps to support other campus sustainability initiatives. Virginia Tech Recycling (VTR) received three FTEs with salaries, and additional operational funding.

Continued funding for VTR and other programs is in jeopardy in the current budget climate, and student interest in establishing a Green Fee appears to be stronger than ever. A $2-5 per semester Green Fee (0.3-0.8% of current fees) would generate more than $100-250,000 per year to support such programs. The operation of such a Green Fee is discussed further in Section IX, Behavior and Campus Life.

b. Establish a "Green Development Fund" and other endowments for sustainability programs

There are many Virginia Tech alumni who have an interest in sustainability—indeed many of them developed those interests while students at the university. A dedicated Green Development Fund operated by University Development could attract private donations from alums and other friends of the university who might not otherwise give. The earnings from such an endowment fund could help support sustainability initiatives proposed in this plan, including costs of efficiency investments, LEED certification in existing and new buildings, and the Office of Sustainability. The university should also develop endowments to support sustainability-related academic instruction and research programs.

Table 2 summarizes the recommendations including their prospective costs and benefits.

Table 2. Administrative Structure and Governance: Prospective Immediate Actions and Impacts

Action/Measure	Rationale	Costs	Benefits
Establish a University Office of Sustainability	Responds to need for continuous cross-university discussion and implementation of sustainability plan, especially behavioral elements	Personnel costs for director, administrative assistant, and student internships	• Enhances implementation of VTCACSP and provides framework for continual updating and revision of plan. • Positions the university for funding related to sustainable campus improvements, instruction, research, and outreach. • Expected ROI from energy savings: 2:1
Establish a Sustainable Development Coordinator in Outreach & International Affairs	Demonstrates university commitment to VTCACSP and University Plan for International Program	Partial faculty salary	• Positions the university for increasing funding opportunities in sustainable development and green workforce training both domestically and internationally • Expected ROI from outreach funding: 3:1
Establish a Senior Fellow or comparable position to coordinate and develop research, instruction, & outreach sustainability programs	Focused position to take advantage of funding opportunities in sustainability research, outreach, instruction	Partial faculty salary	• Positions the university for increasing funding opportunities in sustainability research, curriculum and outreach • Expected ROI • Fundraising for sustainability programs can endow programs and increase visibility
Establish sustainability internship program in Office of Sustainability	Engages students in campus sustainability enterprise	Small wage and academic credit	• Student earn small wage and/or academics credit for work to enhance campus sustainability
Monitoring program to assess progress toward VTCAC goals	Monitoring energy & emissions to evaluate plan implementation	Student intern wage and credit	• Collection and communication of monitored data will provide education for students and help build sustainability culture on campus
Virginia Tech becomes active in AASHE	To become part of the sustainable university movement	Small	• Demonstrates commitment and monitoring • Increases visibility of VT sustainability among peer institutions
Improve VT's grade in sustainability report card to A- in 3 years	Provides realistic university-wide goal	Small	• Demonstrates commitment and monitoring • Increases visibility of VT sustainability among peer institutions
Establish a student Green Fee	Student support is strong and revenue would offset budget reductions	$2-5 per student per semester	• $100-250,000/year to support investments in sustainability programs and efficiency • Sustainability programs enhance student life and justify student fees • Efficiency investments today will reduce future energy costs and future student fees required to pay for them
Establish a Green Development Fund for campus sustainability and other endowment funds for academic sustainability programs	Dedicated funds for donors to support sustainability programs and investment in campus efficiency	None	• Funds may attract donations from those alumni and friends who might not otherwise give to the university • GDF would enhance investments in efficiency, thus saving future operating costs • Endowments for academic sustainability programs would raise visibility and leverage other research and grant funding

VI. Facilities Infrastructure

Any effort to reduce greenhouse gas emissions on campus must begin with its physical infrastructure. This section addresses six areas of facilities infrastructure and the next section discusses its operation. The six areas are

1. The Central Steam and Power plant and Steam Distribution System
2. Virginia Tech Utilities, Virginia Tech Electric Services (VTES)
3. The Chiller System
4. New and Renovated Buildings
5. Existing Buildings
6. Campus Planning, Landscape and Grounds

1. The Central Steam and Power Plant and Steam Distribution System

A. History and Status

The steam plant stack is one of Virginia Tech's most visual icons, and the plant itself has long been a critical target for those urging greater sustainability on campus. In fact, the plant is a mixed-fuel cogeneration unit that produces steam and electricity, and its steam feeds a district heating system across campus. By its nature cogeneration-district heating can be among the most efficient means of energy use. It is popular in some of the most energy efficient economies in the world, such as northern Europe.

The plant burns 68% coal, 31% natural gas, and 1% light fuel oil in five boilers (#6-11). Boiler 11 was added in 1997 equipped with a modern scrubber and baghouse system to control acid gas and particulate emissions. All of the boilers are equipped with superheaters rated at 80-100,000 pounds of steam per hour, and they produce steam at 600 psig and 825^{o}F. The steam feeds a 6,250 kilowatt, 12,470 volt steam turbine powered generator. Steam exits the turbine at 10 psig directly into a steam header serving an underground steam tunnel distribution network. This tunnel network serves over five million square feet of campus buildings with heat through six miles of steam and condensate lines. The turbine also provides steam extraction at 90 psig, which is distributed through the same underground network, to be used as process steam for cooking, sterilization, autoclaving, pressing, and other industrial requirements. **Table 3** shows the current capital project status related to the steam plant and distribution.

Table 3. Capital Outlay Project Status: Steam Plant and Distribution, November 2008

Under Construction:		
Campus Steam plant	Plant upgrades	Increase plant reliability
	Steam distribution upgrades	New piping to serve SW quad
	Boilers 8.9,10 upgrades	Increase efficiency, reduce NO_x
Under Design:		
Campus Steam Plant	Planning authorization for the design of new heating and cooling infrastructure to serve various areas of campus	Life Science corridor steam line in final design; central plant generator in procurement

B. Prospective actions: Immediate (2009-12)

1. Fully Implement Current Central Steam and Distribution System Upgrade

The university is in the midst of a $28.5 million capital project to upgrade the Central Steam Plant and utility distribution system. This includes the Boiler Pollution Controls project which added a scrubber-baghouse system similar to that on boiler 11 to boilers 6 and 7 at a cost of $5.85 million. These controls are expected to reduce particulate emissions from the central steam plant from 42 tons per year to 2 tons per year as well as reduce sulfur dioxide emissions from 460 tons per year to 110 tons per year. In addition, boiler 10 is currently being retrofitted with new low NO_x burners and air controls, which will reduce nitrogen oxide emissions and improve efficiency. Boilers 8 and 9 will also be retrofitted in a like manner this year.

This project will provide distribution underground piping across campus which will greatly improve efficiency and reduce heat losses, and provide a new ability to co-generate electricity year round. Replacing steam traps and installing Variable Frequency Drives on large motors significantly will reduce energy consumption. Annually this should provide more than $1 million in fuel savings and reduce emissions by 10 tons.

C. Prospective actions: Mid-term (2013-2025)

1. **Identify further upgrades of existing system, including co-firing biomass with coal to reduce costs, energy and emissions**

Employ internal expertise and outside Energy Service Companies (ESCOs) as needed to identify further upgrades of the existing system over the next 5-10 years. Options include further efficiency improvements and co-firing of biomass with coal to reduce coal costs and GHG emissions. Faculty research in CALS and CNR on co-firing coal with switchgrass has promise and could provide outside funding for demonstration and research.

2. **Plan for next generation of University Steam and Distribution System**

About 2025, these boilers will approach their design lifetime and the university growth will create greater demand on the south side of campus. This is an appropriate time to plan for conversion to a next generation central heating and cogeneration system to save operating costs and reduce GHG emissions. Planning for this next generation should not wait until the boilers end their useful life but should begin about ten years earlier to take advantage of emerging innovations and technology and to accumulate capital to this investment, which may approach $100 million.

Plans are currently being made in connection with ongoing expansion and repair of the existing steam system to accommodate the power plant changes expected to occur by 2025. Larger steam lines are being installed in the SW Campus Area in anticipation of possible relocation of the power plant there, in accordance with the Campus Master Plan. Consideration is also being given to constructing the system to operate at higher temperatures and pressures required by a new plant.

D. Prospective actions: Long-term (2026-2050)

1. **Fully implement next generation University Steam and Distribution System and retire coal boilers.**

The next generation steam and distribution system provides the opportunity to retire or significantly modify the coal boiler system to retire coal as a central fuel. Since coal combustion amounts to nearly ¼ of campus GHG emissions, replacing coal with natural gas, biomass or other renewable energy would reduce campus emissions significantly. Because coal is likely to soon carry with it a carbon emission cost, this move will also have economic benefits.

Table 4. Central Steam Plant and Steam Distribution System: Prospective Actions

Action/Measure	Description/Rationale	Costs	Benefits
Immediate (2009-2012)			
Complete Upgrades to Power Plant.	1. Install new low NO(x) burners in Boilers 8, 9, 10.	$1.5M	50% reduction in NO(x) emissions for these units, estimated at 19.5 tons for last calculations.
	2. Installation of condenser at turbine exhaust.	$0.5M	Permits year round generation of (cleaner) local power. Will reduce summer electrical energy and demand by 1.5mW
	3. Installation of steam attemperators at Power Plant.	$0.1M	Attemporating steam results in about 2% savings of fuel by supplying steam at or near saturated conditions.
Complete Upgrades to Steam Distribution.		$10.0M	Improved efficiency of current steam distribution through better pipe insulation and other factors. Permits integration of the benefits of power plant upgrades described above. Energy savings in range of 5%.
Mid-term (2013-2025)			
Further upgrades and co-firing biomass/coal	Campus research to demonstrate co-firing biomass	External funding	Reduce GHG emissions
Plan to replace current boilers and generators with new power plant system	In about 2025, Boilers 7, 8, 9, and 10 will be due for major repairs. The University Master Plan calls for potential construction of a new power plant in the SW corner of campus. This will provide an opportunity to integrate available new technology into power plant operations.	Difficult to estimate, thought to be in range of $100M. But costs net of other alternative replacement costs would be less.	More efficient boilers may offer a 3-5% reduction of fuel, as well as potential integration of fuels that are more environmentally friendly, more efficient operation of steam system, potential for increased generation of local "greener" electric power.
Long term (2025-2050)			
Implement next generation steam plant and distribution	Retire coal combustion and replace with low-carbon or non-fossil fuel	$100M	Reduce campus coal emissions, now 21% of total

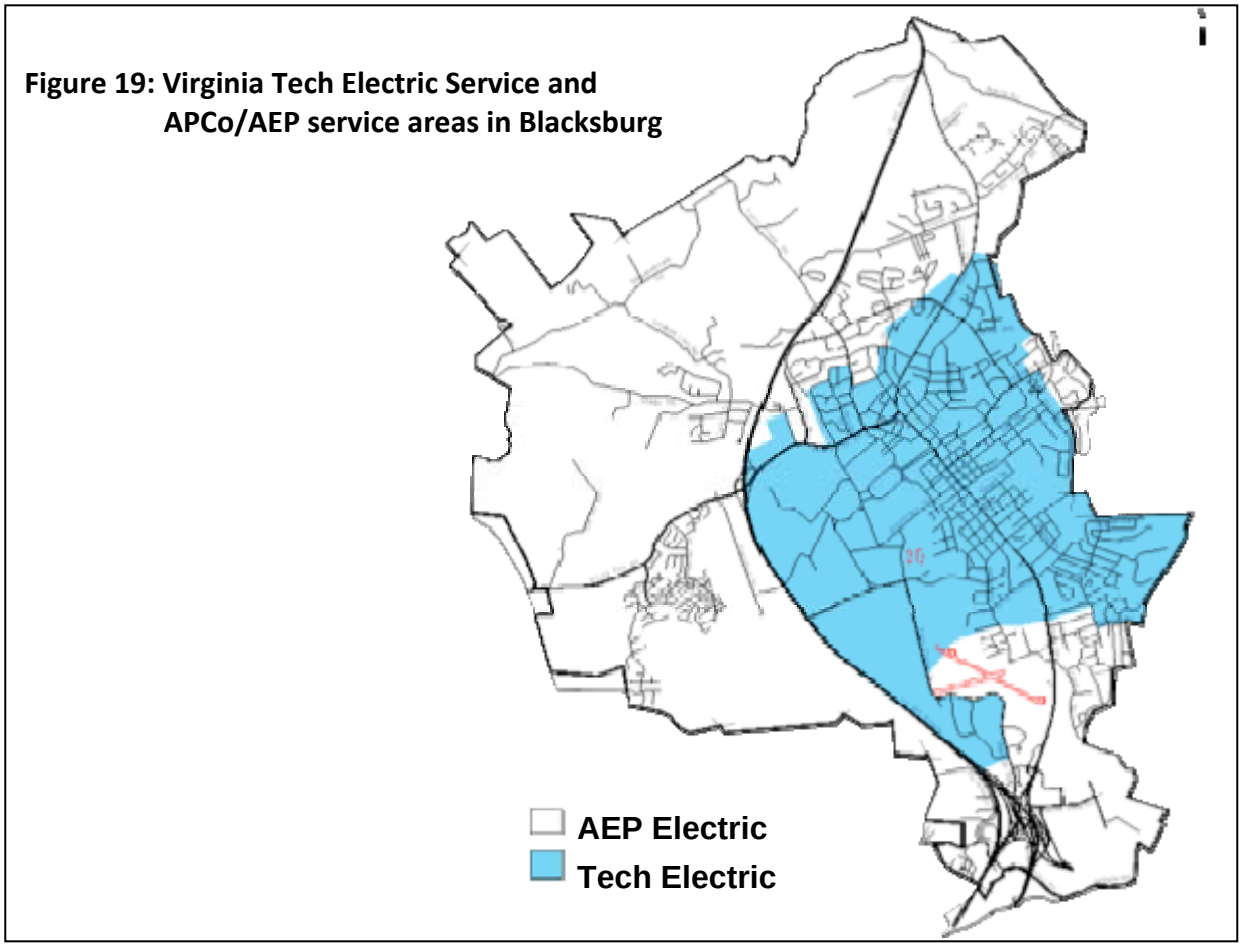
2. Virginia Tech Utilities, Virginia Tech Electric Service (VTES)

A. History and Status

The university began providing electric power to campus and the Town in 1890. In 1946 VPI started purchasing electricity from Appalachian Power Company. APCo now provides nearly 90% of Virginia Tech's demand, the remainder is generated at the cogeneration plant (see **Figure 10)**. There are opportunities to increase on-campus generation in the short-term through improvements for greater generating capability at the steam power plant (see previous section) and in the mid-and long-term through distributed generation on campus, such as building or parking lot integrated solar photovoltaics, wind generators, and fuel cells.

Virginia Tech Electric Service is primarily a power distribution service for the campus and the older portion of Blacksburg. **Figure 19** gives the VTES service area. VTES buys APCo/AEP power at wholesale rates and resells and distributes it on campus and in its service area. As such, it operates like a municipal utility. Having such an institutional arrangement provides opportunities for the university and the Town. VTES could broaden its services for fee to provide demand side energy and load management and interconnection services for distributed generation sources both on campus and in the community.

Figure 19: Virginia Tech Electric Service and APCo/AEP service areas in Blacksburg



B. Prospective measures: Immediate (2009-2012)

1. Increase capacity for on-campus generation of electricity from the steam power plant

Additional on-campus generation of electricity will offset purchases of coal-based and increasingly costly AEP power. Additional generation capacity will result from a current $0.5 million project to add condenser capacity to the plant turbine. There are likely to be other options to increase capacity from the existing system. Special attention should be given to providing peaking capacity since 45% of the university electricity bill is for demand charges.

2. Develop a campus-wide demand-side and load management program

Electricity demand is a major cause of rising costs of campus operations and will increase budget problems for the university as rates increase (see **Figure 14**). The best way to achieve potential savings of electric energy, peak demand, carbon emissions, and expenditures is through a demand-side energy and load management program. The University's Office of Buildings and Utilities Systems manages both utilities and buildings, and thus is in a strategic position to implement such a program. The current energy service company (ESCO) program (currently out for bid, see Operations section) will provide recommendations that can be extended campus-wide. Based on experience on campus, VTES could extend such a program to its community service area. Since DSM measures include both infrastructure investments and facilities operation measures, they are included both in this infrastructure section and in the following operations section.

3. Establish interconnection policies and "smart grid" plans on-site generation

There are likely to be increasing cost-effective opportunities for distributed electric generation on campus and in VTES service area. There is a major federal initiative for "net-zero energy" buildings. It is important for VTES to anticipate and encourage these developments by establishing interconnection policies and "smart grid" improvements for campus and community generation.

C. Prospective measures: mid term (2013-2025)

1. Develop a distributed electricity generation plan on campus

As the cost of carbon-based electricity increases, distributed generation from renewable energy will become more cost effective. Campuses throughout the country are already adding on-site renewable energy generating capacity. A student project estimated that if half of the available flat roofs on campus were dedicated to solar photovoltaic arrays, the systems could produce 7% of the campus' electrical energy demand and as much as 25% of its summer peak power demand. Wind generators could be developed on Tech's agricultural land. Fuel cells and microturbines fueled by natural gas are other viable distributed generation options.

D. Prospective measures: long-term (2026-2050)

1. Implement distributed electricity generation plan on campus At least by 2025, small scale renewable energy technologies are expected to be cost competitive with carbon-based

electricity and the university should implement a cost-effective plan to generate as much of 50% of its on-campus electricity needs on site.

Table 5. Virginia Tech Utilities: Prospective Actions

Action/Measure	Description/Rationale	Costs	Benefits
Immediate (2009-2012)			
Increase steam plant electric generating capacity	Extend current projects to increase on-campus electricity generation	$0.5 million plus	Offset AEP electricity. An additional 2.3mW emergency steam turbine generator also has potential for net reduction in NO_x and SO_2 emissions
Develop campus demand side and load management program	Integrated plan for building and electricity efficiency based on results of ESCO program	Small relative to savings	More effective efficiency program to reduce electric energy and demand costs
Reduce purchased electricity by 10% from 2008 by 2012	By greater efficiency, reduced waste, and on-campus generation	Cost-effective investment	Reduction in electricity costs
"Smart grid" plan and interconnection policies for on-site generators	Accommodate interconnection of on-site generators	Small admin cost	Remove uncertainty and enhance planning for on-site generation on campus and in the community
Mid-term (2013-2025)			
Develop distributed green electricity plan and "smart grid" improvements to accommodate on-site generation	Assess the potential for on-site generation and conditions for cost-effectiveness	Small admin cost	Plan would set the stage for investment in a campus distributed energy system
Reduce purchased electricity by 20% from 2012 by 2025	By greater efficiency, reduced waste, and on-campus generation	Cost-effective investment	Reduction in electricity costs
Long-term (2013-2025)			
Implement distributed green electricity generation plan	Develop cost-effective on-site solar PV, wind, microturbine and other distributed generation	Cost/kWh are now high, about 5 times APCo rates, but will change	Cost-competitive, carbon-free power

3. The Chiller System

The chiller system is the primary provider of campus building cooling. It includes 40 chillers, totaling over 20,000 tons of cooling capacity, operating in 22 separate buildings. The largest plant is the Central Chiller Plant which has a capacity of 7500 tons and serves 22 buildings in the north and upper quad areas of campus. The chiller system was developed in a piecemeal fashion as the campus has grown. Capital budgets for individual projects have often forced the use of individual building chillers rather than more efficient central chillers serving more than one building. A campus-wide study of the chilled water system has been commissioned to maximize efficiency of current chiller capacity.

A. Prospective measures: Immediate (2009-2012)

1. **Complete upgrades to central chiller**

2. **Conduct additional chiller upgrades**

Table 6. The Chiller System Infrastructure: Prospective Actions

Action/Measure	Description/Rationale	Costs	Benefits
Immediate (2009-2012)			
Complete upgrades to central chiller.	Study of campus wide use of chilled water has been commissioned. This aims to maximize existing capacity and efficiency. This project will also assess potential for retrofitting existing R-11 chillers with more modern and environmentally friendly alternatives.	$0.1M (cost of study)	Ensure most efficient use of current capacity. Retrofitting of chillers has the potential to reduce energy usage at the existing central chiller plant by about 6%.
Additional Chiller Upgrades	Campus chilled water study will identify configuration of future system. Current thinking is that this will take the form of several smaller plants located near peak demand centers.	Potential $20M	More efficient overall chilled water operation. Total conversion to larger zoned chillers to provide chilled water in lieu of continued installation of individual building chillers has the potential to reduce energy used for chilled water by 15%. A partial conversion will yield savings in proportion to the number of individual chillers that are replaced.

4. New and Renovated Buildings

A. History and Status

Like many top-tier universities that are expanding, Virginia Tech continues to undertake significant building and renovation projects. **Table 7** lists the current building projects under construction and design. This new building infrastructure is one of the driving factors for the campus's increase in energy use and GHG emissions. If the university is going to mitigate future energy use, costs and emissions, it is important to design new buildings and renovations to minimize life-cycle costs. Between 2004 and 2008, the campus increased building gross floor area by 9%, but it increased electricity peak demand by 26%, electrical energy by 24%, and energy/ft^2 by 13% (see **Figure 14**). Our newest buildings are among our most energy intensive. Many of these are research buildings that have specialized energy loads (see **Figure 16**). We must improve the efficiency of new buildings, systems, and operations or we will break the bank to supply them with energy in the future.

Campus Energy and Water Policy 5505focuses on energy and water efficiency and conservation, and includes requirements for new construction and renovations on campus (See **Appendix I**). The university's design guidelines and standards require low flow water systems, room occupancy sensors, indoor air quality ductwork treatment, variable speed drives and pumps, and heat recovery. The primary exterior cladding material on new buildings is a native limestone, quarried within a few miles of the campus. This material is unique and known to our university community as "Hokie Stone." Not only is this material extremely long lasting and durable, but it is also a local product supporting traditional stone masonry craftsmanship. We have adopted a new installation process that provides enhanced insulation between the Hokie Stone and the building structure which increases energy efficiency. The university has recently completed the first "green roof" system on campus. The Life Sciences I building has two small green roofs, which provide energy savings and improve stormwater quality.

Table 7. Capital Outlay Project Status: Buildings, November 2008

Under Construction:		
ICTAS	99,400 ft^2; Labs, office, workspaces	Fall 2008
New residence hall	92,800 ft^2, 264 beds, Student Prog. off.	Summer 2009
Henderson Hall / Black Box Theatre	38,570 ft^2, 8600 ft2 theatre, LEED silver	
Basketball practice	53,000 ft^2	
Under Design:		
ICTAS II	42,000 ft^2; specialized labs	
Infectious Disease Research (Vet Med)	16,300 ft^2; Labs, offices, support	
McComas addition	27,000 ft^2	
Ambler Johnson Hall renovations	272,000 ft^2; replace building systems, add AC	
Visitors/ Undergrad Admissions Center	20,000 ft^2	
Academic and Dining Building	91,200 ft^2; 4-5 story dining, instruction	
VBI Addition	50,000 ft^2; office, conference space	
Geosciences Building	93,300 ft^2; classrooms, offices, labs	
Center for the Arts	120,000 ft^2; Performance Hall; Shultz renov.	
Engineering Signature building	160,000 ft^2; State of the art technology enhanced flagship building for COE	
Human & Agricultural Biosciences	92,000 ft^2; advanced Ag research lab	
Davidson Hall renovation	50,000 ft^2	
Parking structure	Perry St. lot	

B. Toward Green Buildings on Campus

Determining Virginia Tech's best path to new building energy efficiency is complicated by the rapidly evolving field of green buildings. Building codes, state mandates, rating systems, and federal and industry goals are continually changing. Within this maze described briefly below, the university should become a leader in the Commonwealth, demonstrating building energy and sustainability opportunities beyond minimum requirements.

Codes and Standards. All new public and private buildings must comply with the State Uniform Building Code. That code is based on the International Energy Conservation Code (IECC). For non-residential buildings, IECC is further based on the American Society of Heating, Air Conditioning, and Refrigeration Engineers (ASHRAE) 90-1 standards. By federal law (Energy Policy Acts of 1992

and 2005), state codes are to comply with these ASHRAE standards which are revised every three years. IECC standards and state codes are upgraded accordingly. New state government buildings including Virginia Tech's must go beyond these codes by meeting minimum requirements specified by the Virginia Division of Engineering and Buildings (DEB) with compliance provided by the Bureau of Capital Outlay Management (BCOM). A new set of DEB requirements were issued in December 2008. (See **Appendix J**).

Green Building Ratings: LEED. The university can adopt policies that exceed those requirements. Indeed, it has adopted a goal that all new projects from 2008 onward be designed to LEED Silver-equivalent standards. The U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) system has become the most adopted green building protocol for new construction and existing building renovations in the U.S. Like building codes and standards, LEED protocol are updated every 2-3 years. The current LEED NC (new construction) version 2.2 will convert to LEED NC 2009 in spring 2009. Energy performance for LEED is based on the extent to which buildings exceed ASHRAE standards. Building designs that incorporate specified green design features accumulate points and are rated for achieving or exceeding certain point thresholds: Certified (26 of 69 total points for NC 2.2 or 40 of 110 for NC 2009), Silver (33/69 or 50/110), Gold (39/69 or 60/110), and Platinum (52/69 or 80/110).

The LEED criteria for new construction are grouped into six categories: sustainable sites (26 points for NC 2009), water efficiency (10), energy & atmosphere (35), materials & resources (14), indoor environmental quality (15), innovation & design (6), and regional priorities (4). Although all of these criteria contribute to more livable and productive workspaces and less environmental impact, the energy & atmosphere (EA) criteria, especially the 1-19 points for "optimizing energy performance" and 1-7 points for on-site renewable energy, that have the greatest potential for future energy, emissions, and cost savings. EA #1 points are based on the extent to which the building exceeds ASHRAE 90-1 energy performance. A 2008 study of 121 LEED-NC certified buildings showed average energy performance 25-30% better than the national average. Average savings increased for the higher LEED levels, with Gold/Platinum buildings achieving on average 30% better than ASHRAE 90.1-2004 (NBI, 2008). An important element in achieving design standards is certification or commissioning of buildings to assure they are built and operate in accordance with the design. New DEB standards require certification or commissioning and the university has a commissioning policy in place.

Looking forward: Government and Industry performance targets for buildings. Codes and rating systems continually change as technology and building design and construction practice improve. Where is this headed? ASHRAE is a good place to start since federal mandates and state codes are based on its standards. ASHRAE 90.1 2007 requires about 5% better energy performance than 90.1 2004. It has been reported that 90.1 2010 will incorporate 30% better energy performance. And ASHRAE is targeting "net zero energy buildings" (NZEB) by 2030.

Recent federal legislation and administrative action are also working toward this aggressive goal of NZEB. Dramatically improved building and equipment efficiency (up to 70% better than code buildings today), combined with on-site rooftop solar PV, will likely bring to the market NZE residential buildings by 2020 and NZE commercial buildings by 2030. **Figure 20** shows the expected progression toward NZE buildings. California is already considering incorporating such standards

into its Title 24 code. The federal Energy Independence and Security Act of 2007 (EISA Title IV, subtitle B) establishes a goal of NZE for all new commercial buildings by 2030, for 50% of all commercial buildings by 2040, and all commercial buildings in the U.S. by 2050. The federal government plans to lead the way with its own buildings, requiring (in EISA IV subtitle C) that all new federal buildings and major renovations achieve 55% reduction of fossil-fuel use by 2010 and 100% reduction by 2030 (NSTC, 2008).

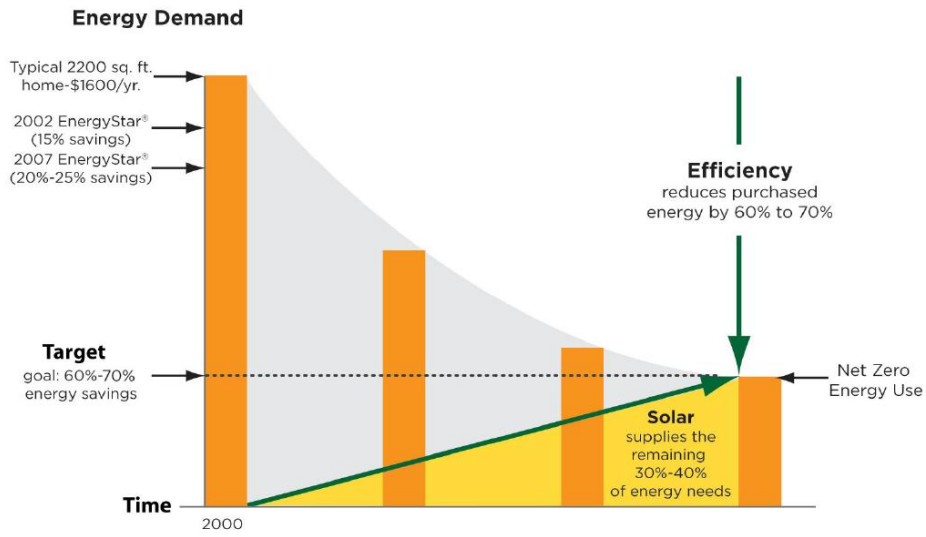


Figure 20. Expected Progression toward Net-Zero Energy Buildings (NSTC, 2008)

Architecture 2030, a non-profit industry group, has set a challenge for energy and climate efficiency for new buildings that has been adopted by the US Conference of mayors, the American Institute of Architects, and numerous other organizations and government agencies. The challenge calls for reductions of energy use in new buildings compared to ASHRAE 90.1-2004 of 30% by 2010, 50% by 2016, 75% by 2022, and carbon neutral by 2030.

The achievement of NZE buildings will require continuing technology development and cost improvement. The university can benefit from this development and achieve dramatically improved efficient buildings within the timeframe of this plan. This also requires the ability of Virginia Tech utilities to develop “smart grid” modifications to accommodate on-site generation from these buildings, as recommended in **Table 5**.

Because of the dynamic and complex nature of building standards, rating systems, and targets, **Table 8** compares relevant standards and targets to show how quickly they are changing and where they are headed. The table includes the 2008 Virginia DEB directive which is discussed below.

Table 8. Comparison of Energy Performance for Selected Building Codes, Ratings, and Goals

Standard/Target	Energy use reduction relative to ASHRAE 90.1 2004	Long term goals/notes
Virginia Code all new bldgs– based on IECC	0%	Upgraded as IECC upgraded
IECC 2006 – based on ASHRAE 90.1	0%	Upgraded as ASHRAE 90.1 upgraded
VA DEB 12/2008 directive: new, renov. state buildings	30%	Options: 30% reduction or LEED certification
ASHRAE 90.1 2004	0%	--
ASHRAE 90.1 2007	5%	--
ASHRAE 90.1 2010**	30%	Effective 12/2010, in IECC 1/2012, adopted by states 12/2013; ASHRAE has NZEB goal by 2030
ASHRAE 189	30%	Similar to LEED criteria
LEED NC 2.2	30% (EA #1: 7 pts new, 9 pts renov)	--
LEED NC 2009	30% (EA #1: 8 pts new, 10 pts renov)	LEED upgraded 2-3 yr cycle
Fed EPAct 2005 – Gov bldgs	30%	--
Fed EPAct 2005 – State codes	0%	Requires upgrades with ASHRAE
Fed EISA 2007 – Gov bldgs	30%	55% fossil fuel 2010; 100% 2030
Fed EISA 2007 – Comm bldgs	--	NZEB by 2030 (new); by 2050 (all)
Architecture 2030	30% (2010); 50% (2016); 75% (2022)	NZEB by 2030

C. Current and Prospective University Policies for New and Renovated Buildings

As discussed above, the university must conform to state directives and has adopted policies for LEED-silver equivalent design and commissioning for new buildings. Decisions to apply for LEED certification have been made on a case-by-case basis. If a project fails to meet certification criteria, the goal has been to incorporate as many green design standards as possible. Virginia Tech registered (a preliminary step before accreditation) its first LEED project in 2007 and is presently designing five buildings to a LEED Silver level, including the Virginia Bioinformatics Institute (VBI) Addition, the Institute for Critical Technology and Applied Science (ICTAS) II, the Visitors and Undergraduate Admissions Center, the renovation of the Ambler Johnston Residence Hall, and Henderson Hall renovation and Black Box Theater.

In December 2008, the Virginia Division of Engineering and Buildings (DEB) issued new regulations for new construction and major renovations of state buildings, for which preliminary building documents have not been approved by December 1, 2008. The standards reference LEED NC 2.2 and ASHRAE 90.1 2004 and require energy and environmental performance in one of two ways: (1) certification at LEED Certified level (minimum 26 of 69 points (NC 2.2)) or (2) energy performance at least 30% better than 90.1-2004, commissioning of energy systems, and other measures including construction pollution prevention, water conservation, recycling, and indoor environmental quality. If the LEED option is selected, compliance can be met in one of four ways: LEED certification or certification results submitted to BCOM or LEED documentation submitted to BCOM or to a BCOM-approved 3rd party. See **Appendix J** for DEB directive.

The university must comply with the DEB requirement. The VTCAC subcommittee believes the university can and should do better to demonstrate further opportunities and play a leadership role for the Commonwealth. The university should emphasize building energy performance in any policy to maximize energy and energy cost savings and reduction of GHG emissions. Of the two paths to compliance with the DEB directive, the subcommittee recommends the LEED certification approach, because it is more transparent and symbolic to the campus community. Regarding pathway to certification, the subcommittee recommends obtaining LEED certification and submitting that to BCOM, for the same transparency and symbolic reasons which it believes trump the "soft" costs of certification.

Many universities which have adopted a LEED standard, such as the University of Florida, have reduced costs further by relying on in-house staff rather than third party vendors. Virginia Tech has many LEED Accredited Professionals among its staff, faculty and students.

D. Prospective Actions: Immediate (2009-2012)

1. Pursue a minimum LEED Silver Certification, including at least 10 LEED NC 2009 points for energy performance, for all new buildings and 12 points for major renovations (35% better than ASHRAE 90.1-2004, 30% better than ASHRAE 90.1-2007),

This recommendation slightly exceeds new DEB standards and so positions Virginia Tech beyond the minimum and toward a leadership role. Emphasis on energy performance provides the most benefits in terms of cost and GHG emission savings. The university should pursue mechanisms to achieve least soft-cost certification through use of in-house expertise.

E. Prospective Actions: Mid-term (2013-2025)

1. Continue to achieve energy performance exceeding ASHRAE 90.1 standards as they evolve.

2. Adopt *Architecture 2030* interim goals for energy use reductions in new buildings relative to ASHRAE 90.1-2004 standards: 50% by 2016 and 75% by 2022.

These recommendations are aggressive but are consistent with anticipated improvements in building technologies and design, and continue to position the university as a leader.

F. Prospective Actions: Long-term (2026-2050)

1. Adopt ASHRAE, *Architecture 2030* and federal Energy Independence and Security Act of 2007 goals for new buildings: carbon neutral and Net-Zero Energy by 2030

This recommendation is aggressive but is consistent with anticipated improvements in building technologies and design.

Table 9: New and Renovated Buildings: Prospective Actions and Impacts

Action/measure	Description/Rationale	Costs	Benefits
Immediate (2009-2012)			
LEED Silver certification required for all new buildings and major renovations	Certification at LEED Certified level is now required for all new state buildings. Virginia Tech can exceed minimum state energy standards.	Soft costs can be kept to 1% of construction costs; hard costs have high ROI	Lower operating costs; Better, more effective workspace; Higher worker/student productivity
Require 35% improvement of energy performance over ASHRAE 90.1-2004 standards.	This exceeds new state standard of 30%, provides 8 LEED-NC 2.2 or 10 LEED-NC 2009 points.	Capital costs can be slightly higher	Provides greatest economic ROI and most GHG emission reduction of all LEED criteria
Mid-term (2013-2025)			
Adopt *Architecture 2030* 2016, 2022 interim goals for new commerce. bldgs	50% reduction in energy by 2016, 75% by 2022. Requires advanced tech.	Higher capital costs	Lower operating costs
Long-term (2026-2050)			
Adopt ASHRAE, *Arch 2030* and EISA commercial new bldg goals for 2030	Carbon neutral by 2030; NZE buildings by 2030	Higher capital costs	Lower operating costs
Adopt EISA commercial all bldg goals for 2050	All new and old buildings NZE by 2050	Higher capital costs	Lower operating costs

5. Existing Buildings

A. History and Status

Virginia Tech is blessed with long-lasting and beautiful campus buildings. Finding our way to greater campus sustainability will require not only making new buildings high performance, but also the renovating and retrofitting our existing stock to reduce energy use and related carbon emissions.

Major renovation of existing buildings presents an opportunity to improve overall efficiency. The DEB rules for new building efficiency also apply to renovations in excess of 50% of the building's value for buildings larger than 5,000 gross square feet. Such projects must be LEED certified or achieve 30% reduction of energy use below ASHRAE 90.1-2004 standards and other criteria.

Retrofit projects are smaller in scale and can be incorporated in regular maintenance. For example, we have retrofit light fixtures in Wallace Hall, Whittemore Hall, Hahn Hall, the Vet Med facilities, and the Human Resources Annex and expect to save over $120,000 annually. The recent installation of energy saving occupancy sensors in 146 classrooms will result in $10,370 annual savings in electricity costs. Hancock Hall was recently retrofitted with enhanced lighting, and Fralin Hall is next in line when funding is available.

A campus-wide water audit of all water consuming systems on the main campus identified about $322,000 in annual savings opportunities. Water conservation measures put in McBryde Hall, Pamplin Hall, and the Sterrett Facilities Complex save approximately 2.1 million gallons of water annually.

B. Prospective Actions: Immediate (2009-2012)

1. **Continue campus lighting retrofit program throughout campus including relamping, elimination of all incandescent lighting where practical, and installation of occupancy sensors in classrooms, restrooms, and other indoor spaces where they would be effective.**

Lighting efficiency improvements have significant energy, cost and emissions reduction potential and are among the most cost effective energy efficiency improvements with paybacks ranging from months to less than 5 years.

2. **Continue water conservation program throughout campus to reduce water and sewage costs and save energy and emissions required for pumping and treatment.**

Water efficiency and conservation improvements have long term sustainability benefits in reducing water use, wastewater, and related treatment energy, emissions, and costs.

C. Prospective Actions: Mid-term (2013-2025)

1. **Develop procedures to integrate life-cycle costing, energy efficiency, water efficiency, and other sustainability factors in all campus projects funding from maintenance reserve and operating funds.**

Ongoing maintenance and small renovation projects provide a great opportunity to apply measures to reduce energy, water and emissions. Too often these projects do not seize this opportunity. For a small increment of investment, such projects can yield significant savings.

D. Prospective Actions: Long-term (2026-2050)

1. **Develop long-term renovation plan for existing buildings to respond to higher operating costs for energy, water, and emissions. Plan should incorporate:**
   a. **cutting-edge cost-effective thermal and electricity efficiency technologies developed to achieve the federal 2007 EISA goals of NZE existing buildings by 2050.**
   b. **solar electric and thermal and other on-site energy production technologies**

The 2007 Energy Independence and Security Act, Title IV, subtitle C, establishes an aggressive goal of retrofitting all commercial buildings to net-zero-energy use by 2050. It is now unclear how that can be achieved cost-effectively with existing technology and current costs of technology and energy. But these factors are all likely to change, and the university should monitor developments and plan to be an early adopter of new retrofit technologies to drive down the net-energy use and emissions from existing buildings.

Table 10. Existing Buildings: Prospective Actions and Impacts

Action/measure	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Complete relamping of buildings and installation of Occupancy Sensors	Installation of occupancy sensors completed in 152 general assignment classrooms.	$88,312	Estimated 22% energy savings. Savings calculated at $17,981 per year. Simple payback less than 5 years
	Relamping completed in 36 buildings totaling 3 million ft^2. Relamping projects scheduled in another four buildings.		Approx. 25% reduction in energy usage for lighting. Savings will vary by building depending on hours lights are utilized. Lighting consumes 10%-15% of most large building electricity, so energy usage in relamped buildings should drop by 3%.
	Relamping another 21 bldgs totaling 1 mill. ft^2 requires replacement of fixtures.	$6.0M	Approx. 25% reduction in energy usage for lighting. Savings will vary by building depending on hours lights are utilized.
Complete water conservation projects identified in campus-wide water audit	Implement cost-effective measures identified in audit		Long-term water and related wastewater, energy, and emissions savings.
Mid-term (2013-25)			
Integrate energy and water efficiency in all maintenance reserve projects	Opportunity to meet efficiency objectives as projects are being done anyway		Sustainability improvements should become part of the day to day projects of the university
Long-term (2026-50)			
Develop a long-term retrofit/renovation plan for existing bldgs that incorporates emerging energy technologies	Learn from technology developments expected during period to meet federal goals for existing building	Large cost-effective investment	University can lead the state in retrofitting campus buildings

6. Campus Planning, Landscape and Grounds

The university takes great pride in its beautiful campus resulting from campus planning and landscape management. Recent policies and projects in the three following areas have enhanced campus sustainability, including:

1. Campus Planning
2. Tree Canopy
3. Stormwater Management

A. History and Status

Recent campus planning and grounds policies and projects related to sustainability include:

- A policy for in-fill development that has contributed to a more compact campus and shorter travel distances enhancing pedestrian movement and reduced vehicle miles.
- In 2007, the university contracted with an engineering consultant specializing in "Low Impact Development" (LID) to develop a campus-wide comprehensive hydrologic model to better analyze and manage stormwater.
- Several new parking lots have been built, or are in construction, using LID bio-swales, bio-retention, and infiltration trenches to manage stormwater quantity and quality through on-site detention and infiltration features.
- Through the Office of the University Architect and department of Forestry, we have developed a campus tree inventory and initiated a tree planting program.
- In 2008, Virginia Tech was one of eight campuses across the country selected for the Campus Tree Tour sponsored by the National Arbor Day Foundation and Toyota. The program gave the university 100 trees that were planted by students, faculty and staff in a grand one-day event.

B. Prospective Actions: Immediate (2009-12) and Midterm (2013-25)

Campus Planning: Effective campus planning that emphasizes infill and compact development can help reduce use of cars on campus and associated vehicle miles traveled, fuel use, and emissions. This is largely due to the location of key support services within walking distance to classrooms, labs and offices. In addition, compact and infill development patterns maximize the efficient use of utility and transportation infrastructure and lessen impact on contiguous, undeveloped land.

1. **Incorporate mixed use, compact, and infill development principles in the Campus Master Plan and all new development projects**

Tree Canopy Cover: In conjunction with the Campus Tree Tour event and for this plan, students in Urban Affairs and Planning conducted a study of the campus tree canopy and the costs and benefits of a dedicated tree planting program. Their study used the existing tree inventory and employed CityGreen, GIS software developed by American Forests for ecological analysis.

Currently, tree canopy covers 18% of the campus land cover. Buildings also cover 18%, paved surfaces 32%, and grass 30%. The trees provide not only aesthetic amenity, but they also remove carbon dioxide and air pollutants from the air, mitigate stormwater flows by slowing and absorbing precipitation and runoff, stabilize riparian areas, and diminish the campus heat island effect.

The CityGreen analysis showed that the existing tree canopy:

1. removes more than 4000 pounds of air pollutants with a dollar benefit of more than $10,000,
2. absorb and store 15 tons of carbon (55 tons of CO_2) annually,
3. slow store stormwater equivalent to $260,000 worth of engineering storage capacity.

The students also found that the 100 trees of the Campus Tree Tour would provide the following benefits once they mature:

1. Increase canopy cover by approximately 2%,
2. Increase air pollutant removal by 484 pounds/year, valued at more than $1,000/year.
3. Capture and store 1.69 tons of carbon (6.2 tons of CO_2) annually.

2. Plant 100-200 2"+ caliper trees per year to increase tree canopy land cover by 2% per year to maximize canopy cover by 2025 as we meet other campus land needs.

Based on the experience of the 2008 Campus Tree Tour and the student analysis, this plan recommends annual tree planting of 100-200 2"+ caliper trees per year to maximize canopy cover by 2025 within constraints for other campus land uses. The Campus Master Plan would be revised to identify the appropriate location, timing, and species for the increased canopy. A high priority will be placed on areas where collateral benefit is maximized e.g. establishing low-maintenance zones where leaf litter can be left in place, stabilizing riparian areas, maximizing storm water management advantages, etc.

Planting would occur during Sustainability Week in October and Earth Week in April. Fund-raising could cover the cost of the trees, and student and staff volunteer labor would be used to plant the trees. These events would provide educational benefit as well. Estimated maximum installation cost is $30,000 (based on adding 120 trees a year to gain 100-tree net increase). To the extent that trees are donated and volunteer labor is used for planting, these costs can be significantly reduced. The annual maintenance cost is estimated to be $2500.

According to the CityGreen analysis, increasing the tree canopy to 50% would result in:

1. Removal of an additional 7,745 pounds of air pollutants per year with an annual value of $20,000.
2. Stormwater management benefits estimated at $1.3 million dollars.
3. Capture and storage of 41 tons of carbon (150 tons CO_2) annually.

There are some constraints to achieving this increase in canopy cover, including land use conflicts with development plans, impervious surfaces, and poor soil conditions including compaction and high pH. Planting should emphasize trees with a high tolerance for soil compaction and elevated pH such as, red maple, swamp white oak, dawn redwood, hedge maple, elm hybrids, and red oak.

Stormwater Management. Campus planning should continue to develop a hydrologic model to serve as a basis for a comprehensive stormwater management plan. All new development should incorporate low impact development (LID) design concepts to incorporate on-site measures to minimize impacts.

3. Complete Hydrologic Model to guide stormwater management plans and practices

4. **Incorporate LID design in all new building and parking projects to minimize impervious surface and maximize retention and infiltration of runoff on-site**

Table 11: Prospective Actions: Campus Planning, Landscape and Grounds

Action/Measure	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Incorporate mixed use, compact, infill principles into Campus Master Plan	Mixed use development lessens VMT (largely due to the location of key support services within walking distance to classrooms, labs and offices). Compact and infill development patterns maximize the efficient use of utility and transportation infrastructure and lessen impact on contiguous, undeveloped land.	Should be possible at no additional cost.	Urban Land Institute estimates 20% less driving in compact development areas. Cost savings in infrastructure development should be possible.
Increase campus tree canopy by 100 trees per year	This action will add 100 2"+ caliper trees to the campus annually (net increase). This action will target adding trees to areas where multiple benefits can be achieved.	Installation cost estimated at $30,000/yr (based on adding 120 trees/yr to gain net 100 tree increase) Maintenance cost estimated at $2,500/yr.	Each additional 100 trees will capture 6.2 tons of CO_2/yr, will improve ambient air quality, will diminish campus heat island effect, and will diminish storm water runoff and, by eliminating turf areas, will reduce mower fossil fuel use and related pollution.
Complete Hydrologic Model to guide stormwater plans and practices	Comprehensive approach to stormwater (StW) management requires good modeling	Currently under contract	Provides basis for more comprehensive StW management and should expedite StW reg. compliance
Incorporate LID design in all new building and parking projects to minimize impervious surface and maximize retention and infiltration of runoff on-site	On-site stormwater retention and infiltration is most effective option to manage quantity and quality of storm runoff	Some increase in project cost, but overall reduction in stormwater management costs	More effective stormwater management and additional on-site amenity benefits.
Midterm (2013-25)			
Increase tree canopy to 50% canopy cover by 2025	Plant 120 trees per year approximately 1800 trees by 2025	Fundraising for trees; volunteer planters during SW & Earth Day. Tree location determined by campus plan and soil constraints.	CO_2 sequestration 150 tons/year; Stormwater storage: 658,593 cu. Ft. ($114,838/year); Air pollution removal: 12,102 lbs/year ($29,221/year); Other amenity benefits

VII. Facilities Operation

The physical infrastructure determines to a large extent campus energy use and related carbon emissions, but so does its operation. This is affected by the operations management discussed in this section and occupant behavior addressed in part IX. Recommendations in the following four areas of operations management are presented below:

1. Thermostat Settings, Air Handling, and the Chiller System Operation
2. VT Recycling
3. Smart Procurement

1. Thermostat Settings, Air Handling and Chiller System Operation

A. History and Status

The operation of campus heating and cooling system, including thermostat settings, air handling, and chiller loop temperatures, has historically not been operated to optimize efficiency. Simple no-cost adjustments can save significant energy, costs, and emissions. For example, there are opportunities to better match the air handling system operation to building use. The air handling system is often operated 24 hours a day, wasting energy at night. Shutting down the air handlers when they are not needed can save both heating and cooling energy. In addition, the cooling system has not taken advantage of "free cooling" or economizer opportunities when outside temperatures are mild. There are also opportunities for raising chiller loop temperatures for greater efficiency.

The greatest savings may come from modifying building temperature settings for heating and cooling. The University Energy and Water Policy 5505 recommends setting building temperatures to 68^{o}F in the winter and 74^{o}F in the summer. Facilities management began implementing these settings on a pilot basis in certain buildings in summer and fall 2008, and implemented the winter setting in all centrally controlled buildings in December 2008. It is estimated that the summer setting will reduce cooling energy by 4% and the winter setting will reduce heating energy by 8%.

B. Prospective Actions: Immediate (2009-2012)

1. **Implement temperature settings outlined in campus energy policy: 68^{o}F heating season, 74^{o}F cooling season. Involve staff, faculty and students in an education campaign to achieve acceptance of the program.**

This zero-cost measure will have a significant impact on energy use, cost, and GHG emissions, with an estimated reduction of 4% of cooling energy and 8% of heating energy. This will require acceptance by the campus community through an education campaign. Monitor energy results and survey occupants to optimize temperature settings for specific buildings. Engineering controls and solutions will be monitored and adjusted for efficiency and environmental satisfaction.

2. **Operation of Campus Air Handlers: Shutdown 3rd shift operation and monitor impact on users and energy savings.**

This zero-cost measure will save wasted energy at night. Monitor results and impacts on occupants.

3. **Operation of Campus Chiller System: Maximize free cooling opportunities and monitor impact on energy savings.**

This zero-cost measure should save wasted energy by using ambient temperature air during mild weather to assist cooling needs and reduce need for chilled water.

4. **Operation of Campus Chiller System: Raise chiller loop temperatures and monitor impact on users and energy savings.**

This zero-cost measure could potentially save energy and related costs and emissions by optimizing loop temperatures to meet cooling demand efficiently.

Table 12. Temperature Settings and Chiller Operations Prospective Actions and Impacts

Action/Measure	Description/ Rationale	Benefits	Costs
Immediate (2009-2012)			
Implement temperature settings outlined in campus energy policy: 68^{o}F heating season, 74^{o}F cooling season.	Regulate set points of HVAC systems in buildings with automated control capability.	Reductions in energy usage. Reducing building temperatures during winter to 68 ^{o} F is estimated to reduce heating energy use by 8%. Raising building temperatures during summer to 74^{o}F is estimated to reduce cooling energy use 4%.	Implementation cost zero, but possible impact on employee productivity and use of electric space heaters.
Operation of Campus Air Handlers: shutdown 3rd shift	Further, the shutdown of air handlers over the third shift is currently scheduled to begin during Spring, 2009.	This additional step should raise overall savings for heating and cooling to approximately 10% on annual basis.	none
Operation of Campus Chiller System: maximize free cooling opportunities	Maximize use of free cooling during favorable seasons in lieu of operating chilled water	Potential for 2% savings in energy usage for chilled water, providing that operational issues associated with free cooling can be overcome.	none
Operation of Campus Chiller System: Raise chiller loop temperatures	Pilot program to raise chiller loop temperatures in existing chilled water system.	Ensure most efficient use of current capacity. Early results indicate peak electrical demand reduction of 5% is possible, reducing peak demand charges. Energy savings can be realized from this program if the loop temperature can be raised during the summer months and still control building humidity levels.	none

2. Virginia Tech Recycling

A. History and Status

Virginia Tech Recycling (VTR) Program has long recycled a wide range of materials. Volunteer efforts to organize campus recycling at Virginia Tech date back to at least the mid-1970's. In 1991, Physical Plant hired a part-time Recycling Coordinator, who in 1992 resigned his

appointment as English Instructor to become the university's first full-time Virginia Tech Recycling (VTR) Coordinator.

Over the first couple of years of operation, VTR established a daily collection route for corrugated cardboard; formalized and expanded collection of Mixed Paper; helped negotiate arrangements for the handling of cans and bottles by Custodial Services; and entered into a university contract with Waste Management to provide 30-cubic yard recycling "rolloffs" for use by the dining halls.

In 1992, VTR coordinated with the Grounds Department to develop a low-tech leaf/grass composting arrangement, and initiated a yardwaste/pallet mulching operation, both situated at the university's closed sanitary landfill.

Collection of mixed paper from academic departments was provided until budget cuts in 2002 eliminated funding. Numerous departments and individuals requested continuation of collection services in some form, and VTR facilitated by providing bins, bags, and carts, and operating a campus recycling station in the Overflow Parking Lot. Meanwhile, VTR continued to manage other aspects of campus recycling notably for corrugated cardboard, commingled cans/bottles, Print Shop scrap, and ferrous/non-ferrous metals. In FY2007-08, funding was reinstated, and VTR was able to add employees, a truck, and materials to expand recycling including paper collection from academic buildings. Paper recycling in the residence halls is currently being collected by a student volunteer crew through the Environmental Coalition.

In the course of establishing a durable recycling collections operation, Virginia Tech Recycling initiated significant improvements in the efficiency and cleanliness of trash collection, especially during the periods of Student Move-In and Student Move Out. Since 2006, the YMCA, with assistance from VTR, has coordinated the award-winning "Y-Toss?" event, which collects usable discards during Move Out, and resells them (after sorting, cleaning, and repair), to students the following fall through the Y's Thrift Store. Recycling, far from being simply an expensive "add-on," can effectively improve a basic service.

Materials now recycled by VTR and other university departments include: corrugated cardboard, sorted office paper, magazines, newspapers, phonebooks, Print Shop paper cuttings, aluminum cans, glass bottles (includes brown), steel cans, plastic bottles (#1 & #2), scrap metals (includes old farm equipment, air handlers, steel pipe, copper cabling), shipping pallets, leaves/brush, fluorescent lamps & ballasts, toner cartridges, kitchen grease, e-waste (monitors, hard drives, printers, microwaves, TVs, etc), auto batteries, and tires. In addition, materials collected and credited by state DEQ as "Solid Waste Reused" include carpets, furniture, room accessories (e.g., fans, shelving, bedding, and lamps), clothes, mattresses, and asphalt.

The Recycling program reported a total of over 2.6 million pounds of recycled material in 2006 and 2.9 million in 2007. The increase was largely due to a significant amount of the old metal removed during the installation of new steam distribution piping by Virginia Tech Utilities. The 2007 VT recycling rate was 34% (an increase of 12% over 2006). In 2007 Virginia Tech participated in the first state-wide university electronic waste recycling competition and collected 122,600 pounds of e-waste.

The reinstated budget in 2007 also reinstated the Paper Recycling Program by adding three FTEs specifically for recycling, a dedicated recycling collection truck, 1,500 paper bins/800 commingled beverage container bins/accessory bins, carts, bags, and equipment. Program execution began in late November 2007 and was competed by the end of March 2008. All eight colleges and associated academic and administrative buildings are equipped with new containers and the collection schedules.

Recycling has expanded beyond being the province of one office (VTR), and has been initiated independently by other offices and programs. Culinary Services has taken the lead on composting, for example, and Capital Construction and Design, as part of the LEED certification process, has provided for the recycling of construction materials from the Black Box theatre project, and Ambler-Johnson renovations (among other projects). Environmental Health & Safety Services is very active in the e-waste, battery, fluorescent lamp, oil, lamp ballast, and other recycling programs. This trend is likely to continue.

B. Virginia Tech Recycling: Prospective Actions: Immediate (2009-2012)

1. **Assure sustained funding of the Virginia Tech Recycling Program**

VTR is a fundamental program and symbol of the university's commitment to sustainability. It should be considered a necessary cost of doing business. If budget cuts jeopardize funding of VTR, other revenue sources, such as the student Green Fee, should be used to support the program.

2. **Continue participation in national RecycleMania competition including its Waste Minimization program**

RecycleMania is an important national competition that provides a measure of a university's commitment to recycling and sustainability. The Waste Minimization component is an important element of the competition and one that is recognized by the President's Climate Commitment. Virginia Tech currently qualifies for this PCC action since it engages in four of the 18 practices (three are required), including office equipment with waste prevention capabilities, surplus property sale/donation, campus mail reusable envelopes, and online alternatives to printed documents. Two others are recommended by this plan (dining services composting and reusable mugs).

3. **Optimize the recycling program by gathering and analyzing data on recycle bin volume by location and modifying bin placement.**

Student interns can assist VTR by identifying optimal placement of bins for effective recycling.

4. **Increase recycling rate to 35% by 2012**

The 2006 rate was 22% before the reinstatement of the paper recycling program. The high 2007 rate of 34% was an anomaly due to high level of recycled steel from steam pipe replacement. The market for recyclable goods will likely dictate our ability to reach those goals.

C. Virginia Tech Recycling: Prospective Actions: Midterm (2013-2025)

1. Reduce waste generated per student/employee and increase recycle rate to 50% by 2025.

This ambitious dual-goal is achievable with a high level of participation and commitment of the campus community. The market for recyclable goods will likely dictate our ability to reach those goals.

Table 13: Waste Management and Recycling: Prospective Actions and Impacts

Action/measure	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Provide adequate and stable Funding for Virginia Tech Recycling (VTR)	Continue campus-wide collection of mixed paper and cans/bottles from academic buildings, housing, and dining.	$90-100,000 per year for personnel, materials	Revenue from collection of recyclables to offset costs of program. Reduced landfill costs. Reduction in GHG emissions.
Continue participation in national RecycleMania competition including its Waste Reduction program	Compete in the national recycling competition for colleges and universities. Campuses compete in many different challenges, but most are on a per-capita basis.	Minimal – advertising to promote the campaign	Use the competition aspect to increase campus population's recycling rates. The per-capita emphasis will increase student feeling of responsibility to do their part Increasing recycling behavior increases more conscious and sustainable behavior
Optimize the recycling program by gathering and analyzing data on recycle bin volume by location and modifying bin placement	This could be used to determine where the most effective indoor and outdoor locations for bins would be by looking at traffic patterns	Cost of student intern	- Understanding where the bins are most needed will make the whole system more efficient and easier to use. - Making the system easier to use will increase its use. - Engaging students in this process will foster better recycling behavior.
Increase recycling rate to 35% by 2012	Expand and optimize program and increase participation	Cost of additional bins and education campaign	Increased recycling rates and decreased amount of material going into the landfill. Demonstration of moving toward sustainable campus
Midterm (2013-2025)			
Increase recycling rate to 50% by 2025	Expand and optimize program and increase participation	Cost of additional bins and education campaign	Increased recycling rates and decreased amount of material going into the landfill. Demonstration of a sustainable campus

3. Smart Procurement

An important principle of sustainability is life cycle thinking from cradle-to-grave, or being aware of the costs and impacts of actions from the source to the final deposition. So we should think of the impacts associated with the production, use and disposal of what we purchase and use. We are usually aware of the impacts of the use of the product, such as energy and related emissions, because we pay the operating bill. Recycling helps on the tail end of this process, and there is an emerging philosophy of "cradle-to-cradle" popularized by William McDonough that emphasizes reuse of former waste to renew the life cycle in a closed loop.

An important, but less emphasized part of the life cycle is the smart purchase of products that have less impact in their production and transport, consume fewer resources in their use, and are easy to recycle and reuse. Smart procurement of equipment and appliances, vehicles, paper, food, cleaning products, and other products and materials can reduce energy and environmental impact and promote greater sustainability.

This section addresses central procurement of equipment and paper. Sections on Transportation address vehicle purchase and Behavior and Campus Life address dining and residence hall purchases.

A. History and Status

Campus Energy and Water Policy 5505 states "Unless otherwise referenced in this policy and whenever feasible, all energy consuming equipment should be Energy Star rated in efficiency or better....It is strongly encouraged that all computers at the university should be Energy Star rated, have LCD monitors/screens…except in those cases where specific research, instruction, of office mission requirements demand otherwise." Since Energy Star rated computers have become the industry standard and the practice of university purchasing, there is no reason that this "encouragement" should not be a "requirement."

Paper purchasing has increasingly become centralized. Copy Management Program, an operation with Printing Services, now serves about 75% of the universities copiers with the remaining 25% handled by individual activities/ departments. Copiers from Printing Services are leased and approx 98% use provided paper. All of the provided paper is 30% recycled paper from a paper vendor called Xpedx and the product they use is "Hammermill". There is a state contract for recycled paper, but their prices are very similar to Hammermill and their product inferior to Hammermill. Most of the customers seem very satisfied with the Copy Management Program and the Hammermill product.

A select few of the Facilities Services units have started using 50% recycled paper in 2009 for a pilot program to generate data on use and cost issues with 50% paper. All three Digital Print Centers use the Hammermill 30% recycled paper now and customers seem satisfied. Customers continue to have a choice of using one of more grades of paper to ensure satisfaction. Based on the results of the pilot use of 50% paper in Facilities, a change to 50% recycled content paper will be considered at the Digital Print Centers and through the Copy Management Program.

The Lithographic Plant wants to ensure the customer has a choice of using whatever grade of paper needed to gain satisfaction. Priority for the plant will be to achieve certification by the Forest Stewardship Council (http://www.fscus.org/).

B. Prospective actions: Smart Procurement: Immediate (2009-12)

1. **Require all purchases of equipment including computers, peripherals, appliances, and other products for which Energy Star ratings have been promulgated to meet Energy Star ratings unless the specific use of the product requires otherwise.**

Equipment has a large impact on electricity use and operating costs and purchase of highly efficient models can reduce operating electricity, cost and emissions without sacrificing performance.

2. **Require that all purchases by all organizational units of copy paper have at least 30% post consumer waste (PCW) content.**

The university consumes an incredible amount of paper. Recycling can divert waste paper from the landfill. Purchasing higher content recycled paper reduces use of virgin material at the front end of the life cycle. It also helps support the market for recycled paper. 30% PCW paper is readily available and not excessively more expensive than virgin paper. Units can order 50% or 100% if they chose to do so. Cost and bulk availability are current concerns with mandating higher than 30% recycled content, but these issues may change over time.

3. **Establish guidelines for purchase of products ranging from carpeting to cleaning products to help integrate sustainability considerations in all aspects of university procurement.**

Housekeeping services is already moving to use of more "green" cleaning products. Guidelines should be developed for a wide range of products to assist central purchasing as well as departments toward more sustainable practices.

Table 14: Smart Procurement: Prospective Actions and Impacts

Action/measure	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Require purchase of Energy Star rated equipment	Energy Star unless use requires otherwise	Small	Lower operating electricity, costs, and emissions
Require all purchases of copy paper have at least 30% post consumer waste (PCW) content	30% PCW paper is readily available and not excessively more expensive than virgin paper. Units can order 50% or 100% if they chose to do so.	30% PCW does not add costs; higher PCW content may add cost	Reduced virgin material
Establish sustainability guidelines for all product purchases	Furnishings: low impact carpet and other Cleaning products	Small	Part of comprehensive sustainability practices of university

VIII. Transportation

Transportation is a critical element of campus sustainability. According to the GHG inventory, commuting and on-campus transportation contributes about 8-10% of campus GHG emissions. In addition, fuel used by Fleet Services amounts to another 0.6% and aviation services another 0.3% of total Virginia Tech emissions. Transportation is managed by Transportation and Campus Services (TCS), with the exception on the university policy for telecommuting and flexible work scheduling. The major components of sustainability-oriented transportation at Virginia Tech are

1. Alternative Transportation Program
2. Telecommuting and Flexible Work Schedules
3. Local and Regional Transit
4. Parking Services
5. Fleet Services

A. History and Current Status

TCS has been successful in moving toward more sustainable transportation through its policies and programs for fleet services, alternative transportation and partnership with local transit programs. Its alternative transportation received a grade of "A" in the national Campus Sustainability Report Card for 2008 and 2009. Fleet services has purchased some hybrid electric vehicles and experimented with B20 biodiesel in campus diesel vehicles. The university has partnered with Blacksburg Transit and the Valley Metro for the Roanoke-Blacksburg Smart Way bus, both of which have developed into very successful transit programs. However, there are additional opportunities to reduce transportation fuel use and resulting GHG emissions.

The Alternative Transportation Program advocates modes of transportation other than the single occupancy vehicle (SOV). Alternative transportation may include carpools, vanpools, public transit, bicycling, walking, among other modes of moving from point-to-point. Virginia Tech encourages the entire campus community (i.e. students, faculty, staff, and visitors) to utilize alternative transportation whenever possible for commuting to and from campus and moving around campus.

In 1999, TCS hired a full-time alternative transportation manager, and the Commuter Alternatives Program (CAP) was initiated. CAP provides incentives for people to use alternative modes of transportation for commuting purposes, such as a limited number of daily parking permits for days when they need to drive alone, Emergency Ride Back (guaranteed ride back to local residence or vehicle in case of personal emergency), and (for carpoolers) reserved parking areas and lower cost permits.

The Alternative Transportation Program has continued to expand, with CAP splitting into the Carpool group, with reduced cost permits, and Bike, Bus, and Walk (BB&W), which is free. It has also added a vanpool program. All of these programs continue to be advertised and to grow annually. TCS has also applied for, and received over $600,000 in enhancement grants and has constructed bike lanes, bike trails, and other cycling amenities.

Telecommuting and Flexible Work Schedules. The state has goals for reduced commuting by state employees and the university has policies that address telecommuting and flexible work schedules that help achieve those goals. Since telecommuting or flexing 1 day per week decreases emissions

by 20% per employee participating in the program, this has a substantial impact of commuting emissions. The TCS or the Sustainability Manager should assess the level of participation in telecommuting and flexing, the current impacts on parking and emissions, and the factors that encourage and constrain participation.

Local and Regional Transit. TCS has partnered with Blacksburg Transit for over 25 years. All Virginia Tech employees and students can ride BT fare-free. The cost of students riding is covered by their student fees, and the cost of employees is covered by a percentage of parking permit sales. Seeing the need for regional as well as local transit, a partnership was formed with Valley Metro (Smart Way Bus) and other members of the MPO to offer regional bus service from Roanoke to Blacksburg. TCS also offers discounted monthly passes to Virginia Tech employees and students. During the last several years, Virginia Tech students, faculty, and staff have accounted for about 95% of Blacksburg Transit ridership. Currently Virginia Tech contributes the majority of operating funds for the local match for service. TCS will encourage Blacksburg Transit to implement and inform customers regarding real-time transit information and trip-planning system. Utilizing existing technology is another key area for improving BT efficiency and creating a user-friendly interface. In 2008, BT, in conjunction with the Department of Rail and Public Transportation, had Google Transit activated, an on-line trip-planning service that makes it easier for people to use public transportation (see www.google.com/transit/).

TCS will continue to encourage BT to continue their work on getting customer oriented real-time transit info available for customers. In addition, TCS will Encourage Blacksburg Transit to purchase hybrid buses as new and replacement buses. Blacksburg Transit should be encouraged to replace old buses (replacement buses) and expansion buses with hybrids, or other new technologies that become available, to help them move away from fossil fuel dependence.

Parking Services controls the construction and maintenance of parking lots on campus, and setting parking fees and policies with the assistance of the Transportation and Parking Committee which reports to the Commission on University Support in the governance system. The university has had a long standing policy of allowing freshmen to have cars on campus. Parking fees have increased in recent years to $150 per year for faculty and staff and $114 for students, but they still are among the lowest of all Virginia universities. In June 2008, the university approved construction of its first parking garage/deck, a $26 million structure that will be funded by parking fees. Fees are likely to increase significantly for four years to fund the project. This may start a trend toward replacing the campus's expansive parking lots with more compact parking garages/decks, a trend that will require a additional increases in parking fees.

Fleet Services manages campus vehicles as well as "daily rental" vehicles available for use by faculty and staff for university-related travel. The Campus Energy and Water Policy 5505 states "the university should strive to achieve a passenger fleet vehicle average fuel efficiency of 30 miles per gallon." Fleet Services has begun replacing older vehicles with higher efficiency models including hybrid electric vehicles.

B. Transportation: Prospective Actions and Impacts: Immediate

1. **Fleet Services – Switch from diesel to B10 (10% biodiesel) initially and transition to B20 by 2012 for all campus diesel vehicles**

The university used 33,600 gallons of diesel in FY2008. Conversion to B20 would cost about $16,000 per year, but reduce CO_2 and other air pollutant emissions.

2. **Fleet Services – Replace vehicles with more fuel efficient vehicles**

Initial assessment of replacing 11 Crown Victorias at 25 mpg with higher efficiency options (32 mpg HHR or 45 mpg hybrid) could reduce CO_2 emissions by 7.7-15.6 tons.

3. **Parking Services - Moving parking trucks over to T-3 electric personal transport**

These vehicles could test the operational issues of small electric vehicles on campus, and provide a visual symbol of university efforts for sustainability.

4. **Blacksburg Transit – Encourage Blacksburg Transit (BT) to Implement and Inform customers regarding real-time transit information and trip-planning**

This improved service will help to increase ridership. TCS will continue to encourage BT continue pursuing their work on getting customer oriented real-time transit information available for our customers.

5. **Blacksburg Transit – Encourage Blacksburg Transit to purchase hybrid buses as new and replacement buses.**

At $2.30/gal diesel for 15 years, a more costly hybrid bus breaks even economically with a conventional diesel bus as a result of better fuel efficiency. At higher diesel prices it is more cost-effective and in any case, a hybrid bus would produce far less air pollution and 119 tons less CO_2. A hybrid bus costs $580K and a conventional diesel bus costs $390K. Purchasing a hybrid bus will require additional state and/or federal funding. Blacksburg Transit in considering converting their entire current fleet of buses to bio-diesel.

6. **Alternative Transportation – Assess participation in telecommuting/flex scheduling, factors affecting participation, and impacts on parking services, commuting VMT, and emissions.**

Existing policy encourages telecommuting and flex scheduling to achieve state goals for reduced commuting VMT. Human Resources or other unit should assess participation and the factors currently encouraging and constraining participation, as well as the impacts of current and additional participation.

C. Transportation: Prospective Actions and Impacts: Midterm (2013-2025)

1. **Alternative Transportation - Institute Bike Share Pilot Program on Campus. Assuming 30 bikes for pilot project.**

Having public bikes available on campus would increase bike ridership and decrease car use for short cross-campus trips, decreasing congestion slightly, and reducing energy use and emissions. A 30-bike pilot program would require about a $200,000 set up fee. The pilot project could test user demand, operational options, and cost reduction strategies. The pilot and full program could be implemented by the University Services System.

Table 15: Estimate of Energy and emissions savings of Bike Share pilot program

# of Bikes*	# of Daily Users per Bike	# of Miles Traveled/ Day/Bike	Gallons of Gas Saved**	Lbs of CO2 Emissions Saved/Day***	Lbs of CO2 Emissions Saved/Year****
1	2	4	0.18	3.51	751.42
30	60	120	5.43	105.34	22,542.62
***Our Current Pilot program calls for 30 bikes.**					
****Based on the EPA estimate of 22.1mpg for passenger cars.**					
*****Based on EPA estimate of 19.4lbs of CO2 emitted per gallon of gas burned.**					
******Based on number of days the students are on campus - 214 for 2008-09**					

2. Alternative Transportation - Institute Bike Share Program on Campus, based on Pilot Program

Based on results of the pilot project, a campus-wide bike sharing program could be established.

3. Alternative Transportation - Place high fuel efficiency and/or electric vehicle rental service on campus for cross-campus trips. Assuming 10 vehicles for pilot project, then establish program based on pilot.

Conduct a pilot project for high fuel efficiency and/or electric vehicle rental for cross-campus trips.

4. Parking Services - Institute a "no freshman car rule" at VT allowing for exceptions based upon special circumstances

Eliminating most freshman cars would reduce the number of cars on campus each day by approximately 1,500 vehicles, reduce land needed for parking lots, reduce vehicles on the road, create a more pedestrian and bike friendly campus, and reduce CO_2 emissions by about 20 tons per year.

5. Parking Services - Offer parking permit price discount for vehicles with a MPG rating of 35 or higher to promote higher efficiency and hybrid vehicles

Encourage more fuel efficient vehicles by lowering the cost of annual parking permits for vehicles with a minimum EPA mpg rating, such as 35 mpg.

Table 16 on the following two pages contains the Transportation and Parking Services actions.

Table 16: Transportation and Parking Cost/Benefit Table

Action/Measure	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Fleet Services – Switch from diesel to 20% biodiesel	FY 07/08 pumped 33,598.2 gallons of diesel. No mpg available for equipment using diesel fuel	$16,700 Annually	Using B-20 reduces CO_2 by 16%
Fleet Services – Replace vehicles with more fuel efficient vehicles	Replace 11 Crown Victoria rated at 25 mpg. 100,000 miles = 4,000 gal of gas producing 35.12 metric tons of CO_2 **Options:** a. HHR rated at 32 mpg on State contract cost $15,421 each. 100,000 miles = 3,125 gal of gas producing 27.4 metric tons of CO_2. b. Hybrid Prius / Civic rated 45 mpg, estimated cost $23,000 each. 100,000 miles =2,222 gal of gas producing 19.5 metric tons of CO_2.	Reduced passenger capacity Reduced passenger capacity Additional sunk cost after fuel consideration $63,500	Reducing CO_2 by 7.7 metric tons Reducing CO_2 by 15.6 metric tons
Parking Services - Moving parking trucks over to T-3 electric personal transport	Using T-3 in place of trucks for enforcement. The cost to operate one T-3 is between 4 and 5 cents per day.	The purchase price is cost neutral since the vehicle cost at $11,500 per T-3 is essentially the same as a truck. This is a less utilitarian vehicle which does not have capacity to carry material and only transports one person. It does not operate well in snow or rain, or at night.	Reduce CO2 by 19,351.5lbs. per year
Blacksburg Transit – Encourage Blacksburg Transit to provide users with real-time transit information and trip-planning	To improve BT efficiency and creating a user-friendly interface by working on getting customer oriented real-time transit info available.	Local match portion of technology grants.	Increased ease of BT use.
Blacksburg Transit – Encourage Blacksburg Transit to purchase hybrid buses as new and replacement buses.	Blacksburg Transit should be encouraged to work with the Department of Rail and Public Transportation to replace old buses (replacement buses) and expansion buses with hybrids, or other new technologies that become available, to help them move away from fossil fuel dependence.	Initial purchase cost for hybrids is approximately 1.5 times a diesel bus, $580,000 as opposed to $390,000. Over the vehicle's lifespan, hybrids cost slightly more than diesel buses over a 15-year span in terms of capital plus operating costs. Diesel buses cost $1,109,450 while Hybrids cost $1,289,130, an increase of $179,680 assuming diesel at	Replacing one diesel bus with a hybrid bus can eliminate about 238,709 lbs or 119 tons of harmful greenhouse gases from Earth's atmosphere

		$2.30/gal through 2020 (WMATA 2008)	
Alternative Transportation – Assess participation in telecommuting /flex scheduling	Existing telecommute/flex schedule policy can have a big impact on commuting VMT and emissions	Could be incorporated into employee parking surveys.	Estimate current impacts and identify opportunities and constraints for additional participation
Midterm (2012-2025)			
Alternative Transportation - Institute Bike Share Pilot Program with 30 bikes	Having public bikes available on campus would increase bike ridership and decrease car use for short cross-campus trips. Could be implemented through University Services System	Initial set up fee – approx. $200,000. Ongoing annual maintenance of IT as well as bikes/racks approx. $50,000 for a 30 bike system.	Some decrease in cross-campus auto traffic. Reduce about 11 tons CO_2 /y
Alternative Transportation - Place high fuel efficiency and/or electric vehicle rental service on campus for cross-campus trips. Assuming 10 vehicles for pilot project.	Having high fuel efficiency and/orelectric rental vehicles would reduce carbon emissions from employee's personal vehicles, by allowing them access to these vehicles.	Initial purchase of 10 vehicles $190,000. Battery charge, approx. $3,650 annually.	Approx. 13,430 lbs of CO2 emissions reduced per year. See attached spreadsheet.
Parking Services - Institute a "no freshman car rule" at VT allowing for exceptions based upon mitigating circumstances	60% of resident students are freshman. Eliminating freshman cars would reduce number of cars on campus each day, reduce land needed for parking lots, reduce vehicles on the road and create a more pedestrian and bike friendly campus.	$216,669 annually loss from no permits sold. Permit fees to other parking users may have to increase to cover loss.	Reduce CO_2 by 22 tons/yr (at 3 mi/da, 25 mpg). Reduce parking area needed
Parking Services - Offer parking permit price discount for vehicles with a MPG rating of 35 or higher to promote higher efficiency and hybrid vehicles	This would give a small incentive to people driving fuel efficient cars	Undefined loss in permit revenue. Hard to project how many participants and whether an incentive would actually increase these vehicles usage.	Promote vehicles that get 35 mpg or more

IX. Behavior and Campus Life

President David J. Skorton of Cornell University asks his campus, "Each of us has a part to play in sustainability at Cornell. What piece of the puzzle do you hold?" We should be asking that of our Virginia Tech community members as well. Behavior and campus life are incredibly important aspects of campus sustainability and reducing overall greenhouse gas emissions. As it was noted earlier in this report, the behavior of students, faculty, and staff directly impacts the effectiveness of all of the VTCAC's proposed actions in terms of participation, engagement, and overall campus culture. Reducing campus-wide emissions requires conscious and educated efforts to mitigate personal and institutional impacts on the natural environment, as well as the reexamination of consumer habits.

There are seven sections identified under the umbrella category of Behavior and Campus Life:

1. Student Culture & Engagement
2. Faculty &Staff Engagement
3. Housing Services and Residence Life
4. Dining Services
5. University Unions and Student Activities (UUSA)
6. The Inn at Virginia Tech and Skelton Conference Center (IVTSCC)
7. Athletic Department

For all of these sections, a history and current status is given and short explanations of the proposed immediate, midterm, and long term prospective actions. Further explanations, logistics, and research on many of these proposed items are located in the supporting Behavior and Campus Life **Appendix K**.

1. Student Culture & Engagement

A. History and Current Status

In the 2009 Sustainability Report Card, the Sustainable Endowments Institute nationally recognized student engagement on campus by awarding Virginia Tech with an "A" rating in this category. Students have been active on the issue of sustainability for multiple years including a major campaign for a "green fee" in 2006 to generate money for recycling and energy efficiency initiatives. In addition to the Environmental Coalition, the largest organization focused on sustainability, there are multiple other environmentally based student organizations working on these issues. The Coalition for Campus Sustainability, a 18-member student organization coalition, was formed in the spring of 2008. Also in the spring of 2008, The Green Team, Virginia Tech's environmental awareness and sustainability education team, was student initiated and coordinated. It has been successful in giving 31 programs and educating over 460 students. A graduate student is also starting a study on reducing energy usage in the residence halls. Recently, students have been engaged in campus efforts by working directly with the Sustainability Programs Manager in events and internship positions to help with various initiatives including sustainability week, data calculations, and the development of this commitment.

Involving students is incredibly important for campus sustainability because engaging students in university operations and activities will make them more aware of the impacts of their actions as individuals and as a campus community. Being more conscious of their actions, engaged students

may change their behavior to use less energy, produce less waste, and in turn, minimize their carbon and environmental footprints. Student pressure for more environmentally conscious campus operations has no doubt grown in the past few years. Active students find, however, that a disconnect remains in the general student body. Basic awareness of individual actions and their translated environmental impacts is only found in students with environmental majors or enrolled in environmentally focused classes. These proposed action items were formulated to educate all Virginia Tech students equally and build a base line, campus-wide awareness of sustainability and environmental impact. Educating and engaging students in campus sustainability will lead to a shift in campus culture to be more knowledgeable, prepared, and confident in understanding their role in sustainability and taking on the challenges of the future.

B. Student Culture & Engagement: Prospective Actions: Immediate (2009-12)

1. Continue current sustainability education through the Green Team

Currently, the only entity working to educate all students on sustainability issues is the Green Team. This peer-to-peer education style has shown to be effective, and has actively engaged over 30 students. In addition, until all students are exposed to these issues in the classroom, this program should persist to ensure that all students, regardless of major, have the opportunity to learn about them.

2. Incorporate sustainability into new and transfer student orientation

An introduction to sustainability issues, an overview of current campus initiatives, and a brief explanation of how students can get involved during orientation could establish Virginia Tech's focus on sustainability for all new Hokies. This emphasis from the onset of becoming a Hokie will demonstrate the university's commitment to the future of their incoming freshman and transfer students. In addition, a short overview of environmental challenges, potential solutions, and what they can do in their daily lives to reduce their individual impacts will lead to more conscious students when they arrive each fall. A green purchasing guide could also be distributed to parents to let them know about more sustainable amenity options. Aspects of the event itself could also be greened to give the impression of "talking the talk, but also walking the walk." By fostering basic awareness of sustainability issues at the onset of their collegiate experience, the orientation will have a lasting impact on students during their time at Virginia Tech and beyond.

3. Develop a Sustainable Living Guide for all new students

In an effort to target student behavior in correlation to campus life, a Sustainable Living guidebook should be developed. This guide would be a comprehensive packet illustrating the importance of mindful behavior and could be divided into sections highlighting an introduction and history of sustainability at Virginia Tech, greener living tips for on and off campus residents, sustainable dining, alternative transportation information, as well as curriculum and involvement opportunities. Ideally this guide could be distributed to all first year students during orientation, available in offices around campus, and online in PDF format on the Virginia Tech Office of Sustainability website. It could be developed for students by students and could continue to be updated through the Office of Sustainability as a student internship project. A draft guide was developed by students in the Environmental Policy and Planning studio class and can be viewed in **Appendix L**.

4. Implement a $2-5/semester student "Green Fee"

An effective tool to raise funds for institution-wide sustainability initiatives on campus and visibly show a commitment to those initiatives is a student green fee. The student campaign in 2006 collected over 7,000 student signatures in support of a similar fee, and students today seem even more willing to contribute to these efforts. This fee would be added to the student fee structure to specifically fund sustainability action at Virginia Tech and would not be available for diversion to other purposes. This is a popular option at many universities where they range from $2-20/semester. We recommend starting the fee at $2 per semester and increasing it by $1 per semester until it reaches $5. This ranges from 0.3 to 0.8 percent of the current $650 per semester student fees

Not only would the Green Fee provide immediate revenue to facilitate action on campus, but it could also empower students during the decision-making process. A grant-making committee consisting of students, faculty, and staff would be ideal to select projects for fund allocation. A subcommittee under the existing Energy and Sustainability Committee could serve this function. The committee could also facilitate campus engagement and interaction through a project proposal process from the Hokie community. Future use of these fees could incorporate a revolving loan fund, which would be a fund for projects that have quantifiable monetary savings or returns and capitalize on long-term profitability of sustainability projects. Therefore, a student green fee could range to support short, mid, and long-term sustainability projects.

5. Engage students through a sustainability internship program

Many of the proposals in the VTCACSP will take more time, planning, and research to fully implement. By engaging students to help create these projects, campus can become a living laboratory for sustainability and students will gain the hands-on knowledge and skills to take on real world challenges. This internship program could be coordinated by the proposed Office of Sustainability and could engage students in projects through internship positions, class credit, or research opportunities. Logistics of the program and a list of potential internships can be found in **Appendix K**.

6. Educate, update, and engage alumni through a campus sustainability newsletter

Alumni are Hokies too, and they can do their part to help reduce the impacts of Hokies worldwide. A regular column in the alumni magazine or short newsletter could be developed through a student internship opportunity and distributed electronically to interested alumni and made available to the general public on the Office of Sustainability website. It could cover current projects, new tips for reducing your footprint, a research update, and a showing of the cumulative environmental and financial savings from campus sustainability projects.

7. Incorporate environmental awareness into the common book selection

Since all freshmen are required to read a common book each year, environmentally focused books could become one of the selected readings. Seminal books on environmental activism, such as Rachel Carson's *Silent Spring*, or William McDonough's *Cradle to Cradle*, could be assigned reading for all freshmen.

C. Student Culture & Engagement: Prospective Actions: Midterm (2009-12)

1. Incorporate programmatic aspect of a campus sustainability into Hokie Camp

Hokie Camp is a new student's first opportunity to learn more about time-honored university traditions, respect for diversity, and the community-oriented spirit that thrives throughout the Virginia Tech campus and Town of Blacksburg. Incorporating some aspects and information about campus sustainability into this program will set a foundation for sustainability to be included as part of the university culture and tradition.

2. Develop a culture around sustainable living on campus

Through all of the prospective actions listed here and in the rest of this commitment, paired with visible reminders and active encouragement around campus, the emphasis and education on sustainable living will help to build a student culture around sustainability.

Table 17. Behavior and Campus Life: Student Culture and Engagement Prospective Actions

Actions/Measures	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Continue Green Team funding	Ensure funding for student coordinators	Minimal	• Continues peer-to-peer sustainability education
Sustainability session at freshman and transfer student orientations	An introduction to green living on campus, the university's commitment to sustainability, and how they can get involved. Establishes a focus on sustainability for new students.	Free, can be administered by student Green Team members or the Office of Sustainability	• Demonstrates university commitment to sustainability • Gives a lasting first impression • Makes involvement opportunities well known • Builds parent knowledge of sustainable focus
Sustainable Living Guide development	Given to all new and current students addressing sustainability initiatives on campus and ways to live more sustainably	Minimal. Could be developed by students and distributed mostly electronically	• Comprehensive, condensed way to address student behavior and sustainability at VT • Will affect student behavior and lead to energy and monetary savings
Student "Green Fee"	A small student fee to pay for sustainability initiatives on campus	Generation of money each year for projects	• Raises funds for VTCAC initiatives • Shows sustainability commitment to all students and parents • Student involvement in project choices engages them
Create a student sustainability internship program through the Office of Sustainability	Students can help with campus sustainability initiatives by either earning class credit or a small stipend depending on project	Free to minimal – most would work for class credit	• Help Virginia Tech meet its VTCAC goals quicker and cheaper • Engaging students in the process of becoming a more sustainable campus makes them feel more vested in the projects and sustainability as a whole

Alumni sustainability update through magazine column or newsletter	Newsletter highlighting Office of Sustainability work to update and engage alumni	Free – can be produced by student interns and distributed electronically	• Will keep alumni and the general public updated on what work is being done • Will engage alumni by providing tips on how to reduce impacts • Will ensure progress and accountability
Incorporate environmental awareness into the common book selection	Having a sustainability oriented text as the common book	Free	• Strengthens the emphasis on the importance of sustainability to first year students • Adds a new type of exposure to the issues
Midterm (2009-12)			
Sustainability at Hokie Camp	Incorporating a small program aspect into the full program	Free – can be administered by the Office of Sustainability	• Sets a foundation for sustainability to be a part of university tradition and culture

2. Faculty & Staff Engagement

A. History and Current Status

Virginia Tech faculty and staff are also contributors to campus emissions, but can make great strides in reducing their contribution by having more sustainability-oriented operation practices and behavior. There have not yet been any over-arching faculty and staff sustainability related programs, although there are small working groups within some units that are making a big difference. For example, Residence Life Director, Leon McClinton, formed a sustainability task force to look at the basic practices in the Residence Halls and Residence Life in March of 2008. Team ECCO (Education, Communication, Collaboration, and Cooperation), a student programs staff group, has two main goals: educating students and employees on environmental issues, and to communicate, both internally and externally, ways to reduce our negative effects on the Earth. Groups such as this have no doubt had a positive impact on faculty and staff members, but more needs to be done to further engage faculty and staff in sustainability programs on campus.

B. Faculty & Staff Engagement Prospective Actions: Immediate

1. Education, assessment, and encouragement campaign among all campus units

Academic and auxiliary units could request educational sessions, conducted by the Office of Sustainability, to explain major environmental issues, sustainability, and how the actions of individuals and of larger units can contribute to becoming a more sustainable campus. An office wide assessment or survey could then be conducted to look at current office practices, habits, and operations in academic and auxiliary units. A sustainable practices guide could also be developed and distributed to list sustainable behaviors and their economic and environmental

benefits. Increasing awareness of the benefits of energy efficiency and conservation will result in behavioral change and expenditure savings on paper, office supplies, and electricity.

2. Education session for all new Virginia Tech employees

Similar to how all new students are educated on the issues of sustainability upon arriving on campus, all new faculty and staff members should have a similar education and engagement session and be provided with a small document that covers the campus issues, campus goals, and what they can do to help achieve those goals.

3. Introduce a Sustainability Pledge

A sustainability pledge is an informal yet powerful method for increasing awareness of sustainability issues. Several universities, including Yale University, Harvard University, Carleton College, Trinity College and a host of others, have introduced sustainability pledges on their campuses. The pledges outline important sustainable behaviors, such as turning computers and electronics off when not in use, setting thermostats lower at night, using compact fluorescent bulbs, etc. The purpose of the pledge is to help increase awareness of climate and sustainability issues, and to provide faculty, staff and students with ways they each can contribute to lowering carbon emissions, reducing wasteful energy losses, and improving campus sustainability.

4. Address computer updates and phantom power loss

Many computers are left on all night because of network updates and IT work that results in wasted energy. Computer updates and other IT work could be scheduled at times during work hours when the computers were not in use (e.g. during classes or lunch hour). In addition, plugging electronics and other devices into power strips which are turned off when not in use would also save energy. There are also power strips that have built in motion sensors that automatically turn off items like lamps and printers when getting up from your desk.

5. Establish a faculty and staff sustainability group

Establish a faculty and staff “green” organization could maintain and broaden engagement and enthusiasm for campus sustainability issues. During the education and assessment sessions, each office could designate a green advocate who could work with this group. In addition to discussing different ways to lessen the impacts of Tech employees, this body could generate the document described above providing easy tips for "greening" workspaces. This could then be distributed to all university faculty and staff. Creating a formal sustainability group to oversee office sustainability practices would not only broaden the scope of current efforts, but also create a horizontal and peer-to-peer focused organization.

C. Faculty & Staff Engagement Prospective Actions: Midterm (2013-25)

1. Host competitions between buildings on electricity, heat, and water use

The Office of Sustainability couldhost friendly competitions between different academic units or buildings. These competitions could foster reductions in electricity, heat, resource, and water use.

Utilization of a "cap and trade" approach could also be effective. The Collegiate Times can be engaged by publishing and web tracking of monitoring electricity use and recycling rates in individual academic departments or buildings.

Table 18. Behavior and Campus Life: Faculty and Staff Engagement Prospective Actions

Actions/Measures	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Education, assessment, and encouragement campaign, Sustainability Pledge	Education sessions, assessments of practices, and regular encouragement of sustainable practices in campus units. Understanding these issues is important for changing behavior.	Sessions can be administered by the Green Team and Office of Sustainability, but sessions will also take faculty and staff time	• Increasing awareness of climate, environmental and sustainability issues on campus • Energy and monetary savings will result from behavior changes • Lowered resource consumption, reduction in waste, and higher recycling rates
Education session for all new VT employees during orientation	Communicate campus sustainability policies and goals to all new employees	Minimal	• Increase awareness and emphasize campus commitment
Introduce Sustainability Pledge	Emphasize campus sustainability policy through a pledge by faculty and staff	Minimal	• Helps educate and commit faculty and staff to sustainability goals and facilitates cultural change
IT collaboration and power strips distribution	Working with IT groups to promote turning computers off when not in use, and use of power strips to ease shut off	Minimal compared to savings, students can help with distribution	• Very quick payback period • Significant savings in electricity costs with very minimal effort
Create a faculty and staff sustainability group	This group would help address F&S behavior and develop innovative ideas on how to do so.	Free	• Behavioral changes will result in energy and monetary savings • Will sustain F&S enthusiasm and will foster new consciousness
Midterm (2013-25)			
Conservation competitions	Having friendly competitions between units to reduce energy, water, and resource consumption	Minimal to significant	• Adding competition will increase participation in sustainable practices • Students can be engaged in helping track consumption levels

3. Housing Services and Residence Life

A. History and Current Status

There have been many strides made by Housing and Dining Services to make operations more sustainable. It is important to realize that they manage 50 of the 100 buildings on the Blacksburg campus and occupy 26% of the total campus gross square feet. Only some of the recommendations being made for this area are listed because of the extent of work being done and commitment being made by Housing and Dining Services. Their dedication to sustainability

is truly commendable and a full list of recommendations and initiatives that have been pursued can be found in **Appendix K**.

In the residence halls, sustainability initiatives include: replacing lighting fixtures with more efficient models, installing low flow shower heads, replacing windows to improve building envelope efficiency, using sustainable carpet options, using 100% recycled content paper products, and providing a recycling bin to each Residence Hall room. Major renovations in Ambler Johnson Hall have been designed to meet LEED Silver certification upon completion.

Residence Life plays a major role in affecting student behavior due to their ability to reach and educate students through resident advisors, programs, and visibility. Some of the most impressive actions taken have been the planning for and promotion of RecycleMania, hosting a Go Green Picnic, and partnering with the Residence Hall Federation to provide reusable bags for on-campus residents.

Residence Halls consume 9% of total campus electricity consumption and house around 9,000 students. Making simple and visible infrastructure improvements will not only make progress toward reducing emissions, but will provide visual markers of a commitment to sustainable practices, show a proactive approach towards sustainability, and provide an excellent model for student behavior.

B. Housing Services and Residence Life Prospective Actions: Immediate (2009-12)

1. Continue energy efficiency upgrades and infrastructure improvements in all buildings

Given the number of on-campus residents and frequency of use within residence halls, making simple and low-cost adjustments will make significant strides to lessen overall campus energy and resource consumption.

2. Increase recycling availability in and around residence halls

Proving more convenient, accessible locations for recycling bins in and around the residence halls will inspire students to recycle more, diverting materials from the landfill, saving energy and resources. Students could also evaluate traffic patterns and identify the most ideal locations for bins through a student sustainability internship opportunity.

3. Provide reusable bags for on-campus students each year

Providing reusable tote bags for students could result in a reduction of the use of petroleum based plastic bags. Reusable bags are convenient for take-out food, bookstore purchases, and grocery shopping. Consistent use of reusable bags could result in a significant reduction in the purchase of plastic bags for use on campus. In addition to saving money, using fewer petroleum-based products will lessen the environmental impact of students' normal activities. In the future, a university policy should be considered to charge a small fee for or remove availability of plastic bags on campus.

4. Incorporate sustainability into Resident Advisor trainings

Resident advisors (RAs) have the most direct contact with students in the residence halls, and have the greatest potential to affect their behavior. If RA's were educated on the different

environmental issues, what Virginia Tech is doing, and how students can get involved, they would be comfortable and confident in talking about these issues with their residents. In addition, if students have questions about the issues or what they could do, the RA's could serve as a resource for sustainable practices and behavior.

5. Green the current "model" room

By having the model residence hall room that every prospective student sees fitted with energy efficient options and products, it emphasizes to students and their parents that Virginia Tech is committed to reducing emissions and sustainable living practices. It will leave a lasting impression on all who visit, and could attract more sustainably minded students.

C. Housing Services and Residence Life Prospective Actions: Midterm (2013-25)

1. Energy Star® requirement for all on-campus appliances used by students or staff

By requiring appliances to meet the Energy Star® standard, these appliances will all use significantly less energy than other models. This increase in energy efficiency will save money and emissions.

2. Develop and implement a Sustainability Advisors Program for the residence halls

If each residence hall had a Sustainability Advisor (SA), in addition to RA's, each hall community would have a direct resource for establishing and maintaining sustainable lifestyles. This program could be fully integrated into the existing RA and Hall Director structure, and could be part of the student sustainability internship program through the proposed Office of Sustainability. These SA's could provide a peer-to-peer style experience for educating and promoting sustainable living practices.

3. Host sustainability competitions in the residence halls

Green competitions within and between residence halls provide fun incentives to increase recycling, reduce waste, reuse products, and reduce energy, water, and resource consumption. Green prizes could be awarded to the winner/s of each contest to give incentive to participate and promote green living. Students could have fun while helping to reduce campus emissions.

Table 19. Behavior and Campus Life: Housing Services and Residence Life Prospective Actions

Actions/Measures	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Energy efficiency upgrades and infrastructure improvements in all buildings	Re-lamping buildings, low-flow water fixtures, motion sensors, etc. The installment of these items will considerably reduce energy and water consumption in the halls.	Significant, but the energy savings from these upgrades will be realized in short amounts of time.	• Savings of money, greenhouse gases, and pollution because of lowered energy consumption • Quick payback period for most of these projects

Increased recycling availability in and around residence halls	Making paper and commingled recycling more accessible in and around the residence halls by adding more bins and an efficient collection system	Significant - cost of bins for each hall	• Makes it easier for students to recycle, which encourages more recycling • Increased recycling means less going into the landfill • Increasing better recycling behavior will be the first step to increasing sustainable behavior
Reusable bag initiative	Provide reusable bags for all on-campus students to use for to-go dining, bookstore purchases, and grocery shopping	Significant – at least $5,000	• Savings of petroleum based plastic bags • Students can use these instead of the university providing plastic bags for on campus purchases
Sustainability session/orientation for RA's	Have a session on the major environmental issues and causes, as well as an overview of what Virginia Tech is doing about these issues to be more sustainable	Free, can be administered by the Green Team or Office of Sustainability	• Formalized training for all student staff • RA's will be more comfortable &confident talking about these issues with their residents • Savings will be seen because of the resulting behavior changes.
Create a green model room	Replacing all of the items in the current model room with energy efficient and eco-friendly products	Significant	• Demonstrates to every prospective student and parent that Virginia Tech is committed to sustainability • Could bring more students because of that first impression
Midterm (2013-25)			
Energy star® requirement for all on-campus appliances	All equipment must have the Energy Star® label from the US EPA, including resident room appliances	Free for policy, and appliances could be replaced as they wear out	• Helps save money and resources • Students could lease the efficient models from the RHF
Develop and implement a Sustainability Advisors Program	Sustainability Learning Community or internship program where students serve as an advisor for sustainable behavior and activities for a residence hall.	Designating rooms for this program. Potential for a small stipend, but could be done on a volunteer basis	• Creates an environment friendly and accessible for residents to learn more about sustainability • SA's would also help foster more sustainable behavior in their residents – which will translate into less energy and resource consumption
Host sustainability competitions between halls	Halls could compete to reduce energy use, water use, and waste	Minimal for coordination and tracking, could be done by students	• Would result in financial savings due to less energy use • Reduction in emissions

4. Dining Services

A. History and Current Status of Dining Services

Dining Services serves over five million meals each year, managing 11 different restaurants on campus, consuming about 5% of all campus electricity. They recently hired a sustainability coordinator to develop and oversee more sustainable operations. Recently, Dining Services has implemented a tray less practice in the D2 and Shultz dining centers, resulting in a significant reduction of food waste. They opened a local/organic venue in Owens Hall, increase the recycling of cardboard, commingled, and mixed paper (in both front and back of house operations in all dining facilities), and begin a composting project in January 2009. The most effective and highest impact actions are listed below, but a full list of initiatives can be found in **Appendix K.**

B. Dining Services: Prospective Actions: Immediate (2009-2012)

1. Develop food waste reduction strategies

Through smaller batch cooking, going tray less in dining facilities and providing more reusable take out containers, food waste can be dramatically reduced. Reducing food waste will save money and greenhouse gas emissions.

2. Divert edible un-eaten food to non-profit organizations

Edible un-eaten food can be donated to Feeding America and the Salvation Army non-profit organizations under the Bill Emerson Good Samaritan Act. This diversion of food could be a low cost option, enable the less fortunate to eat quality food especially in hard economic times, and result in large environmental and social benefits.

3. Compost in-edible organic wastes from all dining facilities

Food waste and organic materials produce methane when landfilled due to improper decomposition conditions; Methane is twenty times more powerful as a greenhouse gas than carbon dioxide. Composting all organic food waste saves landfill space, reduces methane emissions, and restores soil nutrients by the application of the composted materials onto agricultural areas.

4. Pledge to support local and sustainably produced food

The average food item currently travels approximately 1500 miles prior to reaching the consumer's plate. Numbers like this make our food system the second largest drain on fossil fuel (19%) in our economy. Some estimates show that our food system contributes up to 37% of total greenhouse gas emissions in the United States. These emissions are related to both high "food miles" traveled and industrial food production practices. Industrial livestock farms are the single largest contributor of greenhouse gases in our food system, and also drain

significant portions of our remaining fresh water supply. The word “local” is more than a mere number and must be considered on a case-by-case basis. The Real Food Challenge currently calls for all colleges and universities to devote 20% of their food budget to local and sustainably produced food by the year 2020. By choosing to support local food producers who use sustainable farming practices, Virginia Tech can become part of a greater national effort while simultaneously decreasing our contribution to climate change, keeping money in our local economy, and building valuable relationships with our food producers.

C. Dining Services: Prospective Actions: Midterm (2013-25)

1. Develop a student run farm that uses composted matter and grows food for facilities

Student participation in on-campus farming that not only produces food that they eat, but also utilizes the composted materials from their food production waste, will help students build a true connection with their food. By having a connection with the food, students will savor it and decrease their waste of it. This results in decreased greenhouse gas emissions due to less food wasted and decreased food miles traveled.

2. Complete energy efficient lighting upgrades

Energy efficient lighting in all facilities will save an incredible amount of money and emissions.

3. Create a policy on energy efficient equipment replacements

As equipment wears out and needs to be replaced, only Energy Star® rated appliances should be used to reduce energy use and emissions.

D. Dining Services: Prospective Actions: Long-term (2026-2050)

1. Approach or reach “Zero Waste” operations

A goal of having all materials going in and out of the dining facilities be reduced and either reused, recycled, or composted. This would create a closed loop system in the halls on campus.

Table 20. Behavior and Campus Life: Dining Services Prospective Actions

Actions/Measures	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Waste reduction through smaller-batch cooking and going tray less	See EPA Surplus Recovery Hierarchy	Will likely save money through less resources required	• Decreased food costs, less food/water waste • Equates to decreased greenhouse gas emissions
Diverting edible un-eaten portions to Feeding America and Salvation Army	See EPA Surplus Recovery Hierarchy	$2,500-$3,000 for health department approved transportation materials	• Utilizing food for nourishment that will be converted to usable energy in human beings rather than turning into harmful greenhouse gases
Composting in-edible organic wastes and utilizing compostable containers	See EPA Surplus Recovery Hierarchy	$20,000 composting costs + $250,000 compostable container costs	• Decreased greenhouse gas emissions (methane) by turning waste into rich nutrients to restore our soil in Virginia
Pledge to support local and sustainable produced food	Purchasing food products from local suppliers who use sustainable farming practices	Significant	• Environmental and financial benefits from local purchasing • Reduction in “food miles” emissions • Supports the local economy
Midterm (2013-25)			
Student run farm that uses composted food waste to grow vegetables for the dining centers	Growing our vegetables connects students with their food.	$50,000	• Creates student connection with food • Decrease in waste / over consumption • Decrease in emissions from unused food • Decreased “food miles”
All energy efficient bulbs	Saves electricity consumption and costs	$10,000	• Decreased greenhouse gases
Policy on energy efficient equipment replacements	When equipment wears out, replace with an energy efficient model	Minimal	• Saves energy and costs • Will reduce emissions
Long term (2026-50)			
“Zero Waste”	Having all materials going in and out of the dining facilities be reduced and either reused, recycled, or composted	Significant	• Creates a closed loop system on campus • Makes no contributions to landfill expansion • Saves considerable amounts of energy and emissions

5. University Unions and Student Activities (UUSA)

A. History and Current Status

UUSA has already begun efforts to reduce their contribution to campus emissions. UUSA is a unit within the Division of Student Affairs and is made up of two departments – Student Activities and University Unions. Their facilities include Squires Student Center, Johnson Student Center, the Graduate Life Center, and War Memorial Chapel. Renovations have been made in the restrooms of Squires Student Center to be more sustainable with auto shutoff faucets, auto flush and low flow toilets and urinals, and motion sensors. The same efficiency features are being installed in the Graduate Life Center restrooms. Energy efficient lighting is being installed by UUSA Maintenance to reduce overall electricity consumption, and more sustainable furnishings using recycled materials have been purchased. The recycling program has increased by adding recycling containers in all major meeting rooms and venues, offering a battery and cell phone recycling program in the outdoor recreation center, and recycling ceiling tiles when they are replaced. UUSA staff has also planted over two hundred plants around student center facilities as a sustainability effort.

B. UUSA: Prospective Actions: Immediate (2009-2012)

1. Incorporate sustainability into the student budget board process

Instead of having paper budget applications from all student organizations, a new budget submission process can be established and expanded to have online forms that are submitted electronically. Not only would this initiative save UUSA money, but massive amounts of paper and trees annually. This would also demonstrate to all organizations that a sustainable culture is developing on campus.

2. Continue the development of a green facility improvement plan

UUSA is currently developing a green facility improvement plan to incorporate more sustainability initiatives into practice including using sustainable cleaning products, replacing more light fixtures with energy efficient ones, turning off additional lighting during closure hours, and reducing interoffice electronics power consumption.

3. Add filtered water refilling stations for water bottles in student centers

Making water-refilling stations available will encourage the use of reusable containers over purchasing bottled water for students, faculty, and staff. It can also be paired with an education campaign to let students know the benefits of reusing containers. Reusing a container for water is much better than using individually bottled water, even if the container is recycled. This initiative will significantly reduce bottled water use and waste.

Table 21. Behavior and Campus Life: UUSA Prospective Actions

Actions/Measures	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Incorporate sustainability into the student budget board process	Making student organization budget proposals electronic	Minimal to get website database set up, savings would add up quickly	• Financial savings • Using less paper / saving trees
Continue the development of a green facility improvement plan	A currently being developed plan to incorporate more sustainability initiatives into practice	Minimal	• Savings in energy costs • Visual changes will demonstrate commitment to community members • Better indoor air quality
Add refilling stations for water bottles in student centers	Making stations available where students can refill their bottles with filtered water	UUSA estimates a cost of $1,000	• Builds sustainable culture • Less waste produced • Less consumption of petroleum based product

6. The Inn at Virginia Tech and Skelton Conference Center

A. History and Current Status

The Inn at Virginia Tech and Skelton Conference Center is, along with athletics, one of the most visible aspects of the university. Each year, multiple large conferences and alumni events take place there, and the facility is used as a gateway to the university. A representative from the Inn attended a sustainability lodging meeting this past summer and they joined the Virginia Green Lodging program in the June of 2008. Membership requires a commitment to five core activities: proving an optional linen service, recycling, water conservation, energy conservation, and offering green events, conferences, and meetings. There are many initiatives that the Inn has pursued to reduce their emissions from their operations including: replacing inefficient lighting with more efficient models, turning down temperatures in meeting areas during low use, having individual thermostats in each room, installing motion sensors, installing low flow water fixtures, purchasing recycling content paper products, and making recycling available to all of their staff and guests. They are also in conversation with a facility to begin composting all of their hotel and conference food waste.

There is a movement in the lodging industry to adopt more sustainable practices because fortunately, many sustainability initiatives result in monetary savings as well. Because hotels and the lodging industry in general are large consumers of energy and resources, implementing successful sustainability initiatives result in the prevention of pollution and greenhouse gases and the conservation of precious natural resources. There are many other benefits, in addition to monetary and environmental savings, including gaining a competitive edge in marketing, a higher long-term value of the property, improved air quality and health of employees, more satisfied customers, and an increase in business because of the new interest in sustainable tourism. A full list of all of their current sustainability efforts, a complete list of reasons to

practice green lodging, options for different projects, background on industry programs, and examples of successful programs can all be found in **Appendix K**.

B. The Inn: Prospective Actions: Immediate (2009-12)

1. Complete an energy and waste audit of the facility and develop an efficiency and conservation plan

Although the Inn is a new facility, many improvements could be made to improve its overall energy and resource efficiency. Operations can also be assessed to identify ways to cut down on waste. When energy and water efficiency products and conservation practices are introduced to operations, energy and resource costs are significantly reduced. Significant emissions reductions and lessened environmental impact can also be seen due to the reduced energy consumption, lessened consumption of resources, lessened amount of material being land filled, and less harmful chemicals entering the water system. Components of an efficiency and conservation plan include, but are not limited to: replacing all lighting with energy efficient models that can save on energy costs and cooling needs, installing motion sensors, reducing waste by turning off lights when not in use or when being used only as decoration, and installing low-flow water fixtures. A full list of conservation and efficiency measures, as well as ways to provide a more sustainable experience, can be found in **Appendix K**. A student intern, possibly studying hospitality, could be engaged in helping to develop this plan.

2. Provide a more sustainable experience for hotel and conference guests

There are many ways that the experience of hotel and conference center guests can be made more sustainable, while saving the hotel a lot of money. Some examples include: providing in-room recycling containers, providing in-room amenities in bulk instead of individual packages or not automatically providing shampoos in plastic bottles and other plastic items unless asked for by guests much as toothpaste and razors are done now, providing free newspapers by guest request only, using recycled paper products, utilizing filtered water stations to minimize the use of bottled water, making refillable containers available, and improving indoor air quality with low or no-VOC products. Having a more sustainable experience will not only attract more business, but it will have guests leaving knowing that the Inn is doing its part to lessen its impact on the natural world.

C. The Inn: Prospective Actions: Midterm (2013-25)

1. Implement the efficiency and conservation plan, maintain membership with the Virginia Green Lodging program, and consider joining the “Green” Hotels Association

After gauging where the facility stands in terms of energy consumption, resource consumption, and waste, steps can be taken to begin larger efficiency projects and initiate facility-wide conservation practices. The “Green” Hotels Association is a national organization committed to encouraging, promoting and supporting ecological consciousness in the hospitality industry. Joining these well-established groups will ensure more sustainable practices and show, visibly, a commitment from the facility. More detailed information on both of these programs is available in **Appendix K**.

Table 22. Behavior and Campus Life: IVTSCC Prospective Actions

Actions/Measures	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Conduct an energy and waste audit and develop an efficiency and conservation plan	Assess the facility and operations to identify best ways to reduce costs, emissions, and energy consumption.	Minimal – could engage student help in planning and development	• Understanding where biggest returns on investment are • Energy, costs, and emissions reductions
More sustainable experience for guests	Having sustainability amenities and aspects of conferences let guests know that operations are sustainable.	Minimal to significant depending on what projects are pursued	• Savings in energy costs and emissions • Attract business • Guests knowing the Inn is doing its part
Midterm (2013-25)			
Implement E&C plan and consider joining the "Green" Hotels Association	Begin large efficiency projects and initiate facility-wide conservation practices	Significant for the plan implementation, Minimal for the membership fee	• Savings in costs, energy, emissions • Shows a visible commitment and ensures compliance

7. Athletic Department

A. History and Current Status

Hokie athletics are one of, if not the most, highly visible aspects of our university and serves as a gateway view of Virginia Tech for all those that are not on campus. The athletic facilities are responsible for 6% of total campus electricity consumption; Lane Stadium itself is the second largest consumer of electricity, right behind the central chilled water plant. A major public statement could be made about the importance of sustainability to Virginia Tech by incorporating greener features to events, especially when events are being broadcast on national television. Engagement of and communication with fans, tailgaters, and alumni are an important opportunity to extend Virginia Tech's green efforts to all aspects of the Hokie community, while also educating the public.

In the past two years, the athletic department has teamed up with Mark Helms, Director of Buildings and Grounds, and Larry Bechtel, Recycling Coordinator, to address recycling at entrance two and inside the stadium on game day. This is addition to the placement of the large recycling containers in the close in parking lots that have been used for years. They also worked to collect recyclable material that was in the seating area of the stadium. Additional maroon and orange collection barrels had also been provided at main avenues of entrance into the stadium. At the request of the President's Office, recycling containers were provided for the President's suite on game days. During the Duke game this past fall, athletics worked with the Student Government Association to assist with picking up bags for recyclables that students distributed to tailgating groups. They also have been providing representation at the Energy and Sustainability Subcommittee meetings since the summer of 2008.

B. Athletics Prospective Actions: Immediate (2009-12)

1. Conduct a waste stream assessment of home football games

At athletic events, there are many areas that generate waste: the stadium, private boxes, and tailgating lots. With a team of student volunteers, an assessment of how much waste is being generated, how much of which materials are being generated, and extrapolating the benefits of a waste reduction and recycling program could be easily determined. This waste assessment would also be able to demonstrate the effectiveness of the recycling program, once implemented, and serve as a baseline for a long-term waste reduction strategy.

2. Develop an in-stadium and tailgating recycling and fan engagement program for home football games

At NC State University, Outreach Coordinator Ryan Powell explains that, "Now, as recycling has become embedded in the culture of our university, most of our fans have already taken the time to collect all of their recyclables when we come by… Wolfpack fans don't recycle because someone told them to – they do it because they understand that this is what we do at NC State University." Currently, access to recycling containers is very limited and they are not placed in convenient locations, which have made fan and tailgater participation minimal. Most of the items that are thrown away during tailgating activities are recyclable, and tons of materials could be saved from the landfill if they can be recovered. Of the 14 teams played this past season, 12 of them have active athletic event recycling programs. These teams, in addition to many of our peer institutions, have effective programs that could be adapted to implement in our stadium and tailgating lots. A pilot program could be run next fall season, with the intentions of full implementation of the program in the 2010 season. Development of a program will show visibly to all alumni, fans, and students a commitment from the athletic department and the university to more sustainable operations. Communication with and engagement of fans is key to a successful program. Details of their athletic recycling programs and logistics of a possible Virginia Tech program are listed in **Appendix K**.

3. Assess Athletic Department operations and develop an efficiency and sustainability plan

An assessment of department and building operations and practices should be conducted to identify ways to save money and reduce waste. Efforts have been made to minimize the use of lights in Lane Stadium when events are not occurring, and new strategies can be developed through this assessment. Efficiency and conservation measures can be paired for all athletic facilities and operations to save money, electricity, and emissions. Student interns could help to develop this plan.

C. Athletics Prospective Actions: Midterm (2013-25)

1. Assess waste generation after implementation of recycling program and develop a waste reduction strategy

After evaluating the success of the recycling program, consider the incorporation of composting bins into the resource recovery stations. Composting food waste instead of landfilling it will minimize the release of methane, a potent greenhouse gas, into the atmosphere. Develop a plan on how to reduce the overall amount of waste that is produced from events. Waste reduction strategies like providing bulk condiments versus individual packets, purchasing plastic cups that are recyclable, and

starting a reusable cup program for games, could save a lot of money and natural resources. Vendors could also be engaged by incorporating waste reduction strategies into their event contracts, and this will encourage them to generate items that are compatible with the event collection system. Student interns, through the student sustainability internship program, could help the athletic department evaluate operations and develop a plan.

D. Prospective Actions: Long term

1. Develop and implement a zero waste plan for all athletic events

Ideally, all materials could be recycled, reused, or composted after an event if it is planned with sustainability in mind. This will result at the peak of the implementation of the waste reduction strategy and sustainability plan.

Table 23. Behavior and Campus Life: Athletics Prospective Actions

Actions/Measures	Description/Rationale	Costs	Benefits
Immediate (2009-12)			
Waste stream assessment	Study to figure out how much of which materials are being generated at games. Helps in developing a waste reduction strategy.	Free – could be run by student volunteers	• Sets a baseline of waste generation • Benefits of a recycling program could be easily determined • Engages students in recycling
Game Day recycling program	In stadium and tailgating recycling program to collect recyclable material. Emphasizes and encourages sustainable behavior at athletic events.	Minimal – could be run by volunteers and small cost of bags	• Reduction in emissions • Diverts recyclable material from the landfill • Demonstrates to all students, faculty, staff, alumni, supporters, televised audience that VT is committed to sustainability
Operations assessment and development of an efficiency and sustainability plan	Assess facilities and operations to figure out where waste can be cut and more efficient practices can be incorporated	Free –could be a joint project between athletics and a student intern. Implementation will be the most costly part	• Savings in energy, emissions, and waste • Monetary benefits for waste reduction
Midterm (2013-25)			
Development of a waste reduction strategy	Assess waste generation and decipher best ways on how to reduce it	Free – could be a joint project between athletics and a student intern	• Reduction in amount of material being landfilled • Reduction in costs of hauler fees
Long Term (2026-2050)			
Zero Waste plan for all events	All materials from events could either be recycled or composted	Significant	• Reduction in emissions • No materials being landfilled

X. Academic Programs

A. History and Current Status[2]

In the mid-80s, the Center for Environmental Studies directed by UDP John Cairns in Biology was expanded to the Center for Environmental and Hazardous Materials Studies (CEHMS) and engaged additional faculty in engineering (John Novak), urban planning (David Conn), and political science (Richard Rich). Some projects resulted, but this collaborative effort diminished by 1990, and the Center has been dormant since Cairns retired in 1995.

In the early 1990s, David Conn was appointed special assistant for environmental studies to then-Provost Fred Carlisle. He organized several committees for enhancing academic programs, environmental literacy, interdisciplinary research, and campus environment. This effort produced some successes (such as the Environmental Policy and Planning degree and the Environmental Programs website), but resulted in more discussion than action. This position was eliminated when Carlisle retired and Conn moved on to another university.

In the early 1990s, Wayne Clough initiated the Green Engineering program in the College of Engineering as a unique effort to promote engineering approaches for environmental sustainability and to develop a curriculum for all engineering majors. Clough's departure reduced the commitment to the program, but it still remained an undergraduate concentration in the college and now is an undergrad minor with a significant increase in enrollment in 2008-09. A 2008 benchmarking study of Sustainable Engineering Education highlighted Virginia Tech's program:

> An exemplar of an institution with an unusually comprehensive approach to undergraduate education in sustainable engineering is Virginia Tech. At Virginia Tech, students from any undergraduate engineering program can choose a concentration related to sustainable (green) engineering. The students take a total of 18 semester credit hours of courses with sustainable engineering content: six hours within their major, 6 hours of interdisciplinary electives and 6 credit hours that are core to the option. The two core courses provide a general background in environmental science and an introduction to life cycle approaches to engineering problem solving. The consistent approach across all engineering departments and the common core courses, taken by engineers from all departments, make this program noteworthy.[3]

In the late-90s, then Provost Peggy Meszaros initiated the cross-cutting initiatives (CCI), a three-year campus-wide effort to develop seven interdisciplinary program areas, one of which was Energy and Environmental Systems (EES). The 20 member EES committee, chaired by John Randolph, explored opportunities to coordinate and elevate the university's related programs. As expectations for new resources for the CCI faded with state budget realities, the EES effort turned to a low-cost proposal for a "virtual" Virginia Tech Institute for Environmental and Energy Studies, basically a web presence that provided an overview of and links to Virginia Tech's related programs. Although the idea was endorsed by the Provost, no resources became available, and the website was never developed. In

[2] This section is taken from a discussion paper by John Randolph, Sept 2004: "Enhancing Coordination, Collaboration, and Visibility of Virginia Tech's Research and Academic Programs Related to Environmental Sustainability: *The Institutes for Environmental Sustainability at Virginia Tech*, *The Academic Programs for Environmental Sustainability at Virginia Tech*".

[3] Allen, D., et al. 2008. Benchmarking Sustainable engineering Education: Final Report. EPA Grant X3-83235101-0

the interest of keeping the effort alive, Richard Rich took on the role of place-holder director of the Institute, but no resources or additional university recognition have materialized.

In 2003, the Governor's office requested universities to submit research initiatives in three areas, including Earth and Environmental Sciences. Several deans, recognizing the university's collective strengths, encouraged the development of a cross-college initiative related to the environment. Jim Blair convened a small group of representatives from five colleges (John Randolph, Bill Knocke, John Novak, Don Orth, Jack Webster, Saied Mostaghimi, Tamim Younos) to develop a proposal on the theme of water, and that group developed a skeletal proposal titled "Water and Watershed Sciences." However, Blair decided to shelve the proposal because the short deadline provided insufficient time to complete a cross-college proposal, but he encouraged further work to develop ideas for better coordinating university environmental programs.

In 2003-04, several groups of faculty answered the call by the Provost for cluster hiring to strengthen the university's research expertise in interdisciplinary, cross-college areas. Several of these discussions centered on sustainability topics, ranging from environmental health to water to global environment to urban ecology and ultimately led to a proposed "cluster of clusters." While these discussions were useful to bring faculty together, few new positions materialized for cluster hiring, none in the environmental area.

In 2004, the Earth Sustainability (ES) program was piloted to a small group of freshmen. The two-year series is five course credits each semester under the four themes: Worldviews and Water; Energy and Shelter; Food and Agriculture; and Waste, Health, and Pathways to the Future. Completing the entire series fulfills university CLE areas 2 through 7. The third ES cohort in 2008-10 has grown to 150 students.

The 2006-12 University Strategic Plan is comprised of three scholarship domains of learning, discovery, and engagement. The discovery domain emphasizes four areas of immediate research focus, including Energy, Materials and Environment. To bring to life the research foci, the deans sponsored a series of Deans Forums that invited faculty and programs through campus to submit posters on related research and outreach for a one-day massive poster presentation. The first Forum in fall 2007 was on Energy and more than 120 posters by faculty and graduate students were displayed. The second Forum on Environment attracted more than 200 posters and led to a 226 page volume, *en**V**ironment innova**T**ions: Dean's Forum on the Environment*.

The university now boasts a comprehensive set of academic degrees, majors and minors related to sustainability (see **Table 24**), including environmental engineering; environmental science; environmental policy and planning; landscape architecture; humanities, science, and humanities; as well as many related majors in agriculture, natural resources, and the sciences.

In addition, the university hosts several research and outreach centers and institutes (see **Table 25**) that focus on specific aspects of environmental sustainability. These provide the foundation for sustainability-related research, but many faculty conduct such research outside of the center structure.

Table 24: Sustainability-Related Graduate & Undergrad Degrees, Minors, Concentrations

College of Agriculture and Life Sciences
- Agriculture and Applied Economics (conc: Environmental & Resource Economics)
- Biochemistry
- Biological Systems Engineering
- Crop and Soil Environmental Sciences (degree: Environmental Science)
- Entomology
- Horticulture
- Plant Pathology, Physiology, Weed Science

College of Architecture and Urban Studies
- Architecture (conc: Green Buildings)
- Landscape Architecture
- Urban Affairs and Planning (degree: Environmental Policy and Planning)

College of Engineering
- Civil and Environmental Engineering
- Green Engineering Program (minor)

College of Liberal Arts and Human Sciences
- Political Science (conc: Environmental Politics and Policy)
- Science and Technology in Society (degree: Humanities, Science and Environment)

College of Natural Resources
- Fisheries and Wildlife Sciences
- Forestry
- Geography

College of Science
- Biological Sciences
- Chemistry
- Geosciences

College of Veterinary Medicine
- Biomedical Sciences and Pathobiology

University-wide Minors and Graduate Certificates
- Environmental Politics & Policy
- Natural Resources
- Watershed Management

Table 25: Centers & Institutes Conducting Sustainability Related Research and Outreach

University Research and Outreach Centers:
- Center for Environmental and Hazardous Materials Studies (~1975, inactive since 1995)
- Center for Geospatial Information Technology (2002)
- Powell River Project (1980)
- Virginia Center for Coal and Energy Research (1977)
- Virginia Tech Museum of Natural History (1990)
- Virginia Water Resources Research Center (1965)
- Cooperative Extension Service
- Agricultural Research and Extension Centers

College and Departmental Centers:
- CAUS: Metropolitan Institute (Green Regions) (CAUS) (2001)
  Community Design Assistance Center (CAUS) (1988)
- COE: Center for Energy and the Global Environment (COE, ECE) (1994)
  Center for Geotechnical Practice and Research (COE, CEE) (1994)
  Energy Management Institute (COE, ME) (198?)
- CNR: Thomas M. Brooks Forest Products Research Center (CNR) (1990)
  Center for Earth Applications of Remote Sensing (CNR) (1998)
  Conservation Management Institute (CNR) (2000)
  Sustainable Engineered Materials Institute (CNR, WSFP) (2002)
  The Reynolds Homestead Forest Resources Research Center (CNR) (1970?)
  Catawba Sustainability Center
- COS: Environmental Toxicology Laboratory (COS, BIOL) (198?)
  Virginia Tech Stream Team (COS, BIOL) (198?)

A 2004 discussion paper on coordinating environmental programs provided the following lessons from past efforts:

1. Virginia Tech's environmental programs are very diverse and well established and involve many departments and colleges. Collectively, this is one of the university's strongest areas. However, it has been difficult to design a structure that organizes these programs in a centralized way because they are relatively autonomous, have established "turf," and have had individual success ("if it ain't broke, don't fix it").
2. In the meantime, however, several universities have been able to organize themselves in a centralized and visible way, often with lesser quality programs than ours, and that has given them some advantage in recognition and competitive research funding.
3. Promoting Virginia Tech's strengths in sustainability is worth pursuing for historical, principled, and pragmatic reasons. The university has a rich history in related fields of agriculture, life sciences, engineering, architecture, and natural resources. In principle, efforts to expand and disseminate knowledge of environmental sustainability, to enhance and protect human and ecological health for today's and future generations, has strong public and moral support. It is a good thing. And pragmatically, elevating these programs through coordination and visibility could attract additional recognition and the significant funding support emerging in the area from government and foundation sources.
4. Past successes in Virginia Tech's efforts to promote its related strengths have been tailored narrowly (e.g., CEHMS, Green Engineering, new degrees), while broad initiatives to centralize programs have been less effective (e.g., CCI EES suffered from a sometimes awkward mix of environmental programs with energy programs).
5. The success of any cross-college programmatic area involving multiple deans and academic vice-presidents (such as environmental or international programming that has instructional, research, and outreach dimensions) requires a strong commitment from higher administration and related deans and a strong champion or champions among department heads, center directors, and faculty.

Before giving prospective actions for Instruction and Learning, Research and Discovery, Outreach and Engagement, the following action recognizes the need for senior leadership for all sustainability-related academic programs.

B. Prospective Actions: Academic Programs: Immediate (2009-12)

1. Establish a Senior Fellow for Sustainability Programs or comparable position to develop and coordinate academic instruction, research, and outreach sustainability programs.

Virginia Tech has an impressive array of academic programs related to sustainability, but it continues to lack sufficient coordination to take advantage of growing instruction, research, and outreach opportunities in the sustainability field. A Senior Fellow reporting to the Provost or President could provide leadership for coordination, collaboration, fundraising, and new initiatives. This position could help establish coordinate the virtual Virginia Tech School of Sustainability (proposed below) and work closely with academic colleges and departments, related research and outreach centers, and the offices of the vice presidents for undergraduate and graduate education, research, and outreach and international affairs.

C. Prospective Actions: Instruction and Learning: Immediate (2009-12)

There are multiple ways to integrate sustainability considerations into instruction and learning curricula in the university. Annie Pearce, assistant professor of Building Construction, suggests six:[4]

- Infiltrate the Core: add sustainability components to all major courses and projects
- Add technical or general electives on sustainability-related topics
- Coordinate existing courses: string together into comprehensive program (e.g. Green Engineering minor, Earth Sustainability core)
- Sprinkle sustainability throughout fundamental courses (e.g., math, freshman English, physics)
- Provide opportunities outside the classroom (e.g., internships, service learning, Solar Decathlon)
- Integrate campus operations and use campus as sustainability laboratory

Individual departments need to decide how best to address sustainability in their programs, but there is also a need to provide guidance from the deans and provost level to encourage, facilitate, coordinate, and communicate the diversity of sustainability related instruction at Virginia Tech.

1. **Establish a *Virtual School of Sustainability at Virginia Tech* to coordinate sustainability-related instruction and learning programs.**

There is a need for greater coordination, collaboration and visibility of sustainability related academic programs. The *Virtual School of Sustainability at Virginia Tech* (VSVT) would be a web-based clearinghouse of all sustainability-related instruction and learning programs. It would provide links to specific majors, minors, and concentrations as well as profiles of specific programs. It would have a link from the Freshman Admissions webpage.

2. **Provide stable funding of marquee VT sustainability instructional programs: *Earth Sustainability* and *Green Engineering***

Two of the most prominent, unique, and increasingly popular sustainability-related programs on campus are *Earth Sustainability* and *Green Engineering*, but both programs do not have stable funding. It is a priority that these programs be base funded.

3. **Benchmark peer institutions and inventory VT undergraduate and graduate degree, minor, and certificate programs to identify gaps and opportunities to enhance offerings available to students**

The VCVT requires a full inventory of sustainability-related instructional programs. In addition we need to benchmark our programs against peer institutions if we plan to improve.

4. **Implement new sustainability minor(s), grad certificate(s), and consider literacy requirement for Virginia Tech students that could be fulfilled in a number of ways**

There are many ways to integrate sustainability into the curriculum, and campus-wide sustainability minor and graduate certificate that tap the wide array of existing courses would provide opportunities for students with minor investment. There is also a case that every student should acquire a level of proficiency about sustainability to understand the challenges they will face in coming decades and the

[4] Annie Pearce, Myers-Lawson School of Construction "Green Curricula and Green Workforce Development" presentation to Greening Virginia Campuses Conference, Virginia Tech, October 2008.

ways they can contribute to solving them, be they become engineers, doctors, scientists, teachers, financiers, designers, artists, or managers. This could be done in a number of ways, from high school credit to completion of a long list of sustainability-related courses, to a special 1-credit course co-taught by a number of faculty.

C. Prospective Actions: Instruction and Learning: Midterm (2013-25)

1. Implement recommendations from benchmark-inventory study in action 4 above

The benchmark and inventory study would reveal opportunities and recommendations for enhancing VT sustainability instruction programs. The Green Curriculum Coordinator should work with the Provost's office, Deans' offices, and relevant departments to implement these recommendations.

Table 26. Academic Overall & Instruction & Learning Programs: Prospective Actions and Impacts

Action/measure	Description/Rationale	Costs	Benefits
Immediate (2009-2012)			
Establish a Senior Fellow or comparable position to coordinate and develop research, instruction, & outreach sustainability programs	Focused position to take advantage of funding opportunities in sustainability research, outreach, instruction	Partial faculty salary	• Positions the university for increasing funding opportunities in sustainability research, curriculum and outreach • Fundraising for sustainability programs can endow programs and increase visibility
Establish a *Virtual School of Sustainability* to coordinate sustainability-related instruction and learning programs	A web-based clearing-house of all sustainability-related instruction and learning programs.	Small: GCC plus student interns	Greater visibility, coordination, collaboration of instruction programs
Establish a *Green Curriculum Coordinator* to develop the *Virtual School of Sustainability*	GCC coordinates programs and develops VSVT	Partial Faculty buy-out	Capacity to implement *Virtual School of Sustainability*
Provide stable funding of marquee VT sustainability instructional programs: *Earth Sustainability* and *Green Engineering*	Base funding for ES and GE which serve as primary vehicles to integrate sustainability into curriculum	Faculty and staff support	Both programs currently generate large enrollments and are growing rapidly.
Benchmark peer institutions and inventory VT undergrad and grad degree, minor, and certificate programs to identify gaps and opportunities to enhance offerings available to students	University needs a full inventory of programs and good ideas borrowed from peer institutions	Small: inventory by student intern; BM by GCC, faculty	Good information to improve programs
Implement campus-wide sustainability minor, graduate certificate; consider literacy requirement	Multi-path approach to assure all VT students understand the challenges & solutions of their planet	Small	Sustainability not just for a few majors but for all VT students
Midterm (2013-25)			
Implement recommendations from benchmark-inventory study	Improve/initiate instructional programs	Small to large	Advance VT in sustainability instruction & learning

D. Prospective Actions: Research and Discovery: Immediate (2009-12)

Although as a nation we are currently in a financial crisis, the global economy is in a tailspin, and state budget cuts loom large for the foreseeable future, the outlook for research funding in sustainability related fields is surprisingly bright, especially green energy, green infrastructure, climate change, carbon capture and storage, and related fields. The Obama Administration is expected to find money to support research and development in these areas, and Virginia Tech should be prepared to take advantage of these funding opportunities.

1. Retain the Special Assistant for Energy Initiatives position in OVPR

The Special Assistant and the Faculty Fellow positions in OVPR have provided effective coordination and communication of university research related to energy and sustainability. The first two successful Deans Forums demonstrated the range of energy and environmental research going at the university. Improved research collaboration across disciplines can increase funding which is growing rapidly in this field.

2. Promote new research in energy efficiency and sustainability using the university campus as a laboratory and using undergraduate research.

The campus provides a great laboratory for undergraduate research which can address the many inventory, monitoring, and analysis tasks of this plan relating to facilities, transportation, buildings, and campus life.

3. Benchmark peer institutions and inventory VT sustainability-related research expertise, centers, and institutes to identify gaps and opportunities to enhance sustainability research funding

Continue to monitor and communicate VT sustainability research and compare benchmark peer institutions to identify opportunities to advance our programs.

E. Prospective Actions: Research and Discovery: Midterm (2013-25)

1. Implement recommendations from benchmark-inventory study in action 4 above

The benchmark and inventory study would reveal opportunities and recommendations for enhancing VT sustainability research programs. The Special Assistant for Energy Initiatives should work with the VP for Research and relevant centers, institutes and departments to implement these recommendations.

Table 27. Academic Research & Discovery Programs: Prospective Actions and Impacts

Action/measure	Description/Rationale	Costs	Benefits
Immediate (2009-2012)			
Retain the Special Assistant for Energy Initiatives position in OVPR	Point person for energy and sustainability research initiatives	Partial Faculty buy-out	Positions VT to take advance of growing research funding in this area
Promote new research in energy efficiency and sustainability using the university campus as a laboratory and using undergraduate research	Develop undergraduate research program in energy and sustainability using campus as laboratory	Small	Undergraduate research projects focused on making improvement to campus facilities, buildings, transportation, and culture.
Benchmark peer institutions and inventory VT sustainability-related research expertise, centers, and institutes to identify gaps and opportunities to enhance sustainability research funding	University needs a full inventory of programs and good ideas borrowed from peer institutions	Small: inventory by student intern; BM by SAEI	Good information to improve programs
Midterm (2013-25)			
Implement recommendations from benchmark-inventory study	Improve/initiate research programs	Small to large	Advance VT in sustainability research & discovery

F. Prospective Actions: Outreach and Engagement: Immediate (2009-12)

Like research and discovery, there are huge opportunities for sustainability-related outreach and engagement programs in the coming decades. “Green jobs” is a buzzword of the day and professional and continuing education and green job training programs should enjoy increased funding opportunities.

1. Establish a *Sustainable Development Coordinator* in Office of Outreach and international Affairs

The Sustainable Development Coordinator would be drawn from existing faculty and would have a partial appointment to work with the Office of Outreach and International Affairs to coordinate sustainability outreach initiatives, professional education, and green workforce training programs. Cost of the coordinator would include some teaching release and summer salary. The position would be similar to the Special Assistant for Energy Initiatives in OVPR.

The position would work across the university coordinating and adding visibility to the large array of existing related outreach efforts and identify opportunities for new initiatives and grant prospects for funding them.

2. Develop a Green Jobs Training Program in Continuing and Professional Education

The Sustainable Development Coordinator should work with related departments and faculty to develop a Green Jobs Training Program. External funding should be available to help support this program.

3. Identify a Green Jobs Coordinator for Career Services

Because of the national and state emphasis on green jobs and expected financial incentives for this employment sector, it is important that graduating Virginia Tech students have access to the best available green job information through Career Services.

Table 28. Academic Outreach & Engagement Programs: Prospective Actions and Impacts

Action/measure	Description/Rationale	Costs	Benefits
Immediate (2009-2012)			
Establish a *Sustainable Development Coordinator* in Office of Outreach and international Affairs	SDC coordinates/develops sustainability outreach & green training professional education programs	Partial Faculty buy-out	Point person to coordinate and initiate sustainability-related outreach programs
Develop a Green Jobs Training Program in Continuing and Professional Education	Significant funding should be available for Green Job development	Pro-motion costs	Significant revenue generation opportunities
Identify a Green Jobs Coordinator in Career Services	Assist VT students in seeking growing market for green jobs	Assign to staff	Provide information on green job opportunities for VT students and graduates

XI. Future Energy and GHG Emission Scenarios for Virginia Tech

The wide array of measures presented above illustrates the opportunity not only to improve the design and operation of Virginia Tech's physical infrastructure toward greater efficiency and less reliance on carbon energy, but also to change the culture of the institution toward greater awareness of the impacts of our actions on the fiscal health of the university and the environmental health of our community and our planet. The Virginia Energy Plan calls on the state's universities to "lead by example by implementing energy-efficiency actions across their campuses. These actions will not only reduce energy use and lower energy bills but will also help educate our next generation of leaders on how to manage energy wisely in their lives."

What will the future of the Virginia Tech look like in terms of sustainability? Well, it depends…

- It depends on the internal will of the students, staff, and faculty to adopt smart, less wasteful patterns of material and energy use…
- It depends on the will of higher administration to adopt policies that foster greater efficiency of energy, water and material use…
- It depends on the advance of cost-effective efficient and carbon-free energy technologies, either through technological breakthrough, increased cost of carbon-based fuels, or both…
- It depends on the availability of resources to invest in cost-effective measures to improve efficiency and reduce and replace carbon-based energy…
- It depends on external events and decisions of our energy utility providers and of state and federal governments.

One way to characterize possible futures is to identify two driving forces that are likely to affect the future and to articulate scenarios determined by different outcomes of these forces. This technique of scenario development has been popularized by the Global Business Network (www.gbn.com) and it has become increasingly popular in planning circles because it embraces uncertainties and focuses on the power of individuals, institutions, and communities to effect change and their future.

From the list above, two composite driving forces for the sustainability future of Virginia Tech are

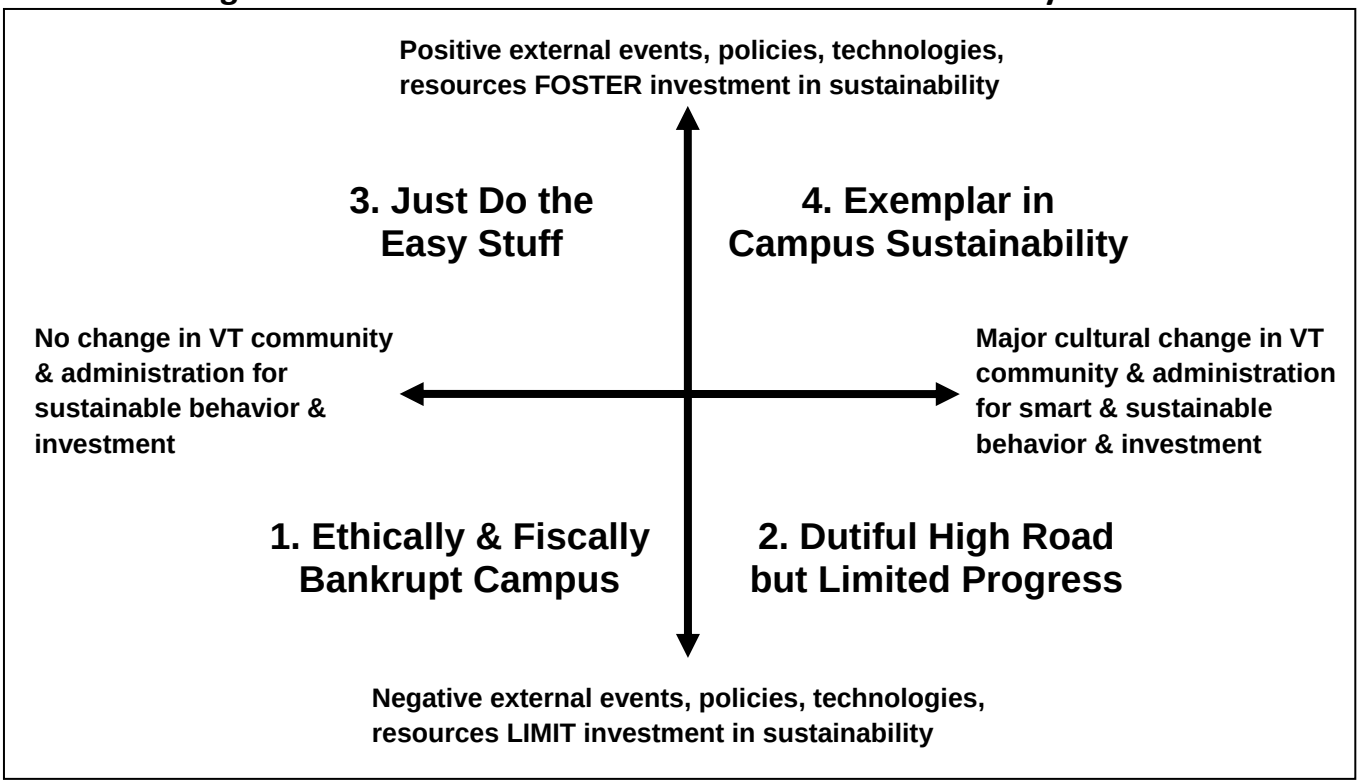
- the internal will of the university community and administration
- the external events, policies, technological development, and available resources for sustainability

Placing these driving forces on a two-by-two matrix defines four future scenarios in four quadrants shown in **Figure 21**:

5. **Ethically, Fiscally Bankrupt Campus**: a combination of negative external forces and no change in campus culture for sustainability lead to a future on dramatically increasing energy and carbon costs and a campus community that follows rather than leads.
6. **Dutiful High Road but Limited Progress**: if campus culture changes but external forces, especially resources, are limited, the community will do what it can but will be frustrated about its limited progress.

7. **Just Do the Easy Stuff**: with positive external forces, the campus will invest in easy fixes but without a culture change affecting community behavior and administrative policy, the easy stuff will have limited impact.
8. **Exemplar in Campus Sustainability:** a combination of positive internal change and external forces would positive Virginia Tech to be a leader for the Commonwealth and the nation, driving down energy use and emissions and creating a more livable and enjoyable campus environment.

Figure 21 Possible Future Scenarios for VT Sustainability



XII. VTCAC: Targeting Energy Savings and Emission Reduction

The Virginia Tech Climate Action Commitment (VTCAC) is presented here in two parts:

a. a commitment to take necessary steps to achieve specific targets for energy savings and GHG emission reduction, and
b. a resolution specifying the rationale for the commitment and necessary steps to move toward those targets

Section XII addresses the targets and goals. Section XIII provides an assessment to meet the target reductions. Section XIV contains the statement of the Virginia Tech Climate Action Commitment in resolution format.

The commitment begins by setting targets for GHG emission reductions achieved primarily through energy savings but also through reduction of water and material consumption, diversion of landfill waste through recycling and expanding the campus tree canopy. The selection of these targets is informed by those set by the Commonwealth of Virginia and the federal government, as well as other universities and localities. Alternative targets include:

1. The 2007 Virginia Energy Plan (VEP) and 2008 Governor's Commission on Climate Change (GCCC) target of reducing emissions to 2000 levels by 2025.
2. The GCCC endorsed long term target of reducing emissions to 80% below 1990 levels by 2050. This target is recommended by the Intergovernmental Panel on Climate Change (IPCC) and has also been adopted by the Town of Blacksburg, the Obama administration, and several proposed bills in Congress.
3. The American Colleges and Universities Presidents Climate Commitment of "climate neutrality" by a date specified by the institution's climate action plan.

The targets recommended for the commitment are illustrated in **Figures 22** and **23**. As shown in **Figure 22** the VTCAC adopts the VEP and GCCC target for 2025. For Virginia Tech, that is 255,000 tons CO_2, or about 19% less than 2006 emissions as estimated by the GHG Emission Inventory. The VTCAC also has an interim short-term target for 2012 of 295,000 tons, or about 7% less than 2006. This target follows the straight-line path toward the 2025 target.

As a long-term goal, the VTCAC adopts the emission reduction target of 80% below 1990 levels, the target recommended by the IPCC, and adopted or endorsed by the Obama administration, GCCC, the Town of Blacksburg and many other communities. For Virginia Tech that would be 38,000 tons of CO_2. (See **Figure 23**.)

This level of emissions reduction by 2050 would make possible the achievement of climate neutrality or zero net emissions of carbon through further reductions or purchase of carbon offsets. Current rates for carbon offsets are about $2/ton on the Chicago Carbon Exchange and $15-20/ton on the European Climate Exchange. If the 2050 target were achieved, the cost of achieving zero net emissions through offsets would be $76,000-750,000 at those rates.

Are these targets achievable? The intent of this plan is to show that we can move on the path toward these targets, but that it will be difficult to achieve them without fundamental changes in the patterns of energy use locally and nationally. Beyond what we can achieve from the measures provided in this plan, achieving these targets requires aggressive federal and state efficiency mandates for vehicles, buildings and equipments; improved cost-effective efficiency and renewable energy technologies; changes in the energy sources both on campus and from utility providers; a cost on carbon that will drive investments toward efficiency and renewable energy; and other changes we cannot imagine. Part XIII provides an analysis estimating the emission reductions from many of the actions recommended by this plan and identifies gaps in achieving the targets that must be filled with currently unknown measures. These gaps are expected since we cannot today envision all of the possibilities 10-40 years from now. The analysis does show that the actions of this plan can help meet our interim 2012 target which is on the straight-line path to the 2025 target.

Figure 22 **Virginia Tech GHG emissions**

Real data 2000-2006, extrapolated back to 1990, projected forward to 2025
Virginia Energy Plan Goals to 2025

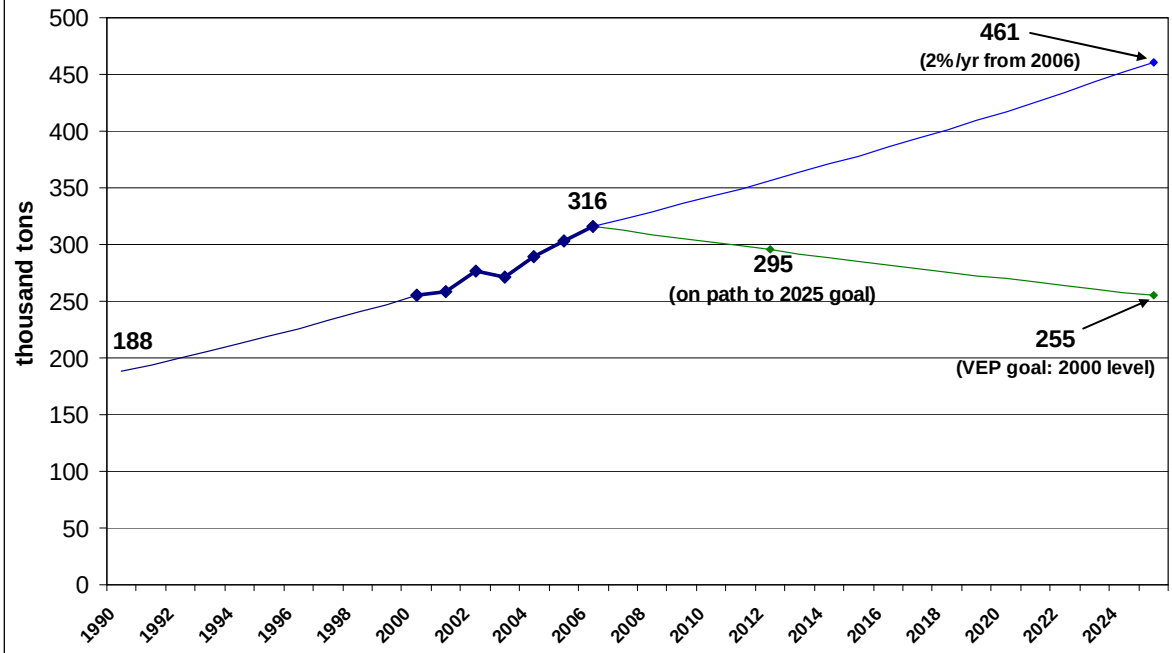
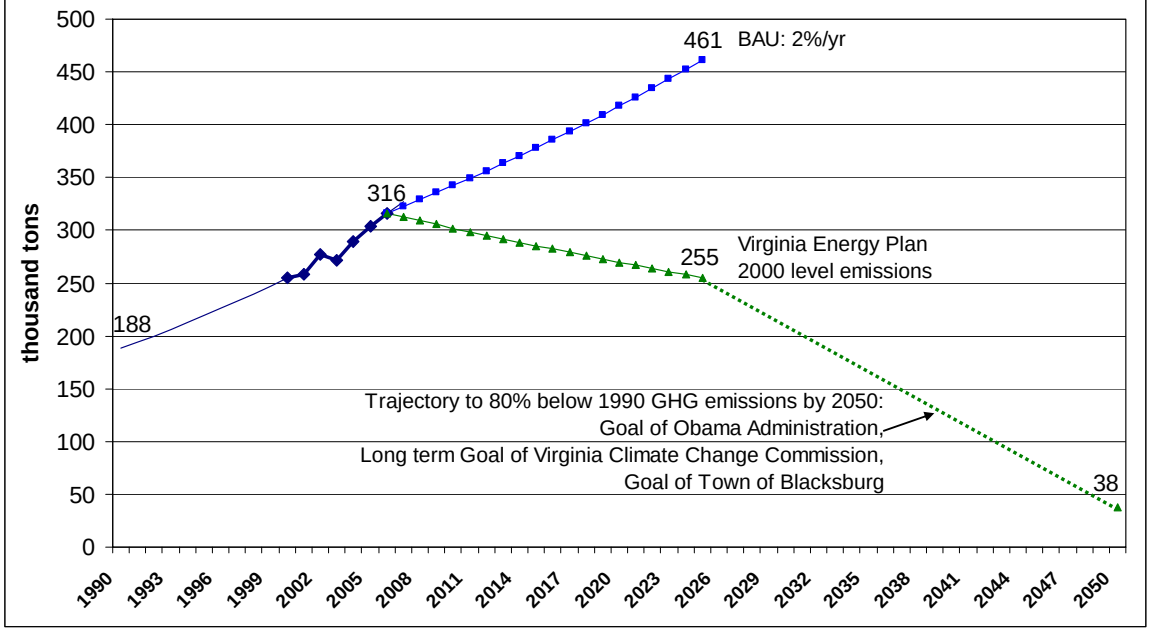


Figure 23 **Virginia Tech GHG emissions**

Real data 2000-2006, extrapolated back to 1990, projected forward to 2025
Virginia Energy Plan Goal to 2025, Various Goals to 2050



XIII. Achieving the VTCAC: Assessing Actions to Meet Emission Reduction Targets

It is important to assess the prospective actions of VTCAC &SP for meeting the goals and targets of the commitment. This plan was developed in only six months and has a very long time horizon. Although it involved a large number of people and aimed to be comprehensive, it is limited by the capacity of the participants and the uncertainties of the future. The list of prospective actions is long, but cannot be expected to include the full range of possibilities that the future will hold for reducing energy and waste and replacing carbon-based fuels. Future measures that are currently unknown will certainly complement the log list of strategies presented here. Therefore, it is important that this plan become a living document subject to continual review, critique, and revision as results of monitoring become known and new options are devised.

Still it is important to assess the measures contained in the plan to see how well they contribute to energy and emission targets of the commitment. For this purpose, we used a "solution wedge" approach that aims to see how the cumulative effects of different actions contribute to the targets. The first step in this process is to review the GHG emission inventory and estimate emissions from end use sectors addressed by the prospective actions. **Table 29** gives an estimated breakdown of GHG emissions for different end uses and some notes indicating how they were derived. **Figure 24** shows the distribution of emissions in a pie chart.

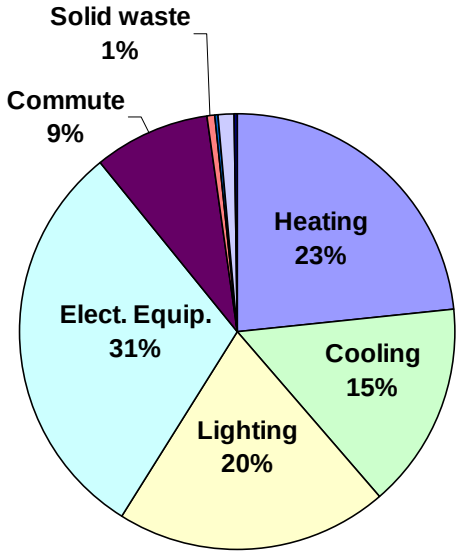


Figure 24. VT 2006 GHG Emissions by End-Use

Table 29. Virginia Tech 2006 GHG Emissions by End Use

2006 GHG emission by end use			
End use	**GHG**	**%**	
Heating	74	23%	60% of NG + 78% steam plant fuel
Cooling	48	15%	24% of electricity (central chiller is 8-9% and is 37% of total chiller capacity)
Lighting	64	20%	based on national figures that lighting is about 40% of non-heating and cooling electricity for non-mall commercial buildings
Elect. Equip.	96	30%	60% of non-heating and cooling electricity for institutional bldgs
Commuting	27	9%	
Solid waste	2	1%	
Water, WW	1	0%	
Fleet	3	1%	
Aviation	1	0%	
TOTAL	316	100%	

Using estimates of savings related to these end uses from the specific actions and the timing of those actions (immediate, mid-term, and long-term), solution wedge diagrams were developed in a large spreadsheet model based on ICLEI climate action planning software. Those diagrams are given in **Figures 25-28**. A description of the methodology and the spreadsheet is given in **Appendix M**. A complete list of VTCAC&SP Action Strategies is presented in **Appendix N**.

Figure 25 focuses in the short-term immediate period of 2009-2012. It shows the 2000-2006 emissions, the 2%/year business-as-usual (BAU) projection, and the target for 2012, as given in **Figure 22** (p. 96). Various prospective actions related to the facilities infrastructure and operations (heating, cooling, lighting, on-site generation, new and existing buildings), behavior of building occupants (lighting, equipment), alternative transportation (transport), and recycling (solid waste), set us on a path to the 2012 target. The biggest wedge comes from savings in lighting energy due to relamping with more efficient lights and a campaign to turn off lights when not in use.

Figure 26 focuses on the mid-term period of 2013-2025. This assessment is conservative since it assumes continued 1%/year growth in BAU emissions and subtracts wedges from that 2025 end point of 336,000 tons. Here the biggest savings come from cooling, equipment, new and existing buildings, on-site generation, transportation, and campus tree canopy. But these measures fall well short of the needed reductions to achieve the 2025 target and the largest wedge to meet the target is "unknown." It is assumed that external forces and new technologies can fill this wedge.

Figure 27 focuses on the long-term period 2026-2050, which shows a BAU growth of 0.5%/yr. Major savings are estimated from on-site generation, existing building renovation, and heating system changes, but again the unknown wedge is the largest. **Figure 28** combines these figures into one.

Figure 25

Campus GHG Emissions Projected to 2012
Estimated reductions from VTCAC Recommended Actions

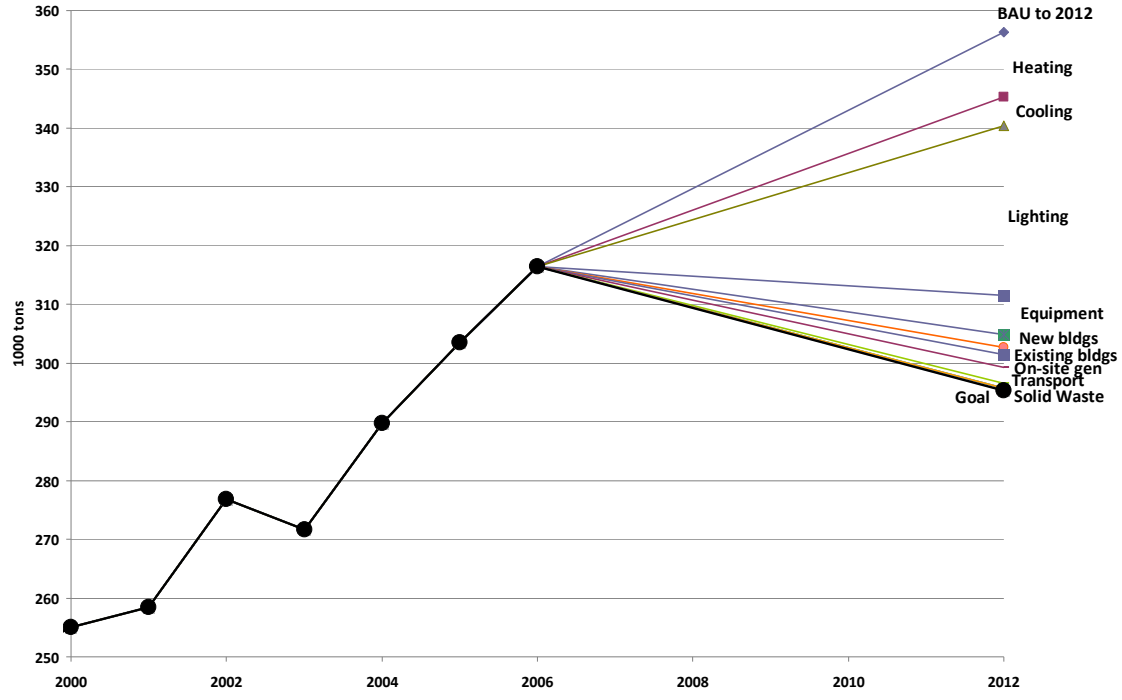


Figure 26 Campus GHG emissions Projections from 2012 to 2025

Estimated reductions from VTCAC Recommended Actions

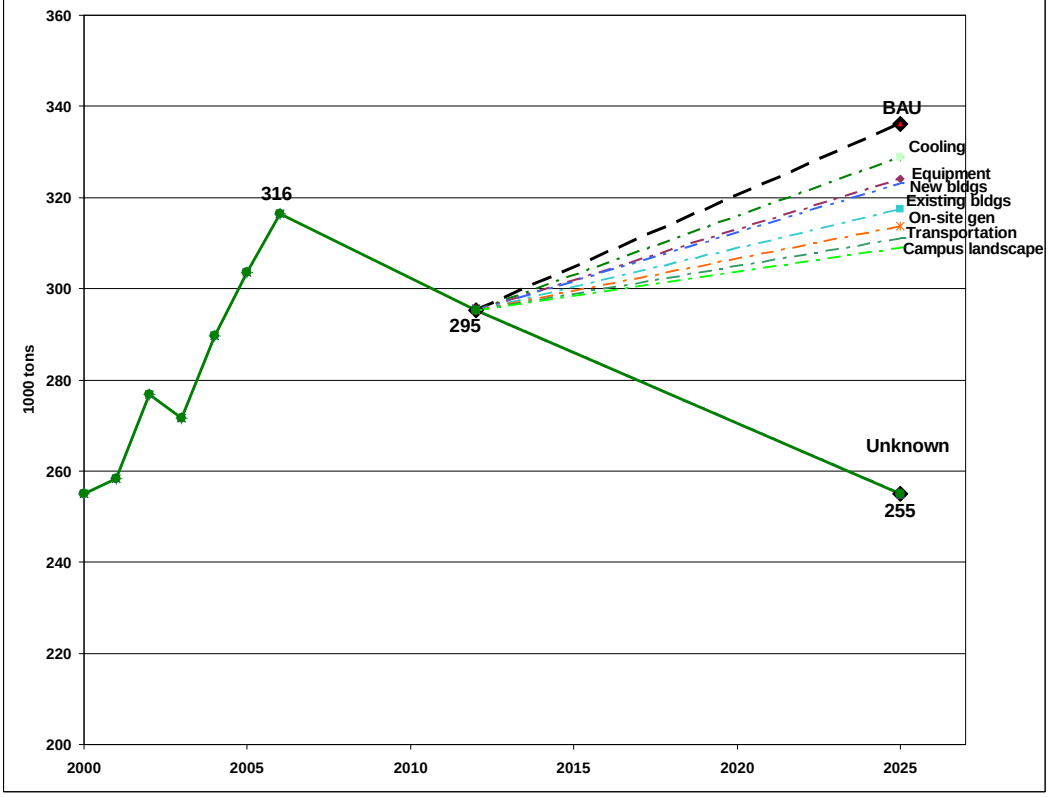
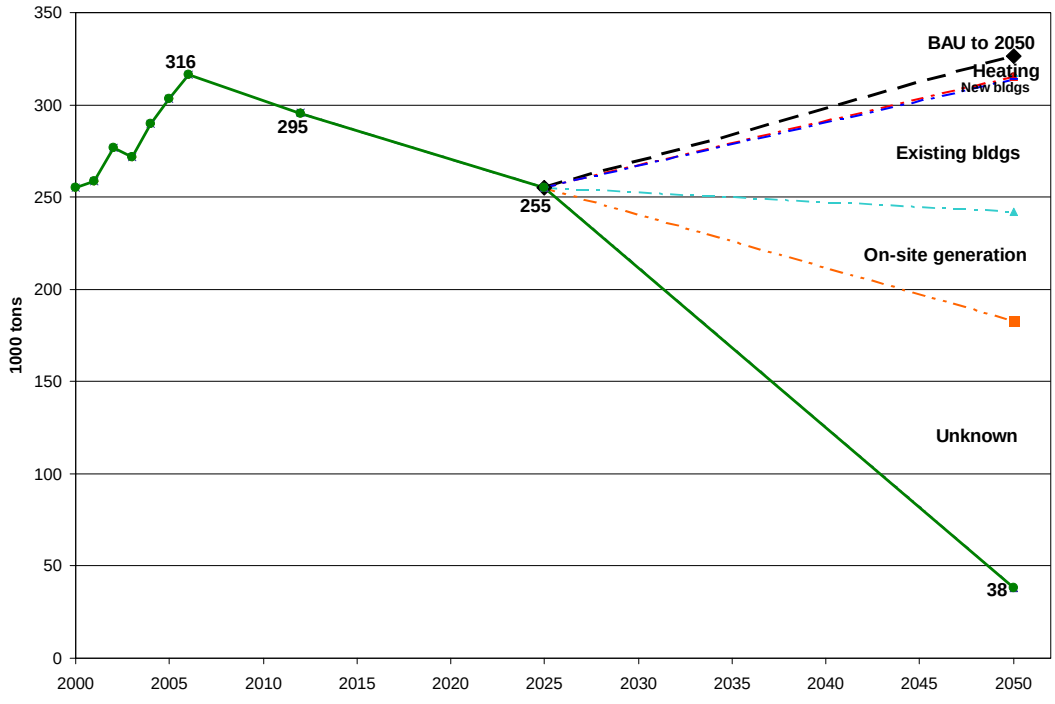


Figure 27 Campus GHG emissions Projections from 2025 to 2050

Estimated reductions from VTCAC Recommended Actions



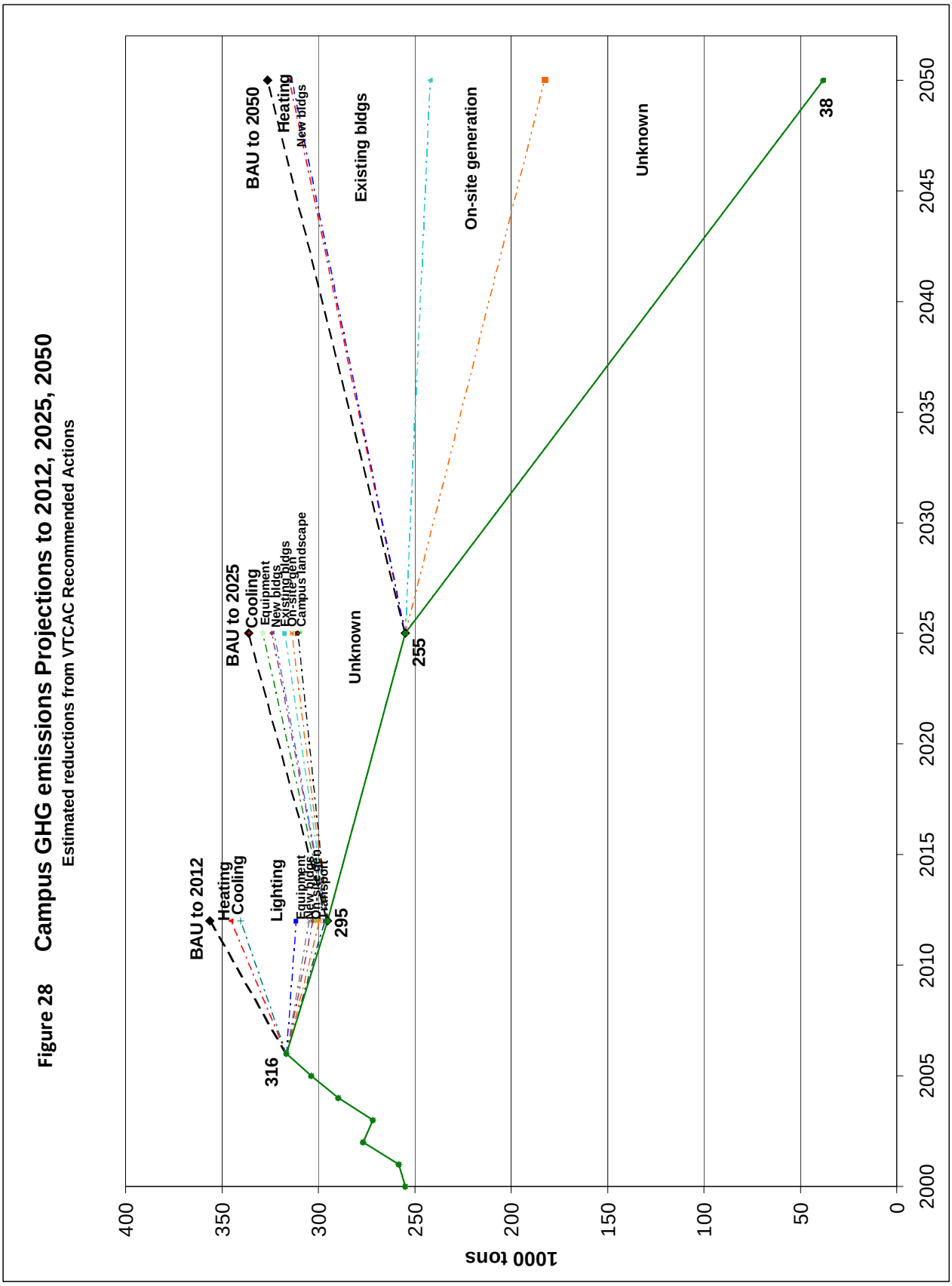


Figure 28 Campus GHG emissions Projections to 2012, 2025, 2050
Estimated reductions from VTCAC Recommended Actions
1000 tons
400
350
300
250
200
150
100
50
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
BAU to 2012
Heating
Cooling
Lighting
Equipment
New bldgs
Existing bldgs
Campus landscape
Transport
316
295
BAU to 2025
Cooling
Equipment
New bldgs
Existing bldgs
Campus landscape
Unknown
255
BAU to 2050
Heating
New bldgs
Existing bldgs
On-site generation
Unknown
38

XIV. The Virginia Tech Climate Action Commitment

Whereas, in December 2007 President Steger met with students about the Presidents Climate Commitment, and in April 2008, President Steger charged the Energy & Sustainability Committee with drafting a Virginia Tech Climate Commitment and sustainability plan;

Whereas, Virginia Tech's electricity bill increased 54% from $8.2 to $12.6 million from 2004 to 2008 at a time of major state budget reductions, and electricity rates are expected to increase;

Whereas, efforts to reduce electricity and energy use and related greenhouse gas (GHG) emissions also reduce the rising costs of energy;

Whereas, the 2007 Virginia Energy Plan and 2008 report of the Governor's Commission on Climate Change call on the Commonwealth to reduce its GHG emissions to 2000 levels by 2025;

Whereas, the Governor's Commission, Governor Kaine, the Town of Blacksburg, the Obama administration, and countless states, cities, and campuses across the country, have endorsed a long term target for GHG emissions of 80% below 1990 levels by 2050;

Whereas, the Virginia Division of Engineering and Buildings issued new rules in December 2008 requiring all new state buildings and major renovations to achieve either LEED certification or a 30% improvement in energy performance over ASHRAE 90.1 2004 and other requirements;

Whereas, the Governor's Commission calls on the state agencies to lead the Commonwealth to lower emissions by example, and Virginia Energy Plan also calls on the state's universities to "lead by example by implementing energy-efficiency actions across their campuses. These actions will not only reduce energy use and lower energy bills but will also help educate our next generation of leaders on how to manage energy wisely in their lives;"

Whereas, many colleges and universities throughout the country have joined this "lead by example" challenge and joined a national movement to "green" university campuses; 606 have signed the American Colleges and Universities Presidents Climate Commitment, including 7 ACC schools, 15 Virginia colleges, 16 top 50 research universities, and 26 land grant institutions; and

Whereas, Virginia Tech is the premier technical and design university in the Commonwealth and should take on this leadership role, exceed minimum state standards, and demonstrate emerging technologies and management approaches to reduce energy consumption and costs and reduce GHG emissions; and

Whereas, Virginia Tech has adopted Campus Energy and Water Policy 5505 that establishes a foundation for this commitment regarding efficient use of energy on campus.

Whereas, 18 Virginia Tech student organizations are members of the Campus Coalition for Sustainability and student, staff, and faculty interest in sustainability issues is at an all-time high;

Let it be resolved:

That the university shall adopt the following Virginia Tech Climate Action Commitment:

1. Virginia Tech will be a Leader in Campus Sustainability.
2. The university will represent the VTCAC&SP in the Virginia Tech Strategic Plan.
3. Virginia Tech will establish a target for reduction of campus GHG emissions to 80% below 1990 emission level by 2050, and interim targets from 2006 emissions of 316,000 tons consistent with the Virginia Energy Plan, the Governor's Commission on Climate Change, the Town of Blacksburg, and the federal administration: for 2012, 295,000 tons (on path to 2025 target); for 2025, 255,000 tons (2000 emission level); and for 2050, 38,000 tons (80% below 1990 emission level).
4. Virginia Tech will work toward these emission reduction targets through improved energy efficiency, reduction of energy waste, replacement of high-carbon fuels, and other measures identified in the VTCAC&SP.
5. Virginia Tech will establish an Office of Sustainability to
   a. Coordinate programs for campus sustainability,
   b. Oversee implementation of the VTCAC&SP,
   c. Monitor annual electricity and other energy use and GHG emissions, and
   d. Working with faculty and departments, manage a campus-wide student internship and undergraduate research program using the campus as a sustainability laboratory
6. Virginia Tech will pursue LEED Silver certification or better and exceed ASHRAE 90.1 2004 energy performance by 35% (ASHRAE 90.1 2007 by 30%) for all new buildings and major renovations. Capital budgets should account for future energy price, cost of building operation, return on investment, and environmental benefits of achieving this level of performance.
7. Virginia Tech will improve electricity and heating efficiency of campus facilities and their operations, including the heating and cooling infrastructure and operation, lighting efficiency, controls and operation, and equipment efficiency and controls.
8. The university will adopt at least 4 reduction measures in the Waste Minimization component of the national RecycleMania competition. Virginia Tech Recycling will adopt a goal of 35% recycle rate by 2012 and 50% by 2025.
9. Virginia Tech will require purchase of Energy Star rated equipment, maximum practicable recycled-content paper, and other low life-cycle cost products, with exceptions for special uses.
10. Virginia Tech will engage students, faculty and staff through education and involvement to reduce consumption of energy, water, and materials in academic and research buildings, dining and residence halls, and other facilities.

11. Virginia Tech will improve transportation energy efficiency on campus through parking, fleet, and alternative transportation policies. Alternative transportation use will increase from the current level of 45%, to a goal of 52% in 2015, and 60% in 2020.

12. The university will create and support a virtual Virginia Tech School of Sustainability or similar mechanism to coordinate, develop, and communicate related instructional, research, and outreach academic programs.

13. The university will monitor energy use and GHG emissions as well as changing internal and external conditions, prepare an annual 'report card' showing progress towards targets, and periodically re-evaluate targets, making adjustments to targets as appropriate based on changing internal and external conditions and evolving technologies.

14. With regard to all the items in this resolution, major personnel and investment decisions, including capital projects, associated with implementing the VTCAC&SP will be based on a joint review of costs and benefits by university financial and facilities staff and be subject to availability of funds. Virginia Tech will provide funding to support sustainability programs through a variety of sources, which might include savings from reduced electricity and energy fuels, E&G funds, loans, a Green Development Fund from private sources, and a student Green Fee.

APPENDICES

APPENDIX	DOCUMENT
A	President Charles W. Steger's Charge Memo to the E&S Committee and Letter to the Environmental Coalition
B	The American College and University President's Climate Commitment (PCC)
C	Governor Executive Order 48 (2007) "Energy Efficiency in State Government"
D	Energy and Sustainability Committee (2008-2009) Roster
E	VTCAC&SP Subcommittee Roster
F	Urban Affairs and Planning Course Student Workshop and Results
G	Virginia Tech's Campus Sustainability Report Card 2009 rating from SEI
H	The Talloires Declaration
I	Campus Energy and Water Policy 5505
J	VA Division of Engineering and Buildings (DEB) Notice 120108
K	Behavior and Campus Life
L	Hokies 4 the Future Sustainability Living Guide
M	Solution Wedge Methodology
N	List of the VTCAC&SP Action Strategies

Appendix A:

VirginiaTech

Charles W. Steger, President

210 Burruss Hall (0131)
Blacksburg, Virginia 24061
540/231-6231 Fax: 540/231-4265
E-mail: president@vt.edu
www.vt.edu www.president.vt.edu

Memorandum

TO: Members of the University Committee on Energy and Sustainability

FROM: Charles W. Steger

DATE: April 25, 2008

SUBJECT: Drafting the Virginia Tech Climate Commitment

In the attached letter that I sent to the members of the Environmental Coalition on April 23, I laid out the rationale for my determination that Virginia Tech would be better served by developing a sustainability plan that is specific to Virginia Tech than by my signing the generic President's Climate Commitment. Given the long-term impact that the Virginia Tech Climate Commitment will have on the policies, operations, and budget of the university, securing the support of the university community through the governance system is critical to its successful implementation.

Accordingly, I am assigning to the Committee on Energy and Sustainability the important responsibility of developing a draft Virginia Tech Climate Commitment. This plan should be developed in close collaboration with and under the guidance of the Vice President for Administrative Services, Dr. Sherwood Wilson, and his staff. The plan should outline clear, measurable, and realistic goals. I would like to be briefed by the Committee chair at regular intervals while the plan is being developed. I am requesting that the Committee complete the draft plan by the end of the Fall Semester 2008, and submit a copy to the Commission on University Support and to me.

The next step would be for the Commission on University Support to review and approve the plan in resolution format, and then to send the resolution forward to University Council for action. As you know, University Council acts in an advisory capacity to the President. The goal is for University Council to act on the resolution prior to the end of the Spring Semester 2009.

Thank you in advance for the tremendous contribution you will be making to the university and future generations of students, faculty, and staff through this important work.

Enclosure

cc: Commission on University Support

VirginiaTech

Charles W. Steger, President

210 Burruss Hall (0131)
Blacksburg, Virginia 24061
540/231-6231 Fax: 540/231-4265
E-mail: president@vt.edu
www.vt.edu www.president.vt.edu

April 23, 2008

Dear Members of the Environmental Coalition,

I regret that I could not be with you for the Green Event yesterday, but having had the opportunity to meet you in December, I was confident that the event was exceedingly well organized and would be a success. I am also grateful to Denny Cochrane for representing me.

The presentation that you made in December was highly impressive, and I have considered your points carefully. As I pledged to you at that time, if I make a promise, I intend to keep it. I do not make empty promises. That is why I asked our Vice President for Administrative Services, Dr. Sherwood Wilson, to examine the cost implications before I would make a decision.

Two particular tenets of the President's Climate deserve close examination. First is the commitment to carbon neutrality, which cannot be taken lightly. I have been advised that it is not feasible for Virginia Tech to accomplish this using current technology without purchasing carbon credits on the open market to offset our carbon production. Based on the university's carbon footprint of over 280,000 tons of CO_2 annually and the current market price per carbon credit, the additional cost to achieve climate neutrality could approach $2 million annually. This assumes a 25 percent reduction in carbon emissions through engineering and behavior modifications.

Second is the requirement to purchase or produce at least 15 percent of our electricity from renewable sources within one year. Although it is technically possible to purchase 15 percent of the university's electricity from renewable resources within one year, the premium price on green power would exceed $1 million annually.

I must consider these costs in the context of the university's strategic plan and all of the *critical* initiatives that are under way or planned to support that plan, coupled with the unplanned expenditures—and the overall impact on tuition. The unplanned expenditures include nearly $10 million that the university has expended to deal with the tragedy of April 16, 2007, and to begin to implement the recommendations contained in the Governor's Panel's Report as well as our three internal studies. These expenditures will grow significantly as we continue with the implementation. Moreover, state support for higher education in Virginia in general and for Virginia Tech in particular continues to decline. Total state funding for Virginia Tech is less today than seven years ago, even though enrollment is higher. Adjusted for inflation, this represents a loss of 23 percent of buying power. In 2000-01, the state provided 59 percent of the cost of education at Virginia Tech; this year, that support is only 41 percent. By the state's own calculation, Virginia Tech is underfunded (base budget adequacy) by more than $64 million annually.

Taking all of these factors into consideration, my decision is not to sign the generic President's Climate Commitment. Rather, I will ask the university's Committee on Energy and Sustainability that was created last year to assume the task of developing a Virginia Tech Climate Commitment that is specific to our university and that outlines clear, measurable goals that we can realistically achieve. That Committee will work closely with Dr. Wilson and his staff. I would expect to be briefed on their work along the way, and the plan would be vetted through the university governance structure—from the committee, on to the Commission on University Support, and then to University Council. The result should then be a commitment tailored to Virginia Tech that I can sign with high confidence that we will be able to fulfill it.

Needless to say, the university is not going to wait for the Virginia Tech Climate Commitment to be finalized before we take any action. We will continue with the initiatives under way and launch new ones.

For example, to the extent possible, we are ensuring that University facilities are designed, constructed, renovated, operated, and maintained in accordance with the latest energy/water efficiency standards and in a manner consistent with the US Green Building Council's LEED™ Building Rating Systems. We also recently hired a new associate vice president for facilities. Among his main responsibilities will be to coordinate our energy efficiency efforts.

Some of the more recent initiatives include:

- In spring of 2007 Virginia Tech converted 13 acres of campus from regularly maintained turf grass to low maintenance native grass meadows and wildflowers.

- Several other new projects incorporate sustainable features that are becoming standard at Virginia Tech. Energy efficiency has been increased with improved lighting and third party commissioning of HVAC systems.

- Virginia Tech has secured $17.25 million in state funding in support of a $28.75 million capital project established to carry out upgrades to the steam utility distribution system and Central Steam Plant. This project will provide more than $1 million annually in fuel savings, including the new ability to co-generate electricity during the summer months. The project will also reduce emissions by 10 tons annually.

- In addition, we are looking at some new educational endeavors to help prepare K-12 students and community college students to be more aware of energy conservation and to be a part of a new "green-workforce" that we will need in the future.

- Virginia Tech is also pleased to be one of the founding partners, along with Hannon Armstrong and Pepco Energy Services, in the Energy Efficiency Partnership of Greater Washington established last October, and to play an integral role in the greening of this important U.S. metropolitan area. Virginia Tech and our partners are launching a large-

scale building retro-fitting project in the Washington metropolitan area. Pepco Energy Services will carry out energy audits, supply materials, and perform building retrofits as well as guarantee the energy savings of the retrofit projects. Hannon Armstrong, an energy efficiency financier, has made a very substantial commitment to finance the retrofitting at no capital cost to building owners. Virginia Tech has entered into this partnership because it fits perfectly with our core missions of research, learning and outreach. In today's interconnected global environment, the problems of one city, nation or region are fast becoming the problems of all. Virginia Tech, as a leading research institution, has a responsibility to show leadership in addressing large-scale problems. And cross-sector partnerships with government, business and civil society are an important avenue in addressing these challenges.

- Today, I spoke at the "20-Now" Financing Green Buildings Action Forum in Washington, DC sponsored by Meridian International Center in partnership with the Energy Efficiency Partnership of Greater Washington (of which VT is a founding member), the World Business Council for Sustainable Development, and United Technologies. The event was designed to promote global and national best practices in financing energy efficiency projects to achieve zero net emission buildings and had an audience of more than one hundred regional and national building owners, developers, and financial institutions that expressed an interest in and commitment to energy efficiency in their work.

- On June 17, 2008, Virginia Tech will host Governor Kaine's Commission on Climate Change. The Virginia Energy Plan released last September set a goal for the state to reduce greenhouse gas emissions by 30 percent by 2025. We are looking forward to what we can learn from the Commission's report, due to be released in December.

The drive towards sustainability has strong support throughout the university's senior leadership; the deans and many of the vice presidents have been champions of this cause. And, I commend the Environmental Coalition for being a champion of environmental issues among the students; I am well aware that the desire for Virginia Tech to be a leader in terms of sustainability permeates the entire student body, as well as the faculty and staff. I look forward to the work of the Energy and Sustainability Committee and to signing a sustainability commitment tailored to Virginia Tech with realistic goals that will produce meaningful and enduring results.

Sincerely,

Charles W. Steger
President

cc: University Council
Commission on University Support
Committee on Energy and Sustainability

The Presidents Climate Commitment

http://www.presidentsclimatecommitment.org

Mission Statement:

The fight against global warming will shape the 21st century. Colleges and universities must exercise leadership in their communities and throughout society by modeling ways to eliminate global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality. Campuses that address the climate challenge by eliminating global warming emissions and by integrating sustainability into their curriculum will better serve their students and meet their social mandate to help create a thriving, ethical and civil society.

The Commitment:

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

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

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

We further believe that colleges and universities that exert leadership in addressing climate change will stabilize and reduce their long-term energy costs, attract excellent students and faculty, attract new sources of funding, and increase the support of alumni and local communities.

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

1. Initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible.

    a. Within two months of signing this document, create institutional structures to guide the development and implementation of the plan.

    b. Within one year of signing this document, complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel) and update the inventory every other year thereafter.

    c. Within two years of signing this document, develop an institutional action plan for becoming climate neutral, which will include:

        i. A target date for achieving climate neutrality as soon as possible.

        ii. Interim targets for goals and actions that will lead to climate neutrality.

        iii. Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students.

        iv. Actions to expand research or other efforts necessary to achieve climate neutrality.

        v. Mechanisms for tracking progress on goals and actions.

2. Initiate two or more of the following tangible actions to reduce greenhouse gases while the more comprehensive plan is being developed.

    a. Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent.

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

    c. Establish a policy of offsetting all greenhouse gas emissions generated by air travel paid for by our institution.

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

    e. Within one year of signing this document, begin purchasing or producing at least 15% of our institution's electricity consumption from renewable sources.

f. Establish a policy or a committee that supports climate and sustainability shareholder proposals at companies where our institution's endowment is invested.

g. Participate in the Waste Minimization component of the national RecycleMania competition, and adopt 3 or more associated measures to reduce waste.

3. Make the action plan, inventory, and periodic progress reports publicly available by providing them to the Association for the Advancement of Sustainability in Higher Education (AASHE) for posting and dissemination.

COMMONWEALTH OF VIRGINIA

OFFICE OF THE GOVERNOR

Executive Order 48 (2007)

ENERGY EFFICIENCY IN STATE GOVERNMENT

Importance of the Initiative

Commonwealth agencies and institutions spent over $290 million in fiscal year 2006 for facility and transportation energy. It is critical that the Commonwealth use energy in the most efficient manner possible to save taxpayer money and provide leadership to all Virginians in using our natural resources wisely. Improvements in energy efficiency and protection of our priceless natural resources are inseparable goals. Reducing the amount of energy we consume will reduce the emission of greenhouse gases that are largely responsible for global climate change. State government has the capacity and responsibility to save taxpayer money while protecting our climate and natural resources for future generations.

The Commonwealth's citizens, businesses, and governments are also faced with managing the effects of more costly and less reliable supplies of energy, as well as the environmental effects of energy production and consumption. In response, the General Assembly enacted into law in 2006 a state energy policy and directed the Department of Mines, Minerals and Energy to develop the Virginia Energy Plan. This requires coordination of energy activities among many private organizations and state agencies and institutions.

By the power vested in me by Article V of the Constitution of Virginia, and Section 2.2-103 of the *Code of Virginia*, and subject always to my continuing and ultimate authority and responsibility to act in such matters, I hereby direct the Governor's Secretaries and all executive branch agencies and institutions to reduce energy

consumption and costs in state government operations in the executive branch. I also set forth a process for coordinating energy policy development within the executive branch.

Agency Energy Management

All agencies and institutions shall provide adequate management support to their energy-savings activities. In order to ensure agencies have sufficient expertise in energy management, every Agency Energy Manager for an agency or institution with energy costs exceeding $1 million shall be certified as an energy manager by the Association of Energy Engineers by June 30, 2008.

State Agency and Institutions Energy Savings Goal

I hereby set a goal for executive branch agencies and institutions to reduce the annual cost of non-renewable energy purchases by at least 20 percent of fiscal year 2006 expenditures by fiscal year 2010. Any agency or institution that can demonstrate to the Senior Advisor for Energy Policy that they met the 10 percent energy savings goal established for 2006 in Executive Order 54 (2003) shall reduce costs of non-renewable energy purchase by an additional 15 percent of fiscal year 2006 expenditures by fiscal year 2010.

In order to meet this goal, agencies and institutions shall aggressively pursue (i) all energy-savings activities whose costs are recoverable in one fiscal year, such as use of screw-in fluorescent and other high-efficiency lighting in place of incandescent bulbs and other less efficient lights; (ii) energy-savings performance contracts that are in compliance with Section 4-4.01v of the Appropriations Act; (iii) other funded capital energy-savings improvements; (iv) alternate procurement techniques for energy; (v) renovations of existing buildings consistent with LEED (including the use of Virginia forest products with alternate certifications) or Energy Star requirements as provided for in this executive order; (vi) the transportation energy use requirements provided for in this executive order; or (vii) purchases of renewable energy. Further, after having complied with requirements regarding roof repair or replacement and deferred maintenance projects in accordance with Section 4-4.01c of the Appropriations Act, agencies shall aggressively pursue maintenance reserve projects leading to energy conservation.

Agencies shall report their progress towards the energy-savings goals as part of the Governor's Management Scorecard, Resource Stewardship objective. Such progress shall also be reported to the public on the Department of Mines, Minerals and Energy's website.

New and Renovated State-Owned Facilities

All agencies and institutions constructing state-owned facilities over 5,000 gross square feet in size, and renovations of such buildings valued at more than 50% of the assessed building value which have not advertised for architectural and engineering services by the effective date of this order shall be designed and constructed consistent with the energy performance standards at least as stringent as the U.S. Green Building Council's LEED rating system (including the use of Virginia forest products with alternate certifications) or the United States Environmental Protection Agency/Department of Energy's "Energy Star" rating.

The Senior Advisor for Energy Policy shall periodically assess the cost effectiveness of incorporating a photovoltaic power system or a green roof in any roof renovation for buildings over 5,000 gross square feet in size. If the Senior Advisor for Energy Policy finds that the projected energy savings over a 15-year period can pay for the additional cost of installing a photovoltaic or green roof system, then the Department of General Services shall require that any roof replacement design address that option. Agencies and institutions shall incorporate the option if it meets the 15-year payback limit for that replacement.

Leased Facilities

When a Commonwealth agency or institution is to lease space in a metropolitan area where public transit is available, it shall seek to lease space within a quarter mile of a bus, trolley, Metro, or commuter rail stop. The Commonwealth shall encourage the private sector to adopt energy-efficient building standards by giving preference when leasing facilities for state use to facilities meeting the U.S. Green Building Council's LEED rating system (including the use of Virginia forest products with alternate certifications) or the United States Environmental Protection Agency/Department of Energy's "Energy Star" rating. The Commonwealth shall also provide a preference when leasing facilities for state use to facilities that are pedestrian and bicycle accessible. The Division of Real Estate Services of the Department of General Services shall consider these preferences in approving new leases or extensions of current leases.

Transportation Energy Use

The Department of General Services, by Executive Order 89 (2005), is responsible for developing a consistent, efficient, and cost-effective fleet management program for all vehicles owned by the Commonwealth. Therefore, the Department of General Services shall include in its policies and procedures requirements for the purchase of fuel-efficient, low-emission state-owned vehicles. In addition, the Department of General Services

shall include in its policies and procedures for leasing vehicles requirements that give a preference to compact, fuel-efficient, and low-emission vehicles.

All agencies and institutions shall maximize biodiesel and ethanol use in state fleet vehicles except where use of biodiesel will void warranties or incur unreasonable additional costs to the agencies. The Department of General Services shall make available, at selected sites based upon the locations of state-owned flex-fuel and diesel vehicles, E85 and B20 fuels for agencies. Agencies and institutions that independently purchase fuel shall use E85 and B20 fuel sites to the maximum extent reasonably possible.

All agencies and institutions shall take necessary actions to minimize vehicle miles traveled related to state operations. All agencies and institutions shall implement transit and ridesharing incentive programs within the parameters of the Department of Human Resource Management's guidelines, and shall maximize the use of telecommuting consistent with the policies of the Office of Telework Promotion and Broadband Assistance.

State vehicles used for law enforcement and emergency response shall be exempt from the provisions of this section. Public safety agencies are expected to make all reasonable efforts to reduce transportation energy use when possible in ways that do not adversely impact their missions and ultimately the safety of our citizens.

State Government Equipment and Supplies

Commonwealth agencies and institutions shall purchase or lease Energy Star rated appliances and equipment for all classifications for which an Energy Star designation is available. All new copiers, faxes, printers, and other such office equipment purchased or leased by the Commonwealth that uses paper shall be recycled paper-compatible. The Commonwealth shall purchase only recycled paper except where equipment limitations preclude the use of recycled paper.

Senior Advisor for Energy Policy and Energy Policy Advisory Council

There is hereby established the position of Senior Advisor to the Governor for Energy Policy and the Governor's Energy Policy Advisory Council to provide expertise and advice to the Commonwealth on the Virginia Energy Plan and other energy matters. The Senior Advisor will serve as the Governor's principal advisor on energy-related issues, and is directed to coordinate energy policy across state agencies and institutions, including advising state institutions of higher education on coordinating energy research efforts.

The Senior Advisor shall develop and update the Virginia Energy Plan in conjunction with the Division of Energy of the Department of Mines, Minerals, and Energy, as provided for in Chapter 2 of Title 67 of the Code of Virginia, drawing upon expertise of other agencies and institutions and Virginia businesses as appropriate.

The Governor's Energy Policy Advisory Council shall be chaired by the Senior Advisor for Energy Policy. The Council shall consist of 15 members appointed by the Governor, to serve at his pleasure. Appointees shall include representatives of Virginia's energy providers and producers, residential, commercial and industrial energy consumers, Virginia's conservation community, and the Secretaries of Natural Resources, Commerce and Trade, and Technology. The Advisory Council shall make a report of its activities by December 1 of each year.

The Advisory Council's responsibilities shall include the following:

1. Review the recommendations set forth in the Virginia Energy Plan as well as other relevant reports and studies.
2. Evaluate strategies for implementing recommendations of the Virginia Energy Plan, including prioritization, approach, and timeline.
3. Monitor implementation of the Virginia Energy Plan.
4. Identify additional energy policy options for the Commonwealth to address energy issues.
5. Make other recommendations as may be appropriate.

Responsibilities of the Department of Mines, Minerals and Energy

The Department of Mines, Minerals and Energy shall be responsible for providing technical assistance to state agencies and institutions in achieving energy savings. Specifically, the Department of Mines, Minerals and Energy shall:

1. Assist state agencies in their efforts to conserve energy to the maximum extent feasible;
2. Assist agencies and institutions with implementation of this Executive Order;
3. In cooperation with the Department of Environmental Quality, assist agencies with calculating the extent to which their energy savings result in a reduction in greenhouse gas emissions; and
4. Maintain a system to monitor and report on progress made by state agencies toward reducing from its 2006 baseline energy costs and consumption for state-owned facilities, and provide a report at least annually on its website.

This Executive Order shall become effective upon its signing and shall remain in full force and effect until June 30, 2011, unless amended or rescinded by further executive order.

Given under my hand and under the Seal of the Commonwealth of Virginia this Fifth day of April, 2007.

_____
Timothy M. Kaine, Governor

Attest:

_____
Secretary of the Commonwealth

Appendix D

ENERGY AND SUSTAINABILITY COMMITTEE (2008-2009)

CHARGE: To review and provide advice to the University Administration on broad policy issues relating to the university's energy supply and use, and resource conservation. ***Reports to: Commission on University Support.***

Mike Coleman	**Chair**	**2009**
(President will appoint annually from among members of the committee)		
Sherwood Wilson	**Vice President for Administrative Services or designee**	**ex officio**
Dwight Shelton	**Vice President for Finance and CFO or designee**	**ex officio**
Michael Coleman	**Associate Vice President for Facilities Services**	**ex officio**
Scott Hurst	**University Architect**	**ex officio**
Denny Cochrane	**Sustainability Program Manager**	**ex officio**
Rick Johnson	**Director of Housing and Dining**	**ex officio**

Two representatives from Virginia Tech Facilities Services selected by the Vice President for Administrative Services ***(three-year terms)***

Bruce Ferguson	**University Planning, Design, and Construction**	**2009**
Ben Myers	**Facilities Services**	**2010**

One representative from Virginia Tech Environmental Health & Safety Services selected by the Vice President for Administrative Services ***(one-year term)***

Rob Lowe	**Environmental Health & Safety**	**2011**

Four representatives from the Faculty Senate nominated by the Faculty Senate ***(three-year terms)***

Madeline Schreiber	**Geosciences**	**2011**
Sean McGinnis	**Materials Science and Engineering**	**2009**
Annie Pearce	**Department of Building Construction**	**2010**
John Randolph	**Architecture and Urban Studies**	**2010**

Two representatives from the Staff Senate nominated by the Staff Senate ***(three-year terms)***

Tom Tucker	**Facilities Information Systems**	**2010**
Mike Cutlip	**Sponsored Programs**	**2010**

One college dean selected by the Council of College Deans ***(two-year term)***

Jack Davis	**Architecture and Urban Studies**	**2010**

Two representatives from the Graduate Student Assembly nominated by the GSA ***(one-year term)***

Brian Perkins	**Wood Science and Forest Products**	**2009**
Sara Murrill	**Forestry**	**2009**

Two representatives from the Student Government Association nominated by the SGA ***(one-year term)***

Angella De Soto	**Environmental Policy and Planning**	**2009**
Kristina Hartman	**Biological Sciences**	**2009**

Appendix E

Virginia Tech Energy and Sustainability Committee Sub-Committee to Develop the Draft Virginia Tech Climate Action Commitment and Sustainability Plan 2008-2009

John Randolph (Chair)	Professor and Chair, Urban Affairs & Planning
Denny Cochrane	Sustainability Program Manager, Facilities Services
Michael Coleman	Associate Vice President for Facilities Services
Jack Davis	Dean, College of Architecture & Urban Studies
Angella De Soto	Undergraduate Student Sustainability Intern, Environmental Policy & Planning
Michael Ermann	Associate Professor, Architecture Program Chairman
Bruce Ferguson	Associate Director, University Planning, Design & Construction
Richard Hirsh	Professor, History
Scott Hurst	University Architect
Rick Johnson	Director, Housing and Dining Services
Rob Lowe	Environmental Engineer, Environmental Health & Safety Services
Steve Mouras	Director, Transportation & Campus Services
Erik Olsen	Transportation Planner, Blacksburg Transit
Brian Perkins	Graduate Student, Wood Science & Forest Products
Scott Reed	Senior Associate Director, Operations & Services, UUSA
Mary Seyler	Buyer Senior, Purchasing Department
Lylah Shelor	Facilities Manager, Information Technology
James Torgersen	Facilities Manager, Athletic Department
Tom Tucker	Architectural Planner, Facilities Information Systems, and President of the Staff Senate

VTCAC&SP Campus Workshop Brainstorming Ideas and Rankings

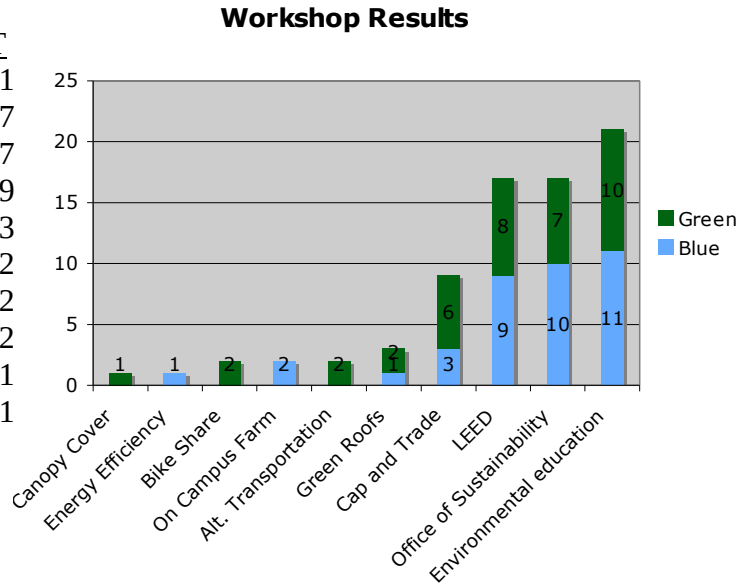
The following ideas and rankings were provided by students of the Environmental Planning Studio Course in Urban Affairs Planning during a campus brainstorming workshop during Sustainability Week on October 23, 2008:

Full-time arborist
Green Fee
On-Campus Composting
Campus Greenhouse
Green Roofs
Hybrid Buses
Censored Lights
Computers off when not in use (Math Emporium)
Commuter outreach programs
Dorm-unique thermostats
Lane Stadium lights off
More bike racks
Energy accountability on department level scale
Increase cyclist and pedestrian safety
Duel flush toilets
Rainwater harvesting
Phase out coal use
Increase bio-diesel blend B20 -> B80
Solar Buses
Solar Pavement
Bi-annual tree planting
Sustainability education @ new student orientation
More recycling, more money for recycling
CFL's, no incandescent
Higher priced parking passes
Decentralized chiller
Phantom energy reduction
Green funding from alums
Centralized office of sustainability
Ride share
Bike share
Carbon cap and trade between departments
2:1 tree replacement ratio
LEED policy on campus
Educational programs

Dot Count:

	Gr	Bl	T
Environmental education	10	+11	= 21
LEED	8	+ 9	= 17
Office of Sustainability	7	+10	= 17
Cap and trade	6	+ 3	= 9
Green Roofs	2	+ 1	= 3
Bike share	2	+ 0	= 2
Alternative Transportation	2	+ 0	= 2
On campus farm	0	+ 2	= 2
Canopy Cover	1	+ 0	= 1
Energy Efficiency	0	+ 1	= 1

Green = top priority
Blue = 2nd priority



Appendix G

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

B-

Administration	**B**	President Steger has charged the Committee for Energy and Sustainability with developing a sustainability plan and climate action commitment by the end of the 2009 spring semester. Virginia Tech employs a sustainability coordinator and several other full- and part-time sustainability personnel, and has recently revised their Campus Energy and Water Policy.
Climate Change & Energy	**C**	In compliance with the governor's executive orders, the university met a goal of 10 percent energy savings in 2006 and is planning to reduce purchases of nonrenewable energy an additional 15 percent by 2010 subject to unanticipated increases in energy costs. The installation of occupancy sensors, commissioning of HVAC systems, and lighting retrofits on campus have increased energy efficiency.
Food & Recycling	**B**	The recycling program diverted 34 percent of the waste stream in 2007, including yard waste, scrap metal, and tires. Dining services purchases 8 to 15 percent of food locally and is looking into food composting and compostable to-go containers. Dining Services has one unit that is dedicated to serving organic food.
Green Building	**B**	According to 2008 policy, all new capital construction projects will be designed to LEED Silver standards, with formal certification pursued on a case-by-case basis. Currently four projects are registered for LEED certification and an additional eight projects are in the early stages of planning and design.
Student Involvement	**A**	There are 14 student organizations in the Coalition for Campus Sustainability, which was launched in the spring of 2008 and is facilitated by the student-run Environmental Coalition. The GREEN Team has been integral in spreading sustainability awareness on campus and employs a student coordinator. Students are also employed in sustainability jobs by several offices. Students have organized engaging events including "Focus the Nation" and "Earth Week 2008."
Transportation	**A**	Virginia Tech offers many incentives for public and shared transportation, including fare-free access to the local transportation system and carpool incentives. The university has received federal enhancement grants to encourage bicycling on campus. The physical plant department has 15 vehicles running on biodiesel and one hybrid vehicle, while Fleet Services offers four hybrid vehicles in its rental inventory.
Endowment Transparency	**F**	The university makes its list of endowment holdings available only to trustees and senior administrators. The university does not make its shareholder voting record public.
Investment Priorities	**A**	The university aims to optimize investment return and is currently invested in alternative energy firms and community development financial institutions.
Shareholder Engagement	**D**	The university provides its investment managers with guidelines that determine its proxy votes.

Notes on the data.

Appendix H

THE TALLOIRES DECLARATION

We, the presidents, rectors, and vice chancellors of universities from all regions of the world are deeply concerned about the unprecedented scale and speed of environmental pollution and degradation, and the depletion of natural resources.

Local, regional, and global air and water pollution; accumulation and distribution of toxic wastes; destruction and depletion of forests, soil, and water; depletion of the ozone layer and emission of "green house" gases threaten the survival of humans and thousands of other living species, the integrity of the earth and its biodiversity, the security of nations, and the heritage of future generations. These environmental changes are caused by inequitable and unsustainable production and consumption patterns that aggravate poverty in many regions of the world.

We believe that urgent actions are needed to address these fundamental problems and reverse the trends. Stabilization of human population, adoption of environmentally sound industrial and agricultural technologies, reforestation, and ecological restoration are crucial elements in creating an equitable and sustainable future for all humankind in harmony with nature.

Universities have a major role in the education, research, policy formation, and information exchange necessary to make these goals possible. Thus, university leaders must initiate and support mobilization of internal and external resources so that their institutions respond to this urgent challenge.

We, therefore, agree to take the following actions:

1. Increase Awareness of Environmentally Sustainable Development
Use every opportunity to raise public, government, industry, foundation, and university awareness by openly addressing the urgent need to move toward an environmentally sustainable future.

2. Create an Institutional Culture of Sustainability
Encourage all universities to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward global sustainability.

3. Educate for Environmentally Responsible Citizenship
Establish programs to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens.

4. Foster Environmental Literacy for All
Create programs to develop the capability of university faculty to teach environmental literacy to all undergraduate, graduate, and professional students.

5. Practice Institutional Ecology
Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations.

6. Involve All Stakeholders
Encourage involvement of government, foundations, and industry in supporting interdisciplinary research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with community and nongovernmental organizations to assist in finding solutions to environmental problems.

7. Collaborate for Interdisciplinary Approaches
Convene university faculty and administrators with environmental practitioners to develop interdisciplinary approaches to curricula, research initiatives, operations, and outreach activities that support an environmentally sustainable future.

8. Enhance Capacity of Primary and Secondary Schools
Establish partnerships with primary and secondary schools to help develop the capacity for interdisciplinary teaching about population, environment, and sustainable development.

9. Broaden Service and Outreach Nationally and Internationally
Work with national and international organizations to promote a worldwide university effort toward a sustainable future.

10. Maintain the Movement
Establish a Secretariat and a steering committee to continue this momentum, and to inform and support each other's efforts in carrying out this declaration.

~ Association of University Leaders for a Sustainable Future, revised 1994

ORIGINAL

Virginia Polytechnic Institute and State University **No. 5505 Rev.: 1**

Policy and Procedures **Date: January __, 2009**

Subject: Campus Energy and Water Policy

1. Purpose

The purpose of this policy is to guide the operations of the university in order to achieve the highest standards in energy/water usage with consideration of the impact on environmental quality and economic performance. To accomplish this goal, the university shall establish procedures to consider energy/water use in the design and operation of university facilities in the most economical and environmentally friendly manner possible, educate the university community on the use of energy/water, and consider energy/water use in purchasing decisions and transportation. The benefits gained include, but are not limited to, protection of ecosystems, improvement of air and water quality, reduction of waste, and conservation of resources.

2. Policy

University facilities shall, to the extent possible, be designed, constructed, renovated, operated and maintained in accordance with the latest energy/water efficiency standards and in a manner consistent with the US Green Building Council's LEED™ Building Rating Systems. Specifically the university shall:

1. Comply with Governor Timothy M. Kaine's Executive Order 48 (2007) "Energy Efficiency in State Government."
2. Make decisions concerning investments for renovations or new construction of all facilities at the university based on total cost of ownership or life cycle cost analysis.
3. Identify and strive to implement those strategies identified as being available and least costly.
4. Evaluate and compare alternative energy sources for short and long-term costs while considering future projections for availability and price escalation of all energy sources.
5. Explore teaching and research opportunities to assist in evaluating energy and water usage and recommending potential conservation measures.

3. Procedures

3.1 Efficiency and Conservation

Virginia Tech achieved the 10% energy savings goal established for 2006 in Executive Order 54 (2003). Executive Order 48 (2007) "Energy Efficiency in State Government" requires the university to reduce costs of non-renewable energy purchases by an additional 15% of fiscal year 2006 expenditures by fiscal year 2010. Specific recommendations for energy/water efficiency and conservation include:

1. Identify, evaluate and implement, when practical, cost effective strategies to reduce energy/water demand.
2. Develop and implement strategies to encourage full participation of building occupants in energy/water efficiency and conservation programs. Include strategies such as information dissemination and incentive programs.
3. Develop and promote energy/water efficiency and conservation strategies whenever possible and practical.

3.2 Design

This policy incorporates the Virginia Tech *Design and Construction Standards,* latest edition, which, in turn, shall incorporate the latest energy/water standards and codes. Specific facility design recommendations include:

1. Review plans for construction, renovation, and maintenance of university-owned facilities and the installation of equipment within those facilities for compliance at each stage of the design and prior to finalizing bid documents.
2. Design, renovate, and operate building lighting, heating and cooling systems to align space use and occupancy patterns with a goal of reducing energy use during unoccupied periods.
3. Review university facility control systems with the objective of establishing the ability to communicate with each other and with the goal of reducing energy costs.
4. Set a minimum standard for all energy consuming equipment to be Energy Star® rated in efficiency or better.
5. Set a minimum standard for all water-related equipment and fixtures to meet or exceed the Federal Energy Policy Act of 1992/2005 (EPAct) or EPA WaterSense requirements.
6. Properly commission all new buildings or significant renovations prior to substantial completion.
7. Incorporate as high a solar reflectivity as practical for the situation and application on all roofs.

3.3 Operation and Maintenance

The university shall strive to educate all building users and occupants concerning the use of campus buildings, with an emphasis on safety, energy and resource efficiency. Recommendations for operation and maintenance include:

1. Set nominal temperature targets for occupied facilities to be 68°F in the winter and 74°F in the summer. Exterior windows and doors should be closed when heating and cooling systems are in operation.
2. Ensure that all computers at the university are Energy Star® rated, have Liquid Crystal Display (LCD) monitors/screens (or best performing equivalent) set to default to sleep mode after a period of 15 minutes or less of disuse, except in those cases where specific research, instruction, or office mission requirements demand otherwise.
3. Install occupancy sensors to de-energize room lighting after a period of 15 minutes or less of non-use in all suites, meeting rooms, classrooms and other spaces used sporadically as per campus goal. For all spaces not controlled by occupancy sensors (for reasons of practicality), encourage occupants to take responsibility for turning out the lights when the space is not in use.
4. The use of portable electric space heaters, window air conditioners, and refrigerators is discouraged. If there is a valid need for using the devices they must be of a type approved by Environmental Health and Safety Services. Encourage the discarding or recycling of old and inefficient appliances.

5. To avoid the wasteful use of energy, the university should upgrade temperature control equipment.

3.4 Transportation

The university shall strive to achieve a passenger fleet vehicle average fuel efficiency of 30 miles per gallon or as appropriate to be consistent with Federal fuel efficiency guidelines. Specific recommendations for transportation include:

1. Increase the number of hybrid passenger vehicles available for use through Fleet Services.
2. Convert all other existing university vehicles to use biodiesel fuel whenever practical.
3. Continue to promote the use of carpooling and alternative modes of transportation including, but not limited to, utilizing Blacksburg Transit, bicycles, walking and alternatively fueled vehicles.

3.5 Billing

The university's records concerning energy/water usage shall be consolidated and current. Specific billing recommendations include:

1. Ensure coordination for utility billing and payment processes for Educational and General (E&G) centralized facilities and investments in utility conservation measures occur through a combination of external and internal systems and entities.
2. Continue to operate the university's internal billing systems in the existing manner. The Associate Vice President for Facilities Services is assigned the responsibility for the payment of these utility charges, where appropriate, using centrally managed funds for each utility (electricity, gas, steam, chilled water, potable water, domestic hot water and propane).
3. Maintain responsibility among decentralized operating units for billing processes and funding commitments associated with their facilities. This decentralized billing process shall apply to utility bills from external parties for service to outlying parts of the campus as well as off-campus operations.

3.6 Point of Contact

- The Associate Vice President for Facilities Services is the point of contact for this policy.

3.7 Energy and Sustainability Committee

- The university's Energy and Sustainability Committee shall assist the Associate Vice President for Facilities Services and the Vice President for Administrative Services with the development and implementation of the Campus Energy and Water Policy.

3.8 University Departments and Regulatory Agency Contracts

The Associate Vice President for Facilities Services office will coordinate with other university departments and outside regulatory agencies to develop and implement procedures to ensure full compliance of the design and execution of the work with applicable codes, standard permitting requirements and other university concerns. Each of the university activities below should identify a lead person responsible to represent them and to support the Associate Vice President for Facilities Services to coordinate university wide sustainability initiatives. These contacts should include, but are not limited to:

- Academic Deans and Departments
- Athletic Department
- Environmental Health and Safety Services
- Office of the University Architect
- Recreational Sports
- Student Programs
- University Unions and Student Activities

- Virginia Department of Environmental Quality
- Virginia Department of Mines, Minerals and Energy

3.9 Implementation and Compliance

Each department head or supervisor shall:

- Designate an energy/water conservation representative for each organization or unit occupying each building.
- Communicate this policy to everyone under his/her supervision by providing access to the policy and discussing with his/her employees.
- Identify all training requirements in this area that may apply to those individuals working in the organization and inform supervisors of the need for appropriate training.

4. Definitions

ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers

Commissioning: A process which ensures that systems are designed, installed, functionally tested, and performing in conformity with the design intent.

Energy Star®: A program of the US Environmental Protection Agency including rating of appliances and equipment for energy/water efficiency.

Energy Policy Act (EPAct): Federal legislation governing permissible flow rates for water-consuming fixtures and appliances. Original legislation for most common fixtures was passed in 1992, with several updates in 2005.

Facility: Any portion of a building, structure or area, including the site on which the building, structure or area is located, wherein specific services are provided or activities are performed including all utilities, systems and building service equipment associated with the facility.

HVAC: Heating Ventilating and Air Conditioning.

LEED®: A building rating system developed by the US Green Building Council, Leadership in Energy and Environmental Design; a voluntary, consensus-based national standard for developing high-performance, sustainable buildings with three versions of rating systems: LEED-NC (New Construction), LEED-EB (Existing Buildings), and LEED-CI (Commercial Interiors).

Maintenance: Work performed to a facility or the fixed systems and building service equipment therein, for the purpose of maintaining quality and function.

Portable: HVAC equipment used within a facility but without permanent connection to the building's utility services.

Renovation: Any work to a facility or the fixed systems and building service equipment therein which is done to improve the existing level of quality and function, or to accommodate a change in the nature of the use of a space within a building or facility.

Repair: The reconstruction of or renewal of any part of an existing facility for the purpose of maintenance or restoration of its state.

Retro commissioning: A systematic process for improving and optimizing an existing building's operations and supporting those improvements with enhanced documentation and operator training.

Utilities: Energy (electricity, steam, chilled water, domestic hot water, natural gas, and propane) and water (potable water/sewer).

WaterSense: A program of the US Environmental Protection Agency including rating of appliances and equipment for water efficiency.

5. References

ASHRAE 90.1 (Energy Standard for Buildings except Low-Rise Residential Buildings)

EPA Water Conservation Plan Guidelines, Safe Drinking Water Act, USC 42

National Energy Conservation Policy Act, Public Law 95-619

National Appliance Energy Conservation Act, Public Law 100-12

Virginia Tech *Design and Construction Standards*

Governor's Executive Order 48 (2007): Energy Efficiency in State Government

6. Approval and Revisions

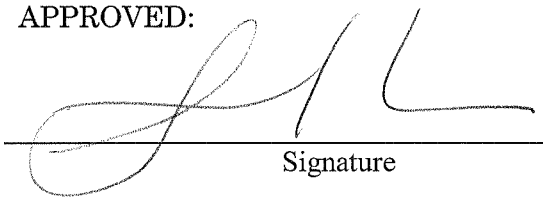
Approved September 26, 2006 by Vice President for Business Affairs, Kurt J. Krause.

- Revision 1

  Significant revisions to enhance energy and water conservation and support university sustainability efforts.

  Approved by Energy and Sustainability Committee September 25, 2008.

APPROVED:



Signature

1-14-09

Date

DEB Notice 120108 – Virginia Energy Conservation & Environmental Standards

Effective 12/01/2008

Add the following to the Construction and Professional Services Manual

Section 709.0 Energy Conservation and Environmental Performance

State agencies and A/Es shall assure that new construction, renovation, and maintenance of building is performed in accord with the following minimum standards for energy conservation and environmental performance.

Section 709.1 Virginia Energy Conservation and Environmental Performance Standards

All new and renovated state-owned facilities, if the renovations are in excess of 50 percent of the structure's assessed value, that are over 5,000 gross square feet shall be designed and constructed consistent with either method A or B of the following energy conservation and environmental performance standards.

A. **Leadership in Energy and Environmental Design (LEED)**

Obtain a minimum score of Certified (26/69)
Demonstrate compliance by one of the following methods:
LEED certification submitted to BCOM
Documentation provided to a 3rd party approved by BCOM to determine LEED certification and then that result submitted to BCOM
Documentation provided to BCOM to determine LEED certification

B. **Virginia Energy Conservation and Environmental Performance Standards**

Energy Performance Data
Provide a design that is a 30% improvement over baseline performance for ASHRAE/IESNA Standard 90.1-2004, Energy Standards for Buildings except Low-Rise Residential Buildings

Commissioning Criteria and Commissioning Report
Conduct a systematic process of verifying and documenting that building energy systems and subsystems perform interactively according to the design intent and owner's operational needs. ASHRAE Guideline 1 – 1996, The HVAC Commissioning Process provides an outline for the commissioning process for each phase of the design.

Atmospheric Emissions Controls

Obtain a minimum score as defined in the attached score sheet for the Emissions and Storage of Hazardous Materials Section the *Green Building Initiative GBI Proposed National Standard 01-2008 Green Building Assessment Protocol for Commercial Buildings.* (Section 11 Emissions and Storage of Hazardous Materials).

Construction Pollution Prevention

Obtain a minimum score as defined in the attached score sheet for the Site Disturbance and Erosion section of the *Green Building Initiative GBI Proposed National Standard 01-2008 Green Building Assessment Protocol for Commercial Buildings.* (Section 7 Site).

Water Conservation

Implement the required number as defined in the attached score sheet of the Best Management Practices (BMP) for water conservation at (federal) facilities. Available at http://www1.eere.energy.gov/femp/water/water_bmp.html

BMP # 1 - Water Management Planning
BMP # 2 - Information and Education Programs
BMP # 3 - Distribution System Audits, Leak Detection and Repair
BMP # 4 - Water-Efficient Landscaping
BMP # 5 - Water-Efficient Irrigation
BMP # 6 - Toilets and Urinals
BMP # 7 - Faucets and Showerheads
BMP # 8 - Boiler/Steam Systems
BMP # 9 - Single-Pass Cooling Equipment
BMP #10 - Cooling Tower Management
BMP #11 - Commercial Kitchen Equipment
BMP #12 - Laboratory/Medical Equipment
BMP #13 - Other Water Use
BMP #14 - Alternate Water Sources

Recycling Materials, Resources, and Waste Management

Obtain a minimum score as defined in the attached score sheet for the Resource Materials Section *of the Green Building Initiative GBI Proposed National Standard 01-2008 Green Building Assessment Protocol for Commercial Buildings.* (Section 10 Resources/Materials).

Indoor Environmental Quality

Comply with all of the following ASHRAE Standards

ASHRAE Standard 52—Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

ASHRAE Standard 55—Thermal Environmental Conditions for Human Occupancy

ASHRAE Standard 62—Ventilation for Acceptable Indoor Air Quality:

Operation and Maintenance Manuals

Provide a minimum of three (3) complete sets to the owner for each facility constructed. Provide instruction and training

Demonstrate compliance by one of the following methods:

Documentation provided to a 3rd party approved by BCOM to determine certification and then that result submitted to BCOM

Documentation provided to BCOM to determine certification

Section 709.2 Compact Fluorescent Lamps

Design of construction and renovation projects shall use CFLs when practical considering program criteria and aesthetics.

Maintenance of building is performed replace incandescent with compact fluorescent bulbs where practical.

Appendix J

Virginia Energy Conservation and Environmental Performance Standards Score Sheet

Energy Performance

Design is 30% improvement over ASHRAE / IESNA Standard 90.1-2004

Commissioning Criteria and Commissioning Report

Criteria defined and building commissioned / report generated

Atmospheric Emissions Controls

Heating

Obtain 18 points as defined by Section 11.1 Heating Equipment
either use path A or B

Cooling

Obtain 21 points as defined by Section 11.1 Cooling Equipment
either use path A or B

Storage of Hazardous Materials

Obtain 6 points as defined by Section 11.3 Storage for Hazardous Materials

Construction Pollution Prevention

Obtain 6 points as defined by Section 7.2.1 Site Disturbance and Erosion

Water Conservation

Six or more BMP strategies implemented

Recycling Materials Resources, and Waste Management

Obtain 12 points as defined by Section 10.1 Assemblies Prescriptive Path

Obtain 10 points as defined by Section 10.2 Furnishing, Finishes
and Fit-outs Prescriptive Path

Indoor Environmental Quality

Complied with referenced ASHRAE Standards

Operation and Maintenance Manuals

Provided to Owner manuals and training

All references are to the GBI Proposed American National Standard 01-2008P
April 25, 2008 available at http://www.thegbi.org/home.asp

Alternate compliance may be submitted for review at Preliminary Design

Appendix K

Behavior and Campus Life

Table of Contents

Appendix K

Student Culture and Engagement Appendix Sections

Appendix K

- History of the Environmental Coalition's Involvement in Campus Sustainability
- The Virginia Tech Coalition for Campus Sustainability
- Virginia Tech Green Team
- Sustainability at Orientation
- Sustainable Living Guide
- Information and Research on a Student Green Fee
- Information and Research on a Student Sustainability Internship Program
- Examples of Successful Residence Hall Competitions

History of the Environmental Coalition's Involvement in Campus Sustainability[1]

The Environmental Coalition, the now largest sustainability focused student organization on campus, was founded in the fall of 2002 in response to the budget cuts and near elimination of the recycling program. The original main goals were to bring students on campus together, maintain the paper-recycling pick-up route, and hold an Earth Day event. In the fall of 2005, motivated EC members were successful in their first campus wide campaign of the "Green Fee" by collecting over 7,000 student signatures to support student fees to pay for energy efficiency and recycling on campus. The campaign lasted four semesters and was eventually defeated by the Virginia Tech Board of Visitors in the spring of 2007. In the fall of 2006, the Campus Climate Challenge campaign was launched to bring more of a climate focus to the organization. Also that fall, members attended the Youth Energy Summit, the first ever Virginia youth climate conference at the college of William and Mary. Virginia Tech had the most members in attendance.

To start 2007, devoted members lobbied state legislators in Richmond for climate legislation during winter break, and ended up running into President Charles Steger, who was there on business. In the fall of 2007, the Environmental Coalition became active on the national level by recruiting the most students of any university in the entire nation to attend Power Shift 2007 that November. One Hokie also served on the event steering committee. Power Shift 2007 was the first ever-national youth summit on global warming and environmental issues that had over 6,000 youth gather to have meaningful discussion and action on these issues. It was not only a monumental event in the global climate movement, but in all of history. One hundred and five Hokies were in attendance and made the bold statement that if we claim to "Invent the Future" at Virginia Tech, that we are dedicated to inventing the *right* future, a sustainable one. **On December 10, 2007 leaders of the Environmental Coalition had a meeting with President Steger to ask him to sign the Presidents Climate Commitment** (PCC) and to make a formal commitment to campus sustainability. They also submitted a photo petition with hundreds of students giving their personal reasons for Virginia Tech to invent a sustainable future.

Two EC members were asked to serve as undergraduate representatives on the Energy and Sustainability Committee for the spring 2008 semester. On January 31, 2008 the EC hosted Focus the Nation at Virginia Tech. Focus the Nation Day was a national educational initiative to teach about solutions to global warming; the unprecedented event included several lectures in the morning, a showcase on the drillfield, the first "Green Effect Event" to support President Steger in signing the PCC, and a panel discussion with representatives from environmental groups, power companies, the town of Blacksburg, and Virginia Tech. In the spring of 2008, the Environmental Coalition began to engage in various on-campus issues by forming several working groups: Energy and Sustainability, Dining Halls, Building the Coalition, Greeks go Green, and Recycling. The results were everything from the creation of table cards to assisting in the elimination of trays at D2 and hosting a community-wide conservation day. This

[1] http://www.theecvt.com/history.php

was also the semester that the Coalition for Campus Sustainability was formed, and within two months, gained 12 partner organizations. Earth Week 2008 was a complete success with daily events and involvement from other organizations and educational programs. **Earth week was when the Environmental Coalition received the letter from President Steger explaining that the Virginia Tech Climate Commitment would be developed instead of signing the PCC.**

In the fall of 2008, Hokies led and coordinated an effort to empower the youth of Virginia to build a sustainable Commonwealth – Virginia Power Shift. As the largest youth state gathering of its kind with over 400 attendees, the conference brought students together from across the state to discuss the challenges of statewide emissions reductions, mountaintop removal mining practices, and the Virginia political climate. Efforts were also in place to expand the Coalition for Campus Sustainability, which grew steadily to 24 student organizations.

The Virginia Tech Coalition for Campus Sustainability[2]

The CCS was founded in the spring of 2008 when leaders of the Environmental Coalition brought together twelve student organizations to promote and support campus sustainability initiatives. Now at 24 organizations, the CCS has bi-monthly meetings to discuss campus issues and potential solutions to them. The Coalition's mission is embedded in the University pylons to bring sustainability into university tradition and culture:

- Brotherhood by engaging in respectful conversation about our shared role in the future
- Honor through accountability in sustainable action
- Sacrifice through small changes that make a big difference
- Service through partnering with our community
- Duty to respect our impact on the environment
- Leadership in sustainable education and campus operations
- Loyality to long term commitments for a sustainable future
- Ut Prosim: That we may serve future Hokies with our actions

Members as of January 2009 include:

- The Environmental Coalition
- The Green Team
- Residence Hall Federation
- The Political Science Club of Virginia Tech
- Young Democrats
- College Republicans
- Emerging Green Builders
- Urban Affairs and Planning Student Association
- Alpha Phi Omega
- American Society of Agricultural and Biological Engineers
- Amnesty International
- Poverty Awareness Coalition for Equality
- S.E.E.D.S. (Seek Education, Explore, DiScover)
- Womanspace
- Applied Environmental Awareness

[2] http://www.vtcoalition.org/mission/

- NRV-CARE (New River Valley Coalition for Animal Rights and Environment)
- Soil and Water Conservation Society
- Natural Resources Recreation Society
- Ocean Conservancy
- Global Justice Alliance
- Sociology Association
- Mountain Justice Blacksburg
- Make the Switch
- Bike Advocacy at Virginia Tech

Virginia Tech Green Team

A student initiated the Virginia Tech Green Team in the fall of 2007 under the sponsorship of the Recycling Coordinator, Larry Bechtel. The program was implemented in the spring of 2008 and was successful in recruiting and developing 30 student leaders, educating over 300 students, and even giving a presentation to the full Residence Life staff. Team members feel that each of us has a responsibility as a Hokie to future generations and to future Hokies to understand the planetary impacts of our actions as individuals and as a society. Team members give a 25-minute interactive program about sustainability, the problems that the earth and the student's generation are facing, and what we all can do as individuals to solve those problems. The program is given in the residence halls, at student organization meetings, and fraternity and sorority meetings. They feel that it is extremely important for their generation to grasp the "bigger picture" of how humans are currently interacting and impacting our planet, so that we can all move into the future aware of what we will be dealing with in the next 10-20 years and having a better understanding of living more sustainably. We are all currently a part of creating the problems, but they feel that we all can play a part in the solutions. The student coordinator has been a paid position since the initiation of the program.

Sustainability at Orientation

In terms of progress, the Green Team coordinator met with Rick Sparks, Assistant Dean of Students and Director of orientation, in the summer of 2008 about incorporating a Green Team presentation into the orientation schedule. At that point, it was too late to fit it into the schedule, but he said that he would be willing to work with the student to try and have it incorporated the next summer. A small sized, shortened green team program with a small discussion afterwards could be given as a great way to educate and engage students before they even get to campus. It would give a great first impression of dedication to sustainability. As a part of leading by example, sustainability practices would also be incorporated into the planning of aspects of all of orientation events.

Sustainable Living Guide

A "Green Living Guide" was prepared by the Green Team Coordinator and submitted to the Director of Residence Life, Leon McClinton, in July of 2008, but it was too late to be able to have them printed and distributed that fall. Students in the Environmental Policy and Planning Studio class developed a draft "Hokies 4 the Future" packet this fall. This draft packet can be viewed in Appendix L. A great example that can be used to guide the development of a packet is that of Cornell's Green Living Guide tips[3]. Some of their tips include: ways to reduce general consumption, messaging on your cell phone instead

[3] http://www.campuslife.cornell.edu/campuslife/housing/green-living-guide.cfm

of email when possible because of the energy savings, unplugging unused electronic devices, skipping on ATM receipts, going paperless with your banking, and so many others geared specifically to college students. These guides could be further researched, developed and updated by students through the sustainability internship program.

Information and Research on a Student Green Fee

An effective tool to raise funds for institution-wide sustainability projects and initiatives on campuses is a student green fee. This fee would be a monetary value, usually ranging from $5.00-$20.00, added to student tuition to specifically fund sustainability action at Virginia Tech.

There are two ways of funding sustainability measures with student fees[4]:

- *Dedicated student fees* are fees of set amount that are dedicated for a specific purpose, in this case, some sort of sustainability purpose. This is the most common type of student Green Fees. Dedicated student fees can either be mandatory, meaning all students are required to pay them, or optional, meaning that students may choose whether or not to pay the fee. Optional fees can be structured to be either opt-in, where the default is non-payment of the fee, or opt-out, where payment of the fee is the default. Dedicated student fees have been used to fund a wide variety of sustainability purposes, including renewable energy purchases, hiring of sustainability staff, purchases of universal access transit passes for students, green buildings, and the creation of funding bodies for sustainability projects.
- *Budget cycle to budget cycle allocation* refers to funding that is determined periodically (usually each year) through a student government administered budgeting process. It is a less secure form of funding than dedicated student fees since it must compete with other funding possibilities in the budgeting process every budget cycle. This type of funding is commonly used to fund student sustainability organizations and has also been used to for larger sustainability purposes.

A student green fee at Virginia Tech would have the potential to raise large-scale funds due to the size of the university. Not only does the Green Fee provide immediate revenue to facilitate action on campus but can also empower students as managers and directors of the trajectory of the fund. Projects created for short-term time period implementation, such as a bike share program on campus or creating an Office of Sustainability with a hired director would be ideal.

How does a Green Fee function?

An effective green fee is a fund that is directly paid and managed by students. To implement a student green fee, there should be a Grant Making Committee created consisting of mostly students and at least one faculty advisor serving as the Grant Coordinator, which may or may not be a paid position. The committee would be responsible for review of project proposals as well as allocation and management of funds. Green Fee By Laws should be written (ideally by students) prior to enactment of the fee, accessible to all students whom are subject to the increase in their tuition. These By Laws should explicitly describe powers and duties of the Grant Making Committee, the role of the Grant Coordinator, the fund allocation and project selection process, as well as any other rules, accountability procedures or pre-designated funding that the university and student community see fit. A subcommittee of mostly students could be created within the standing Energy and Sustainability Committee to serve this function. This subcommittee could be chaired by a student body appointed student, advised by a

[4] http://www.aashe.org/resources/student_fees.php

member of the full committee, and have constant communication with the full committee on potential projects and fund allocation decisions.

At Virginia Tech, a student green fee added to tuition prices would require a referendum by the Student Government Association as well as acceptance from upper level administration. Future use of these fees could incorporate a revolving loan fund, which would be a fund for projects that have quantifiable monetary savings or returns and capitalize on long-term profitability of sustainability projects. Therefore, a student green fee could also range to support mid and long-term sustainability projects depending on its implementation and managed use.

Examples of other universities with successfully implemented Green Fees and their usages

College of William and Mary: since 2008, $15 per semester
Used to fund student research grants for sustainability-related projects, facilities upgrades, and creation of a new green endowment to fund further actions in the future. The College's newly founded Committee on Sustainability will administer the fees.

UNC Chapel Hill: since 2004, $4 per semester
Used to fund the installation of renewable energy technologies on campus, and it generates approximately $185,000 a year. The Renewable Energy Special Projects Committee (RESPC) administers it. RESPC is comprised of 7 students: two appointed by the Student Body President, the Speaker of Congress appoints one chair and two members, and the Graduate and Professional Student President appoints two members. Ex officio members including the Sustainability Coordinator, the Director of Energy Services, the Vice Chancellor of Campus Services, and other faculty and staff advise the RESPC members. The original referendum stipulated that students would revote on the fee increase within two years, resulting in a re-vote in 2009.

Appalachian State University: since 2005, $5 per semester
Used to fund the installation of renewable energy technologies on campus. The funds are administered by a Renewable Energy Initiative Committee, comprised of six students selected by the committee through an application process, one member from Student Government Association, three faculty members, one staff representative, and a representative from ASU Design and Construction. The fee increase is to be collected for three years, meaning that it will expire before the 08/09 school year unless an extension is approved.

University of California, Berkeley: since 2006, $5 per semester
Used to fund the installation of renewable energy technologies on campus, increase energy efficiency and reduce waste as well as support education initiatives, and student internships. Administered by student majority grant making committee.

University of Oregon: since 2005, $2.60 per semester
Used to purchase renewable energy and fund the installation of renewable energy and energy conservation technologies on campus. A portion of the funds is used to purchase wind power for the University's student union. The Energy Conservation and Alternative Futures Fund distributes the remaining funds to on-campus energy conservation, alternative energy, and awareness projects.

University of the South: since 2005, $45 per year
In March 2004, the Sewanee Student Assembly passed a resolution calling for student fee increases of $15/student in 2005, $30/student in 2006, and $45/student in 2007 and thereafter to fund the purchase of

renewable energy. The Sewanee Board of Regents approved this plan in February 2005, and collection of the fee began in fall 2005.

These are just a few examples of an ever-increasing trend on campuses across the nation. Students at the University of Virginia have campaigned heavily to instate a green fee, but have been unsuccessful thus far. Schools that have successfully instated fees to fund energy conservation and renewable energy projects on-campus include: University of Colorado at Colorado Springs, Northland College, and Bemidji State University. Schools that use fee revenues to purchase renewable energy produced off-campus include: University of Colorado at Boulder, University of Utah, Western Washington University, University of California at Santa Cruz, Harvard University's Kennedy School of Government, Connecticut College, and Warren Wilson College. Lastly, schools that use fees to support a combination of off-campus purchases and on-campus projects include: University of Colorado at Denver, University of Illinois at Urbana-Champaign, Middle Tennessee State University, Tennessee Technological University, The Evergreen State College, Metro State University, and University of Wisconsin – La Crosse. A constantly updated list of student Green Fees and their uses can be accessed on the AASHE resources page[5].

Information and Research on a Student Sustainability Internship Program

There have been multiple successful student internship programs focused on campus sustainability implemented on college campuses. These programs range widely in coordination and levels of engagement, but have all shown tremendous benefits in developing a more sustainable campus community and culture. The following recommendations have been developed through research of programs and verbal communication with program coordinators.

This section has a lot of information and can be broken down into the following sub-sections:

- What are the purpose and benefits of a student internship program focused on campus sustainability?
- What resources would be needed to begin a program?
- How could this program be coordinated at Virginia Tech?
- What types of projects would students work on and how would new projects be developed?
- Potential internship opportunities
- What would be the assessment process to measure progress and success of projects?
- How could students be recruited to participate?
- What incentives would be given to students to participate?
- Successful Programs

What are the purpose and benefits of a student internship program focused on campus sustainability?

Many of the proposals in the VTCAC&SP will take more time, planning, and research to fully implement. By engaging students to help with the development of these projects, campus can become a living laboratory for sustainability and students will gain the hands-on knowledge and skills to take on real world challenges. This engagement will lead to students with lessened environmental footprints and a building of campus culture around sustainability. In addition, utilizing students in the planning, development, and implementation of sustainability projects will save considerable amounts of time and money. Student interns could also help to raise the much-needed capital to initiate new sustainability

[5] http://www.aashe.org/resources/mandatory_energy_fees.php

projects and programs by helping in the grant writing process. Grants are how many Offices of Sustainability operate and fund many of their projects.

What resources would be needed to begin a program?

A Program Director would need to be hired and a very minimal amount of money would need to be designated for the program's budget. To begin, it would be best to start with just 10-12 interns. These interns could be recruited through the Environmental Coalition and Coalition for Campus Sustainability. Cooperation would also need to be secured with all of the university's academic colleges and departments to ensure that academic credit would be able to be offered for these internships.

How could this program be coordinated at Virginia Tech?

There would be a Program Director that would meet with, advise, assess, and support all of the student interns. In the case of some specific projects, other Virginia Tech staff or faculty members might directly oversee interns. The time commitment for the intern adviser is estimated to be between 2-3 hours per week per student or project.

Project proposals could be developed and presented at a mid semester stakeholder meeting to gain approval. This would give time to approve projects and have time to recruit the students to work on them. Anyone that would have a role in approving or implementing a project could attend these meetings to voice opinions or concerns on, vote on, and even propose projects. This can ensure that there is broad support for initiatives and will ensure long-term program success.

Interested students would apply for internships by submitting an electronic application, cover letter, and resume through the program website. Each student would also have an in person interview with the Program Director to explain expectations of interns, a description of how the program works, and basic overview of the project that they applied for. Interviews would also have time set for questions and inquiries about the project and other items the student wants to address. Depending on the number of applicants, there could be an application review process to narrow down candidates for interviews.

Students would be selected for positions at the end of the semester to work on projects for the following semester. Internships would be offered on a semester-by-semester basis, unless a project is expected to take longer than one semester. A short training would be given at the beginning of each semester to all new interns to familiarize students with what is going on, how the program works, and who their fellow interns are. Exercises to build trust between the interns and the Program Director would also be included. Interns would then have a weekly or bi-weekly meeting with the program director to discuss their project, a review meeting half way through the semester to assess overall progress, and a final evaluation meeting to discuss how the project went overall, what they learned, and to give students a chance to give feedback on the internship experience and process.

What types of projects would students work on and how would new projects be developed?

There are so many different types of internship projects that could be pursued. Students can be given broad responsibility in research, project development, and communications, and become important members of the Virginia Tech sustainability team. Interns could be assigned tasks that may include: conducting research on the use of resources and options for conservation, producing informational materials to help educate and inform members of the student community, evaluating programs at peer academic institutions, researching, developing, and maintaining an accurate inventory of greenhouse gas

emissions, assisting in raising funds for ongoing projects, and working with professional staff to ensure that goals are met. Internship positions would be offered on a semester-by-semester basis for specific single student and group projects, although some may be available for longer periods of time. There could also be standing positions that are offered each semester, such as media coordinators and website developers. Consideration could also be given to general student interns that can help with anything needed by the Program Director or Office of Sustainability staff.

Projects could be initiated and proposed in multiple different ways: by the Office of Sustainability, by a faculty or staff member or academic unit, or by a student. Proposals would be submitted to the Program Director and would need to include a project description, departments that would have to be involved, an estimated budget, and logistics of how it could be accomplished. These would need to be submitted by the middle of each semester to be considered for the following semester – this is to ensure that it can be proposed at the once-a-semester stakeholder meeting. All of the submitted proposals should be reviewed for feasibility and then sent to the stakeholders, previous to the meeting, for review.

Potential internship opportunities

- **Website Administration Intern/s:** A student could work with and help develop the Office of Sustainability website. They could adjust formatting, add links, create more interactive aspects, expand to include building pages for displaying campus greenhouse gas inventory information, better organize resources on how to live more sustainably on campus and at home into an easier to understand and access location, update and maintain a list of sustainability-related courses, green job listings, internships, volunteer opportunities, and student organizations/how to get involved. This could be geared towards engaging computer science, graphic design, and marketing students.
- **Sustainability Outreach and Publicity Intern/s:** Students could help coordinate public relations around Office of Sustainability projects, help with event planning, and build relationships with the media. They could also help in compiling a sustainability newsletter that could be distributed to media sources and available to the public on the website. This could be geared towards engaging communication, marketing, and journalism students.
- **Communication or Blogging Intern:** A student could develop a campus sustainability blog and post regularly on it. This could be located on the proposed Office of Sustainability's website and could be a great porthole for campus community members to stay updated on and be able to give feedback on current projects. They could also assist in meetings by helping to take notes and record major decisions. This could be geared towards engaging English, communication, and journalism students.
- **Fundraising and Finance Interns:** Students could help research and find potential grants. They could take the lead on applying for these grants and securing funds for sustainability projects across campus. Students could also help with organizing finances within the Office of Sustainability and the Green Fee. This could be geared towards engaging finance, business, and accounting students.
- **Sustainability and Greenhouse Gas Assessment Interns:** Students could be continually keeping track of reductions in energy, water, and resource consumption, emissions reductions, and other strides towards becoming a more sustainable campus. They could also maintain a record of projects that were pursued. They could be charged with putting together an annual sustainability assessment, similar to those other Universities release.
- **Building Efficiency Interns:** Students could be assigned to building managers to work with them to audit the building and help develop an efficiency plan. This could be geared towards engaging building construction, engineering, and planning students.

- **Environmentally Preferable Purchasing Intern:** A student could work with the Procurement Office to develop a campus-wide environmentally preferable purchasing guide or policy. They could assist in researching other universities and different suppliers, developing environmental standards for suppliers, and ultimately working with campus suppliers.
- **Waste Assessment and Reduction Strategy Intern/s:** Students as a group project could work with the Athletics department, Dining Services, and other campus entities to conduct waste assessments of various operations and activities. These students could then research and work to develop a waste reduction strategy for their chosen department. This could be geared towards engaging planning students.
    - **Athletics Intern:** conduct waste assessments of various operations and events. They would also perform an audit of operational, organizational and personal sustainability practices underway. They could then develop a waste reduction strategy.
    - **Dining Services Intern:** conduct food waste assessments of each dining facility and dining operations. They would also perform an audit of operational, organizational and personal sustainability practices underway. They could work with sustainability coordinator to develop a waste reduction strategy.
    - **Residence Life Intern:** conduct waste assessments of office operations and events. They would also perform an audit of operational, organizational and personal sustainability practices underway. This student could then research and work to develop a waste reduction strategy.
    - **Inn at Virginia Tech and Skelton Conference Center Intern:** could help with conducting the energy and waste audit, and help craft efficiency and conservation plan. This could be geared towards engaging hospitality and management students.
- **Residence Hall Competition Interns:** A group of students could design and manage an effective way to run a campus competition between residence halls around the issues of sustainability. They would work with Residence Life, the Residence Hall Federation, Sustainability Advisors, and Resident Advisors.
- **First Year Student Focus Intern:** A student could work with the orientation director and Hokie F-6 director to work specifically on the first year student's experience of sustainability.
- **Recycling Intern:** A student could work with the recycling coordinator and help field recycling questions from students. A study could be done on major outdoor traffic patterns to determine where the best locations for outdoor recycling bins would be. This intern could also maintain a virtual map of where all recycling facilities are available and for what materials. This could be geared towards engaging planning students.
- **Sustainable Living Materials and Resources Intern:** A student could lead the development of and updating of a sustainable living guide for all students. They could also tailor this guide towards parents and their activities at home.
- **The Proposed Sustainability Advisors Program Interns:** This could be a group project that could have dual oversight shared between the Program Director and Residence Life.
- **Green Building Materials Intern:** A student could research and prepare reference materials and specification samples for greener building on campus, and help with the LEED Certification process. They could work with the Office of Capital Design and Construction to identify local and sustainable materials and potentially develop campus-wide Construction Design Standards. This could be geared towards engaging architecture, building construction, interior design, and engineering students.
- **Green Room Development Intern:** This is similar to the example listing above. A student could work with Residence Life and Housing Services to research and find products for a greener residence hall room. Through that research, they could also develop the green

purchasing guide for parents that lists options for more efficient and sustainable alternatives to the standard room amenities.

- **Alternative Transportation Intern:** A student could work with the Alternative Transportation Manager and the Blacksburg Transit to distribute information to students and serve as a liaison to bring student concerns and ideas to those decision makers. This could be geared towards engaging marketing and planning students.
- **"Lab rats"**[6] is a program at UCSB where student interns evaluate lab practices around campus. They assess current practices and try to minimize energy use and make recycling available in all different types of lab settings. This could be geared towards engaging chemistry, biology, and other lab focused students.
- **Herb Garden and Sustainable Agriculture Interns:** Students could help Dining Services and the school of Agriculture in the herb garden development. These students could work to incorporate cutting edge organic gardening methods and other more sustainable agriculture techniques. This could be geared towards engaging agriculture students.
- **Administrative Support Intern:** A student could support and work with the Energy and Sustainability committee and subcommittee members in whatever they need. They could assist with a variety of follow-up and outreach activities, and could track the Committee's initiatives and report on their progress.
- **Faculty or Staff Project Interns:** Students could work directly with a faculty or staff member on research or a specific project that they are working on. This faculty or staff member would then be responsible for overseeing the student, if possible.

The existing Green Partnership between Virginia Tech, the Town of Blacksburg, and Sustainable Blacksburg could be expanded to include an internship partnership. Students would be able to work with these entities to develop more sustainability projects in surrounding areas. One example of this could be having a student work with the K-12 schools in the area to develop recycling systems and sustainability plans. The possibilities are endless.

What would be the assessment process to measure progress and success of projects?

Weekly or Bi-weekly Assessment Meetings: Interns would meet on a weekly or bi-weekly basis, in person, with the Program Director or their staff advisor. It is important to have regularly scheduled meetings to ensure accountability and sustain interest. These meetings would last approximately 45 minutes to an hour, and would be on a project basis. This means that if it is a single student project, it would be an individual meeting, and if it were a multiple student project, it would be a group meeting. These meetings would consist of six main topics: a non-internship check in, each subsection of the project, weekly goals – assessment and development, overall project progress, and questions. A check in on non-internship related items would be first to be able to better gauge the student's stress level and work load for the time period. Taking time to understand where the student stands with issues outside of the internship can help to build in hours flexibility, better ability to mentor and guide the student, and ability to build a strong and trusting relationship with the student. Then discussion about the project would begin. Each subsection of the project, the previous week's goals and whether or not they were met, setting of the following week's goals, and overall project progress and set backs would be discussed. Students would have the opportunity to share their challenges and the Program Director would be able to advise them on logical next steps, provide them with information of people to contact or programs to look into, and give advice on ways to strengthen the project.

[6] http://sustainability.ucsb.edu/LARS/

In the first meeting, a list of steps that will need to be taken and people to be talked to for their specific project will be given. This will ensure that the student will have enough baseline information to get started. As time passes, less and less information and more advice should be given to the student to help advance personal development skills, self-confidence, and their ability to think holistically and analytically. The main roles of the Director are to provide information, motivation, training, resources, advice on how to develop solutions to campus sustainability challenges, and how to develop themselves into confidant campus leaders. Building strong relationships with and confidence in interns will increase and sustain interest in the program, increase productivity due to the stronger sense of leadership and support, increase motivation and confidence to take on greater sustainability challenges in the world, and an overall better internship experience and pride in Virginia Tech.

Evaluation Meetings: A review meeting half way through the semester would be appropriate to assess overall progress, and a final meeting would be critical to discuss how the project went overall, what they learned, and feedback on the internship experience and process. These evaluation meetings are great ways to track overall progress of the project and of the individual's personal development.

Final Products: Deliverables would be determined at the beginning of the internship period between the Program Director or advisor and the Intern, whether it be a grant application, information booklet, or 3 posts a week. These would be different for each project.

How could students be recruited to participate?

There are three main ways found that students can be recruited to participate in an internship program: listings on the program website, utilization of listservs, and working with the career development/services office on campus.

A blog type internship listing on the Office of Sustainability website would be the first step to recruiting students. This would list the internship title, description of the position and duties, commitment hours a week required, and a section on minimum requirements. Students would have to submit a cover letter and resume to the Program Director, and have an in person interview before they can begin an internship.

This is an example of an internship listing for the program at UC Berkeley[7]:

Green Room Development

Positions: 1

Background: The Green Room Series has three demonstration areas (Green Room, Green Apartment, and Green Suite) that are designed to teach the campus community about sustainable living without spending copious amounts of money or drastically changing their lifestyle. Little effort has been made to determine the effects of people visiting the Green Demonstration Areas other than counting the number of guests. The Green Suite is specially equipped to handle up to 40 people and has a specific focus on structural changes and community living innovations that can be made to make a building more environmentally friendly. This area is well equipped to educate discussion sections and classes about sustainable living, but there is no current outreach to campus professors and graduate student instructors. The Green Room Committee seeks a self-motivated and organized student who can help determine the effectiveness of the Green Room Series and expand the scope of the Green Room Series.

[7] http://sustainability.berkeley.edu/interns/2007_09_01_archive.html

Appendix K

Job Description:

- Help administer surveys and analyze the data to determine the effectiveness of the Green Room Series
- Identify changes that can be made to increase effectiveness
- Advertise the Green Room Series so as to have a greater impact on the campus community
- Contact campus departments to inform instructors about the Green Suite.
- Work with course instructors to help integrate a tour into their curriculum.
- Other Administrative duties.

Preferred Skills: Students with previous experience in the environmental field are preferred. Student must be proficient in Microsoft Excel, Word, and Power Point. Experience with Illustrator, Publisher, or web design programs is preferred.

Payscale: $10/hr, 200 hours
Contact: Laura Moreno, lmoreno@berkeley.edu
Application: Submit application and resume by 5 pm on October 10th, 2007. GreenRoom_App.pdf

Listservs will be the second key step to recruiting students. Each academic department has a listserv to distribute information to their students, and these listservs could be utilized, with their cooperation, to announce internship opportunities that are related to their field of study. Internships could be open to any student, listed as geared towards specific majors, or can be made available only to specific majors. A campus sustainability listserv could also be built where students can sign up to get notices about projects and internship opportunities. Student organizations also have their own listservs that could be utilized to get the word out to interested students, either through direct contact from the Program Director or through the notification through the general campus sustainability listserv. A Facebook group could also created to work within the social network that students frequently use.

Working with Career Services would be the third way to recruit students. Posting internship opportunities and descriptions on the career services website, and attending any career fairs happening on campus are great ways to spread the word about these opportunities.

What incentives would be given to students to participate?

Academic credit through internship, independent study, or undergraduate research credit hours could be offered to participating students. Awarding academic credit instead of a monetary sum would allow students access to a whole new field of applied learning while exploring their own campus's operations and activities. Departments would need to be contacted individually about their process for enrolling students in and awarding credits for this type of work. Internships could be worth 1-3 credit hours. A partnership would need to be formed between all of the academic colleges and this program to ensure that requirements are being met and communication is constant. After the program has begun running successfully, there is always the option to offer paid positions for students, especially ones that are a part of the Federal Work Study program. It was noted by the Program Director at UC Santa Barbara that when no paid positions are offered, the diversity of interns will suffer, especially in the case of low income students.

Successful Programs

Some of the universities and colleges with sustainability internship programs, whether focused on campus operations, summer programs, or working with outside entities, include: University of

Maryland[8], Ohio University[9], Stanford University[10], University of California, Berkeley[11], University of Utah[12], Johns Hopkins University[13], Harvard University[14], University of Michigan[15], Indiana University[16], University of New Hampshire[17], University of California, Santa Barbara[18], a University of California system program[19], University of Minnesota[20], Oregon State University[21], Hawaii Pacific University[22], and the University of Nevada in Las Vegas[23].

Examples of Successful Residence Hall Competitions

The most successful program found was the Eco-Olympics competition at Duke University. At Duke University, the "Eco-Olympics" is a dorm vs. dorm sustainability competition that includes a suite of events promoting recycling, energy and water conservation, environmental education and other sustainable practices. Many schools including Harvard, Oberlin, Stanford, UNC Chapel Hill, and Yale run similar competitions under names such as the "Green Cup," "Energy Bowl and Water Derby," and "Do it in the Dark." A full list of competition websites can be found here[24]. The Eco-Olympics program at Duke has been so successful, the Association for the Advancement of Sustainability in Higher Education (AASHE) has teamed up with the student group, Environmental Alliance, that coordinates the program to share how they did it with students across the nation. A comprehensive website[25] has been developed that provides video segments covering different parts of putting on a successful dorm vs. dorm competition, a discussion board to facilitate conversation and field questions, and provides space for video responses to questions to be able to better explain concepts and procedures. Explanatory video segments include topics like fundraising, partnering with other departments, advertising, scoring, and options for competitions[26]. Competitions are based on overall reductions in energy and water use, but segments of the program could include a kickoff ceremony, light bulb exchange, online impact survey, eco-trivia, garbology/recycling, and an eco-film series. Interviews with student leaders and participants are available, and even a sample budget breakdown.

At Ohio University, their "ResChallenge 2008" competition in their 40 residence halls resulted in a savings of 271,668 KWh of electricity, $12,000 in electricity costs, and 300 tons of carbon dioxide[27]. This is equivalent to taking 17,589 cars off the road for a day! This is also proof that engaging in these types of competitions can save a lot of money for the university.

Student interns could work with student organizations to plan and coordinate a student based residence hall competition. With all of this great information available, students could easily facilitate something like this on the Blacksburg campus.

[8] http://www.sustainability.umd.edu/index.php?p=sus_student
[9] http://www.ohio.edu/sustainability/contactus.htm
[10] http://sustainability.stanford.edu/resources/SSSinternships.html
[11] http://sustainability.berkeley.edu/interns/
[12] http://www.sustainability.utah.edu/about/internships.htm
[13] http://www.sustainability.jhu.edu/internships.html
[14] http://www.greencampus.harvard.edu/sip/
[15] http://css.snre.umich.edu/solicit2008.pdf
[16] http://newsinfo.iu.edu/news/page/normal/8304.html
[17] http://www.sustainableunh.unh.edu/internship.html
[18] http://sustainability.ucsb.edu/academics/students-jobs.php
[19] http://www.universityofcalifornia.edu/sustainability/student_affairs.html
[20] http://mntap.umn.edu/intern/index.htm
[21] http://recycle.oregonstate.edu/ssi/grantsjobs.cfm
[22] http://www.hpu.edu/index.cfm?contentID=9824&siteID=1
[23] http://urban21.unlv.edu/internships
[24] http://www2.aashe.org/competitions/competition-websites/competition-websites#comment-25
[25] http://www2.aashe.org/competitions/uncategorized/how-to-use-this-site
[26] http://www2.aashe.org/competitions/video/video-segments-index
[27] http://www.ohio.edu/sustainability/ResidenceChallenge2008.htm

Evidence has also been found of a campus vs. campus sustainability competition - NC State Chancellor challenged UNC's Chancellor to a contest to see which campus could save the most water in residence halls. More details can be found here[28]. In the future, consideration could be given to challenging the University of Virginia or another peer institution to a similar competition.

Faculty and Staff Engagement Appendix Sections

- Education and Awareness Campaigns
- Faculty and Staff Sustainability Group
- Sustainable Procurement in Offices

Education and Awareness Campaigns

There has been some history of faculty and staff education – the Green Team gave a program to the entire Residence Life staff and the Green Team coordinator met with the Community Director for Greek Housing and Acting Coordinator for Fraternity and Sorority Life to discuss ways for her office to be greener. This lead to the development of a document on how offices can have more sustainable operations, but this document can be dramatically improved.

The Green Team can help in the education side of this recommendation. The program that is given can also be slightly tailored to faculty and staff members. A facilitated discussion about office practices and behavior would be best to follow the education presentation. In this discussion, office members could converse about what unsustainable habits there are, identify what will be the most difficult to change, and help decide on the best method to keep office members reminded about being more sustainable (increased signage, reminder emails, end of day check sheet, etc).

Offices could be further engaged by having members designate a green advocate for each office – this could harness the effort, energy, and enthusiasm of employees to green their own departments and work spaces, while educating others and increasing awareness throughout the university. Advocates could serve as a resource by identifying issues and opportunities for improvement at the "ground level," and communicating this information back to the Office of Sustainability. These green advocates could be charged with implementing the agreed upon reminder methods and to meet with all of the other green advocates on a monthly basis. This green advocate group could develop and decide on green office guidelines that could be distributed electronically to all office leaders. Green advocates would then be responsible for helping office mates comply with the green guidelines and maintaining small records on the impact of the education and engagement program. Green advocates would also meet periodically with the Office of Sustainability to report on progress, setbacks, and struggles. There is a successful program similar to this called the Sustainability Advocate Program at New York University.

Items or practices that could be included in the green office guidelines include: mandatory double sided printing and copying, using smaller margins on documents, ability to opt out of receiving printed materials like the VT directory, replacing all lighting with energy efficient models, turning all lights off at the end of each day including those in hallways and bathrooms, turning off lights that are not in use or are not needed during work hours, turning computers and copiers completely off at the end of each day, changing computer settings to the sleep function when not in use during office hours instead of using screen savers, adding one plant for every ten square yards to improve indoor air quality, thermostat setting, recycling stations in each office for mixed paper and commingled and access to cardboard, recycling ink cartridges, increasing the use of post consumer recycled content paper and products,

[28] http://tarheelblue.cstv.com/genrel/110707aaa.html

decreasing volume of paper needed for instruction, only printing what is needed, minimizing paper documents at meetings, encouraging the use of electronic methods of communication instead of printed memos or documents, avoiding chemical cleaners like keyboard cleaners, turning off all items when not in use and in some cases unplugging them, paying bills online, purchasing energy efficient models of office equipment when replacement is needed, encouraging the use of the stairs over elevators, using fans when possible instead of air conditioning, using blinds or curtains for additional temperature control, using power strips to control phantom electricity loads, using scrap paper for taking notes, reducing water bottle use by providing filtered water stations and everyone using reusable cups or mugs, and encouraging waste minimization for lunches by eating in or bringing food in a reusable container.

This impact awareness campaign and new sense of consciousness will contribute to more sustainable behavior, which will result in overall energy, resource, and monetary savings.

Faculty and Staff Sustainability Group

This group could be formed in many different ways and could serve multiple different functions. The purpose of developing such a group is to foster more engagement of the faculty and staff community on campus, and this goal can be reached with many different approaches. This fall, the Environmental Coalition contacted Annie Pearce, an Assistant Professor in the Myers-Lawson School of Construction specializing in sustainable facilities and infrastructure systems, about starting a program like this. She has agreed to begin exploring this program idea, and collaboration will begin this spring.

The majority of current groups are focused on faculty engagement and sustainable curriculum development, but engagement of staff members and promoting sustainable office behavior is an important aspect of campus life that needs to be addressed. Listed below are some specific examples of successful programs that could be used as models for the development of our group.

The Piedmont Project[29]*:* The Piedmont Project at Emory University "emerged as a grassroots effort on the part of concerned faculty to strengthen Emory's engagement with sustainability and environmental issues. Supported by several internal funding sources, it is a curriculum development project that seeks to foster an invigorated intellectual community to address global issues and local environmental awareness. The project has grown from a focus on course development to include a broader group of experiences, both in and outside the classroom, expanding from faculty to graduate students, in ever-widening circles of dialogue." Each summer since 2001, the Piedmont Project at Emory University has drawn together cohorts of roughly twenty faculty members from diverse fields across the university to learn about environmental issues and sustainability. Development of new courses or course materials begins with a two-day introductory workshop in May, immediately after graduation, in which two to four faculty facilitators lead discussions about sustainability, environmental issues, the local Atlanta/Emory ecosystem, and political, economic, social, philosophical, and ethical dimensions of these issues. Three or four resource experts provide information on ecology, public health, environmental justice, and an overview of campus environmental efforts. There are two follow-up meetings (a fieldtrip in August and a dinner the following March), in which participants report on their progress and share their learning experiences. In 2004, this faculty development program was extended to graduate students, and 18 Piedmont Graduate Fellows participated in a workshop and curriculum development project. In addition, sustainability issues were introduced throughout the Graduate School of Arts and Sciences teacher training program, as part of the university's commitment to its Environmental Mission Statement, adopted in 2002.

[29] http://www.scienceandsociety.emory.edu/piedmont/project.htm#faculty

The Ponderosa Project[30]*:* The Ponderosa Project at Northern Arizona University is an interdisciplinary faculty group effort to incorporate environmental sustainability issues into university courses with the ultimate goal of providing future citizens the education and skills necessary to achieve sustainable communities and societies. It operates on the premise that since environmental issues are relevant to many disciplines, the best way to educate students is to include environmental perspectives in the content material presented in a variety of subjects. This overall "greening of the curriculum" has the potential for educating wide numbers of students with recurring themes of environmental sustainability as related to all disciplines. The Ponderosa Group consists of faculty members from various disciplines who share a common vision of education for environmental sustainability. Participants in the Ponderosa Group have attended an intensive three-day training workshop in which they learned about environmental issues and how to incorporate such issues into course materials. After their training, participants revised syllabi for selected courses to include environment-oriented content. The group meets regularly throughout the academic year in support of this "greening" of the curriculum project.

Auburn Fall Line Project[31]*:* Invited speakers and Auburn faculty facilitate discussion of sustainability and its role in the university curriculum during a two-day workshop. The workshop explores techniques for integrating these issues into their classes. They start by taking a close look at Auburn and the larger Eastern Alabama region, but invite participants to engage in local/global comparisons. Skeptics, environmentalists, and those in between have found that their various perspectives are welcomed and enrich the dialogue and the project activities. Faculty and advanced graduate student participants in the Fall Line Project are committed to revising a course to incorporate sustainability.

British Columbia Institute of Technology Pacific Spirit Project Workshop[32]*:* Over the course of two days, faculty explored the challenges and opportunities of incorporating sustainability within their curriculum for the first time this past year. Highlights of the workshop included an experiential, nature walk around Deer Lake, an opportunity to meet and share ideas with colleagues, and group activities to foster insights about how students learn and what evidence could be assessed to determine whether a BCIT education empowers students to contribute to a sustainable future. Wayne Hand, Acting Dean for the School of Construction and the Environment, said, "I truly believe that the outcomes from this exercise have the potential to make a real difference in how our graduates make important decisions throughout their career."

Sustainable Procurement in Offices

The Office of the Federal Environmental Executive[33] describes green purchasing as the acquisition of recycled content products, environmentally preferable products and services, biobased products, energy- and water-efficient products, alternate fuel vehicles, products using renewable energy, and alternatives to hazardous or toxic chemicals." A sustainable purchasing guide can be developed to help office decision makers choose sustainable options for all of their needs. There have already been many documents produced by different colleges and universities as well as by the United States Environmental Protection Agency. Some of the universities that participate in this socially responsible purchasing practice include the University of Pennsylvania, Georgia Institute of Technology, Yale, UNC Chapel Hill, Clemson, University of Michigan, University of Colorado at Boulder, Tulane, MIT, Duke, and Cornell. Links to their purchasing policies and websites can be accessed here[34]. The US EPA has two

[30] http://www2.nau.edu/~ponder-p/
[31] http://www.auburn.edu/projects/sustainability/Fallline.php
[32] http://www.bcit.ca/construction/sustainability/pacspiritworkshop.shtml
[33] http://www.ofee.gov/gp/gp.asp
[34] http://www.aashe.org/resources/purchasing_links.php

resources on this topic – Comprehensive Procurement Guidelines[35] and Environmentally Preferable Purchasing[36]. The Department of Energy has a program where institutions can be connected with suppliers who sell Energy Star qualified products in bulk to save money[37]. Another resource to consider for campus wide procurement is the Responsible Purchasing Network[38], an international network of buyers dedicated to socially responsible and environmentally sustainable purchasing. Their membership program and consulting services provide institutional purchasers with cutting edge procurement tools and resources designed to save money, conserve resources, reduce waste, and improve efficiency.

Housing and Dining Services Appendix Sections

- Full History and Current Status of Sustainability Initiatives
- Items to Include in a Green Purchasing Guide for Parents
- Peer-to-peer Style Sustainability Education and a Sustainability Advisors Program
- Details on the Recycle Mania Competition
- Full Tables for Immediate, Midterm, and Long-term Prospective Actions

Full History and Current Status of Sustainability Initiatives

There is a very impressive list of initiatives that Housing and Dining Services have implemented and have plans to pursue. Rick Johnson, the Director of Housing and Dining Services, has been an active member of the VTCAC subcommittee and has an Ex-Officio membership with the Energy and Sustainability Committee. He, Leon McClinton, the Director of Residence Life, and Andy Sarjahani, the Dining Services sustainability coordinator, have all played pivotal roles in making a commitment to sustainability and a priority for Housing and Dining Services. Below is a complete list of the initiatives that have been initiated and implemented by Housing and Dining Services[39].

Housing Services

- Renovations of Ambler Johnson (AJ) are being designed so that the building can be certified at the Silver level according to the LEED green building rating system.
- New Residence Hall 1 will also be designed and built to LEED Silver certifiable specifications
- Dual flush toilet system is being tested in AJ and will be part of the AJ renovation
- Increased our recycling of fluorescent lamps (we were doing partial recycling before, but have now stepped up the program to all lamps including compact and tube types – these are placed in a tube crusher drum, which is sent to recycle when full.
- Toilet paper at 100% recycled content. Roll towels at 100% recycled content. Black trashcan liners are 60% recycled content (clear liners are virgin plastic).
- All showerheads were replaced from 3gpm to 2gpm (pressure compensating/adjustable shower heads) as part of the Water Management Inc. recommendations in their report reducing water flow by 33%.
- Support RecycleMania.
- Recycling bin in every residence hall room (had them for years).
- No VOC (volatile organic compounds) paint.

[35] http://www.epa.gov/epawaste/conserve/tools/cpg/index.htm
[36] http://www.epa.gov/oppt/epp/
[37] http://www.quantityquotes.net/
[38] http://www.responsiblepurchasing.org/index.php
[39] This list was provided by Rick Johnson, Director of Housing and Dining Services, and Leon McClinton, Director of Residence Life.

- Switch common area light bulbs to T8 light fixtures, as able, within renovation and funding availability
- Replacement of stand-alone battery operated smoke detectors from 9v to 10-year lithium types.
- Mattresses refurbished instead of being totally replaced on an approximate five-year cycle.
- Shower machines are used to clean showers – allowing for bulk/mix-at-site chemical use and more efficiency. The shower cleaner, Green Earth, is a green product.
- Cardboard recycling sites during fall check-in operations.
- Participation and advertisement of the Y-Toss program at the end of the year to reduce amount discarded by students.
- Support the paper recycling program in several halls and worked with groups to add recycling bins in the mailroom areas for junk mail.
- Rooms are limited to one microwave (<1000wats) and a small refrigerator (<4.5 cubic feet)
- Assignments staff changed over to mostly e-contracting and dispersal of materials, including assignment notices. Efforts are under way to reduce print-and-file operations in favor of electronic repositories of records arriving by e-mail.
- New buildings have thermal glass windows helping to reduce energy consumption. Most of the residence halls have received new windows in the past 15 years.
- White roof systems – roofing system recently replaced on Ambler Johnston is of the white membrane type, which is considered a cool-roof system reducing the cooling needs of the building compared to rubber/tar/gravel systems.
- 12v batteries and above are recycled when replaced.
- Bulk chemical containers for housekeeping are made of recycled material. Currently not being recycled due to foaming and rinsing needs, but are being researched for easier recycling.
- New lounge furniture will have sustainable fabric.
- Sustainable carpet in Slusher Hall, Vawter Hall, Miles Hall, Newman Hall, Lee Hall, Pritchard Hall, Barringer Hall, and O'Shaughnessy Hall.
- Discard metal and wood scraps in the hoppers at Physical Plant recycling.

Residence Life

- Promotion for an a marketing campaign for the RecycleMania competition
- The Hokie F-6 program and the GREEN Team partnered to host a Go Green Picnic – a sustainability related program for freshman students.
- Stickers have been placed on light plates, reminding residents to turn off lights when the room is not occupied[40]. Stickers have also been placed on the paper towel dispensers to emphasize only taking how many are needed. Resident Advisors will remind residents of this sticker and practice throughout the year.
- Resident Advisors (RAs) are encouraged to use recyclable materials to decorate bulletin boards. A "Reduce, Reuse, Recycle" Award is presented to an RA that has made the most creative bulletin boards throughout the year.
- Residence Hall Federation (RHF) is co-sponsoring a "grocery bag" that will be issued to every on-campus resident.
- RAs can consider bringing a member of the VT Green Team onto the floor to help educate students about sustainability.

[40] These "reminder stickers" were projects initiated by the Environmental Coalition and were a partnership between the EC and student programs to implement.

- An energy conservation study is currently being conducted by a graduate student to assess the impacts of different methods of education on student behavior in four halls. This study should continue until her thesis is completed.

Dining Services

Administrative

- Hired a sustainability coordinator
- Educating students on their food supply and how they can make a difference in changing our current food system to one that is green, fair, affordable, and healthy.

"Local" food purchasing and production

- Make purchases from 13 local farms and distributors, and purchases 8-15% of food served "locally[41]."
- A Local/organic venue is opening in January in Owens food court
- A partnership is being formed with the Horticulture Department to develop plans for an herb garden project.

Waste Management - Composting and Recycling

- D2 and Shultz have gone completely trayless and estimated savings in D2 alone amounts to 350-400 lbs daily.
- In negotiations with a local composting farm, PME, in Riner, VA to handle all compostable materials from the dining halls. Estimated annual compostable material amounts to 930,560 lbs each academic year. Composting is set to begin in January at the Southgate center, and will gradually expand to all dining facilities as the kinks are discovered and solved.
- Diverting non-PHF's (potentially hazardous foods) to the Salvation Army
- Focusing on source reduction (i.e. decreasing overproduction) at D2 specifically
- Cardboard recycling has been part of Dining operations for years (most of their materials come in cardboard boxing) and is a significant percentage of the University total recycling effort. Used oil, plastic bottles, aluminum cans, and paper are all also recycled in all front of house and back of house operations.
- Recycling bins are being distributed and placed in all of the dining facilities – both in the front of the house and the back.
- Investigating the conversion to compostable products, but would like to focus on reducing the amount takeout orders. There is also research being done on a reusable to-go container system.

Other

- Fair trade coffee is offered, and has been for the past five years, in the specialty coffee shop on campus. They will also be offering organic products on a daily basis.
- Vegan and vegetarian options are offered daily in all dining centers

Items to Include in a Green Purchasing Guide for Parents

[41] "Local" is defined by being purchased within a 500 mile radius.

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A green purchasing guide could be distributed to parents to let them know of the energy efficient and more sustainable options for their child's new room. This guide could help parents make more sustainable decisions on what to buy for their students, and shows them the strong commitment that the university has made to provide a sustainable living and learning experience during their time at Virginia Tech. If parents take the advice given, students using energy efficient equipment in their rooms will result in lower energy consumption, less costs, and lower emissions. In the future, this document could be expanded to include a Sustainable Living Guide for parents – this would give them tips of what they can do in their homes and could impact the parents' decisions and behaviors at home. These guides could be researched and produced by students through the student sustainability internship program.

The following tips could be included in this guide:

- Purchasing Energy Star labeled appliances (microwave, refrigerator, printer, computer, etc)
- Emphasize that they can rent microfridges from the Residence Hall Federation instead of having to buy them
- Purchasing compact fluorescent bulbs instead of incandescent ones for the students lamps and room lighting
- Choosing notebooks, binders, and printer paper that have recycled content in them
- Having their students re-use supplies that they used in high school, if they are in good condition
- Purchasing a reusable water bottle and water filter for their refrigerator
- Finding sheets and towels made from organic cotton
- Purchasing shower supplies and toiletries that are eco-friendly
- Find a carpet that is low or no-VOC emitting
- And many others!

Peer-to-peer Style Sustainability Education and a Sustainability Advisors Program

The first eco-reps program was started at Tufts University in Boston in 2000. "Eco-reps programs" refer to peer-to-peer style sustainability education and outreach campaigns, but these programs have various different names at different universities like the Environmental Ambassadors at California State University at Chico, the Students for Sustainable Living at Duke University, the Resource Efficiency, Graduate Green Living and Harvard Law Green Living Programs at Harvard University, and the Generating Residential Environmental Education Now (GREEN) program at North Carolina State University. Since the first program implementation in 2000, over forty additional programs have been developed and new ones are launched each year.

Successful Eco-Reps Programs at Other Universities

Columbia University[42]*:* Columbia University Eco-Reps are a group of student employees working in partnership with Columbia's Department of Housing and Dining and Office of Environmental Stewardship to provide Peer-to-Peer (P2P) Resources for Columbia students. This means: publicizing available environmental services to students, serving as a bridge of communication between students and the administration, and facilitating campus projects for a reduced university ecological footprint. One student is assigned to each residence hall. Some of their campaigns include: RecycleMania, Green Move-In, a light bulb exchange, and the Green Living Challenge. They also produce and provide multiple resources for students including informative posters, fact sheets, and videos. Applications for program participants open in early fall and spring each semester.

[42] http://ecoreps.environment.columbia.edu/ecoreps-index.htm

Duke University[43]*:* The Students for Sustainable Living (SSL) is a program run through Duke's Sustainability Office. The positions are responsible for building a more sustainable campus culture through new and innovative initiatives and outreach. Job activities may require student employees to: distribute information to their peers and university offices about campus sustainability initiatives, conduct surveys and focus groups, and conduct research to inform program development, and raise awareness about the environmental impact of their campus community's behavior and decisions. There is an application process to work with the SSL program, and the position requires attendance at an hour long meeting each week and participation in group projects. In past years, the average time commitment has varied widely, from 3 to 10 or more hours each week, depending upon each student's availability and course load.

Harvard University[44]*:* Beginning in 2002, the Resource Efficiency Program was established with the purpose of educating and engaging the student body of Harvard in a wide range of campus sustainability initiatives. REP is a peer-to-peer educational program helping students to teach other students how to reduce waste production, decrease resource consumption, and promote sustainable dorm habits. The REP operates as an energetic collaboration between the Harvard Office for Sustainability, Office of Physical Resources, University Operations Services, Harvard University Dining Services, the Environmental Action Committee (a student organization) and Harvard College students. REP provides an effective avenue of communication between students and university decision-makers concerning resource use on campus. Seventeen student representatives, at least one per upper classman dorm and three in the Freshman Yard, are employed to work four hours per week on a range of dorm-based ecological education programs and energy-efficiency measures. Three student captains are employed for 10 hours a week to guide the student Reps, and one of these captains serves as a mentor for the Yard Reps. The Yard Captain and the Yard Reps also coordinate a volunteer entryway Eco-Rep program. An employee of the Office For Sustainability coordinates the entire Resource Efficiency Program. A Steering Group guides the Resource Efficiency Program, consisting of representatives from every funding partner, key student environmental leaders, and REP staff. The Resource Efficiency Program runs several key campaigns around recycling and waste reduction, reuse programs, energy conservation, laundry programs, green cleaning, dining hall practices and choices, travel tips, and now administers an annual Green Cup competition as a way of energizing and monitoring annual campus environmental impact reduction activities.

North Carolina State University[45]*:* The Generating Residential Environmental Education Now (GREEN) program is a collaboration of the Office of Energy Management, Office of Waste Reduction and Recycling, University Housing, and the Inter-Residence Council. Student representatives for the GREEN program educate their peers about sustainability concerns through the facilitation of programs and participation in campus events. Responsibilities include: residential education through the organization of sustainability programs and informational bulletin boards, participation and recruitment of students for GREEN on-campus events and community service projects, and facilitating improvements in their residence hall with regards to recycling and waste reduction, water and energy conservation and other sustainability concerns. A leadership commitment must be made for an entire school year.

University of California, Berkeley[46]*:* The mission statement of the Residential Sustainability Education Coordinator program is: To educate and inform others about the importance of a sustainable lifestyle and to make lasting proactive changes in the environments that we live in. The Residential Sustainability

[43] http://www.duke.edu/sustainability/news_events/items/2008_09_03NowHiringSSL.html
[44] http://www.greencampus.harvard.edu/rep/
[45] http://www.ncsu.edu/energy/2008/green.php
[46] http://www.ocf.berkeley.edu/~recycle/ssec/programs/rsec.html

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Education Coordinators (RSECs) are a diverse group of residence hall students who are interested in educating others about the importance of preserving our environment and instilling in them positive habits that aim to conserve our natural resources. A Unit Sustainability Educating Coordinator (USEC), who serves as the main contact between administration and student coordinators, supervises the RSECs. They work on the issues of recycling, water, energy, transportation, consumption and others. They work closely with the Operations team, Campus Recycling & Refuse Services, Dining, Re-USE, the Green Campus program, and to some extent, ResLife. RSECs are appointed in the beginning of the year for a full two-semester term. RSECs meet with facility managers to discuss pertinent issues and awareness programming. They also attend bi-monthly meetings with the campus-hired Student Sustainability Education Coordinators within Campus Recycling and Refuse Services and the rest of the RSEC team. Together they design outreach, implement ideas, and get the word out to residents that the environment is important and that we should do our best to preserve it.

A full list of current peer-to-peer style sustainability education programs can be found on the AASHE Resources page[47], but some others include: Brown University, Carnegie Mellon University, Costal Carolina University, Dartmouth College, Ithaca College, Johns Hopkins University, Princeton University, Rice University, Stanford University, University of Colorado at Boulder, University of Arizona, Yale University, and even at the University of British Columbia.

What could Sustainability Advisors do at Virginia Tech?

Campus leaders could be developed through this program and it could aid in building a campus culture around sustainability. If each residence hall had a "sustainability advisor" in addition to their resident advisors, each hall community would have a direct resource for establishing and maintaining sustainable lifestyles. They could give tips about how to reduce consumption of energy, water, and other resources, inform students of what can be recycled and where, publicize ways to get involved on campus, and raise awareness about how to engage in and the benefits of greener living. This program could be fully integrated within the existing RA and Hall director structure, and could either be a living and learning community through the Themed Housing Office or a group project of the proposed student sustainability internship program through the proposed Office of Sustainability. Logistics of this program could be developed and formulated around all of the other extremely successful programs, but tailored to the Hokie campus community and intertwined with the Hokie Sprit.

Details on the RecycleMania Competition

RecycleMania[48] is a friendly competition and benchmarking tool for college and university recycling programs to promote waste reduction activities to their campus communities. The program began in February of 2001. Virginia Tech participated in this competition in 2007 and 2008. Over a 10-week period, schools report recycling and trash data, which are then ranked according to who collects the largest amount of recyclables per capita, the largest amount of total recyclables, the least amount of trash per capita, or have the highest recycling rate. Other program rules can be found here[49]. With each week's reports and rankings, participating schools watch how their results fluctuate against other schools and use this to rally their campus communities to reduce and recycle more. In 2007 over 200 schools participated, and in 2008, participating schools collected a total of 58.6 million pounds of recyclables. The calculated climate impacts from the 2008 competition resulted in a prevention of 25,342 metric tons of emissions from entering the atmosphere – equivalent to taking 15,439 cars off the road for a year or

[47] http://www.aashe.org/resources/peer2peer.php
[48] http://www.recyclemaniacs.org/index.htm
[49] http://www.recyclemaniacs.org/rules.htm

196,038 barrels of oil[50]. RecycleMania provides a tool for campus recycling coordinators, student green teams and facility service professionals to engage their campus community in recycling and waste reduction in a fun and friendly way.

Full Table of Immediate, Midterm, and Long-term Prospective Actions for Residence Halls, Residence Life, and Dining Services

Actions/Measures	Description/Rationale	Costs	Benefits
Immediate			
Residence Halls			
Energy efficiency upgrades and infrastructure improvements in all buildings	Re-lamping buildings, low-flow water fixtures, motion sensors, etc. The installment of these items will considerably reduce energy and water consumption in the halls	Significant, but the energy savings form these upgrades will be realized in short amounts of time.	• Savings of money, greenhouse gases, and pollution because of lowered energy consumption • Quick payback period for most of these projects
Energy Conservation Study	Energy Conservation Program conducted by graduate student, which will be included in thesis	Free – it is an academic assignment	• One person can devote a significant amount of time to assessing energy use among 4 buildings
Increased recycling availability in residence halls	Making paper and commingled recycling more accessible in the residence halls by adding more bins and an efficient collection system	Significant - cost of bins for each hall	• Makes it easier for students to recycle which encourages more recycling • Increased recycling means less going into the landfill • Increasing better recycling behavior will be the first step to increasing sustainable behavior
Residence Life			
Annual Go Green Picnic by the Hokie F-6 Program and the Green Team (GT)	Educating first-year students about sustainability and GT	Purchase bags, fruit, and snacks	• Exposure for freshman to sustainability and lets them know of Residence Life's commitment to sustainability
Reusable Bag Initiative	Provide reusable bags for all on-campus students	Significant – at least $5,000 (RHF has donated that amt. to the product)	• Students can use these instead of the university providing plastic bags for meal takeouts and the book store purchases • Students can also use these for grocery shopping • Savings of petroleum based plastic bags
Increased reminder signage in residence halls	This could include signs and posters about turning off lights and computers. More signage to remind students will affect their behavior.	Minimal to Significant – depends on the extent. Can be minimal if incorporated into existing signage practice	• Visual reminders can help foster more sustainable behavior from students in residence halls – this will decrease energy consumption and wastefulness • Marketing students can be engaged in this and asked to create a smart marketing plan
Green Living Guide for all on-campus students	A guide explaining sustainable living on campus – turning off lights, eating in, BT routes, etc and why those things are important to do	Significant, because it will be a multi-page document and one would be placed in each room	• All students will know how to live more sustainably on campus, which will affect student behavior. More sustainable behavior translates into less energy consumed and less resources wasted. • Having these documents given out also

[50] http://www.recyclemaniacs.org/index-pop2008.htm

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			shows a strong commitment to sustainability.
Creation of recycling teams for the residence halls	These would be coordinated by the Residence Hall Federation, and the hall governments will take ownership	Minimal, only costs would be to pay for small incentives for students to participate and for advertising materials	• Student engagement in recycling will foster a more vested interest in recycling on campus • Sustainability leadership opportunities for students • Savings in costs for VTR because of student help
Assessment of vendor products and practices that are sold to RHF	RHF sells products like lofts and microfridges to students to raise money for their yearly budget. A look could be taken at other products offered that have a smaller impact, and also at what practices companies takes to be more sustainable.	Minimal, because the student organization has a contract with a vendor. Also, this assessment could be done by a student "intern"	• Students will get to purchase eco-friendly materials for their room • Shows that RHF is committed to sustainability and sustainable products • Selling more energy efficient products will save money and energy
Green purchasing guides for parents at orientation	Educate parents on what students should bring to campus and how to live eco-friendly/making parents aware of how important this practice is to the	Significant, because it will be a multi-page glossy – could consider placing it on the web	• By having parents buying more energy efficient and eco-friendly products, the University will save in energy costs • Shows university commitment to sustainability • Could potentially affect parents' behavior
Sustainability session/orientation for RAs	Have a session on the major environmental issues and causes, as well as an overview of what Virginia Tech is doing about these issues to be more sustainable	Free, can be administered by the Green Team or the Office of Sustainability	• Formalized training for all student staff • RA's will feel more comfortable and confident talking about these issues with their residents • Shows the university's commitment to sustainability education and behavior • Savings will be seen because of the resulting behavior changes. These behavior changes would lead to lowered energy and resource consumption, reduction in waste, and higher recycling rates – a major financial benefit.
Host an annual green competition between the residence halls on some aspect of sustainability	A competition of recycling rates, electricity consumption reduction, or water use reduction could be hosted between all of the residence halls. A competition of who can be more sustainable	Significant – Would need containers to support the campaign in the halls, but after the first year it would be free because of the existing infrastructure	• Competition usually creates interest, progress and productivity – especially with students • Students will change their behavior which will result in lower energy bills, less wastefulness, and higher recycling rates
Assess Residence Life's large activities and see how they can be greener	Take a look at the aspects of the large Residence Life programs and activities to see how they can use less energy, produce less waste, and incorporate more aspects of sustainability into them	Free, and could be done by a student "intern"	• Greening Residence Life's activities shows a commitment to sustainability • Students will be reminded to act more sustainably when they attend these events
Create a "green" model room	Replacing all of the items in the current "model room" with energy efficient models	Significant	• By having the one Residence Hall room that every prospective student sees be green, it shows all of them that Virginia

	and eco-friendly products		Tech is committed to sustainability • It can potentially bring more and better students here because of that first impression and the importance of sustainability
Develop a green office initiative	Creating a list of ways that people can use less energy, waste less, and recycle more in their offices. This could then be distributed to all campus offices and departments to foster more sustainable behavior	Free if delivered electronically	• Administrators can implement sustainability guidelines for sustainable office behavior • More conscious behavior like turning off lights, using power strips, and others will save a lot of money in reduced energy costs, and a lot of greenhouse gases
Dining Services			
Waste reduction through smaller-batch cooking and going tray less	See EPA Surplus Recovery Hierarchy	Will likely save $	• Decreased food costs, less food/water waste = decreased greenhouse gas emissions
Diverting edible un-eaten portions to Feeding America and Salvation Army	See EPA Surplus Recovery Hierarchy	$2,500-$3,000 for health department approved transportation materials	• Utilizing food for nourishment that will be converted to usable energy in human beings rather than turning into harmful greenhouse gases.
Processing Waste Veggie Oil for fuel	See EPA Surplus Recovery Hierarchy	$40-$60,000 for on-campus processor	• 4,500-5,000 gallons of usable fuel produced from our own waste further supporting a closed-circle system
Composting in-edible organic wastes + compostable containers	See EPA Surplus Recovery Hierarchy	$20,000 composting costs + $250,000 compostable container costs	• Decreased greenhouse gas emissions (methane) by turning waste into rich nutrients to restore our soil in Virginia
Recycling cardboard and co-mingles in "front and back of house"	Cardboard that is unusable will be diverted in the waste stream	N/A	• Cardboard not going to landfill and being recycled means less trees will be cut down and processed and since trees sequester carbon this will ultimately result in carbon sequestration.
Local/organic only venue in Owens Dining Center	Decreasing "food miles" and the external costs associated with globalized, conventionally produced food	Food will be sold in a retail setting so costs will be variable.	• Connecting students with their food supply; decreased "food miles" • Support of ecologically conscious agricultural products.
Green chemicals	Clean up the water supply	$10,000-$15,000 more than our current chemicals	• Cleaner water supply • Less volatile organic compounds and toxins in our air and bodies
Complete a waste audit of all dining halls and set goals for waste reduction	Survey each dining facility to see how much waste is being produced and what the waste stream is composed of. This will make it easier to create an effective recycling and composting system specific to each halls needs	Free to minimal – this could be completed by a student "intern"	• Understanding where each dining hall stands with waste, recycling, and composting ability is critical to developing a waste management plan
Actions/Measures	**Description/Rationale**	**Costs**	**Benefits**
Midterm			
Residence Halls			
Continued energy efficiency upgrades	Re-lamping buildings, low-flow water fixtures, motion sensors, etc. The installment of these items will	Significant, but the energy savings form these upgrades will be	• Savings of money, greenhouse gases, and pollution because of lowered energy consumption • Quick payback period for most of these

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	considerably reduce energy and water consumption in the halls	realized in short amounts of time.	projects
Energy star requirement for all on-campus appliances used by students or staff	All equipment must have the Energy Star label from the US EPA. These are energy efficient models.	Free	• Helps save money and resources
Begin the transition to more sustainable purchasing and procuring	Starting to purchase more energy efficient models and products with recycled content	Products could be significantly more expensive	• Tangible practices have a significant impact
Further increase recycling availability in the residence halls	Placing more recycling bins in and around the halls	Significant – purchase containers for all of the halls	• Make it easier for our students to recycle • Diverting waste from the landfill • Savings in emissions because of energy savings from recycling
Residence Life			
Develop and implement a "Sustainability Advisors" program	Sustainability Learning Community or internship project where students serve as an advisor for sustainable behavior and activities for a residence hall.	Designating rooms for this program. Potential for a small stipend, but could be done on a volunteer basis	• Creates an environment friendly and accessible for residents that want to learn more about sustainability • SA's would also help foster more sustainable behavior in their residents – which will translate into less energy and resource consumption
Have an on-campus living and learning experience for all freshmen.	All students in the halls are exposed to sustainability both educationally and in practice	Significant- literature available to educate students and facilities to support mission	• All freshmen will use all resources efficiently
Begin implementation of greening large activities and continued assessment	Have all Residence Life events be more sustainable	Minimal because some items may be more expensive that current ones	• Emphasizes the commitment of Residence Life to sustainability
Paid position(s) to help coordinate Residence Life's sustainability efforts	Could either be a few student "interns" or a full time sustainability position. This	Significant – depends on the level of compensation	• Monetary incentive provide for student staff that will help department achieve goals • Would tighten communication between Residence Life and the Office of Sustainability on initiatives
Dining Services			
Student run farm that uses composted food waste to grow vegetables for the dining centers	Growing our vegetables connects students with their food.	$50,000	• A connection with food → savoring food → decreased waste / over consumption → decreased greenhouse gas emissions from unused food → decreased obesity • Decreased "food miles"
All CFL bulbs	Saves electricity consumption and costs	$10,000	• Decreased greenhouse gases
Water saving faucets	Decreased water consumption	$15,000	• Save water costs, decrease electricity use
LEED Certification in all new buildings	New buildings will be more energy efficient	N/A	• Decreased greenhouse gas emissions
Actions/Measures	**Description/Rationale**	**Costs**	**Benefits**
Long term			
Residence Halls			
LEED Silver Certification on all new buildings and renovations	Having projects be verified through the US Green Building Council	Significant	• Third party verification • Significant savings in energy use if efficiency is invested in

Residence Life			
Continued competitions: Recycling, Electricity	Monitoring energy uses within all residential communities and provide a monthly report to all students. The hall community with the lowest level of energy and water usage/month will be rewarded for that month. Per capita will be factored into the assessment.	Significant: Equip buildings with energy monitoring devices	• Helping the university save energy, money, and emissions • Educates and engages students
Dining Services			
100% clean, renewable energy through solar, wind, geothermal, and biofuel based energy	Will create better air quality in Montgomery County	Significant	• Decreased greenhouse gases; renewable energy
"Zero Waste"	Everything will be reduced, reused, or recycled	Significant	• Closed-loop system clean energy and food production on campus

Inn at Virginia Tech and Skelton Conference Center Appendix Sections

- All Current Sustainability Practices at the IVTSCC
- Why Practice Green Lodging?
- Sustainable Lodging Practices Options
- Background on the Virginia Green Lodging program
- Background on the "Green" Hotels Association
- Examples of Comparable and Successful Hotel Sustainability Programs

All Current Sustainability Practices at the IVTSCC[51]

Optional linen service is provided, and house cleaners are trained on the process for the service. The facility minimizes the use of bleach and chlorinated chemicals are only used where there is no less toxic alternative. They also use a linen service provider that employs "wet" versus "dry" cleaning.

Recycling of commingled materials, paper materials, and cardboard has been made available to facility staff and guests. A project is underway to try and provide a newspaper station on each floor, rather than to each room, that would be paired with a recycling station. The Inn also recycles their toner cartridges, packing supplies, fluorescent lamps, batteries, and electronic waste. Department leaders were also taken on a tour of the recycling facility in Christiansburg to fully understand the importance of recycling and their efforts. Recycling infrastructure to make it easy and convenient should be available in front of house and back of house dining operations, conference facilities, and each guest room.

They are currently in conversation with the PME facility in Riner as well to compost all of the food waste that is produced in hotel and conference activities.

In terms of waste reduction, bulk soap dispensers are utilized instead of individual soaps, housekeeping staff are instructed to save and reuse unopened items, they minimize the use of disposables and use dishware and glassware, they provide non-bleached napkins and coffee filters, provide condiments and such in bulk, have an effective food inventory program to control waste, purchase recycled-content paper towels and toilet paper, encourage suppliers to minimize packaging, purchase from

[51] Information gathered from the Virginia Green Lodging Membership Application form. This was obtained from Chris Compton, the IVTSCC Chief Engineer, on January 7th, 2009.

environmentally conscious vendors, do two sided copying and printing, use electronic correspondence as much as possible, use green cleaners, purchase durable furniture, use latex paints, reuse of pain thinners, properly dispose of thinners and solvents, preventative maintenance of all appliances, effective inventory system, use less toxic materials, minimize the use of pesticides ad herbicides, and use integrated pest management strategies.

In terms of water conservation and efficiency, high efficiency dishwashers are used, water flow metering is used to discover leaks in addition to preventative maintenance, they discourage water-based clean ups, low flow appliances have been installed, have an effective landscape management plan in place, have effective storm water management, made effort to minimize impervious areas, and have installed vegetative buffers around streams and ponds.

In terms of energy conservation and efficiency, they are tracking overall energy bills and setting goals to reduce them, installed LED exit signs, installed high efficiency fluorescent ballasts and lamps, have a high efficiency HVAC system, utilize individual thermostats for each room, use natural lighting, installed lighting sensors, purchased Energy Star appliances, have thermal-rated windows and insulation, and use directional lighting in parking areas.

For conferences and meetings, they recycle plastic bottles and paper from the events.

Why Practice Green Lodging[52]*?*

1) **Gaining a Competitive Edge in Marketing.** Participants in *Green Lodging* can use the program logo in marketing materials and can promote the ability to provide "environmentally-friendly" conferences and events.
2) **Free Assistance.** DEQ's Office of Pollution Prevention has trained staff that is available to provide on-site assistance and guidance in solving waste management problems.
3) **Public Recognition.** *Green Lodging* provides certificates and room placards listing the pollution prevention practices of the facility. This information and more details are included on the *Green Lodging* website that can be linked to through the facility's site.
4) **Conserving natural resources** - Hospitality facilities use a significant amount of materials and produce a great deal of wastes. Simple measures can be implemented that will greatly reduce this impact.
5) **Preventing Pollution & Saving Money.** Pollution prevention is the way to get there because it focuses on *source reduction* – "why do we produce the waste in the first place?" Pollution prevention solutions usually result in reduced material usage and cost savings.
6) **Catering to Environmentally Aware Customers.** Not everyone will appreciate it, but a significant percentage of your guests will appreciate your commitment to the environment; and they will come back. Many guests will actually be willing to pay a bit more to feel good about supporting an environmentally responsible business.
7) **Increased Conference Business.** Conference planners for environmental organizations must portray a message that is consistent with their organization's goals. Increasingly, major corporations are also requiring that their employees support corporate environmental initiatives.

[52] Information gathered from the Virginia Green Lodging Pollution Prevention Strategies for the Hospitality Industry fact sheet on January 5, 2009.

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Sustainable Lodging Practices Options[53]

Recycling

- Programs in all guest rooms, conference and hotel open areas, and dining operations of:
- Glass
- Aluminum & Steel Cans
- Plastic
- Office Paper & Newspaper
- Cardboard
- Grease Recycling
- Toner cartridges
- Packing Supplies
- Fluorescent Lamps
- Batteries
- Electronics equipment – computers, etc
- Composting of excess food

Waste Reduction

- Track overall waste bills

Rooms

- Bulk Soap Dispensers instead of individual soaps
- Fill up shampoo bottles
- Instruct housekeeping to save and reuse unopened items
- No extra charge for "green" rooms
- Low-flow sink aerators, toggle aerators
- Low-flow showerhead (2.5 to 3.0 gpm)
- Low-flow toilet, 1.6 gpm, or toilet adaptations
- Fluorescent lighting - thinner off-white vinyl-backed lampshades
- Amenities - 100% natural, biodegradable, vegetable-oil base, dye-free, natural scents or scent-free
- Hot water - 125-130 degrees F (52-55 degrees C)
- 100% cotton linens, undyed, unbleached
- Extra blankets - room can be kept colder on winter nights if guests prefer
- Recycling container and notice for guest involvement
- Glass water glasses, no paper covers
- Ceiling fans, reversible
- Cloth laundry bags (can use retired sheets), Baskets to return clean laundry
- Pest Control - cleanliness, preventatives, natural, non-toxic, not on a program
- Ozone generators must be used carefully, i. e., the correct time period for the space
- Occupancy sensors to control lights, AC/heat, TV
- Key switches to control power supply to AC/heat
- Newly purchased furnishings of non-hardwoods

Linen Service

[53] Gathered from both the Virginia Green Lodging and "Green" Hotel Association websites

- Train house cleaners on process for optional linen service
- Laundry detergents - non-toxic, phosphate-free, biodegradable, unscented, dye-free, chlorine-free, concentrated, liquid, recycled packaging
- Minimize the use of bleach and chlorinated chemicals are used only where there is no less toxic alternative, and only in minimal amounts.
- Purchase water-efficient washers and dryers (www.Energystar.gov)
- Use of linens service providers that employ "wet" versus "dry" cleaning
- Require dry cleaners to recycle hangers, plastic film and related materials

Food & Conference Facilities

- Use of water pitchers that minimize use of single-use bottles
- Eliminate the use of Styrofoam
- Use Dishware and Glassware & Minimize use of Disposables
- Disposable containers made from:
    - bio-based materials
    - recycled content
    - compostable material
- Non-bleached napkins and coffee filters
- Provide condiments and cream and sugar, etc, in bulk
- Donation of excess food from events
- Effective food inventory control to minimize wastes
- Purchase locally grown produce and other foods
- Filtering of grease rather than recycling
- Use of organic- and "sustainably-grown" foods
- Paper products - recycled, biodegradable, unbleached, natural scents or unscented, dye-free, paper packaging - use brown paper towels only

Office

- Purchase recycled-content paper-towels and toilet paper
- Encourage suppliers to minimize packaging and other waste materials
- Purchasing from vendors and service providers with a commitment to the environment
- 2-sided copies for all printing
- Changing of margins on documents from the standard 1.25" to .75"
- Use electronic correspondence and forms
- Purchase recycled content paper / toilet tissue
- Using "Green" cleaners that are dispensed in bulk (www.greenseal.org)
- Installation of high-efficiency hand-dryers (www.cleanlink.com/sm/article.asp?id=2387)
- Purchase of durable equipment and furniture

Maintenance

- Use of reused building materials or those from sustainable sources
- Preventative maintenance of all appliances, HVAC systems, plumbing, and vehicles
- Last-in/first-out inventory & effective labeling systems
- Use of no chemical fertilizers or pesticides, and use of "integrated pest management" (IPM) techniques- www.epa.gov/pesticides/factsheets/ipm.htm
- Natural agents, such as Medina (a soil activator), seaweed, "manure teas," and collidal rock phosphates, to improve soil
- Can also compost organic landscape trimmings and other materials and return them to the land

Water

- Tracking overall water usage and wastewater

- Preventative maintenance of drips and leaks
- Water-flow metering to discover leaks and areas of high use
- High efficiency dishwashers
- Discouraging water-based cleanup (sweep first)
- Microfiber technology mops
- Low flow restrictors on faucets and showerheads
- Low flow toilets or Waterless urinals
- Water-savings sprinkler heads for irrigation system
- Effective landscape management plan, which utilizes drought tolerant species, metering and rain gauges, and minimizes lawn areas.
- Rain gardens (www.dof.virginia.gov/rfb/rain-gardens.shtml)
- Green roof development (www.greenroofs.com)
- Cisterns and drip-line irrigation
- Rain barrels (www.epa.gov/reg3esd1/garden/stormwater.htm)
- Effective stormwater management and installment of a retention and/or infiltration basin
- Minimization of impervious areas (paving, concrete, etc)
- Vegetative buffers around streams and ponds

Energy

- Tracking overall energy bills and set a numeric goal to reduce
- Consider the pollution factor of your energy usage by using a pollution calculator, such as www.cleanerandgreener.org/resources/pollutioncalculator.htm
- High efficiency compact fluorescent lightbulbs in all canned spotlights & in rooms
- Install LED Exit Signs (www.energystar.gov/ia/business/small_business/led_exitsigns_techsheet.pdf)
- High efficiency fluorescent ballasts and lamps (T-5's & T-8's)
- Use of ceiling fans
- High Efficiency Heating & Air Conditioning (HVAC)
- Maintain caulking and weather stripping
- Individual thermostats for each room
- Use of natural lighting
- Lighting sensors can be utilized in guest laundry and restrooms
- Purchase of Energy Star computers, appliances, etc.
- Thermal-rated windows and insulation
- Draperies with thermal reflective liners can be used in the facility to keep rooms naturally cooler, or windows that receive direct sun can be tinted
- Use of directional (downward-facing) lighting in parking areas and other outdoor areas
- Design and operation of buildings that are LEED certified
- Solar panels
- Purchase of "Green Tags" or "Renewable Energy Certificates" to offset the additional cost of using energy from renewable sources
- Purchase fuel-efficient vehicles or Hybrids

Indoor Air Quality

- Live potted plants inside the facility and rooms keep air cleaner and healthier. Increasing tree canopy and vegetation around the facility site is also beneficial.
- Use of non-toxic, water-based paints that contain a minimum amount of adhesives, minimizing the release of volatile organic compounds (VOCs) in to the air.
- Reuse of paint thinners
- Proper recycling and/or disposal of thinners and solvents
- Minimize or use no chemical pesticides or herbicides, or aerosol products
- All areas and rooms of the facility are non-smoking
- Purchase "low-VOC" carpets and fabrics
- Use water and elbow grease as main cleaning agents. Use greener cleaning products - non-toxic, phosphate-free, biodegradable, natural scents or unscented, dye-free, concentrated
- Vinegar can be used to clean mirrors, windows and metal fixtures
- Baking soda can be used to clean refrigerators, stoves, sinks, tubs and toilets
- Pumice stone removes toilet bowl hard water deposits without damage
- Vinegar and salt can be used to clean metal
- Tea tree oil and lemon oil can be used to polish wood
- If other cleaner needed, use certified and approved "green" cleaners
- Can use negative ion generators and "Ozinators" to clear dust and odors from the air. Can also use air cleaners with carbon filters
- Maintain air ducts monthly
- Fire extinguishers are metal and refillable. Purchase ones that contain no ozone-destroying agents.

Green Meetings/Conferences

Inclusion of "green meetings/conferences" in marketing packages (see fact sheet on "Environmentally-Responsible Conferences & Events" (www.deq.virginia.gov/p2/lodging/eventplanning.html)

Background on the Virginia Green Lodging Program

Virginia Green[54] is the statewide program that works to reduce the environmental impacts of Virginia's Tourism Industry. It is run as a partnership between the Virginia Department of Environmental Quality, the Virginia Tourism Corporation and the Virginia Hospitality and Tourism Association. Its goal is to encourage more sustainable business practices and tourism options to provide the consumers of Virginia more green options to travel, eat, and enjoy the beautiful state of Virginia[55]. Virginia Green has engaged the lodging industry, restaurants, attraction venues, convention and conference centers, wineries, travel organizations, visitor centers and rest areas, event planners, and even golf courses.

The Virginia Green Lodging Program (VGLP) is the facet of Virginia Green that is focused specifically on the hospitality and lodging sector of Virginia tourism. It is an initiative to promote pollution prevention practices, encourage facilities to be aware of their impact on the environment, and for them to take steps to reduce those impacts. Participating facilities are showcased on their VGLP website with a profile explaining steps being taken to reduce their impacts. The program provides guidance and resources on techniques that have been used in the hospitality industry and proven to reduce impacts, and many times save money.

[54] http://www.deq.virginia.gov/p2/virginiagreen/homepage.html
[55] http://www.virginia.org/green/

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The "Core Activities":

- **Optional Linen Service** – sheets and towels are not automatically changed every day. This decreases the usage of water, energy, and harmful detergents.
- **Recycling** – guests must have the opportunity to recycle during their stay. Recycling is one of the most visible sings to your guests that your facility is green.
- **Water Conservation** – a plan should be in place for minimizing water use. This plan should consider water saving faucets, showerheads, and toilets, leak detection, and an effective landscape-watering plan.
- **Energy Conservation** – a plan should be in place to address energy conservation & efficiency opportunities. The plan must encourage the replacement of lighting and equipment to energy-efficient alternatives such as compact fluorescent lighting, LED Exit signs, lighting sensors, efficient heating and cooling, and Energy Star/energy efficient computers and other equipment.
- **Green Events, Conferences, & Meetings** – facilities should be able to accommodate groups who want "green" events. The facility must offer a "green" or "environmentally-friendly" package for conference, meetings, and other events. At a minimum, you must be able to provide recycling at such events and be willing to work with "environmentally-aware" customers on other techniques to reduce waste.

Joining the Virginia Green Lodging Program

It is a self-certifying program where facilities must verify, through a submitted form, that they are practicing the Virginia Green Lodging "core activities". The checklist type membership form also includes lists that you can check off if your facility is doing more than just the basics, and all practices become listed on a facility's website profile. Membership is free, and there are many benefits. With state supported promotion and a full profile on the Virginia Green tourism website, consumers seeking green traveling experiences can quickly and easily find these VGLP participants. Members also receive a framed certificate for display in the facility summarizing their activities; the facility is included on the Virginia Tourism Corporation's list of "environmentally-friendly" facilities, window decals are sent for display, and the VGLP logo is made available to use on the facility's website, signage, and promotional materials.

Background on the "Green" Hotels Association

The "Green" Hotels Association[56] is a national organization to bring together hotels that are interested in environmental issues and was established in 1993. It is committed to encouraging, promoting and supporting ecological consciousness in the hospitality industry. They define "green" hotels as "environmentally-friendly properties whose managers are eager to institute programs that save water, save energy, and reduce solid waste – while saving money-to help protect our one and only Earth!" They help participating facilities by researching and providing a constant stream of new conservation ideas and resources. A full list of member hotels can be found here: http://www.greenhotels.com/members.htm

Joining the "Green" Hotels Association

[56] http://www.greenhotels.com/index.htm

The membership fee is $150 per year and a $1 fee for each guestroom in the facility. Membership benefits include[57] a "Membership Conservation Guidelines and Ideas" booklet, a guarantee that the facility will save more money that the membership costs by implementing the guide's ideas, a catalog of environmental products for the lodging industry, a resource for sharing information between members on money saving and new conservation ideas, a bi-monthly "Greening Newsletter" packed with greening information, and public relations benefits by having the facility's logo or photo with a web listing on their website.

The Membership Conservation Guidelines and Ideas booklet provides smart and practical ideas, and reveals methods and techniques on how to conserve and save in all of the following areas:

1. QUICK START TO HOTEL CONSERVATION: Beginning your "greening" program, employees, guestrooms, Chemically-Sensitive Guest Requests, no-smoking hotels, public areas / lawn and garden, pest control, restaurants / dining areas / bars, laundry, swimming pool, waterfronts, solid waste, recycling, used bar soap, composting, waste water, clean air, noise control, offices, marketing greenness, create visuals, member internet site, member to member, environmental awards, purchasing, maintenance, conventions / meetings, new construction / refurbishing, community, governmental / organization ideas, ecotourism, internet sites of interest, periodicals, contacts, calendar, annual events, environmental groups of interest, comments / suggestions
2. FORMS: Energy Usage Analysis, Water Conservation, Electricity Usage Analysis, Water Usage Analysis, Solid Waste, Solid Savings, Solid Waste Hauling and Disposal Analysis, Solid Waste Analysis, Comparing Recyclers, Volume-to-Weight Conversions, Hotels' 4-R Checklist Glossary of Waste Management Terms Safe Cleaning Chemicals, Killer Chemicals, Ingredient Guide of Chemical Effects, Information Resources, Food Purchasing Analysis, Cleaning Chemical Inventory, Food Price Change Analysis, Monthly
3. SOLUTIONS / RECIPES
4. STATISTICS RE "GREENING" OF THE LODGING INDUSTRY
5. APPROVED VENDORS
6. FINAL THOUGHTS

Examples of Comparable and Successful Hotel Sustainability Programs

The Hotel Roanoke[58]

The hotel is a member of the Virginia Green Lodging program and has numerous ways that they are trying to lessen their impacts on the natural world. A case study has been done on this facility, and it can be accessed at this website[59]. The following is a list of the specific things that they are doing in the VGLP categories:

- **Water Efficiency:** low flow restrictors (high pressure), sensors on faucets/toilets, low flow toilets, dishwashers that re-circulate, maintenance of drips/leaks
- **Energy Efficiency:** efficient HVAC - natural gas, solar panels/skylights/natural lighting design, lighting sensors and high efficiency compact fluorescents, Energy Star computers, refrigerators, etc., insulation, directional lighting (parking areas, outdoor, non-dome lights that do not cause energy wasting light pollution)

[57] http://www.greenhotels.com/memship.htm
[58] http://www.deq.virginia.gov/p2/lodging/roanoke.html
[59] http://www.deq.virginia.gov/export/sites/default/p2/lodging/pdf/roanoke.pdf

- **Landscaping:** integrated pest management, organic fertilizers and efficiently timed applications, buffer strips around all water bodies, native vegetation, abundance of indoor plants
- **In Rooms:** optional laundry service, glasses/mugs versus disposables, efficient HVAC - individual thermostats, low flow fixtures, optional free papers
- **Laundry:** water efficient washers (reuse or filter washwaters, energy efficient dryers, environmentally-friendly detergents (using proper amount of bleaches), linen segregation, gentle cycles for lightly soiled
- **Sustainability:** carpets with recycled content and no-VOC's, fabrics for furniture and wallpaper with no-VOC's with recycled content, reused building materials, vintage flooring/beams, stonework, fixtures
- **Office:** purchase of recycled content paper, purchase of durable/well-made products w/long life, purchase of energy-efficient equipment, policies for 2-sided copying/printing, Energy Star computers, extensive use of electronic documents/records, purchasing from vendors/service providers w/commitment to the environment, utilizing purchasing power to prescribe minimized packaging wastes, shrink-wrapping, excessive packaging, or to require that vendors take back packaging
- **Maintenance:** preventative maintenance of all vehicles/equipment, last-in/first-out inventory, eliminating use of aerosols, recycling of vehicle fluids, less toxic materials, use of latex paints, minimizing use of HVAC/cooling tower chemicals through magnetic or ionic-flux mechanisms, reusing cooling tower waters as much as possible, effective systems of storage, labeling, handling

The Sponsors Executive Residence Center, University of Virginia Darden School of Business[60]

Sponsors Executive Residence Center is a state-of-the-art conference facility that serves the Executive Education program at the University of Virginia ’s Darden School of Business, and is a member of the Virginia Green Lodging program. The Center provides dining, numerous conference and learning facilities, and full overnight accommodations with 38 spacious rooms. The University of Virginia is committed to environmental excellence, and the Center’s policy is to minimize environmental impacts whenever feasible.

Their Green Lodging practices include:

- Provides optional linen service in rooms
- Offers recycling opportunities to guests
- Practices water & energy conservation
- Offers a green events/conference package
- Low flow restrictors and toilets
- Preventative maintenance of drips and leaks
- Re-circulating or ozone laundry
- High efficiency HVAC using natural gas and individual thermostats
- Lighting sensors
- High efficiency compact fluorescents lightbulbs
- Energy Star computers, appliances, etc.
- Installation of additional insulation
- Use of directional lighting in parking areas and other outdoor areas
- Replacement of grass lawns with beds
- Abundance of indoor plants

[60] http://www.deq.virginia.gov/p2/lodging/sponsors.html

- Discourage use of disposable glass, dishware, etc.
- Can, bottle, newspaper recycling
- Optional free papers (not delivered automatically to room)
- Use of citrus-based cleaners
- Environmentally-friendly cleaners purchased in bulk that are diluted for different applications
- Effective food inventory management
- Grease recycling
- Donation of excess food
- Water efficient washers – those that reuse or filter washwaters.
- Energy efficient dryers
- Environmentally-friendly detergents with minimal use of bleach
- Use of linens service providers that employ "wet" versus "dry" cleaning
- Purchase of recycled content paper
- Recycle toner cartridges
- Purchase of durable/well-made products w/long life
- Policies for 2-sided copying and printing
- Extensive use of electronic documents and records
- Purchasing from vendors and service providers with a commitment to the environment
- Eliminating use of aerosols
- Use of latex paints
- Effective system of hazardous material storage, labeling, and handling
- Carpets with recycled content and no-VOCs

Athletics Appendix Sections

- Logistics of a Game Day Recycling Program
- A List of Some "Green Games" and Event Recycling Examples
- Other Athletic Department Sustainability Initiatives

Logistics of a Game Day Recycling and Engagement Program

A distribution of bins, collection strategy, and volunteer recruitment plan would need to be developed to have an effective recycling program. There are two main areas that would need to be tackled – tailgating lots and Lane Stadium – and waste recovery should be seen as a regular part of each game. To increase overall participation, an active and engaging program needs to be implemented where fans and tailgaters not only understand what can and cannot be recycled and where to place it, but the benefits of recycling and its importance to Virginia Tech. Resources needed would include more recycling bins for the tailgating lots and inside Lane Stadium, volunteers, a small collection truck that could potentially be borrowed from Virginia Tech Recycling, and small incentives to sustain volunteer participation, like free football tickets or program participation t-shirts.

1) Prior to the start of next season's games, notification could be given to alumni, fans, and students about the pilot program that will be run at next year's games. The notification could include an emphasis on the Athletic Department's commitment to recycling, encouragement of them to find the waste recovery stations at games, recruitment and support for volunteer teams, and emphasis on the importance of participating in the program. Notification should also be given to the vendors to ask for their compliance.

2) Set up a tracking method for the pilot program to measure effectiveness. This could be in the form of clipboard recording sheets and a master electronic spreadsheet. This spreadsheet could track the amount of waste being generated each game, amount of recyclables collected at each game, and be able to show trends in both categories. Engagement and excitement levels could also be tracked by having the team leader do a short 5-minute debrief with each team member after each game to gauge how fans reacted to their encouragement of recycling and sustainable living. Volunteer team leaders could be put in charge of data tracking.
3) Identify dates of all home football games and find two organizations to volunteer for each – one for in the stadium and one for the tailgating lots. Teams of at least 10-20 would be needed for each, and this number may change dependent on how the first few games go. Reliance on a volunteer based program is pretty standard in collegiate football recycling programs. Because of the heavy interest of students involved on campus through the Coalition for Campus Sustainability, various environmental groups, and the Student Government Association, there could be a ready supply of volunteers to participate as long as small incentives are given. Having organizations versus a collection of individuals will ensure there will be enough volunteers. A place on the athletics website where groups could sign up would be needed to do this cost efficiently, and there could also have a place on that site where individuals could sign up to help out.
4) Place a large recycling receptacle inside or near the stadium for more convenient and quicker drop offs of materials.
5) Arrange pods called "Waste Recovery Stations" where there is a trashcan and a recycling bin. No trash can or recycling bin should be without the other – this ensures that participation is made easy and convenient. These bins should be well marked, consistently labeled, and easily recognizable. For places that there are permanent garbage cans, and no recycling collection, cover these during the events and put a sign on the covering that says something like "Please help us reduce waste, utilize Event Waste Recovery Stations for your disposal needs".
6) Provide a vendor recycling station for each vendor or area of vendors, and have them break down their own boxes to help make the collection process more efficient. When cardboard carts are full, the recycling volunteer team will empty them into the large receptacle around the stadium and bring the cart back. Their compliance is critical.
7) The number of bins made available in the tailgating lots also needs to be increased to increase fan participation.
8) A Waste Assessment would need to be done at the first home game to assess the materials generated, the location of where and when the materials are generated, the equipment needed to collect the materials, when pickups would be needed, best locations for bins, identify best visual marker for the waste recovery stations, etc. There are several options on the best way to go about doing this. One ways is that "trash teams" could be assigned to collect only one type of item from all of the areas (one team for newspaper/brochures, one for cans/bottles, one for garbage, etc). When these items are all separated in bags, it is much easier to determine the weight of each and calculate the composition of the waste stream. Understanding your waste stream is crucial for developing a waste reduction plan.
9) There would be a designated time and place for the volunteers to meet before the game. In stadium volunteers would need to be there at least one hour before kickoff, and tailgating volunteers would need to be there at least 2-3 hours before kickoff. These times can be adjusted depending on what works best with the pilot programs.
10) Each team of volunteers would be given a 10-minute quick training on the process of collecting the recyclables and how to engage fans. These will be different for the two teams to ensure continuity and full understanding of duties.
11) For the tailgating team, volunteers would be given clearly marked recycling bags to distribute and a few talking points on how to educate and engage the tailgating groups as they are handing out their

bags. After the bags have been distributed, teams could walk around the lots and pick up full bags, point out recycling receptacles in the lots, and continue to encourage fans to separate their recyclables. After kickoff, volunteers could circulate the lots once more to pick up any remaining bags.

12) For the in-stadium team, volunteers will be given their designated areas to monitor and will be sent to engage and encourage fans to properly dispose of their items. Monitoring sites is very important to assist in reducing contamination and educating the public. The volunteer crew would work continuously throughout the game to make sure as much is recycled as possible.
13) Having bright colored program t-shirts that stand out help with participation, as many schools have seen them as a way for fans to recognize the volunteers and a visual reminder that their participation is needed to have a successful program.
14) When possible and appropriate during games, make periodic announcements to encourage fans to help out and recycle their containers. These "eco announcements" could be paired with tips to save energy, save money, and live more sustainable lives. Reminders of the program and its importance are critical in the beginning to ensure buy-in and participation from fans – if they don't think or feel that it is important to you, they wont feel the need to participate. These eco announcements could also get creative with athlete and important alumni engagement to share their favorite eco-tips.
15) Make sure materials are collected and taken to a specific area during the game, and then weighed and hauled off to the recycling centers at the end.
16) Award volunteers with something to show appreciation for their help. Either a football recycling t-shirt or something else to provide incentive for students to continue to help.

A List of Some "Green Games" and Event Recycling Examples

Of the teams that we played this past season, the following Universities have football, other athletic event recycling programs, or have begun piloting one:

- East Carolina University
- Furman
- Georgia Tech
- UNC
- Nebraska
- Boston College
- Florida State
- University of Maryland
- Duke
- UVA
- Cincinnati[61]

ECU[62] began a pilot program for home football game recycling this past fall season.

Furman College engaged student athletes in their Campus Sustainability day by having them participate in a campus clean up activity. The women's soccer team also works on a weekly basis in the winter and spring on environmental projects on campus, and helps with picking up recyclables after all men's and women's soccer games[63]. There is not currently a football-recycling program in place.

[61] http://www.uc.edu/af/sustainability/tailgate_recycling_2008.html
[62] http://www.ecu.edu/campus_operations/facilities/FSrecycle.cfm
[63] http://furmanpaladins.cstv.com/athleteservices/comm-service.html

Georgia Tech[64] began their football recycling initiative this past season with a partnership between students, the Athletic Association and various campus departments. *Student Government President Nick Wellkamp said that, "The program extends Georgia Tech's green efforts to all aspects of the community, including alumni and fans," said Wellkamp. "Football games are large special events that have a huge environmental impact, and recycling all of our glass, plastic and aluminum can save tons of this material from going into landfills. Students are passionate about sustainability and proud that Georgia Tech is becoming a leader in the field of sustainability."* Bags were distributed to every tailgating group and bins were placed inside the stadium and private boxes. The game day recycling program is single stream and organizers have found that almost all fans and tailgaters are willing to participate. Different student organizations volunteered to distribute bags for each game, and more than one ton of materials were collected this first year!

University of North Carolina's football recycling program is currently only focused on collecting materials from inside the stadium, but they are in the research and planning phase of targeting tailgaters for next season[65].

The **University of Nebraska**[66] teamed up with Recycling Enterprises of Nebraska to place a gray recycling bin next to every trash receptacle at all athletic venues this past season.

Boston College[67] has recycling available throughout all of their athletic facilities and provides a bin for each office. For game days, containers are provided in Alumni Stadium, Conte Forum and all luxury boxes.

Florida State[68] has an extensive "Garnet & Gold Goes Green" recycling program, which is a partnership between Tri-Eagle Sales, Inc and FSU Athletics. Approximately 20 to 40 volunteers including individuals, organizations, and/or community members are needed for each home game and they are asked to arrive at the stadium 2.5 hours before kickoff and to stay a little bit afterwards. This recycling program is extended to all home baseball games as well, although on a much smaller scale.

University of Maryland launched an aggressive recycling program for home sporting events this past fall[69]. It was a part of a campus-wide initiative "Creating a Greener University" spearheaded by President Dan Mote. For each home football game of the season, Maryland Athletics will conduct the following activities:

- Place 18 custom 150 gallon recycling and trash containers in and around their stadium to collect bottles/cans, compost, and trash
- Place 11 custom 100-gallon recycling and trash containers at stadium entrances to collect bottles/cans and trash
- Place 410 portable recycling and trash containers in tailgating areas, walkways and garages all over campus
- Distribute 140,000 recycling and trash liners to tailgaters in parking lots
- Distribute 5,000 promotional items to students and fans at a select home football game to promote the program
- Implement a recycling valet vehicle in select parking lots to pick up recyclables

[64] http://www.gatech.edu/newsroom/release.html?id=2123
[65] http://www.dailytarheel.com/online_extras/online_exclusives/unc_recycles_for_games
[66] http://www.huskers.com/ViewArticle.dbml?&DB_OEM_ID=100&ATCLID=1576308&SPID=41&SPSID=173
[67] http://www.bc.edu/offices/facilities/facservices/hkservices/recycle/athletic.html
[68] http://www.sustainablecampus.fsu.edu/GGGGRecyclingProgram.htm
[69] http://umterps.cstv.com/sports/m-footbl/spec-rel/082608aaj.html

These actions are a part of their "Feed the Turtle" recycling program. This program has several objectives, but main goals are in collect at least 35 tons of recyclables (an increase of 65% over the 2007 season), compostable materials, and to establish baselines for future seasons.

Duke[70] has a great "Duke Recycles" program that engages volunteers for recycling pick up at all football and basketball home games.

U. Va.'s recycling program began working with the Athletics Department this year to push recycling at home football and basketball games[71].

Different volunteer groups have run **Penn State**'s recycling program since 1995[72], and it is one of the most successful collegiate programs in the country. In the 2007 season alone, 87 tons of recyclables were collected, which raised over $8000 to go to the Centre County United Way. In one game, they set a record of collecting 23 tons of recyclables.

NC State[73] has an extremely successful "WE Recycle" program that has become a university tradition. The program is dependent on student volunteers, and on average, four tons of cans and bottles are collected at each home game. Outreach Coordinator Ryan Powell explains that, "Now, as recycling has become embedded in the culture of our university, most of our fans have already taken the time to collect all of their recyclables when we come by… Wolfpack fans don't recycle because someone told them to – they do it because they understand that this is what we do at NC State University." Recycling can become part of the tailgating culture at Virginia Tech as well.

Michigan State Athletics launched a "GO GREEN expanded recycling initiative" in August of 2007[74]. It is a three-year initiative to significantly expand its beverage container-recycling program that will be implemented in several phases. The first phase was focused on collecting and recycling all aluminum and plastic beverage containers at home football games, and the other phases were set to expand the program to be one of the most progressive collegiate beverage container recycling programs in the nation.

West Virginia University[75] has a "Mountaineers Recycle" program where volunteers distribute bags to fans and tailgaters that are left to be collected after the game. They offer free admission to 100 student volunteers per game, if they participate. All of their financial recycling proceeds benefit the WVU Children's Hospital and calculations showed a *savings of 68 tons of CO2 in just two seasons*.

The Grounds and Waste Management staff with the help of some graduate students launched the **University of Michigan** football-recycling program in 1995. Each game now has dedicated staff and students that work to earn "Recycling Champions" t-shirts for their time and effort. Waste Management Services staff and student workers collect and recycle cardboard from Stadium vendors and beverage containers from fans before and during home football games. The program began with just paper and cardboard, but in 1999 it expanded to include mixed containers. Since the beginning of the program, over 105 tons of paper materials and almost 100 tons of containers have been saved from the landfill.

University of Wisconsin launched their "Wear Red Think Green" football recycling program this past football season[76]. The program was a partnership between a student group and the athletics program, engaged around 500 student volunteers, and collected roughly 2,800 pounds of bottles. Their efforts

[70] http://news.duke.edu/2008/09/recyclecups.html
[71] http://www.virginia.edu/insideuva/2000/13/recycling.html
[72] http://www.collegian.psu.edu/archive/2003/09/09-09-03tdc/09-09-03dscihealth-01.asp ; http://live.psu.edu/story/30686
[73] http://www.ncsu.edu/featured-stories/engaging-society/oct-2007/we-recycle/index.php
[74] http://msuspartans.cstv.com/genrel/082107aac.html
[75] http://facilitiesmanagement.wvu.edu/recycling_services
[76] http://www.uwbadgers.com/sport_news/fb/headlines/story.html?sportid=111&storyid=16112

were focused solely on collection within the stadium, and were successful in collecting almost 58% of the total bottles and cans sold that day.

Arizona State University[77] started their football-recycling program just this past year through a corporate partnership with the Arizona Department of Environmental Quality. The Arizona DEQ provided the money to purchase the bins needed for in-stadium recycling of cans, bottles, and cardboard (glass is prohibited in the stadium and in surrounding tailgating lots). Also through this partnership, they are able to make radio and stadium announcements about the recycling program and encouraging fans to participate. Through a grant from Coca-Cola, they have also been able to provide recycling bins in their basketball arena. They would like to expand this program tremendously, but they are in a similar budgetary situation and cannot do so until more money is available. Their advice was to pursue grants and corporate partnerships to gain the capital to invest in recycling infrastructure. They are also pursuing green building designs for their new athletic facilities. The new basketball training facility being built is set to achieve LEED Silver certification. A photovoltaic array will be installed to produce 15% of the buildings energy needs, renewably.

Other Athletic Department Sustainability Initiatives

Cornell's Athletic Department decided to deliberately coordinate some of the scheduling of the men's and women's sports so that the teams could travel together. This not only saved on their carbon emissions, but also their travel expenses[78]. They have also begun to schedule their games more strategically with placing games that are in the same region in the same weekend to limit multiple separate trips to the same area. Team travel is one of the athletic departments steepest areas of expense, with the cost of gas, busing or flying, lodging and other accommodations. In pursuing many different projects, they have found that what is environmentally sustainable is typically fiscally responsible as well. Andy Noel, director of the athletic department, is constantly looking for ways to reduce waste and excess which in turn limits necessary expenses in the process. One project they are considering to reduce the consumption of paper is combining media guides of the male and female teams of each sport. The department staff also actively engages in more sustainable behavior in their facilities by encouraging turning off lights when not in use, closing doors, and not leaving windows open.

[77] Information gathered in phone conversation with Bill Givens, ASU Assistant AD – Operations and Facilities, on 01-05-2009
[78] http://cornellsun.com/section/news/content/2008/12/03/cornell-athletics-works-limit-carbon-footprint

Appendix L

Table of Contents

Sustainability, a History

How it all got started

After the student Environmental Coalition asked to sign the President's Climate Commitment, a document that the President of a university signs committing an Institution to developing climate action plans to achieve "climate neutrality" by a target date determined by the university, President Steger responded with his decision not to sign but rather to develop a Virginia Tech Climate Commitment specific to the conditions of the University. The document is currently in draft. We as students felt the need to put added pressure on the University at this time by addressing student behavior so that more students can become more educated on their impacts on the natural environment and the alternatives VT offers.

What is it and what does it have to do with me?

The United States Environmental Protection Agency defines sustainability as **"meeting the needs of the present without compromising the ability of future generations to meet their own needs."** Basically we are just leasing the Earth from our children and need to pass on a planet with the same health and quality we were lucky to have. Creating and implementing a sustainability commitment by the University is an important step to reducing Virginia Tech's overall impacts on the environment, but addressing student behavior is the cornerstone to ensuring sustainability success on our campus! We need to take a look at our own excessive behaviors, including how much electricity, water, food, waste and material goods we use and throw away. If we don't reduce our excessive consumption of these goods and necessities, than any technical efforts would be fruitless. We've put together a quick reference to the easy ways and resources for going green and living more sustainably as a student at Virginia Tech and resident in the Blacksburg community.

Greener Living

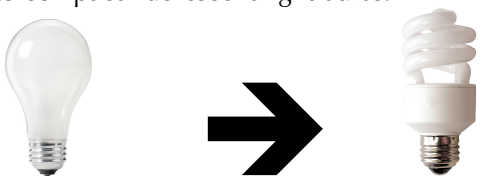
Easy steps to greening your lifestyle in residence halls or apartment home

Save Water

1. Wash clothes in cold water. Only run FULL loads of dishes and laundry.
2. **Turn off your faucet** while you brush your teeth, scrub your hands, and wash your face.
3. **Get a low-flow shower head.** Taking a shorter shower is one way to save, but another is to use a more efficient showerhead. Conventional showerheads use 2.5 gallons of water per minute (measured at 80 psi of water pressure). Today's high-tech low-flow showerheads can deliver the same quality shower, but will use less water per minute. You can save up to nearly 4,000 gallons of water per year!

Save Energy

4. Switch to compact fluorescent light bulbs.



5. If you have a fridge in your dorm room, be sure to go use an Energy Star or other low-energy certified Micro-Fridge.
6. Turn off your lights when you leave a room and your computer at night. Unplug appliances and electronics when not in use to avoid the "Vampire Effect" *(Most electronic equipment, including anything that uses a remote control, is designed to consume energy when it is turned off. That "off" setting is actually a "standby" or "idling" mode).*
7. Turn down heat by 2 degrees in winter and up by 2 degrees in summer.
8. Plug as many of your electronics as possible into a power strip and then turn it off when they are not in use. TVs and VCRs alone waste $1 billion in lost electricity in the U.S. annually.

Personal Habits

9.  Recycle! In Blacksburg, you can recycle all aluminum cans, and plastics #1 and #2! You can recycle cardboard in select locations and e-waste at the YMCA on Main Street. **For more information on what and where to recycle visit: http://www.recycle.vt.edu/**

10. Buy local and green school supplies. Purchase reused and dorm room furnishings from students moving our and other local retailers. Go for chlorine-free, recycled paper, binders and notebooks. Look for recycled versions of backpacks, pens, pencils, scissors and sticky notes.

11. Use reusable canvas bags at grocery and convenience stores.

12. Say no to plastic water bottles! Buy a reusable aluminum or metal bottle and a Brita filter.

13. Buy organic cotton bedding and biodegradable cleaning supplies when stocking up before you more in.
14. Use **non-toxic, environmentally safe, biodegradable cleaning products**, including laundry products, which you can find at any natural grocery and even many mainstream stores. Just read the labels carefully. Some examples are Seventh Generation, Method, and Clorox's Green Works line of cleaning products.
15. Save paper and save TREES! Print reports and papers double sided, recycle your old syllabus and handouts and stop getting junk mail. **http://www.newdream.org/junkmail**
16. Leave your car at home, *come to school with your **bike**!*
17. Buy shampoo, body lotion, peanut butter, cooking oils and other products in bulk when you can, filling your own (reusable) container.
18. Tell the automatic teller machine you don't want that paper receipt and avoid monthly mailings by opting for online banking.
19. Check books out of the library instead of buying new ones – especially if they are books you are unlikely to reread.
20. **Sources and other resources;**
    -http://www.greenlivingapartments.com/
    -http://www.care2.com/greenliving/green-dorm-room-easy-greening.html

One of the best way's we can reduce our impacts on the environment is looking at how we address food. The average American meal travels almost 1,500 miles before it gets to a plate!

Dining on campus? Here are some easy ways to green your dining habits.

- **Dine-in**! Try to **avoid using to-go containers** whenever possible, especially Styrofoam.
- Avoid buying plastic soda and water bottles. If you must buy them, reuse them at home and recycle them when you are finished.
- Or bett yet, ***bring your own water bottle*** to campus and refill at water fountains.
- Don't let your eyes be bigger than your stomach! *Reduce food waste* by purchasing only what you can actually eat.
- **Eat less meat**, or none at all. A 2006 United Nations report summarized that the meat industry is "one of the top two or three most significant contributors to the most serious environmental problems, at every scale from local to global." Because of the labor and resource intensive processes of meat production, reducing the amount of meat we eat by just 20% is equivalent to purchasing a hybrid or small compact car in greenhouse gas emission reductions.
- Don't use trays. Trays encourage you to take more than you need and also require water and energy to be washed.
- Go for **local and seasonally produced**. Try out the new local and organic food station at Owens Dining Hall. You can also support local and eat healthier produce by visiting the Blacksburg Farmer's Market every Wednesday and Saturday! http://bbfarmersmarket.org/

No car? NO PROBLEM!
Alternative Transportation 101 for Hokies

1. Commuter Alternatives

Carpooling

Carpooling will save you money on parking and gas AND it's the closest thing you can get to RESERVED PARKING at Virginia Tech.

Did you know?

-There are reserved Carpool spaces in the front student areas of most of the large parking lots. The Carpool Permit may be used to park in a regular commuter parking space if it is more convenient or if all student carpool spaces are taken. Student Carpool Permits are not valid for parking in F/S carpool spaces.

-Two or more commuter/graduate students who choose to ride together may register to be in a carpool.

Bike, Bus and Walk (BB & W)

BB&W is available to Virginia Tech faculty, staff, and students who use alternative transportation methods as their primary means of commuting to campus (i.e. riding the BT or SmartWay bus, bicycling, and/or walking).

How?

Register for BB&W with the Commuter Alternatives form. F/S and student registration forms for BB&W are available on the parking website, at 455 Tech Center Drive (Parking Services), and at the Student Services Building

2. Bicycling on Campus

All Bicycles on Virginia Tech Campus must be registered with Parking Services. Bike racks are located outside of almost all buildings on campus and around the drillfield.

3. Ridesharing

GoLoco

Virginia Tech is one of the first Universities to partner with GoLoco, a service that helps people quickly arrange ride sharing between friends, neighbors, and colleagues. GoLoco also handles online payments from passengers to drivers for their share of the trip costs. Share costs with everyone traveling in the car See friends and make more friends. ***Save the planet by cutting the per person CO_2 emissions in half or more, for each and every trip. For more info go to*** http://www.goloco.org

RIDE Solutions

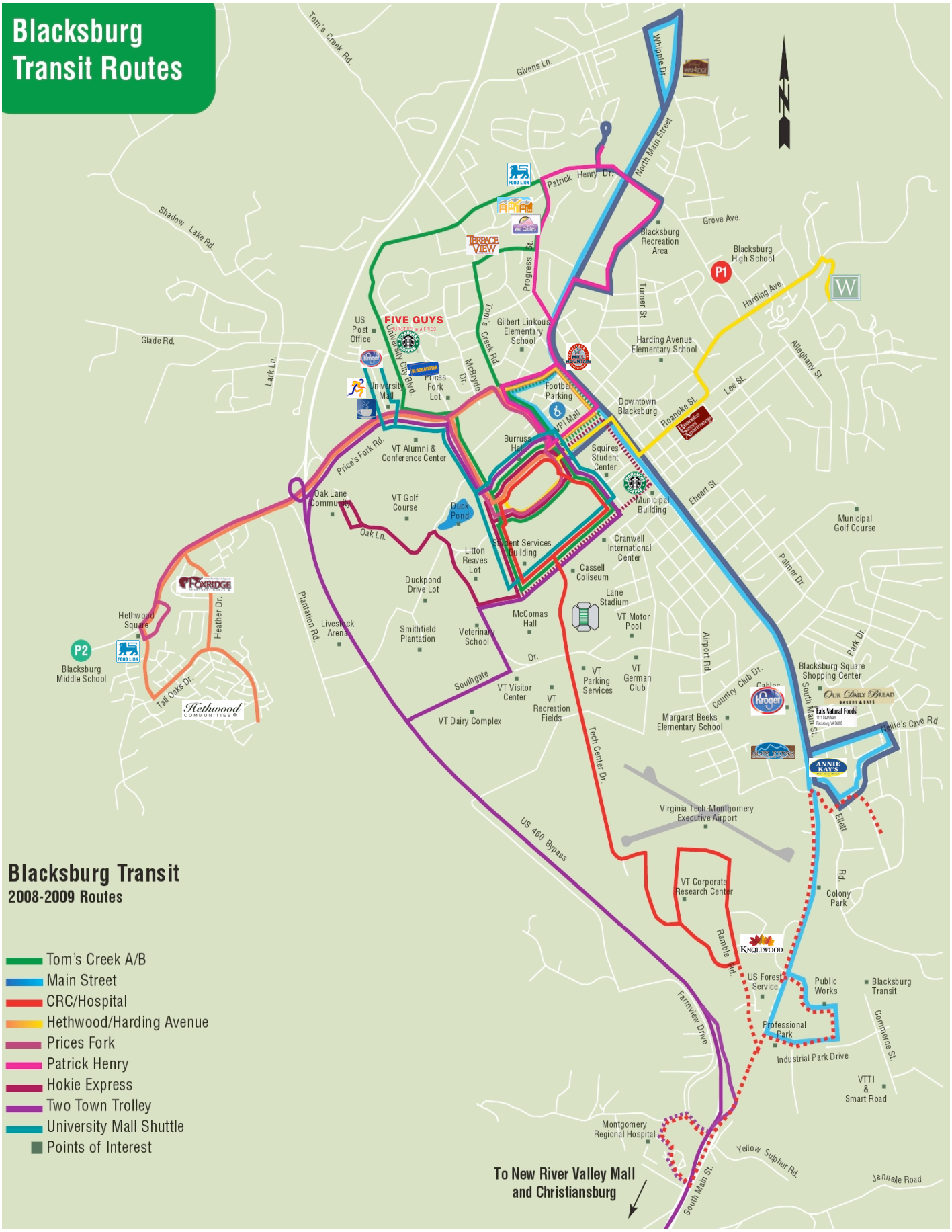
RIDE Solutions is a way to share trips with people in Roanoke and the New River Valley. It provides a "twitter" which gives instant carpool updates allowing you to find rides as soon as they become available.

For more info go to www.RIDEsolutions.org

4. Blacksburg Transit

The bus system is tailored to fit the needs of Virginia Tech Students. Riding the BT is fare-free for Virginia Tech students. Virginia Tech students also have unlimited access to all BT routes. Blacksburg Transit now has *bicycle racks* on all of its buses, so bring your bike to campus.

Looking for somewhere to go on the BT and can't figure out which bus to hop on?
Check out this Map of favorite "Hotspots" and what line will take you there!



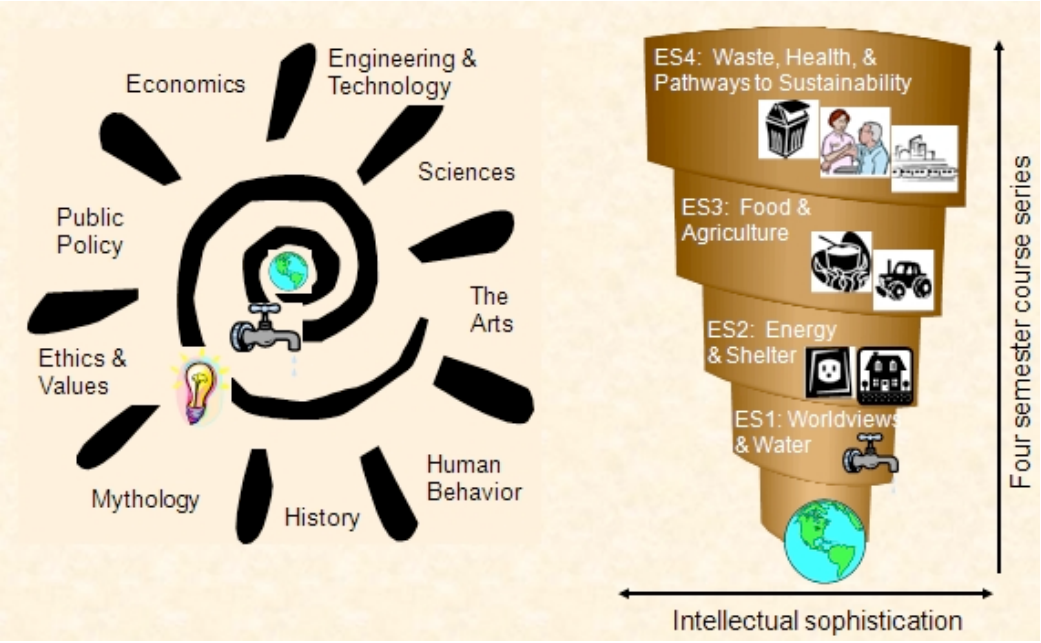
Virginia Tech offers a wide array of environmental and sustainability related courses and degrees. Below are some of the more popular and newest disciplines offered!

For a complete list of all majors and minors you should visit the VT Homepage (http://www.vt.edu)

1. Earth Sustainability Program

The Earth Sustainability (ES) series explores issues surrounding the sustainable use of Earth's energy and material resources. We use these resources to produce food and fresh water, all of our energy and transportation needs, and shelter. And we are using them at ever-increasing rates. How do we make sense of and measure our impact on Earth's systems such that we can create a more sustainable pathway to the future? The ES series is an innovative option in the Curriculum for Liberal Education (CLE). It is part of the newly emerging **Living in the 21st Century** program, which is designed to integrate the goals of the university's Curriculum for Liberal Education in an interdisciplinary theme-based learning experience offered over two years.

http://www.uccs.ceut.vt.edu/



2. Undergraduate Major and Minor Degrees;

Environmental Policy and Planning

Environmental Policy and Planning (EPP) is a part of the College of Architecture & Urban Studies. Managing human interaction with the natural environment, while protecting important natural systems, continues to be one of the critical challenges facing society. The EPP degree provides students the opportunity to study environmental problems and their solutions from an interdisciplinary perspective involving humanities, natural and social sciences, planning, and public policy.

http://www.uap.vt.edu/programs/undergraduate/epp.html

Environmental Science

Environmental Science is a part of the College of Agriculture & Life Sciences. This interdisciplinary, student-oriented major emphasizes the essential role that ecosystem processes play in sustaining Earth's inhabitants. Some of the program's options are aimed at preserving or protecting resources and the ecosystems that provide them. Others are more focused on rehabilitation of ecosystems, so that they can sustain those who will live on the planet tomorrow.

http://www.ensc.vt.edu

Humanities, Science and the Environment

Humanities, Science, and Environment (HSE) is a part of the College of Liberal Arts & Human Sciences. This degree program in HSE provides an interdisciplinary approach to environmental issues. It integrates cultural, scientific, and political approaches to understand the relationship between people and the natural world, in historical and contemporary contexts.

http://www.admiss.vt.edu/majors/index.php?major=HSE

Natural Resources Conservation

The Department of Forestry's natural resources conservation major prepares students for professional careers in resource-based outdoor recreation planning and management and for teaching careers at the elementary, middle, and high school levels. The natural resources conservation major has three options: natural resource recreation, natural resources education (K–6), and natural resources science (K–12).

http://www.admiss.vt.edu/majors/index.php?major=NRC

Geology

The Department of Geosciences offers exciting opportunities for students with an interest in applying a full range of scientific and mathematical skills to examine the earth's properties and dynamic processes. Understanding the enormously complicated earth systems requires strong quantitative skills and solid knowledge of chemistry, physics, and biology. Course work in geosciences emphasizes the acquisition, processing, and interpretation of field data, as well as written and verbal communication skills.

http://www.geos.vt.edu/

Civil and Environmental Engineering

Civil and Environmental Engineering is a part of the College of Engineering. Civil engineers are the principal designers, constructors, operators, and maintainers of many of the constructed facilities in our society. The Charles E. Via, Jr. Department of Civil and Environmental Engineering strives to prepare its graduates to meet evolving infrastructure challenges while continuing the tradition of public service associated with civil and environmental engineering.

http://www.cee.vt.edu

Green Engineering (minor/concentration only)

Green Engineering focuses on the design of materials, processes, systems, and devices with the objective of minimizing overall environmental impact (including energy utilization and waste production) throughout the entire life cycle of a product or process, from initial extraction of raw materials used in manufacture to ultimate disposal of materials that cannot be reused or recycled at the end of the useful life of a product. If you want to make a tangible and positive environmental impact in your professional life as an engineer, no matter your discipline, consider the Virginia Tech Green Engineering Program. This program is flexible, relevant, and based on a rigorous application of scientific and engineering fundamentals.

http://www.eng.vt.edu/green/

How can I get involved on campus?

So you've greened up your act and are even taking some courses on it and want to do more? Here are some of the student organizations and annual events at Virginia Tech dedicated to making our campus more sustainable that students can get involved in.

1. Student Organizations

The Environmental Coalition

The Environmental Coalition (EC) of Virginia Tech is the core student organization that unites, educates, and motivates students, faculty, and community members to advocate for a sustainable future. The organization usually has several working groups proposed and run by members. The purpose of these working groups is to pursue different issues on campus without extending organizational resources. This allows for efficient delegation and leadership growth as well as actively pursuing solutions to issues on campus.

http://www.theecvt.org/

VT SEEDS

The Virginia Tech chapter of SEEDS, (Seek Educate Explore DiScover) SEEDS is a non-profit educational organization that creates a discovery - oriented learning environment. SEEDS has a mission to develop future leaders as people conducting themselves with civic responsibility and accountability in a sustainable society.

http://www.seedsguys.org/

VT GREEN Team

The GREEN Team is Virginia Tech's official Environmental Awareness and Sustainability Education Team. The GREEN Team members strongly feel that each of us has a responsibility to future generations and to future Hokies to understand the planetary impacts of our actions as individuals and as a society. GREEN Team members give a 20-minute interactive presentation for students to grasp the "bigger picture" of how humans and our planet interact.

http://www.recycle.vt.edu/greenteam/

Mountain Justice Blacksburg

The mission of Mountain Justice Blacksburg (MJ) is to educate ourselves and our community on the effect the coal industry has on Appalachia and the world, particularly with regards to Mountain Top Removal; to spread awareness of and promote sustainable sources of energy and income for our region; to network with other organizations working towards these ends; and to stand in solidarity with those most directly affected by the coal industry.

http://www.mountainjustice.org.vt.edu/

SOIL AND WATER CONSERVATION SOCIETY

Soil and Water Conservation Society

A multidisciplinary society that advocates the protection, enhancement, and wise use of soil, water and related natural resources. Through education and example, we promote an ethic that recognizes the interdependence of people and the environment.

Natural Resources Recreation Society

The Natural Resource Recreation Society is a student organization devoted to enhancing educational opportunities within natural resources recreation and related fields. Their goals are to promote networking among students, faculty, and professionals, and to encourage lasting friendships through volunteerism and other activities. The Rec Society emphases educational and professional opportunities, including "field work" such as camping, hiking and canoeing.

http://www.forestry.vt.edu/NaturalResourceRecreationSociety.html

YMCA

Applied Environmental Awareness

Applied Environmental Awareness (AEA) is a program of the YMCA dedicated to spreading awareness of environmental issues through volunteer service and education. AEA focuses on the surrounding Blacksburg community and the Virginia Tech campus and has initiated programs which specifically target the general public rather than the student body alone. We strive to facilitate cooperation with other environmental clubs to ensure beneficial and long-lasting environmental change. This year AEA will be involved with Sustainability Week hosted by Sustainable Blacksburg and Virginia Tech.

http://www.ymcasp.org.vt.edu/AEAhome.html

Emerging Green Builders

The Emerging Green Builder's vision is to integrate students and young professionals into the green building movement. Their mission is to create a network of emerging green building leaders, develop opportunities for involvement through the USGBC, and to further generate momentum for the green building industry.

http://www.egb.org.vt.edu/

New River Valley Coalition for Animal Rights and Environment

NRV-CARE is an official student organization at Virginia Tech, though we operate completely autonomously of the university. Nonhuman animals have certain interests that should be considered by humans. Most prominent among these are the interests to be free of suffering, confinement, and death. NRV-CARE works to insert these interests into the social contracts that govern human behavior. Specifically, we expose, challenge, and fight human behavior that unnecessarily tramples on the interests of nonhumans. NRV-CARE is not affiliated with any other animal rights group, though we often team up with other groups for protests and campaigns.

http://www.slac.com/tree/nrv-care/

Bike Advocacy

Bike Advocacy at Virginia Tech is a student organization dedicated to increasing bike awareness and safety, making our community as bike-friendly as possible, and bringing together students who enjoy riding and want to further the cause.

http://bikeadvocacyatvt.synthasite.com/

The Coalition for Campus Sustainability

This coalition of student organizations is dedicated to making VT a more sustainable campus. With established visionary pylons and 26 student organizations joined, this growing coalition is truly a force for change on campus. Many of the above organizations are member-organizations in the CCS.

Interested in getting your student organization involved? Just email coalition@vt.edu with your name and what organization you represent and why you'd like to see your organization involved in the Coalition. **http://theecvt.com/coalition.php**

3. Annual Events and Programs

Sustainability Week

Every Year during the fall semester, Virginia Tech, the Town of Blacksburg, and Sustainable Blacksburg, with the help of the Environmental Coalition, partner to host the annual Sustainability Week. During the week several events, including keynote speakers, fairs, tours, films, and webinars, are held on campus and in the Town of Blacksburg. The week's events entertain, educate, and highlight sustainability programs and practices working to build a sustainable campus and town.

College Sustainability Report Card

Every year the Sustainable Endowments Institute (SEI) issues a Green Report Card designed to identify colleges and universities that are leading by example in their commitment to sustainability. University officials respond to three surveys that assess levels of sustainability initiation on campuses. The aim is to provide accessible information for schools to learn from one another's experiences, enabling them to establish more effective sustainability policies. Virginia Tech received a C- in 2007 and a B- in 2008.

"Green Effect" Hokie Football Game

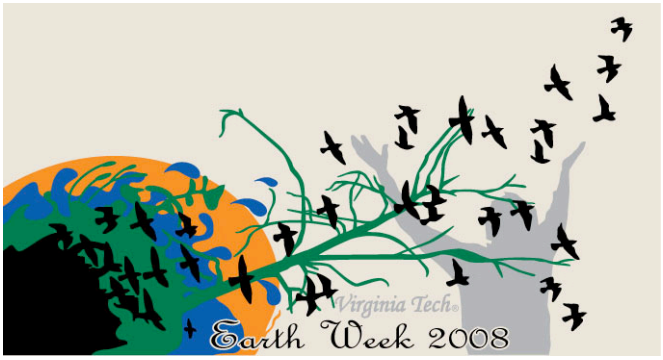
A new endeavor as of Fall 2008, the purpose for this event is to promote sustainability and environmental awareness. Approximately two hours before the kick off, volunteers from the Student Government Association, the Residence Hall Federation, the Environmental Coalition and the GREEN Team distribute green trash bags in lots to tailgaters. This is to encourage the tailgaters to recycle using these green bags. After the game, members of Virginia Tech Recycling collect the bags.

Want to get your student organization involved? Contact the SGA office at 540.231.9879

RecycleMania

RecycleMania is a friendly competition and benchmarking tool for college and university recycling programs to promote waste reduction activities to their campus communities. Over a 10-week period, schools report recycling and trash data which are then ranked according to who collects the largest amount of recyclables per capita, the largest amount of total recyclables, the least amount of trash per capita, or have the highest recycling rate. With each week's reports and rankings, participating schools watch how their results fluctuate against other schools and use this to rally their campus communities to reduce and recycle more.

To see Virginia Tech's RecycleMania in past years go to: **http://www.recycle.vt.edu/php/rmresults.php**



Earth Week

Every spring semester the Environmental Coalition hosts Earth Week, a week of events promoting environmental and sustainability awareness surrounding the nationally recognized Earth Day, April 22. Events include guest speakers, a student organization and local business fair on the drillfield, rallies, contests and games, panels, and films. Earth Week 2009 will be hosted by the entire Coalition for Campus Sustainability.
Want to get your organization involved? Email **ec@vt.edu**

YToss?

The YMCA at Virginia Tech aims to reduce the waste going into landfills from Student Move Out each May with their *Ytoss?* program. Students can donate items they don't want or that can't fit in their cars to the YMCA at Virginia Tech's *Ytoss?* Program. Items collected in May allow students and community members to make affordable purchases of necessary items during August Move In while keeping our campus and community clean and reducing waste going into landfills. This event is quickly becoming one of Blacksburg's most notorious "garage sales."

For more information about dates and collection points go to:
http://www.ymcasp.org.vt.edu/Y-Toss.htm

Appendix M: Methodology for Wedge Analysis

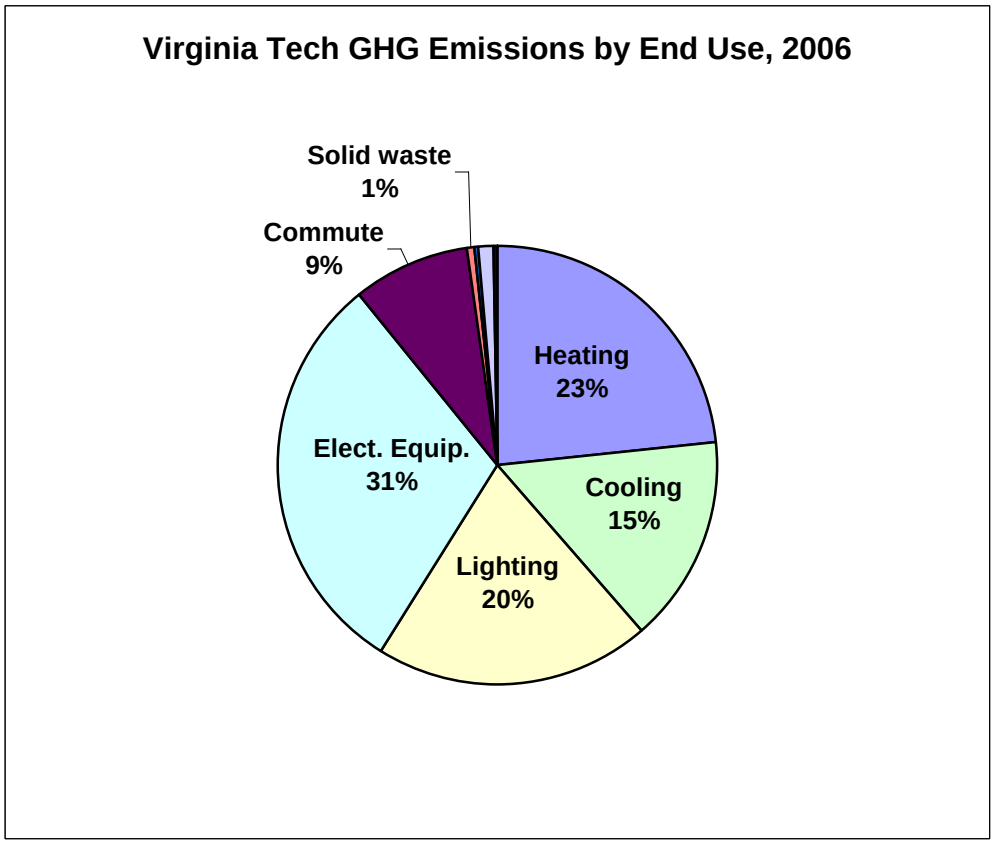
A variation of the CAPPA software developed by ICLEI-Local Governments for Sustainability was used for the wedge analysis. The CAPPA software is the most-used tool for climate action planning at the local level. It is a simple spreadsheet tool that performs individual energy and GHG emission savings for individual measures in separate worksheets. It then aggregates the measures in a final worksheet that graphs the wedges from a "business-as-usual" projection to a desirable future target.

Some examples of the worksheets are given below.

1. Estimate of GHG emission by end use from Inventory:

2006 GHG emission by end use

End use	GHG		
Heating	74	23%	60% NG + 78% steam plant fuel
Cooling	48	15%	24% of electricity (central chiller is 8-9% and is 37% of chiller capacity)
Lighting	64	20%	based on national figures: 40% of non-heating/cooling electricity for institutional bldgs
Elect. Equipment	96	30%	60% of non-heating and cooling electricity for institutional bldgs
Commuting	27	9%	
Solid waste	2	1%	
Water, WW	1	0%	
Fleet	3	1%	
Aviation	1	0%	
TOTAL	316	100%	
Buildings	122		



2. Example of worksheet for individual measure: Cooling

Cooling GHG, 2006		48	1000 tons			
Heating Measures	Immed.		Midterm	Longterm		
Central chiller upgrades		1.09				
Chiller system Upgrades			7.2			
Temp setting to 74		3.84				
		4.93	7.20	0.00		
Cooling measures					**Source**	**When**
Application Summary						
Central chiller upgrades		6%	Central Chiller Energy		VTCACSP	Immed.
Chiller system Upgrades		15%	Cooling energy		VTCACSP	Midterm
Temp setting to 74		8%	Cooling energy		VTCACSP	Immed.
see also New, Existing bldgs						
Notes						
Central Chiller = 38% of total cooling or 18 kilotons GHG						

3. Example of worksheet for individual measure: On-site generation

On-site power generation			1000 tons			
Measures	Immed.		Midterm	Longterm		
Condenser at turbine exhaust		2.10				
additional capacity at power plant			3.78			
Onsite to 50% (32% renewable)				59		
		2.10	3.78	59.20		
Heating measures					**Source**	**When**
Application Summary	**Increase generation**					
Condenser at turbine exhaust		20%	add 1.5 to 6.25MW		VTCACSP	Immed.
additional capacity at power plant		30%	add 2.3 MW		VTCACSP	Midterm
onsite renewables		50%	of total electricity			long term
Implementation Analysis						
Total electricity 2006		185,000,000	kWh	11%	% on-site	2006
				14%	% on-site	new condenser
				18%	% on-site	new turbgen
					% on-site	onsite solar/other
Power plant production:		21	million kWh in 2006			
	plus 20%	25.2	4.2	new on-site mWh		
	plus 30%	32.76	7.56	new on-site mWh		
Benefits:		saves cost of purchase				
		saves 1 lb/kWh		steam generated over AEP		
		saves 2 lb/kWh		renewable generated		

Appendix M

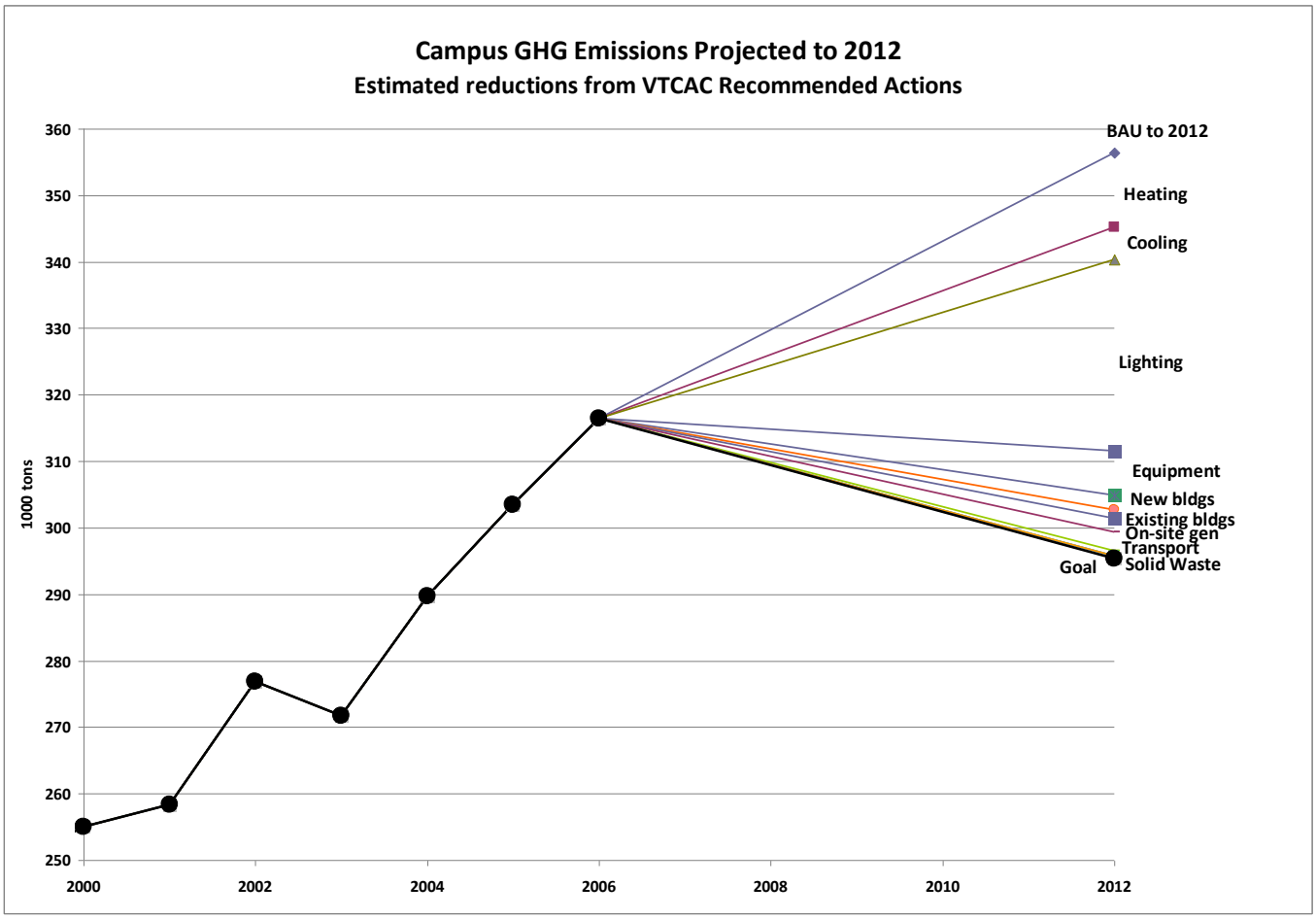
4. Aggregation worksheet

Solution Wedges																		
	BAU to 2012	BAU to 2025	BAU to 2050	Heating to 2012	Heating to 2025	Heating to 2050	Cooling to 2012	Cooling to 2025	Cooling to 2050	Lighting to 2012	Lighting to 2025	Lighting to 2050	Equip to 2012	Equip to 2025	Equip to 2050	New bldgs to 2012	New bldgs to 2025	New bldgs to 2050
1990	188			188			188			188			188			188		
2000	255			255			255			255			255			255		
2001	258			258			258			258			258			258		
2002	277			277			277			277			277			277		
2003	272			272			272			272			272			272		
2004	290			290			290			290			290			290		
2005	304			304			304			304			304			304		
2006	316			316			316			316			316			316		
2012	356.4	295.3		345.3	295.3		340.3	295.3		311.5	295.3		304.8	295.3		302.7	295.3	
2025		336.1	255.0		336.1	255.0		328.9	255.0		328.9	255.0		324.1	255.0		323.0	255.0
2050			326.2			315.1			315.1			315.1			315.1			313.6

Existing bldgs to 2012	Existing bldgs to 2025	Existing bldgs to 2050	On-site gen to 2012	On-site gen to 2025	On-site gen to 2050	Transport to 2012	Transport to 2025	Transport to 2050	Solid Waste to 2012	Solid Waste to 2025	Solid Waste to 2050	Water to 2012	Water to 2025	Water to 2050
188			188			188			188			188		
255			255			255			255			255		
258			258			258			258			258		
277			277			277			277			277		
272			272			272			272			272		
290			290			290			290			290		
304			304			304			304			304		
316			316			316			316			316		
301.4	295.3		299.3	295.3		296.6	295.3		295.8	295.3		295.8	295.3	
	317.5	255.0		313.7	255.0		311.0	255.0		310.8	255.0		310.6	255.0
		242.0			182.8			182.8			182.8			182.8

Campus landscape to 2012	Campus landscape to 2025	Campus landscape to 2050	Unknown to 2012	Unknown to 2025	Unknown to 2050	Goals
188			188			188
255			255			255
258			258			258
277			277			277
272			272			272
290			290			290
304			304			304
316			316			316
295.8	295.3		295.3	295.3		295.3
	308.9	255.0		255.0	255.0	255.0
		182.8			38.0	38.0

5. Example Plot of Wedges: to 2012 (see body of document for other plots):



Appendix N: List of the VTCAC&SP Action Strategies

1. **Administrative Structure and Governance**
    i. Immediate (2009-2012)
        1. Create the Virginia Tech Office of Sustainability
        2. Sign the Talloires Declaration
        3. Establish a Green Curriculum Coordinator in Academic Programs
        4. Establish a Sustainable Development Coordinator in Office of Outreach
        5. Funding mechanisms for Virginia Tech sustainability programs
            a. Establish a student "Green Fee"
            b. Establish a Green Development Fund
        6. Establish sustainability internship program in Office of Sustainability
        7. Coordinate energy and emissions monitoring program to assess progress toward VTCAC goals
        8. Virginia Tech becomes more active in AASHE
        9. Improve VT's grade in sustainability report card to A- in 3 years

2. **Facilities Infrastructure**
    a. **The Central Steam and Power Plant and Steam Distribution System**
        i. Immediate (2009-2012)
            1. Fully Implement Current Central Steam and Distribution System Upgrade
        ii. Mid-term (2013-2025)
            1. Identify further upgrades of existing system, including co-firing biomass with coal to reduce costs, energy and emissions
            2. Plan for next generation of University Steam and Distribution System
        iii. Long term (2026-2050)
            1. Fully implement next generation University Steam and Distribution System and retire coal boilers
    b. **Virginia Tech Electric Services**
        i. Immediate (2009-2012)
            1. Increase capacity for on-campus generation of electricity from the steam power plant
            2. Develop a campus-wide demand-side and load management program
            3. Establish interconnection policies for campus and community on-site generators
        ii. Mid-term (2013-2025)
            1. Develop a distributed electricity generation plan on campus
        iii. Long-term (2026-2050)
            1. Implement distributed electricity generation plan on campus
    c. **The Chiller System**
        i. Immediate (2009-2012)
            1. Complete upgrades to central chiller
            2. Conduct additional chiller upgrades

d. New and Renovated Buildings

i. Immediate (2009-2012)

1. Require a minimum LEED Silver Certification, including at least 8 LEED points for energy performance (35% better than ASHRAE 90.1-2004), for all new buildings and major renovations

ii. Mid-term (2013-2025)

1. Adopt *Architecture 2030* interim goals for energy use reductions in new buildings relative to ASHRAE 90.1-2004 standards: 50% by 2016 and 75% by 2022

iii. Long-term (2026-2050)

1. Adopt *Architecture 2030* and federal Energy Independence and Security Act of 2007 goals for new buildings: carbon neutral and Net-Zero Energy by 2030

e. Existing Buildings

i. Immediate (2009-2012)

1. Continue campus lighting retrofit program throughout campus including relamping, elimination of all incandescent lighting where practical, and installation of occupancy sensors in classrooms, restrooms, and other indoor spaces where they would be effective.
2. Continue water conservation program throughout campus to reduce water and sewage costs and save energy and emissions required for pumping and treatment.

ii. Mid-term (2013-2025)

1. Develop procedures to integrate life-cycle costing, energy efficiency, water efficiency, and other sustainability factors in all campus projects funding from maintenance reserve and operating funds.

iii. Long-term (2026-2050)

1. Develop long-term renovation plan for existing buildings to respond to higher operating costs for energy, water, and emissions. Plan should incorporate:
    a. Cutting-edge cost-effective thermal and electricity efficiency technologies developed to achieve the federal 2007 EISA goals of NZE existing buildings by 2050.
    b. Solar electric and thermal and other on-site energy production technologies

f. Campus Planning, Landscape and Grounds

i. Immediate (2009-2012)

1. Incorporate mixed use, compact, and infill development principles in the Campus Master Plan and all new development projects
2. Plant 100-200 2”+ caliper trees per year to increase tree canopy land cover by 2% per year and achieve 50% land cover by 2025
3. Complete Hydrologic Model to guide stormwater management plans and practices
4. Incorporate LID design in all new building and parking projects to minimize impervious surface and maximize retention and infiltration of runoff on-site

ii. Mid-term (2013-2025)

1. Increase tree canopy to 50% canopy cover by 2025

3. **Facilities Operations**
   a. **Thermostat Settings, Air Handling, and Chiller System Operation**
      i. Immediate (2009-2012)
         1. Implement temperature settings outlined in campus energy policy: 68^{o}F heating season, 74^{o}F cooling season. Involve staff, faculty and students in an education campaign to achieve acceptance of the program.
         2. Operation of Campus Air Handlers: Shutdown 3rd shift operation and monitor impact on users and energy savings
         3. Operation of Campus Chiller System: Maximize free cooling opportunities and monitor impact on energy savings
         4. Operation of Campus Chiller System: Raise chiller loop temperatures and monitor impact on users and energy savings
   b. **Virginia Tech Recycling**
      i. Immediate (2009-2012)
         1. Assure sustained funding of the Virginia Tech Recycling Program
         2. Continue participation in national RecycleMania competition including its Waste Reduction program
         3. Optimize the recycling program by gathering and analyzing data on recycle bin volume by location and modifying bin placement
         4. Increase recycling rate to 35% by 2012
      ii. Mid-term (2013-2025)
         1. Reduce waste generated per student/employee and increase recycle rate to 50% by 2025
   c. **Smart Procurement**
      i. Immediate (2009-2012)
         1. Require all purchases of equipment including computers, peripherals, appliances, and other products for which Energy Star ratings have been promulgated to meet Energy Star ratings unless the specific use of the product requires otherwise
         2. Require all purchases by all organizational units of copy paper have at least 30% post consumer waste content
         3. Establish guidelines for purchase of products ranging from carpeting to cleaning products to help integrate sustainability considerations in all aspects of University procurement

4. **Transportation**
   i. Immediate (2009-2012)
      1. Fleet Services – Switch from diesel to 20% biodiesel for all campus diesel vehicles
      2. Fleet Services – Replace vehicles with more fuel efficient vehicles
      3. Parking Services - Moving parking trucks over to T-3 electric personal transport
      4. Blacksburg Transit – Encourage Blacksburg Transit (BT) to Implement and Inform Customers regarding real-time transit information and trip-planning
      5. Blacksburg Transit – Encourage Blacksburg Transit to purchase hybrid buses as new and replacement buses

6. Alternative Transportation - Institute Bike Share Pilot Program on Campus. Assuming 30 bikes for pilot project

ii. Mid-term (2013-2025)

1. Alternative Transportation - Institute Bike Share Program on Campus, based on Pilot Program
2. Alternative Transportation - Place "light" electric vehicle rental service on campus for cross-campus trips. Assuming 10 vehicles for pilot project, then establish program based on pilot
3. Parking Services - Institute a "no freshman car rule" at VT allowing for exceptions based upon special circumstances
4. Parking Services - Offer parking permit price discount for vehicles with a MPG rating of 35 or higher to promote higher efficiency and hybrid vehicles

5. Behavior and Campus Life

a. Student Culture and Engagement

i. Immediate (2009-2012)

1. Continue current sustainability education through the Green Team
2. Incorporate sustainability into new and transfer student orientation
3. Develop a Sustainable Living Guide for all new students
4. Implement a $2-5/semester student "Green Fee"
5. Engage students through a sustainability internship program
6. Educate, update, and engage alumni through a campus sustainability newsletter
7. Incorporate environmental awareness into the common book selection

ii. Mid-term (2013-2025)

1. Incorporate programmatic aspect of a campus sustainability into Hokie Camp
2. Develop a culture around sustainable living on campus

b. Faculty and Staff Engagement

i. Immediate (2009-2012)

1. Education, assessment, and encouragement campaign among all campus units
2. Education session for all new Virginia Tech employees
3. Address computer updates and phantom power loss
4. Establish a faculty and staff sustainability group

ii. Mid-term (2013-2025)

1. Host competitions between buildings on electricity, heat, and water use
2. Establish a policy on sustainable procurement of equipment and supplies

c. Housing Services and Residence Life

i. Immediate (2009-2012)

1. Continue energy efficiency upgrades and infrastructure improvements in all buildings
2. Increase recycling availability in and around residence halls
3. Provide reusable bags for on-campus students each year
4. Incorporate sustainability into Resident Advisor trainings
5. Green the current "model" room

ii. Mid-term (2013-2025)
1. Energy Star® requirement for all on-campus appliances used by students or staff
2. Develop and implement a Sustainability Advisors Program for the residence halls
3. Host sustainability competitions in the residence halls

d. Dining Services

i. Immediate (2009-2012)
1. Develop food waste reduction strategies
2. Divert edible un-eaten food to non-profit organizations
3. Compost in-edible organic wastes from all dining facilities
4. Pledge to support local and sustainably produced food
5. Composting in-edible organic wastes + compostable containers
6. Redefining "local"

ii. Mid-term (2013-2025)
1. Develop a student run farm that uses composted matter and grows food for facilities
2. Complete energy efficient lighting upgrades
3. Create a policy on energy efficient equipment replacements

iii. Long-term (2026-2050)
1. Approach or reach "Zero Waste" operations

e. University Unions and Student Activities (UUSA)

i. Immediate (2009-2012)
1. Incorporate sustainability into the student budget board process
2. Continue the development of a green facility improvement plan
3. Add refilling stations for water bottles in student centers

f. **The Inn at Virginia Tech and Skelton Conference Center**

i. Immediate (2009-2012)
1. Complete an energy and waste audit of the facility and develop an efficiency and conservation plan
2. Provide a more sustainable experience for hotel and conference guests

ii. Mid-term (2013-2025)
1. Implement the efficiency and conservation plan, maintain membership with the Virginia Green Lodging program, and consider joining the "Green" Hotels Association

g. Athletic Department

i. Immediate (2009-2012)
1. Conduct a waste stream assessment of home football games
2. Develop an in-stadium and tailgating recycling and fan engagement program for home football games
3. Assess Athletic Department operations and develop an efficiency and sustainability plan

ii. Mid-term (2013-2025)
1. Assess waste generation after implementation of recycling program and develop a waste reduction strategy

iii. Long-term (2026-2050)
1. Develop and implement a zero waste plan for all athletic events

6. Academic Programs

a. Instruction and Learning

i. Immediate (2009-2012)
1. Establish a *Virtual School of Sustainability at Virginia Tech* to coordinate sustainability-related instruction and learning programs
2. Establish a *Green Curriculum Coordinator* to coordinate and develop the *Virtual School of Sustainability*
3. Provide stable funding of marquee VT sustainability instructional programs: *Earth Sustainability* and *Green Engineering*
4. Benchmark peer institutions and inventory VT undergraduate and graduate degree, minor, and certificate programs to identify gaps and opportunities to enhance offerings available to students
5. Consider requiring a sustainability literacy requirement for all Virginia Tech students that could be fulfilled in a number of ways

ii. Mid-term (2013-2025)
1. Implement recommendations from benchmark-inventory study in action 4 above

b. Research and Discovery

i. Immediate (2009-2012)
1. Retain the Special Assistant for Energy Initiatives position in OVPR
2. Promote new research in energy efficiency and sustainability using the university campus as a laboratory and using undergraduate research
3. Benchmark peer institutions and inventory VT sustainability-related research expertise, centers, and institutes to identify gaps and opportunities to enhance sustainability research funding

ii. Mid-term (2013-2025)
1. Implement recommendations from benchmark-inventory study in action 4 above

c. Outreach and Engagement

i. Immediate (2009-2012)
1. Establish a *Sustainable Development Coordinator* in Office of Outreach and international Affairs
2. Develop a Green Jobs Training Program in Continuing and Professional Education