Sustainability of Western Kentucky University: An Examination of Campus Environmental Policies, Performance and Potential for Change

Christian Ryan-Downing
Western Kentucky University

Follow this and additional works at: http://digitalcommons.wku.edu/theses
Part of the Earth Sciences Commons, Environmental Health and Protection Commons, and the Medical Sciences Commons

Recommended Citation
http://digitalcommons.wku.edu/theses/420

This Thesis is brought to you for free and open access by TopSCHOLAR®. It has been accepted for inclusion in Masters Theses & Specialist Projects by an authorized administrator of TopSCHOLAR®. For more information, please contact topscholar@wku.edu.
SUSTAINABILITY OF WESTERN KENTUCKY UNIVERSITY:
AN EXAMINATION OF CAMPUS ENVIRONMENTAL POLICIES,
PERFORMANCE AND POTENTIAL FOR CHANGE

A Thesis
Presented to
The Faculty of the Department of Biology
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

By
Christian Ryan-Downing
December 2007
SUSTAINABILITY OF WESTERN KENTUCKY UNIVERSITY:
AN EXAMINATION OF CAMPUS ENVIRONMENTAL POLICIES,
PERFORMANCE AND POTENTIAL FOR CHANGE

Date Recommended 19 November 2007

Quidac Meier
Director of Thesis

Douglas Clayton Smith

Richard 13/11/07
Dean, Graduate Studies and Research Date
ACKNOWLEDGMENTS

There was perhaps never a thesis for which acknowledgments were more befitting than this one. This thesis project is the product of a vast contribution of expertise and information from Western Kentucky University staff, faculty, and students. Writing this thesis has been a fascinating and fulfilling experience that would not have been possible without the wholehearted support, open-mindedness, and genuine interest of my advisor Dr. Ouida Meier. I do not know if Ouida knew what she was getting into when she agreed to be my advisor, but I fear that if she had not, I wouldn’t have been granted the opportunity to pursue my true interest, and to gain experience that has been life-altering. Thank you.

Dr. Terry Wilson and Dr. Douglas Smith, the other two members of my disciplinarily diverse graduate committee, the Dream Team: Terry, my environmental education mentor, granted wishes. Doug opened my eyes to the subject of environmental sociology, a fascinating new world I am inspired to explore.

The pursuit of research and information presented in this thesis project allowed me to know many truly amazing and inspiring people that make Western Kentucky University work. The staff in the WKU Division of Facilities Management; Greg Fear, Dale Dyer, Doug Ault, Cristin Lanham, Charles Harrison, and Dan Chaney were infinitely patient with my incessant questioning and requests for information, always taking time from their responsibilities of keeping the university beautiful and functioning, to give me whatever answers I sought. Thank you.
Dr. Saundra Ardrey and her Political Science Senior Seminar students deserve very special thanks for performing the dirty job of “Garbology”. It takes a special group of students to don jumpsuits and dumpster dive, and a special teacher for allowing them to do it.

Dr. Jennifer Tougas, Alonda Massey, and Dennis Cain in WKU Parking and Transportation; Ken Baushke in Purchasing; Chef Holts of Aramark; Dr. Pan at ICSET: thank you for your patience and for giving me endless data and information.

Brian Kuster and Pam West, thank you for allowing me to work with Housing and Residence Life and for your generous support of my and GreenToppers’ projects.

To the faculty members that took time to respond to my survey: thank you for your submissions and for teaching your students about sustainability.

Thank you to my friends who are also professionals and experts who gave me information; Annie Holt and Elizabeth Schmitz. The “Keep It Clean Bowling Green” awareness materials and information provided by Tim Slattery have been of great value for the stormwater information and in GreenToppers projects and activities. The Office Managers at Monarch Environmental, Gene, and at Southern Recycling, Rebecca, who helped me sort through piles of invoices for data, were of enormous help to me.

Thank you, Jaiya.

Thank you, John for your unwavering belief in me and my ability to make a difference, and for embracing my passion for saving the planet and homeless dogs.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>INTRODUCTION: Sustainability of the College Campus</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAPTER I: Baseline Study</td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>7</td>
</tr>
<tr>
<td>Methods and Materials</td>
<td>9</td>
</tr>
<tr>
<td>Results and Discussion</td>
<td>13</td>
</tr>
<tr>
<td>Building Design</td>
<td>13</td>
</tr>
<tr>
<td>Energy</td>
<td>25</td>
</tr>
<tr>
<td>Greenhouse Gas Inventory</td>
<td>43</td>
</tr>
<tr>
<td>Water</td>
<td>72</td>
</tr>
<tr>
<td>Land</td>
<td>78</td>
</tr>
<tr>
<td>Air</td>
<td>82</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>89</td>
</tr>
<tr>
<td>Purchasing</td>
<td>99</td>
</tr>
<tr>
<td>Transportation</td>
<td>105</td>
</tr>
<tr>
<td>Food and Dining</td>
<td>115</td>
</tr>
<tr>
<td>Sustainability in the Curriculum</td>
<td>122</td>
</tr>
<tr>
<td>Conclusion</td>
<td>131</td>
</tr>
<tr>
<td>CHAPTER II: Reduce Your Use!</td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>135</td>
</tr>
<tr>
<td>Methods and Materials</td>
<td>135</td>
</tr>
<tr>
<td>Results and Discussion</td>
<td>138</td>
</tr>
<tr>
<td>Conclusion</td>
<td>141</td>
</tr>
</tbody>
</table>
Appendix O. Pictures from Reduce Your Use! Conservation competition between Bemis- Lawrence and Barnes-Campbell Halls in October 2007………..184

Appendix P. Calculations for determining potential revenue from capturing all recyclables on campus, using results of singe dumpster audit….186

LITERATURE CITED........................................................................................................187
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sources of information by personal communication</td>
<td>9</td>
</tr>
<tr>
<td>2. Examples of LEED elements used in building design, construction,</td>
<td>16</td>
</tr>
<tr>
<td>and renovation and realized savings of money, energy, and water</td>
<td></td>
</tr>
<tr>
<td>3. Percent allocation of billing for main campus operations, based</td>
<td>29</td>
</tr>
<tr>
<td>on square foot area</td>
<td></td>
</tr>
<tr>
<td>4. Energy units to Btu conversion factors</td>
<td>31</td>
</tr>
<tr>
<td>5. Summary of 2005-2006 main campus energy GHG emissions for three</td>
<td>52</td>
</tr>
<tr>
<td>different protocols</td>
<td></td>
</tr>
<tr>
<td>6. Water Efficient Technology for Buildings</td>
<td>74</td>
</tr>
<tr>
<td>7. Sources of indoor air pollutants in universities</td>
<td>85</td>
</tr>
<tr>
<td>8. Average tons of solid waste generated in 2005-2006 for each division</td>
<td>91</td>
</tr>
<tr>
<td>9. Campus Shuttle services: miles driven, gallons of fuel used,</td>
<td>106</td>
</tr>
<tr>
<td>passengers carried, and hours in service per month</td>
<td></td>
</tr>
<tr>
<td>10. Biodiesel compared to petroleum diesel</td>
<td>110</td>
</tr>
<tr>
<td>11. WKU courses that are reported to include sustainability as a</td>
<td>123</td>
</tr>
<tr>
<td>concept or theme</td>
<td></td>
</tr>
<tr>
<td>12. Weekly use of Kilowatt hours (Kwh) in Bemis-Lawrence and Barnes-</td>
<td>138</td>
</tr>
<tr>
<td>Campbell Halls for the month of October 2007</td>
<td></td>
</tr>
<tr>
<td>13. Pounds of plastic, paper and aluminum recycled in Bemis-Lawrence</td>
<td>139</td>
</tr>
<tr>
<td>and Barnes-Campbell Halls for the month of October 2007</td>
<td></td>
</tr>
<tr>
<td>14. Baseline data provided for electricity use in Kwh in Bemis-Lawrence</td>
<td>140</td>
</tr>
<tr>
<td>and Barnes Campbell Halls from June 2006 to August 2007</td>
<td></td>
</tr>
<tr>
<td>15. Summary of potential revenue if results of the dumpster audit are</td>
<td>147</td>
</tr>
<tr>
<td>applied to the greater campus</td>
<td></td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Percentage of energy budget by energy source for fiscal year 2006-2007</td>
<td>26</td>
</tr>
<tr>
<td>2.</td>
<td>SERC Tennessee Valley geographic region</td>
<td>27</td>
</tr>
<tr>
<td>3.</td>
<td>SERC Tennessee Valley Region fuel mix sources for electricity generation</td>
<td>27</td>
</tr>
<tr>
<td>4.</td>
<td>Percentage of use by energy source for August 2006 – July 2007</td>
<td>34</td>
</tr>
<tr>
<td>5.</td>
<td>WKU main campus energy use by month for August 2006 – July 2007 for Coal, Electricity, and Natural Gas, in Btus</td>
<td>32</td>
</tr>
<tr>
<td>6.</td>
<td>WKU main campus total energy use by month for August 2006 – July 2007</td>
<td>33</td>
</tr>
<tr>
<td>7.</td>
<td>The energy flow on the WKU Main Campus for 2006-2007</td>
<td>41</td>
</tr>
<tr>
<td>8.</td>
<td>Growth trends in enrollment and energy use at WKU from 2002-2006</td>
<td>42</td>
</tr>
<tr>
<td>10.</td>
<td>Carbon dioxide emissions by energy source on the WKU main campus using results of the WBSCD/WRI protocol</td>
<td>54</td>
</tr>
<tr>
<td>12.</td>
<td>Solid waste stream at WKU main campus</td>
<td>92</td>
</tr>
<tr>
<td>13.</td>
<td>Pounds of waste recycled in 2006 calendar year</td>
<td>95</td>
</tr>
<tr>
<td>14.</td>
<td>Profit generated from recyclables, and costs of cardboard dumpster pulls</td>
<td>96</td>
</tr>
<tr>
<td>15.</td>
<td>Breakdown of materials retrieved from dumpster in dumpster audit</td>
<td>145</td>
</tr>
<tr>
<td>16.</td>
<td>Breakdown of recyclable materials in the dumpster audited</td>
<td>146</td>
</tr>
<tr>
<td>17.</td>
<td>Value of waste in dumpster audited</td>
<td>146</td>
</tr>
<tr>
<td>18.</td>
<td>Realized and potential revenue from cardboard dumpster with and without cardboard compactor</td>
<td>150</td>
</tr>
<tr>
<td>19.</td>
<td>Revenue from cardboard transported by WKU recycling crew and potential revenue with cardboard compactor and elimination of trips</td>
<td>151</td>
</tr>
</tbody>
</table>
20. Comparison of revenue results from 2007 move-in cardboard drive
with and without cardboard compactor........................................... 152
Institutions of higher learning are in a pivotal position to address the environmental problems that global society faces now, but response to this challenge requires transformation in priorities and practices. Recognizing the impacts that universities have on the environment and the social and economic costs associated with these impacts, institutions of higher learning are changing policies and management to become more sustainable. Sustainability is defined by the World Commission on Environment and Development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (1987).

To evaluate the environmental impacts and level of sustainability at Western Kentucky University, ten indicators were assessed: Building Design, Energy, Water, Land, Air, Solid Waste, Purchasing, Transportation, Food and Dining, and Environmental Literacy.

Average annual energy consumption for each campus community member is 4,139 kWh of electricity, 527 pounds of coal, 3,600 cf of natural gas, totaling over 22 million Btus, costing $317 and emitting 3.34 metric tons of greenhouse gas emissions. Additionally, 14,244 gallons of water are used, and 248 pounds of solid waste are generated per campus community member annually.
WKU’s physical growth provides opportunities to incorporate elements of energy efficiency and sustainable design into new buildings and renovations that provide permanent savings in energy and water. University energy costs and carbon footprint can be reduced through initiatives including physical and policy change and education campaigns that engage students, faculty, and staff. Sustainable building design and construction and energy conservation have indirect positive impacts, reducing water use, blending with the natural landscape, and reducing water and air pollutants.

Less than 4% of WKU’s solid waste is recycled. Investment in recycling infrastructure can make recycling economically self-supported through revenue and avoided landfill fees. WKU has no policy for environmentally responsible purchasing. A “green purchasing” guide could promote the use of recycled content paper, and energy efficient appliances.

University shuttles are decreasing carbon emissions by using 5% biodiesel, and plan to increase the blend. Campus-community initiatives such as bike lending and expanding shuttle service are progress toward sustainability. Further steps could include purchase of university fleet hybrid cars and a ride-share program for commuters.

According to Worldwatch Institute, food transportation is the biggest, fastest-growing source of greenhouse gas emissions worldwide. WKU food services could decrease the university’s carbon footprint while supporting the local economy by using food produced locally, and reduce environmental impacts and landfill fees by composting food waste.

A survey sent to WKU faculty requesting submissions of courses including sustainability as a concept resulted in 42 courses from within four main campus Colleges.
Ecological literacy is essential in preparing students to be productive and engaged citizens of a global society.

Efforts toward sustainability reduce the university ecological footprint and have far-reaching positive impacts in reduced operating costs, improved quality of services to students and faculty, and providing a model for local communities. Universities invested in sustainability also give their graduates critical knowledge and skills to find creative solutions to challenges facing society.
INTRODUCTION: Sustainability of the College Campus

Sustainability Defined:

*noun* 1: capability of being sustained; 2a: of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged

*sustainable techniques* <sustainable agriculture> b: of or relating to a lifestyle involving the use of sustainable methods *sustainable society*

-circa 1727 Merriam-Webster

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”


“...Then I say the earth belongs to each...generation during its course, fully and in its own right. The second generation receives it clear of the debts and encumbrances, the third of the second, and so on. For if the first could charge it with a debt, then the earth would belong to the dead and not to the living generation. Then, no generation can contract debts greater than may be paid during the course of it's own existence.”

-Thomas Jefferson, Sept. 6, 1789

“Sustainable development, sustainable growth, and sustainable use have been used interchangeably, as if their meanings were the same. They are not. Sustainable growth is a contradiction in terms: nothing physical can grow indefinitely. Sustainable use, is only applicable to renewable resources. Sustainable development is used in this strategy to mean: improving the quality of human life whilst living within the carrying capacity of the ecosystems.”

“No institutions in modern society are better equipped to catalyze the necessary transition to a sustainable world than Universities. They have access to the leaders of tomorrow and the leaders of today. They have buying and investment power. They are widely respected. Consequentially what they do matters to the wider public.”

- David Orr, *The Last Refuge: Patriotism, Politics, and the Environment in an Age of Terror*

Because of the global social, economical and ecological issues we face today, individuals, institutions, and communities are examining decisions and activities affecting the health of our planet. Recognizing the substantial impact that universities have on the environment in contributions to global warming, resource consumption, waste generation, and deteriorating water and air quality, as well as the social and economic costs associated with these impacts, many institutions of higher learning are changing policies and management to become more sustainable. In more instances than not, these changes are inspired by students, gardeners, food service managers, purchasing agents, and recycling directors. The results of these efforts reduce the university ecological footprint and have broad positive impacts such as reducing operating costs, improving the quality of services, and providing a model for local communities.

Universities that are more sustainable are also giving their graduates the knowledge and skills to find creative solutions to the challenges facing the global society today.

Although universities are reporting millions of dollars in savings from better campus planning and management (The Apollo Alliance and Energy Action, 2004), quantifying the degree to which these practices are reducing impacts of human activity on the natural environment is difficult.

Right now, a search on the internet produces dozens of campus sustainability programs and initiatives. One ranking system for evaluating colleges and universities, developed by David Orr (1994), assesses the degree to which a university moves the world in a more sustainable direction. Orr employs five criteria as follows: 1. the quantity
of material goods the university consumes on a per capita basis; 2. university
management policies for materials, waste, recycling, purchasing, landscaping, energy
use, and building; 3. ecological literacy engendered in the curriculum; 4. degree to which
university finances help build a sustainable regional economy; and 5. what graduates do
in the world, or how they contribute to a sustainable society (Orr, 1994).

In *Greening the Ivory Tower: Improving the Environmental Track Record of
Universities, Colleges, and Other Institutions* (1998), Sarah Hammond Creighton
describes the effort at Tufts University to reduce or eliminate the environmental impacts
from the university’s operations. The Tufts CLEAN! (Cooperation, Learning, and
Environmental Awareness Now!) project was funded in 1990 by the U.S. Environmental
Protection Agency because of Tufts’ leadership role in environmental education and
research and its commitment to environmental programs. The project team identified five
key ingredients essential to successful university environmental action: 1. understanding
how the institution works, its players, and its decision-making; 2. university commitment
and demonstrated support for environmental action, often articulated in an environmental
policy; 3. a university-wide environmental planning committee or smaller issue-specific
committees; 4. individual leaders; and 5. an understanding of the basic principles of
environmental protection. In addition, the business of creating a more sustainable
university requires identifying and gathering data that contributes meaningfully to
change, and “attention to the economic realities of proposed actions, an
acknowledgement of existing university priorities, a willingness to try projects on a small
pilot scale, attention to publicity, and an understanding that priorities may need to be set
along the way” (Creighton, 1998).
In this document, I have attempted to provide insight into all of the elements identified as essential by the Tufts CLEAN! research team by taking a hard look at the sustainability of Western Kentucky University (WKU). This report is a collection of both quantitative data and qualitative observation, and as a whole is intended to measure and document current trends and impacts, to identify areas of progress, and to provide practical and realistic recommendations for improvement and change learned from achievements at other universities. It serves as a starting point for improving sustainability at WKU. Ultimately, this project reflects the depth of impact that WKU has on the ecological and social environment, and the seemingly limitless extent to which positive change is possible.
CHAPTER I: BASELINE STUDY

Introduction

Before we can decide which initiatives Western Kentucky University can take toward greater sustainability, it is necessary to know where the university is presently. The information compiled in this project is the result of a comprehensive investigation into the status of WKU resource use and environmental impacts and the degree to which students are presented with the opportunity to get the knowledge and skills they need to live and work sustainably. I attempted to limit the scope of my research to the main campus, but found it very difficult to draw boundaries. Appropriate edges of natural systems are difficult to define, and this is especially true when anthropogenic components are added to the mix. Often the boundaries are obscured, suggesting possibilities for further consideration and research. One example is the degree to which commuter carbon dioxide emissions should be included as university impacts.

My primary goal for this project was to accumulate and illustrate as much quantitative data as possible, against which change could be measured. While many indicators can be expressed numerically, sustainability is more than kilowatt hours used or tons of waste generated. Just as considering the environmental and social costs in a sustainable economic investment is necessary, including qualitative observations concerning responsible decision-making, environmental literacy in the curriculum, attitudes and behaviors, and civic engagement in an organizational sustainability assessment is necessary. As I began to gather data, I found that the existing methods of collecting and recording information dictated how it could be used. For example, many typical audits would express energy use by building; WKU main campus energy use is
not metered at each building, so energy use must be expressed differently. My goal in compiling and reporting data was to make the process transparent and repeatable, so that successive audits for measuring progress can be conducted with relative ease.

**The Indicators**

There are a variety of campus audits and toolkits available to help students assess the sustainability of their universities, the best known of which may be *Campus Ecology – A Guide to Assessing Environmental Quality & Creating Strategies for Change*, created by April A. Smith and The Student Environmental Action Coalition (Smith, 1993).

*Campus Ecology* was born from the first comprehensive study of the “state-of-the-environment of a college campus” by a group of graduate students in a UCLA Urban Planning Program (Smith, 1993). Since this first student-initiated campus assessment, many students have looked at their own campus’s ecological footprint and prepared reports in the form of indicators, benchmarks, and recommendations for change. After studying many of these as models, and looking at the structure of WKU, I decided to incorporate those aspects of various indicator and audit reports that I felt were best suited to WKU considering its size and structure. I chose ten different indicators that I felt would illustrate Western Kentucky University’s environmental impact and level of sustainability. These ten indicators are: Building Design, Energy, Water, Land, Air, Solid Waste, Purchasing, Transportation, Food and Dining, and Environmental Literacy.

I have attempted to provide a thorough assessment of each indicator’s status and management regime at WKU. Where possible I have collected data to provide benchmarks against which to measure future changes. In each area there is potential for increased sustainability such as reducing pollution of air, water, and soil; conservation of
resources; reducing waste; and maintaining the integrity of ecosystems. Where there are already attempts at or movement toward sustainable practices, I describe those individuals and projects, and the success they have achieved where measurable. For each indicator I also chose an example of a successful program at another university to profile. There are some additional initiatives present on our campus that do not fall under any department or manager, such as independent student projects and research, which are profiled as well.

**Methods and Materials**

Information and data presented in this document came from a variety of sources including departments and individuals throughout the university, outside the university, and literature. Information was obtained through many personal interviews, data requests, and open records. I take full responsibility for all errors in understanding the data provided to me and all errors in transcription or calculation. I cannot certify the authenticity of the data provided in its raw form. Limitations included incomplete or unavailable data; extrapolations or estimates are identified and are conservative. Any inaccurate information compromises the usefulness of the assessment. I ask all readers to contact me with corrections or perspectives.

<table>
<thead>
<tr>
<th>Informant</th>
<th>Title</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>All, John, Ph.D.</td>
<td>Assistant Professor</td>
<td>WKU Department of Geography and Geology</td>
</tr>
<tr>
<td>Ardrey, Saundra, Ph.D. and the Fall 2007 Political Science Senior Seminar students</td>
<td>Department Head</td>
<td>WKU Political Science DepartmentWKU Political Engagement Project</td>
</tr>
<tr>
<td>Ault, Doug</td>
<td>Director, Planning Design and Construction</td>
<td>WKU Division of Facilities Management</td>
</tr>
<tr>
<td>Baker, John, Ph.D.</td>
<td>Instructor</td>
<td>WKU Gordon Ford College of Business Leadership Studies Program</td>
</tr>
<tr>
<td>Baushke, Ken</td>
<td>Director of Purchasing/Accounts Payable</td>
<td>WKU Purchasing and Accounts Payable</td>
</tr>
<tr>
<td>Berry, Wes, Ph.D.</td>
<td>Assistant Professor</td>
<td>WKU Department of English</td>
</tr>
<tr>
<td>Name</td>
<td>Title/Position</td>
<td>Organization/Field</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Britt, Annie</td>
<td>Environmental Compliance Technician</td>
<td>WKU Environmental Health and Safety</td>
</tr>
<tr>
<td>Cain, Dennis</td>
<td>Transportation Analyst</td>
<td>WKU Department of Parking and Transportation</td>
</tr>
<tr>
<td>Chaney, Dan</td>
<td>Project Manager for Capital Construction</td>
<td>WKU Division of Facilities Management</td>
</tr>
<tr>
<td>Clemmons, Tammy</td>
<td>Sustainability Coordinator</td>
<td>Berea College</td>
</tr>
<tr>
<td>Colley, Tim</td>
<td>Manager</td>
<td>WKU Dining Services</td>
</tr>
<tr>
<td>Downing, Neal, AIA</td>
<td>Associate Professor/Architect Director: AMS Institute</td>
<td>WKU Architectural &amp; Manufacturing Sciences</td>
</tr>
<tr>
<td>Dyer, Dale</td>
<td>Manager of HVAC and Utilities</td>
<td>WKU Division of Facilities Management</td>
</tr>
<tr>
<td>Fear, Greg</td>
<td>Facilities Grounds Manager</td>
<td>WKU Division of Facilities Management</td>
</tr>
<tr>
<td>Garrett, Jan, Ph.D.</td>
<td>Professor</td>
<td>WKU Department of Philosophy and Religion</td>
</tr>
<tr>
<td>Gray, Marshall</td>
<td>Director</td>
<td>WKU Postal Services</td>
</tr>
<tr>
<td>Grismer, John</td>
<td>Post Office Supervisor</td>
<td>WKU Postal and Printing Services</td>
</tr>
<tr>
<td>Gumbley, Paul</td>
<td>Buyer (previous)</td>
<td>Southern Recycling, Inc.</td>
</tr>
<tr>
<td>Hagan, Ellen</td>
<td>Student, Big Red’s Bikes Project Manager</td>
<td>WKU GreenToppers Students for Campus Sustainability</td>
</tr>
<tr>
<td>Harrison, Charles</td>
<td>Assistant Director of Facilities</td>
<td>WKU Division of Facilities Management</td>
</tr>
<tr>
<td>Hess, Herb</td>
<td>Electronics Technician</td>
<td>WKU Division of Facilities Management</td>
</tr>
<tr>
<td>Holt, Annie, M.S.</td>
<td>Hydrologist</td>
<td>Previously with WKU Center for Cave and Karst</td>
</tr>
<tr>
<td>Holts, Gilbert</td>
<td>Executive Chef</td>
<td>WKU Restaurant &amp; Catering Group</td>
</tr>
<tr>
<td>Huskey, Steve, Ph.D.</td>
<td>Assistant Professor</td>
<td>WKU Department of Biology</td>
</tr>
<tr>
<td>Kuster, Brian</td>
<td>Director</td>
<td>WKU Housing and Residence Life</td>
</tr>
<tr>
<td>Lanham, Cristin</td>
<td>Gardener</td>
<td>WKU Division of Facilities Management</td>
</tr>
<tr>
<td>Lienesch, Philip, Ph.D.</td>
<td>Associate Professor</td>
<td>WKU Department of Biology</td>
</tr>
<tr>
<td>Massey, Alonda</td>
<td>Transit General Manager</td>
<td>WKU Department of Parking and Transportation</td>
</tr>
<tr>
<td>McClanahan, Cait</td>
<td>Sodexho Sustainability Coordinator</td>
<td>Berea College Dining Services</td>
</tr>
<tr>
<td>Meier, Ouida, Ph.D.</td>
<td>Adjunct Assistant Professor</td>
<td>WKU Department of Biology</td>
</tr>
<tr>
<td>Morrow, Rebecca</td>
<td>Office Manager</td>
<td>Southern Recycling, Inc.</td>
</tr>
<tr>
<td>Neighbors, Jamie</td>
<td></td>
<td>Southern Recycling, Inc.</td>
</tr>
<tr>
<td>Pan, Wei-Ping, Ph.D.</td>
<td>Institute for Combustion Science and Environmental Technology</td>
<td>WKU Center for Research and Development</td>
</tr>
<tr>
<td>Reader, Daniel, M.S.</td>
<td>Instructor</td>
<td>WKU Department of Geography and Geology</td>
</tr>
<tr>
<td>Riley, Tom</td>
<td>Director (previous)</td>
<td>WKU Division of Facilities Management</td>
</tr>
<tr>
<td>Robb, Elizabeth, B.S.</td>
<td>Environmental Education Specialist</td>
<td>Kentucky Department for Environmental Protection, Division for Air Quality</td>
</tr>
<tr>
<td>Schnultz, Kevin, Ph.D.</td>
<td>Associate Professor</td>
<td>WKU Engineering</td>
</tr>
<tr>
<td>Simpson, Ryan</td>
<td>Senior-year student</td>
<td>WKU Mechanical Engineering and Math</td>
</tr>
<tr>
<td>Slattery, Tim, CPSWQ</td>
<td>Hydrologist</td>
<td>Bowling Green Department of Public Works</td>
</tr>
<tr>
<td>Smith, Michael, Ph.D.</td>
<td>Assistant Professor</td>
<td>WKU Department of Biology</td>
</tr>
<tr>
<td>Stokes, Michael, Ph.D.</td>
<td>Associate Professor</td>
<td>WKU Department of Biology</td>
</tr>
<tr>
<td>Thurmond, Jennifer</td>
<td>IT Helpdesk Consultant</td>
<td>WKU Information Technology Help Desk Operations</td>
</tr>
<tr>
<td>Toulouse, Jennifer</td>
<td>Director</td>
<td>WKU Department of Parking and Transportation</td>
</tr>
<tr>
<td>West, Pam</td>
<td>Associate Director of Facilities</td>
<td>WKU Housing and Residence Life</td>
</tr>
<tr>
<td>Wilson, Terry, Ph.D.</td>
<td>Director</td>
<td>WKU Center for Math, Science, and Environmental Education</td>
</tr>
</tbody>
</table>
Management of the WKU physical campus is outsourced to Sodexho Campus Services, a division of Sodexho, Inc., known on campus as the Division of Facilities Management (DFM). Most of the information and data on building design, energy, water, land, and solid waste in this report were obtained from the DFM. I obtained quantitative data on energy use and solid waste generation from records that are either posted for viewing by the public, or which I requested. Much of the information I received on energy systems and building design I obtained through personal interviews conducted with Sodexho staff during the months of May through October 2007. Information and data on energy use in student housing was obtained from personal interviews and records from personnel in Housing and Residence Life (HRL).

Greenhouse gas (GHG) emissions were calculated using energy data obtained from the WKU DFM and protocol and worksheets from both the Clean Air Cool Planet protocol (CA-CP, 2006) and the World Resource Institute/World Business Council for Sustainable Development GHG Protocol (WRI/WBCSD, 2007, Gillenwater, 1995). On-site measurements of emissions data were obtained from the Research Report for MACT Compliance Baseline Testing on NOx/SO2 Emission, HCl, Total Selected Metals and Mercury at WKU's Heating Plant, prepared by the WKU Institute for Combustion Science and Environmental Technology, or ICSET (Chen et al., 2006).

Transportation at WKU is managed by the Parking and Transportation Department. Information and data on shuttle ridership, fuel use, parking trends, and other components of Parking and Transportation were obtained through records requests and personal interviews with staff in this department.
Dining and Catering at WKU is managed by Aramark Food Services, known on campus as WKU Restaurant and Catering Group. I obtained information and data on dining trends and food sources and choices through personal interviews with the Executive Chef and Manager in this department.

Purchasing data were obtained through personal interviews and records requests from staff in the Purchasing Department and in Auxiliary Services.

Statistics such as student enrollment were obtained from the *Western Kentucky University 2006 Fact Book* and *2007 Fact Book*, prepared by the Institutional Research Staff, Office of Institutional Research, WKU.

Information about sustainability in the WKU curriculum was obtained through an informal email survey to WKU faculty. The survey was approved by the WKU Human Subjects Review Board. I obtained permission to use names and additional quotes or information from respondents before including them here.

Off-campus sources of information on air and water quality and impacts included the Kentucky Division for Air Quality, City of Bowling Green Public Works Stormwater Management and Kentucky Division of Water. Information and data were obtained from public records and personal interviews with representatives from these agencies.

I also investigated sustainability initiatives at other college campuses across the country through books, published papers, reports on websites, and personal interviews at several conferences and by telephone. I interviewed WKU students to learn about student projects in progress on our campus. These sources are cited as reported.
Results and Discussion

1. Building Design

The design, construction, renovation, operation and maintenance of academic, administrative, housing, and other campus buildings provide the greatest opportunities for improving university sustainability, because the physical structures of buildings are the first determinants of energy use, and because innovations in energy efficiency and energy savings within buildings are permanent and ongoing. Incorporating energy saving measures such as ambient lighting, efficient lighting ballasts, and remote or occupancy sensor lighting, heating, and cooling into the initial design and construction phase allows for realization of immediate benefits of such measures, avoids costly retrofitting projects, and is the least expensive point to introduce these measures and gain maximum benefit. Impacts of such measures persist long after individual students, faculty or staff have left the campus. Operations and maintenance provide opportunity for such conservation measures as remote controlled heating and cooling, load shedding during periods when buildings are underutilized, and replacement upgrades of more efficient appliances and systems components.

At WKU, building design and construction falls under the management of WKU DFM: Planning, Design, and Construction. Doug Ault is the Director of WKU Planning, Design, and Construction. DFM manages maintenance and operation of the physical campus, and Housing and Residence Life (HRL) manages renovation, maintenance, and operation of student housing. All of the physical campus design, construction, and operations are guided by the WKU Master Plan, prepared by a Master Plan committee of university facilities managers, administrators, staff, and faculty. The Master Plan
committee members include Provost Barbara Burch, Brian Kuster, Dennis George, Doug Ault, Eric Reed, Gene Tice, Helen Siewers, Jennifer Tougas, John Osborne, Karl Laves, Lisa Cook, Melissa Cansler, Neal Downing, Randy Deere, and Sharon Hartz.

Right now, the Master Plan does not contain sustainability objectives. However, Ault has proposed the inclusion of sustainability into Western’s Master Plan, which serves as the blueprint for campus planning. Master Plan Committee Members, some of whom expressed feeling “behind the curve” when it comes to the idea of sustainability, recently requested training from the Association for the Advancement of Sustainability in Higher Education (AASHE), now headquartered in Lexington, Kentucky. Ault has attended conferences and training to learn more about sustainability initiatives, and has included sustainability in the *2007-2008 Planning, Design, and Construction Strategic Plan*. Specifically, the concept is listed within the following initiatives:

- **Strategic Initiative 3: Leadership** lists the development of a plan for LEED [Leadership in Energy Efficiency and Design] familiarization training for all staff.

- **Strategic Initiative 4: Collaboration** includes: “Work with Academic Affairs, Student Groups and other SACS [Southern Association of Colleges and Schools] Departments to develop a campus wide sustainability program.”

At the corporate level, Sodexho Inc. is beginning to focus on sustainability as well: “Sensitivity to environmental issues is an integral part of Sodexho’s way of doing business. Our approach is evolving as we take a more critical look at how we can promote a more environmentally friendly and sustainable society through changing our operations, and working with our suppliers and clients.” (Sodexho, 2006). A closer look at Sodexho’s approach to supporting sustainability is detailed in a later section. Currently,
there is only minimal evidence of sustainability or environmental initiatives undertaken by DFM at WKU.

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

The U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) program is a system for designing, constructing, operating, and certifying green buildings. The LEED rating system is divided into five environmental categories in which performance points can be earned. Additional points can be earned for innovation in design. The categories include: Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Sustainable Sites, and Water Efficiency. The LEED program has increased recognition of and value for high-performance building design and LEED certification has become a standard by which buildings are measured.

The costs of green buildings depend on many factors including local conditions, the project, design, construction, and operation. In *Green Building Costs and Financial Benefits* (2003), Gregory H. Kats reports that in comparing 33 green buildings from across the United States to conventional designs for those same buildings, the average premium for the green buildings is less than 2%. Most of this cost can be attributed to increased architectural and engineering design time and, according to Kats’ findings, the earlier that green building features are incorporated into the design process, the lower the cost of incorporating those features. It is also reported that this minimal upfront investment of about 2% to support green design would, on average, result in life cycle savings of 20% of total construction costs (Kats, 2003). Financial benefits include lower energy, waste disposal, water, operations, and maintenance costs. From a review of 60
LEED rated buildings, Kats found that green buildings use 30% less energy than conventional buildings (Kats, 2003); these savings are permanent and recurring.

Gregory Kats also reports on the human health and productivity benefits of green buildings. He cites a study by the Heschong-Mahone group that looked at students in three cities and found that students in classrooms with the greatest amount of natural daylighting performed up to 20% better than those students in classrooms with little daylight (Kats, 2003.)

Some examples of LEED new construction buildings and renovations of existing building and the energy savings realized by these projects through incorporating LEED elements are listed in Table 2.

**Table 2. Examples of LEED elements used in building design, construction, and renovation and realized savings of money, energy, and water.** Source: Green Building Research Center, University of California at Berkeley. 2006 Best Practice Case Studies. Green Buildings, UC Berkeley website: www.greenbuildings.berkeley.edu.

<table>
<thead>
<tr>
<th>Building</th>
<th>Size of project area</th>
<th>Total cost of building project</th>
<th>LEED elements incorporated into design</th>
<th>Annual Energy/Water Savings realized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonoma State University Student Recreation Center - new construction</td>
<td>53,000 square feet</td>
<td>$11.6 million</td>
<td>70% natural ventilation, sustainable materials, 85% natural lighting</td>
<td>339,000 kWhr 43% greater energy efficiency than Title 24 standards*</td>
</tr>
<tr>
<td>University of California, Los Angeles, La Kretz Hall – new construction</td>
<td>22,000 square feet</td>
<td>$7 million</td>
<td>25% of building is recycled material CO2 monitoring and control system</td>
<td>34% reduction in water consumption 32% greater energy than Title 24 standards</td>
</tr>
</tbody>
</table>

*Annual Energy/Water Savings realized*
| University of California, San Francisco Health Sciences Lab – renovation | 11,000 square feet | $4 million | 75% of construction waste diverted from landfill, all materials formaldehyde-free and low volatile organic compounds | 14% reduction in water consumption, 32% greater energy efficiency than Title 24 standards; $80,000 saved in energy costs annually |
| University of California, San Diego Cognitive Science, Heating, Ventilation - Air Conditioning (HVAC) retrofit | 55,235 square feet | $150,000 | Central control system, occupied/unoccupied and night setback modes, Electrical and thermal metering | 180,000 kWhr; $29,600 saved in energy costs annually |


The extensive LEED documentation process and associated costs can be barriers to LEED certification. Institutions may opt to build using LEED or “green” principles but choose not to pursue formal LEED certification by the US Green Building Council.

Estimates vary widely, but it is reported that experienced teams can achieve the documentation required for certification for $10,000, while inexperienced teams have incurred costs as high as $60,000 (Howard and Watson, 2002). LEED certification fees are based on square foot area of the project, and review of construction and design. The LEED certification process can also be time-consuming. It is suggested by the USGBC that having a LEED Accredited Professional as the project contact and team member responsible for coordinating the process is helpful. The USGBC website lists LEED registration and certification fees; a summary of these fees can be found in Appendix A.
An alternative to these fees is to require architects to design buildings according to LEED standards without pursuing the final step of LEED certification.

Buildings currently under construction on the WKU main campus are: Smith Stadium addition, new Snell Hall building, College Heights Herald and Talisman building, and the Health Center. Outside the main campus, a substantial South Campus addition is under construction as well. Buildings in the design phase include the new College of Education, Preston Center addition, Van Meter renovation, and the Science and Technology Hall renovation. According to Ault, LEED technologies are being considered for the new College of Education building, and renovations being planned at Van Meter and Science and Technology Hall include a focus on energy upgrades such as lighting retrofits and room occupancy sensors to improve efficiency. While there are not plans for specific LEED certification, architects and engineers are now being instructed to look at “green” and sustainable technologies for new buildings and renovations (Ault, pers. comm.).

The US Department of Agriculture plans to build an Animal Waste Management Research Laboratory (AWMRL) where the current Thompson Complex North Wing building stands. The design of the AWMRL, according to the Federal Government’s guidelines on ‘Greening the Government Through Leadership in Environmental Management’ (Executive Order 13148), will “provide for the protection of the environment through energy efficiency, recycling, pollution prevention, and affirmative procurement” to the greatest extent possible. This does not insure that the building will be LEED Certified, as the sustainability elements of the project and whether it will be registered with the US Green Building Council (USGBC) have not yet been determined.
Doug Ault has approached the student organization, GreenToppers Students for Campus Sustainability, about assisting in an energy conservation outreach campaign, and has expressed the need for indicator data, such as greenhouse gas (GHG) emissions for the campus. As a leader of that group, I have consulted with him on methods for obtaining and processing the data in this report to ensure a repeatable and appropriate methodology for this and future audits.

**Recommendations for Change**

Western Kentucky University should include LEED building design in the Master Plan and make it standard for all new construction and existing building renovations. There are several buildings in the design phase that could meet LEED standards. The incorporation of LEED standards in building design and construction not only saves money and energy in the long term, but these buildings are healthier for the occupants and the environment. Any future campus construction should be of sustainable design. LEED-standard buildings add value to the campus in many ways besides energy efficiency: they are models for the greater community, and they are “learning buildings” for faculty, staff, students, and visitors. While LEED is a U.S. model for energy efficiency in building design, the concept is being incorporated into architecture and building design curriculum throughout the world. The University of Hong Kong (HKU), Department of Architecture has created the Building Energy Efficiency Research (BEER) project to engage students in research on energy efficiency in building design and operation. Suggested reading for HKU’s “Sustainability in the Built Environment” course has included United States university sustainability reports (HKU, 2003). To continue to build buildings without LEED elements is not only unsustainable, but it misses
opportunities to save money and attract positive attention from stakeholders and students alike.

The rate of physical growth on the WKU campus in new building construction makes it prudent to begin building sustainably immediately. WKU administrators have cited cost as the number one barrier to green building. The estimate by Kats (2003) that the premium for building green is only about 2%, going mostly for additional effort in the design phase, and resulting in about 30% less energy use annually, has already been described. Additionally, a recent 2006 study published by Davis Langdon, an international construction and property firm reports that “there is no significant difference in average costs for green buildings as compared to non-green buildings” (Matthiessen, 2006). This study, Cost of Green Revisited – Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption, compared construction costs of similar buildings including academic, laboratory, and library buildings and found that LEED-seeking buildings were not more costly than non-seeking buildings. The study also noted that the projects that most successfully achieved sustainable goals within their original budget established clear sustainable goals from the start and integrated the elements into the project at an early stage. Making it clear early in building construction and design that sustainability and LEED standards are essential elements in every project is important for WKU.

Campus Profile:

Berea College

Berea College in central Kentucky has incorporated elements of sustainability into all aspects of their campus, including the physical plant, campus operations, and
curriculum. Tammy Clemmons is the campus Sustainability Coordinator. According to Clemmons, Berea incorporates sustainable landscaping, uses some organic and local foods (some grown by students at the College Farm) in their dining hall, and has built an Ecovillage that houses some students, including family housing, and is designed to be more efficient and self-contained, producing much of its own energy with solar and wind power, and filtering and recirculating water. Berea also boasts the first LEED certified building in Kentucky, Lincoln Hall.

Clemmons and students give guided tours of Lincoln Hall and describe its renovation. As Berea College’s Administration Building, Lincoln Hall was constructed in 1885 and was named for Abraham Lincoln. The 24,000 square foot National Historic Landmark building experienced a catastrophic structural failure in 2001, when the center bay of the upper two floors collapsed onto the main entrance level. The building was completely renovated using sustainable design and construction techniques, including low volatile organic compound (VOC) building materials and new building materials specified to include recycled content. By reusing 75% of the existing historic structure, more than 50% of construction and demolition debris was diverted from the landfill. The redesign used Forest Stewardship Council (FSC) -certified wood trim and hardwood flooring reused from an old house. Building design included use of daylighting, occupancy sensors, remotely controlled ceiling fans and “open window” indicators. The heating, ventilation, and air conditioning (HVAC) system is equipped with an economizer that shuts off when outside temperatures are favorable. These and other energy efficiency measures use about 25% less energy than standard features. Low-flush toilets and water efficient landscaping result in 30% less water use than previously.
Recycling stations are built into every floor, and bike racks and showers encourage bicycle use.

Berea College has completed a second green building renovation in Draper Hall, built in 1937. This building meets LEED standards, but the College did not seek LEED registration or certification because, according to Clemons, the paperwork and costs associated with certification were simply not worth the extra effort and expense. Clemons explains that the building was not designed for sustainability to boast LEED Certification; it was designed for sustainability because it makes environmental and economic sense.

The Sodexho Facilities Management Approach to Supporting Sustainability

WKU DFM is outsourced to Sodexho Campus Services. Sodexho states that its mission is “to enhance the quality of daily life through our services and systems” (Sodexho Corporate Responsibility, 2006). Sodexho is working on a sustainability policy and has created the document, *Sodexho Facilities Management Approach to Supporting Sustainability*, which is distributed to employees. The document is 31 pages, one-sided, and looks much like a printed Power Point presentation, including a “Purpose” and a list of broad and general “Action Steps”. In this document, Sodexho defines sustainability as follows: “Sustainability can be defined simply as meeting contemporary needs without compromising the ability of future stakeholders to satisfy their needs.” Sodexho states that they have the opportunity to share their “philosophy of being good stewards” with the people employed by, managed by, and served by Sodexho. They claim to have been
focused on sustainability for many years, and cite an Environmental Protection Agency (EPA) award for efforts in recycling at New Mexico State University\(^1\).

As stated in the *Sodexho Facilities Management Approach to Supporting Sustainability*, “The purpose of this sustainability plan is to assure [name of campus/school] Campus Community’s approach towards meeting the contemporary needs of our community without compromising the ability of future stakeholders of [name of campus/school] to meet their needs.” Action Steps toward sustainability are broadly outlined in the plan for the following areas:

A. Communication - educate the campus community of the action plan
B. Design for Sustainability – sustainable construction and building design
C. Landscape Maintenance and Design – use of natives, drip irrigation, permeable surfaces
D. Maintenance and Operations - temperature setbacks, motion sensors, preventive maintenance, Energy Star products
E. Custodial Practices – Green Seal products, recycling, reduced water consumption
F. Vehicle Fleet – hybrids, encouragement of public transportation and carpooling
G. Energy Conservation and Management
H. Procurement – support environmentally and socially responsible products and services
I. Investment – engage in socially responsible and environmentally responsible investing
J. Transportation - develop incentives and infrastructure for walking, cycling, ridesharing, and public transportation

\(^1\) Note: I have been unable to find any information on the New Mexico State University recycling program, outside this Sodexho document.
K. Calculate carbon footprint

The Sodexho document also includes as appendices *The American College and University Presidents Climate Commitment* and the LEED Point system. Sodexho’s listed Action Steps are inclusive of many sustainability initiatives but are not specific how and where these initiatives will be implemented. It is suggested in the document that some Action Steps included in Communication, Maintenance and Operations, Custodial Practices, and Energy Management and Conservation initiatives are planned for August 2007, but no specifics are provided. For all other Action Steps, no planned implementation dates are noted.

Sodexho is Berea College’s food service provider, and was asked by the College to create the position of Sustainability Coordinator for its Berea operations in the fall of 2006. Through resources on and off campus, this Coordinator oversees Sodexho’s Sustainability Program at Berea College in all aspects including food, recycling, energy conservation, and composting of food wastes. The position was created by Sodexho to align with the mission and priorities of the school. The Berea Sodexho sustainability position is described in more detail in the dining section. WKU food services are provided by Aramark, and are also described in detail in the dining section.
2. Energy

"More than ever, universities must take leadership roles to address the grand challenges of the twenty-first century, and climate change is paramount amongst these."

-Michael M. Crow, President, Arizona State University

Energy Management

Dale Dyer is the energy manager at WKU, with the official title of "Manager of HVAC and Utilities." Dyer supervises the Central Steam Plant, energy systems throughout the main campus, HVAC installation and maintenance, and energy conservation efforts.

Energy on the WKU campus is primarily used for heating, cooling, ventilation and lighting. Most of the energy used on campus, including electricity, natural gas, and coal, is from nonrenewable fossil fuel sources. Some of electricity purchased from Bowling Green Municipal Utilities (BGMU) is generated with nuclear, hydroelectric, and renewable methods by Tennessee Valley Authority (TVA), but 66% is coal generated (Figure 3). Energy use on the main campus and satellite campuses, departments, and centers is measurable by purchased quantities of electricity, coal, and natural gas.

The annual energy budget for the Main Campus is $6 million, of which electricity accounts for about $4 million (Dyer, pers. comm.). University energy use and costs are available for public view on the WKU Facilities Management website (www.wku.edu/Dept/Support/FacMgt). It is reported that in fiscal year 2006-2007, electricity used by the main campus totaled 72,020,435 Kilowatt hours (kWh), at a cost of $4,416,303. Natural gas use totaled 631,867 hundred cubic feet (Ccf). Of this natural gas, 192,140 Ccf were required by the Central Heat Plant; the remaining 439,727 Ccf were used in heating and water heating throughout main campus, at a total cost of
Finally, in fiscal year 2006-2007, 4,221 tons of coal were purchased, at a cost of $473,748 (Figure 1). The university currently does not purchase offsets or green power (Dyer, pers. comm.). See Appendix B for WKU energy and water use and cost for fiscal years 2000-2001 through 2006-2007.

In fiscal year 2006-2007, electricity accounted for 79% of the energy budget for the main campus (Figure 1), and 59% of use (Figure 4). Electricity is mostly used for lighting, electronics, ventilation, cooling, and hot water production. Electricity is purchased from the local distributor for the TVA, BGMU. In this region, known as the Southeastern Electric Reliability Council (SERC) Tennessee Valley, 66% of the electricity supplied from TVA is coal-powered (Figures 2 and 3). As a largely fossil fuel generated energy source, purchased electricity has environmental impacts that cannot be readily seen or associated with campus use. However, these impacts contribute to the campus carbon footprint and will be discussed in the greenhouse gas emission section.

Figure 1. Percentage of energy budget by energy source for fiscal year 2006-2007. Source: 2006-2007 Energy data, Facilities Management, Western Kentucky University.
Figure 2. Southeastern Electric Reliability Council (SERC) Tennessee Valley geographic region. Figure from EPA Power Profiler website: http://www.epa.gov/cleanrgy/powpro/srtv.gif

Figure 3. Southeastern Electric Reliability Council (SERC) Tennessee Valley Region fuel mix sources for electricity generation. Source: EPA Power Profiler website.
Most University buildings on the main campus are not individually metered for energy or water use, and where buildings are metered the data are not regularly collected or recorded. This makes it difficult to identify the most significant sources of electricity consumption, which on college campuses are often laboratories, or to measure positive change from conservation efforts (Dautremont-Smith, 2002). Buildings are metered collectively for electricity use at five BGMU substations (Appendix C), but work is currently underway to switch from five substations to one substation for the entire main campus, which is expected to increase overall efficiency and reliability. (This is much like upgrading a house from a 120-ampere to a 220-ampere circuit box: more electricity can be distributed through the line, and lines are less likely to be overloaded, causing fuses to blow.) The project to move to one substation is about 30% complete but has been delayed periodically due to funding limitations (Dyer, pers. comm.) Dyer is currently seeking federal funding to complete the project.

Pam West, Associate Director of Facilities for HRL, reports that electricity use is metered and recorded in dormitories and residence halls for billing purposes, but in practice the meter in at least one residence hall has been non-operational for several months at a time. According to Dyer, billing is determined by square foot percentage of campus building area. Billing for energy (electricity, coal, and natural gas) and water use is based on percentage of square foot area of building space (Table 3). The accuracy of this billing method is questionable, as it does not reflect trends in use and conventionally higher use buildings. Without individual metering, there is no method for more accurate billing. Those buildings cooled by the Student Life Foundation (SLF) Central Chiller
Plant are metered for chilled water used in air conditioning production and SLF bills DFM for chilled water accordingly.

**Table 3. Percent allocation of billing for main campus operations, based on square foot area.** Source: Dale Dyer, WKU Energy Management, Department of Facilities Management, 2007.

<table>
<thead>
<tr>
<th>Source</th>
<th>Electric percent allocation</th>
<th>Coal percent allocation</th>
<th>Central Heat Plant Gas percent allocation</th>
<th>Gas percent Allocation</th>
<th>Water percent allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division of Facilities Management</td>
<td>68.0</td>
<td>69.7</td>
<td>69.7</td>
<td>88.9</td>
<td>69.6</td>
</tr>
<tr>
<td>Restaurant &amp; Catering Group</td>
<td>1.2</td>
<td>1.1</td>
<td>1.3</td>
<td>1.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Downing University Center and Garrett Conference Center</td>
<td>7.7</td>
<td>5.4</td>
<td>6.9</td>
<td>8.8</td>
<td>7.1</td>
</tr>
<tr>
<td>University Bookstore</td>
<td>0.8</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Housing and Residence Life</td>
<td>22.3</td>
<td>23.4</td>
<td>21.6</td>
<td>*</td>
<td>22.6</td>
</tr>
</tbody>
</table>

*Housing and Residence Life is charged separately for gas used in resident halls (used primarily for water heating).

Natural gas accounts for 12% of the total energy budget, and 19% of total energy use on the main campus. Natural gas is used in the Central Heat Plant for heat production during the fringes of the winter season, usually in November and May, and as supplement during the winter months. Only one boiler uses natural gas; the remaining three are coal-fired for steam heat production during winter months. Natural gas is also used for primary heating in both Diddle Arena and Service Supply buildings, and for hot water production throughout campus. Natural gas is purchased from Atmos Marketing.

Coal accounts for 9% of the total energy budget, and 12% of energy use on main campus. Coal is used to fire steam boilers for heat production in the severe winter months through steam piped to most campus buildings. The steam distribution method is detailed later. Coal is purchased through a broker, Wood Coal Company that buys coal from multiple mines in Indiana and Kentucky, and sometimes other states. The goal is to use a
coal source as close in proximity to the buyer as possible, as fuel for transportation of coal drives the price up dramatically. The coal we use at WKU is currently valued at $70 per ton, but the cost of fuel for delivery from eastern Kentucky to Bowling Green raises the price up to $115 per ton. To exceed air quality compliance standards and get the most efficiency from coal, WKU uses low-sulfur, low-moisture, sub-bituminous coal (Dyer, pers. comm.).

To compare relative amounts of energy use on the main campus, I converted each fuel into units of heat content: British thermal units (Btu). The conversion factors used are in Table 4. These conversion units are from the Energy Information Administration – Official Energy Statistics from the U.S. Government website; www.eia.doe.gov. After converting each energy fuel used to Btus, making a meaningful comparison of energy commodities used on the WKU main campus is possible. Figure 4 illustrates relative use of each fuel for August 2006 - July 2007. To determine seasonal or other temporal patterns of usage throughout the year, I converted monthly usage to Btu as well. Figure 5 illustrates trends in energy use for the August 2006 – July 2007 period. This graph reflects the trends of natural gas heating on winter season fringes, coal use for steam production during the colder months, and electricity use higher during the warm months for cooling. Total energy use on the main campus for each month for the August 2006 – July 2007 period is illustrated in Figure 6. Campus cooling and heating as well as other uses of energy are described in the following sections.
Table 4. Energy units to Btu conversion factors. Source: U.S Energy Information Administration

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Btu</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>73,293,451,938</td>
<td>19%</td>
</tr>
<tr>
<td>Coal</td>
<td>87,294,501,000</td>
<td>22%</td>
</tr>
<tr>
<td>Electricity</td>
<td>227,697,158,640</td>
<td>59%</td>
</tr>
</tbody>
</table>

Figure 4. Percentage of use by energy source for August 2006 – July 2007. Electricity is the energy form most used (59%) on the WKU main campus, powering all lights, electronics, fans, pumps, and some hot water heating. Coal and natural gas are supplements for heating and hot water. Source: 2006-2007 Energy data, Facilities Management, Western Kentucky University
Cooling

Many university buildings are cooled in the summer months with chilled water produced by the Student Life Foundation (SLF) Chill Water Plant, or at individual water-cooled chiller units that serve specific buildings. Some buildings use air-cooled split systems (split because the condensing unit is on the outside of the building and the air handler is inside) or through-the-wall units. Since student housing is owned and maintained by SLF, but billed for energy in combination with other WKU buildings through BGMU substations, DFM bills SLF for energy used in SLF buildings, and SLF bills DFM for chilled water used in WKU buildings. A few of the main campus buildings are connected to a central energy management system that remotely turns back cooling equipment during evening hours and on weekends (Appendix D).

Figure 5. WKU main campus energy use by month for August 2006 – July 2007 for Coal, Electricity, and Natural Gas, in Btu’s. Source: 2006-2007 Energy data, DFM.
Figure 6. WKU main campus total energy use by month for August 2006-July 2007. Source: 2006-2007 Energy data, DFM.

The SLF Chill Water Plant

The Chill Water Plant is owned by the SLF and has, until recent upgrades, provided chilled water to fourteen Main Campus buildings, served by north and south distribution loops. The north loop buildings are dormitories only: McLean, Bates-Runner, Central, East, West, North and South Halls (all dormitories). The south loop buildings are: Hugh-Poland, Bemis-Lawrence, Barnes-Campbell, and Pearce-Ford dormitories, plus the Academic Complex, Tate-Page Hall and Mass Media and Technology Hall. The Chill Water Plant originally used two 1000-ton centrifugal chillers but in summer of 2007 was expanded to include two additional chillers, which will increase capacity by 2000 tons and serve additional buildings including Smith Stadium and Health Services. The
Chill Water Plant is fully automated, using electricity to chill and circulate condensed water.

Each building served by the plant has a meter that monitors and records flow rate and associated energy usage in Btu for that building. Btu values are converted to ton-hours per month. Peak loads for each building have not been recorded but due to variations in building type, occupancy, and physical orientation with respect to sun and wind, peak loads are diversified. The WKU Main Campus Energy Audit 2005, performed by Sodexho Campus Services and Thermal Engineering Group, Inc. (Sodexho C. S. and Thermal Eng. Group, Inc., 2005), using 2003 and 2004 consumption data and assuming that the simultaneous load on the Chill Water Plant consists of 100% of the peak load of the buildings that operate continuously during the summer, and 50% for other buildings), estimates a peak load of 1653 tons for WKU’s main campus. Diversification of load is significant in that if all buildings experienced peak loading simultaneously, the plant would have exceeded its original capacity of 2000 tons.

The annual electricity consumption for cooling at each building is based on the cooling load factor (average cooling equipment efficiency and the estimated cooling load in tons for each building) and the peak cooling electric demand. Following this procedure for each building yielded annual total electricity consumption for cooling of 13,730,485 kWhr for the year April 2003 to March of 2004 (Sodexho C. S. and Thermal Eng. Group, Inc., 2005). This is the most recent estimate of this figure, but considering the changes in cooling infrastructure since this time, this estimate is no longer accurate.

Chemical treatment, maintenance, and water and sewer costs are expense factors in chilling water as well. Chemical treatment for main campus chillers costs nearly
$100,000 annually (Sodexho C. S. and Thermal Eng. Group, Inc., 2005). Water required at the Chill Water Plant and at individual chillers includes the make-up water lost to evaporation and to blowdown, a process required to remove solid sediments from cooling towers (Sodexho C. S. and Thermal Eng. Group, Inc., 2005). For the year October 2006 to September of 2007, the chiller plant used 12,431,760 gallons of water.

**Heating**

Main campus buildings are heated by steam, electric, and natural gas. Most buildings are supplied heat through steam-to-hot-water delivered by the Central Steam Plant. Diddle Arena and the Service Supply Building are heated throughout the winter with natural gas.

**The Central Steam Plant**

The Central Steam Plant operates during colder months, from October to roughly April. The plant consists of five steam boilers. Boiler #1 is a natural gas-fired boiler. Boilers #2 and #3 are coal-fired boilers. Boilers #4 and #5, natural gas-fired, have been decommissioned because they are outdated and inefficient. Other equipment includes fly-ash collectors for the coal boilers, feedwater pumps, softeners, and transfer pumps. All three boilers operate to maintain system pressure and discharge into a common steam header. The steam that is not used within the plant is distributed through three main service lines to the main campus. Boiler controls were upgraded in 2006 to increase efficiency in the plant; however, the boilers in the plant are still operating at an estimated 70% efficiency (Dyer, pers. comm.). According to Dyer, modern boilers operate at 8-12% loss of ignition (LOI), meaning that 8%-12% of the coal or biomass is not
combusted or converted to Btus. Due to the configuration and age of our boilers, they operate at 30% LOI.

The federal and state environmental protection agencies are setting new requirements for stationary combustion plants like the WKU Central Steam Plant to add fabric filters (a "baghouse") for control of particle emissions. The baghouse will actually allow the boilers to burn hotter, producing higher Btu’s per unit of coal. The addition of the baghouse will therefore increase efficiency in our Central Steam Plant while reducing particulate matter emissions. Dale Dyer has applied for funding for this project.

Boiler logs from 2003-2004 winter season indicate that total steam production was 125,744 Mlbs/year, with peak demand of 61,000 pounds per hour. Reliable data are not available for the 2005-2006 and 2006-2007 seasons due to inconsistencies from retrofitting activities on boiler controls. Steam is distributed throughout the main campus through 2.96 miles of piping. Heat can be lost during distribution through leaks due to pipe degradation as well as heat transfer to pipelines and earth.

Natural gas is used on the fringes of the cool seasons and to supplement coal in the Central Steam Plant during winter. Coal is used during peak winter months and is currently purchased for $115 per pound including delivery (Dyer, pers. comm.). One load of coal from Pike County costs an average of 140 gallons in diesel fuel, round trip (currently just more than $3.00 per gallon). Coal used at WKU is a mix of Gibson and Wood (company names). To exceed air quality compliance standards and get the most efficiency from coal, WKU uses low-sulfur, low-moisture, sub-bituminous coal. In our region coal is the least expensive fuel for generating steam for heat, but there is also an associated expense of ash removal. Currently, ash is removed and transported to the
landfill by Monarch Environmental services. Flyash may be used in asphalt and other industries but the small quantities generated in the Central Steam Plant (about 315 tons in 06/07) are not sufficient to sell or recycle (Dyer, pers. comm.). Electricity use in the plant is not directly metered but is associated with power requirements of boiler equipment and can be estimated based on power requirements for the equipment and on the number of hours of operation for each boiler. Water consumption is for make-up to the steam system.

Two-pipe and four-pipe systems

The Main Campus buildings that use chilled and hot water as the heating and cooling methods have pipe systems that deliver the water. Older campus buildings have two pipe systems, while all newer buildings have four pipe systems. In a two-pipe system, chilled and hot water use the same circulating pipes and coils within the building so that heating and cooling cannot occur simultaneously. A physical change is required to switch between heating and cooling in the two-pipe system. Water is treated with nitrates to control corrosion and scaling in the pipes. When the chilled water system is changed to a hot water system, oxygen is released from the water, which can cause significant damage to the pipes, valves, and fittings, as well as increased iron corrosion and calcium scaling inside the pipes. Corrosion and scaling decrease efficiency by decreasing heat transfer at coils and restricting flow inside the pipes. Restricted flow increases work of circulation pumps, increasing energy costs and requiring increased maintenance and replacement of parts.

In four-pipe systems, chilled and hot water circulate within separate pipes, alleviating many issues associated with the two-pipe systems. Responding to local
climate variations and associated requests from students and faculty regarding building temperatures is also easier. In the two-pipe system, once the system is changed from chilled to hot water, or vice versa, it is in place for the season. Therefore late spring cold snaps and Indian summers may be uncomfortable in two-pipe buildings. Four-pipe systems are reported to be more efficient and allow for necessary control of humidity and fresh air circulation in buildings (Dyer, pers. comm.).

The main campus is converting to a four-pipe system whenever buildings are constructed or renovated. This conversion is costly, but allows for more control and efficiency in systems. Four-pipe systems can be remotely controlled and can be set back to energy saving settings on weekends and holidays. The ability to respond to inter-seasonal temperature variations alleviates conditions such as when building occupants find it necessary to open windows during warm spells after the switch to heat has been made.

**Hot Water**

Heated water for use in restrooms, kitchens, showers, and research and classroom laboratories throughout campus is provided by steam, electricity, natural gas, and a combination of these. Residence halls and dormitories have the greatest consumption of hot water. Hot water is provided by electric water heaters, natural gas heaters, or steam to domestic hot water heat exchangers (Sodexho C. S. and Thermal Eng. Group, Inc., 2005). Campus housing hot water is produced using gas in most months out of the year. During the colder months when the Central Steam Plant is operating, 95% of campus gas water heaters convert to steam generated hot water as a by-product of steam generation for heat production (West, pers. comm.).
Main Campus Electric Consumption

Annual electric consumption for the main campus for fiscal year 2006-2007 was 72,020,435 kWh. Electricity accounted for 59% of campus energy use, 79% of the energy budget, and as will be illustrated later, 72% of greenhouse gas emissions from main campus energy use. Much of the electricity used on campus is for lighting. Many campus indoor and outdoor lighting stays on constantly, 24 hours per day, seven days per week. Conservation measures such as gradual replacement of T-12 with more efficient T-8 fluorescent bulbs are in process; however, some campuses and institutions are now changing from T-8 to T-5 for even greater efficiency. A pilot program is in place for testing occupancy sensor lighting in classrooms and common areas. This program is described in greater detail in the conservation measures section.

Computers are an additional major source of electricity use. The WKU Information Technology center reports there are 750 faculty and 1,350 staff computers on campus (Jennifer Thurmond, pers. comm.). Each University-owned computer can be tracked through its Inventory Control Number. A survey to determine the number of computers owned by students in campus residences may provide a more accurate idea of total number of computers on campus and associated energy use.

There are approximately 130 chilled soft drink vending machines on campus. On average, each vending machine uses 66.7 kWhr per week (2500-4400 per year), according to Pepsi vending.

Energy flow on the main campus including inputs, uses and consumption, and outputs, is illustrated in Figure 7. While main campus energy consumption has grown with enrollment (Figure 8), costs of natural gas and coal have increased while electricity
costs have stayed relatively consistent (Figure 9). Increased cost of coal is largely due to increased fuel costs associated with delivery.

While coal is still relatively inexpensive to purchase as an energy source, there are hidden environmental and human costs that make coal one of the least sustainable energy choices available. Kentucky coal mining produced 119 million tons of coal in 2005 (Lashof et al., 2007). Coal mining is one of the United States’ most dangerous professions, causing fatal and nonfatal injuries, and serious health problems for miners and mining communities; surface mining clear cuts trees and fragments habitat, destroying natural ecosystems; waste rock from strip mining and mountaintop removal is deposited in stream and river valleys, choking them with sedimentation and altering water chemistry; and coal mining produces air pollution such as methane and particulate matter as well as waste such as sludge (Lashof et al., 2007). Coal combustion produces air pollutants including particulate matter, nitrogen oxides, sulfur dioxide, mercury, and carbon dioxide (Lashof et al., 2007). These pollutants cause a multitude of human health problems such as lung disease and respiratory illness which can lead to premature death. Exposure to high levels of mercury can harm the brain, heart, kidneys, lungs, and immune system and in unborn babies may harm the developing nervous system (EPA, 2007). Environmental effects such as acid rain and low level ozone compound human health effects. In 2005-2006 at WKU, an average of 527 pounds of coal per year was burned directly on behalf of each campus community member, and more was consumed in the form of electricity from regional coal-fired power plants. When our energy use so adversely impacts the health and well-being of our communities and ecosystems within the Commonwealth, the need for energy conservation becomes a matter of personal and
institutional ethics. The next section considers greenhouse gas emissions from use of purchased electricity and combustion of coal and natural gas on the WKU campus.

Figure 7. The energy flow on the WKU Main Campus for 2006-2007. Source: Energy data from WKU and personal communication with Dale Dyer.
Figure 8. Growth trends in enrollment and energy use at WKU from 2002 through 2006.

Figure 9. Growth trends in enrollment and energy cost at WKU from 2002 through 2006.
Western Kentucky University Greenhouse Gas Emissions

"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 Signatories of the American College and University Presidents Climate Commitment, 2007.

The awareness of greenhouse gases as drivers of global climate change makes a Greenhouse Gas (GHG) Emissions Inventory a pertinent way of measuring a university’s contribution to global warming. Many university Presidents have signed declarations or statements of intent to reduce greenhouse gas emissions such as The Talloires Declaration: University Presidents for a Sustainable Future (Appendix E) and the American College and University Presidents Climate Commitment (Appendix F). These documents outline goals for reductions in carbon emissions overall and specific ways to work toward climate neutrality. To date, 415 University Presidents have signed the Presidents Climate Commitment. Campus efforts toward reaching these goals include using LEED design for new buildings, use of alternative fuels and energies such as wind and solar where possible, awareness programs for behavior changes such as turning off lights, computers, and using energy efficient settings on electronics, and policy changes ranging from residence hall rules to incorporating climate neutrality goals into master planning.

WKU’s President Ransdell signed The Talloires Declaration in summer of 2007. No documented action has yet been taken toward meeting the goals outlined in the document. The President has been asked to sign the Presidents Climate Commitment by GreenToppers Students for Campus Sustainability. Although President Ransdell has not
yet signed, Dale Dyer, WKU Energy Manager; John Osborne, Associate Vice President for Campus Services and Facilities; and Gene Tice, Vice President of Student Affairs & Campus Services, attended a conference at University of Kentucky that offered training and workshops on the Presidents Climate Commitment and climate neutrality for college campuses. The Association for the Advancement of Sustainability in Higher Education (AASHE) is encouraging Kentucky university and college presidents to sign the commitment, and offering training and assistance in working toward climate neutrality.

**Greenhouse Gas Inventory**

**Introduction**

Greenhouse gases absorb infrared radiation as it is reflected from the earth’s surface back toward space, trapping heat in the atmosphere. Increases in the atmospheric abundance of greenhouse gases from human activities have altered the energy balance of the climate system. The most important and abundant greenhouse gas is carbon dioxide (CO₂), which enters the atmosphere through the burning of fossil fuels, because of other chemical reactions such as the manufacture of cement, and land use change. Additional anthropogenic sources of greenhouse gases include: methane (CH₄), emitted during the production and transport of coal, natural gas, and oil, agricultural practices, livestock production, and decay of organic waste in solid waste landfills; and nitrous oxide (N₂O), emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid wastes. Fluorinated gases, such as hydrofluorocarbons (HFCs), perfluorocarbons, and sulfur hexafluoride, are typically emitted in smaller quantities from a variety of industrial process, but because they are so potent they are called High Global Warming Potential gases (EPA U.S. Greenhouse Gas Inventory Report, 2007).
While many gases exhibit “greenhouse” properties, the heat trapping ability of one metric ton (1,000 kilograms) of CO\textsubscript{2} is taken as the standard, and emissions may be expressed in terms of metric tons of CO\textsubscript{2} equivalent (MTCDE) or Carbon Dioxide Equivalents (eCO\textsubscript{2}), according to their Global Warming Potential (GWP), which is a measure of the relative contribution of each gas to climate change. At the university entity level, the predominant source of GHGs is carbon dioxide itself, both directly and indirectly from the use of fossil fuels (Tufts, 2002). As stated earlier in the energy section, energy for WKU heating, cooling, and electricity all comes from fossil fuels. Hydrofluorocarbons (HFCs) and chlorofluorocarbons (CFCs) are likely associated with refrigeration equipment leakage such as the Chill Water Plant, or individual building chillers. Fluorinated gases are beyond the scope of this emissions inventory; however, a more comprehensive inventory could include these gases. Chlorofluorocarbons are ozone-depleting and are being phased out of use under the Montreal Protocol and Clean Air Act Amendments of 1990 (EPA U.S. Greenhouse Gas Inventory Report, 2007).

GHGs are measured using emissions coefficients (or emissions factor). An emissions coefficient expresses gas released through a particular process. For example, combusting one gallon of gasoline releases about 19.56 pounds of carbon dioxide on average. The CO\textsubscript{2} emissions coefficient for gasoline is 19.56 lbs. CO\textsubscript{2}/gal (Dautremont-Smith, 2002). A GHG inventory systematically identifies and records sources of GHG emissions at an institution. The inventory provides a common benchmark against which improvements can be quantified, allowing investment in energy reduction actions to be justified. It also promotes better knowledge of the structure and operation of the institution for all emissions and environmental stressors, and identifies the most
important, as well as less obvious, emission releases. The inventory also serves as a reference for communication about the importance and status of reduction efforts.

The definition and scope of a GHG inventory are often difficult to identify. For example, in the 2005-2006 academic year, WKU, an academic institution of 18,645 graduate and undergraduate students, served 1.5 million meals on the main campus, generated more than 2200 tons of solid waste, commuted many miles, and used 66,050,883 kWh of electricity. Sources of greenhouse gas emissions are extensive. To include emissions resulting from transportation such as campus deliveries, faculty and student commutes, and airplane travel is extremely difficult, as methods for obtaining these data are imprecise and require assumptions. A more comprehensive emissions inventory would also include the WKU Farm, Glasgow campus, South campus and other satellite sites. Here, I have chosen to focus on those GHG emissions that are both related to main campus operations and for which data and methods are quantifiable and repeatable.

Methods and Materials

GHG inventories are a new tool and variations in methodology are widespread throughout the academic, government, and corporate sectors, depending on availability of data and depth of analysis. The President’s Climate Commitment requires the use of a calculation tool endorsed by the World Resources Institute (WRI). AASHE recommends the “Clean Air Cool Planet” (CA-CP) Climate Action Toolkit and Inventory, a WRI endorsed program, used at more than 200 schools across North America (CA-CP, 2006). CA-CP provides the Campus Climate Action Toolkit, which includes the GHG Emissions Inventory Calculator, a framework for leadership and action, and technical resources and
case studies. It provides guidance and information for considering GHG emissions reduction target and timetable, developing a campus climate action plan, and implementing such a plan. The GHG Emissions Inventory Calculator is based on workbooks provided by the Intergovernmental Panel on Climate Change (IPCC) for national inventories, and has been adapted for use at institutions such as universities, following the same protocols.

A calculation tool developed for businesses by the WRI and World Business Council for Sustainable Development (WSCSD) is more specialized, allowing for more detailed data regarding on-site combustion emissions, described later in greater detail. For comparison, I used both the CA-CP and WBCSD/WRI calculation tools to determine GHG emissions from energy use on the main campus. The Institute for Combustion Science and Environmental Technology (ICSET) has also performed on-site stack tests on coal combustion emissions at the WKU Central Steam Plant. The results from these tests are reported here as well.

The completion of an inventory provides an essential foundation for effective outreach and action on the issue of climate change. While a comprehensive inventory is beyond the scope of this project, I will provide a solid starting point for such a comprehensive inventory, which will provide some basic, repeatable and quantifiable data for use as a baseline, and fundamental action.

In determining the scope of an emissions inventory, the CA-CP GHG calculation protocol follows standards established by the World Business Council for Sustainable Development and the WRI (WBCSD/WRI). These standards identify operational
boundaries for institutions to “scope” their emissions sources. The protocol divides emissions into three scopes.

- **Scope 1** includes direct GHG emissions, which occur from sources controlled within the confines of the university campus, such as the Central Heat Plant or other stationary boilers and university transportation. Scope 1 emissions are primarily based on purchased quantities of commercial fuels such as coal or natural gas.

- **Scope 2** includes indirect sources of emissions such as purchased electricity, based on metered electricity consumption.

- **Scope 3** represents other indirect sources such as transportation of purchased fuels and goods, travel, commuting of students and faculty, transportation of waste, and waste disposal.

The CA-CP guide identifies the four major source-of-emissions categories on campus as: energy, agriculture, waste, and refrigeration and other chemicals. This inventory considers only limited Scope 1 and Scope 2 energy emissions for the WKU Main Campus. It is limited to purchased energy, measured in kilowatt hours, and stationary combustion of fuel for energy, measured by purchased quantities of coal and natural gas. These data were obtained from reports created by DFM Energy Manager Dale Dyer. The inventory does not consider campus vehicle fleets, air travel, commuters, agriculture, or refrigeration and other chemicals. Thus, these findings will be a conservative estimate.

While energy is likely the largest source of emissions (possibly 90% according to CA-CP, 2006), a more comprehensive inventory, which would include the WKU Farm and Scope 3 emissions, is desirable and offers possibility for future research.
Electricity

Although emissions from electricity consumption are generated remotely and are therefore indirect, a report prepared for the Pew Center on Global Climate Change (Morgan et al., 2005) concludes that “[a] consensus is ... growing to account for electricity usage because of its ubiquity and the degree of control possessed by organizations to modify their electricity consumption” (WBCSD/WRI, 2006). Purchased electricity is reported by DFM in a spreadsheet posted on the WKU website (www.wku.edu/Dept/Support/FacMgt/Energyhome). For the GHG worksheet, the provider of purchased electricity must be identified to determine the source of the electricity provided. As described previously, electricity is provided by the SERC TVA and is 66% coal-generated in our area.

To determine CO₂ emissions from purchased electricity, the WBCSD/WRI worksheet uses the following formula:

\[
\text{Amount of electricity purchased in kilowatt hours} \times \text{a standard emission factor (determined by U.S. region of electricity production)} = \text{CO}_2 \text{ emissions.}
\]

The emissions factors are from 2000 and are provided by the U.S. EPA Office of Atmospheric Programs (prepared by E.H. Pechan & Associates, Inc., May 2003). The 2000 CO₂ emissions factor for SERC Tennessee Valley is 622.7 grams CO₂/kWhr. So:

\[
66,050,883 \text{ kWhr} \times 622.7 \text{ grams CO}_2/\text{kWhr} = 41,129.88 \text{ metric tons CO}_2
\]
Coal and Natural Gas

Coal and natural gas are both used on-site for heating of buildings and water. The quantities purchased of each are reported on the DFM webpage Energy Use spreadsheet. Natural gas is reported in Ccf (hundred cubic feet) and Mcf (1000 cubic feet) and must be converted to MBtu (million British Thermal Units). There are various conversion rates for cubic feet of natural gas to Btu’s but a standard is one Mcf = 1.026 Btu (U.S. Department of Energy, 2007).

The WBCSD/WRI provides a worksheet for determining emissions from stationary combustion of fuels that is more detailed and requires entry of data regarding energy use as follows: fuel type, quantity of fuel combusted, calorific value, carbon content factor, and oxidation factor. I completed this worksheet to compare the results and used the values shown below, received from Dale Dyer, from analyses regularly performed on coal purchased by the university. WKU purchases a blend of Gibson and Wood coals. These data are from the 2005-2006 academic year and in instances of calorific value, carbon content factor and oxidation factor, were reported as an average, as analysis yields varying results depending on the coal mix being used during the particular instance. Coal blends vary slightly from delivery to delivery depending on availability and market value.

For emissions from stationary combustion of coal, I used the following parameters:

Quantity = 4955 short tons
Calorific value = 13,569 Btu/lb (GCV)
Carbon content factor = 56.459577 lb C/MBtu
Oxidation factor = 98%
The WBCSD/WRI worksheet uses the following formula for determining CO2 emissions from stationary fuel combustion (at WKU, coal and natural gas):

\[
\text{(quantity of fuel combusted} \times \text{heat or calorific value}) = \text{energy content of fuel combusted}
\]

\[
\text{(energy content of fuel combusted} \times \text{carbon content factor} \times \text{oxidation factor} \times \frac{44}{12}) = \text{CO}_2 \text{ emissions}
\]

For coal:

\[
4955 \text{ tons} \times 27.138 \text{ MBtu/ton} = 134,468.79 \text{ MBtu}
\]

\[
134,468.79 \text{ MBtu} \times 56.459577 \text{ lb C/MBtu} \times 0.98 = 7,440,210 \text{ lb.}
\]

Convert to kg: 7,440,210 lb. $\times 0.4536 \text{ kg} = 3,374,879.2 \text{ kg}

\[
3,374,879.2 \times \frac{44}{12} = 12,374,557.24 \text{ kg CO}_2 \text{ or } 12,374.557 \text{ metric tons CO}_2
\]

For natural gas:

\[
64,882.3 \text{ Mcf} \times 1.026 \text{ MBtu/Mcf} = 66,569.24 \text{ MBtu}
\]

\[
66,569.24 \text{ MBtu} \times 33 \text{ lb C/MBtu} \times 0.995 = 2,185,800 \text{ lb.}
\]

Convert to kg: 2,185,800 lb. $\times 0.4536 \text{ kg} = 991,478.9 \text{ kg}

\[
991,478.9 \times \frac{44}{12} = 3,635,422.56 \text{ kg CO}_2 \text{ or } 3,635.424 \text{ metric tons CO}_2
\]

The WKU Institute for Combustion Science and Environmental Technology (ICSET) has also performed a single set of on-site stack tests on coal combustion emissions at the WKU Central Steam Plant. The results from these tests are reported in the Research Report for MACT Compliance Baseline Testing on NOx/SO2 Emission, HCl, Total Selected Metals and Mercury at WKU’s Heating Plant, 2006. The testing and report were performed and prepared by Chen et al., 2006. I report their CO2 emissions results here as well for comparison. These results are based on an average of results from coal blends as well, as the research team performed tests on varying blends of Gibson and Wood Coals.
Results and Discussion

The results of all three methods are shown in Table 5. The differences between the CA-CP and WBCSD/WRI results may be attributed to the inclusion of specific details in the WBCSD/WRI protocol. The coal that WKU uses in the Central Steam Plant has a higher calorific value, producing greater Btu per pound than the default, or average values used in the more generalized CA-CP worksheet. The higher calorific value can be entered into the WBCSD/WRI worksheet, which may explain the higher emissions value in the WBCSD/WRI protocol results. The reason for the discrepancy between the protocols and on-site stack tests for coal combustion emissions is not understood at this time. However Pan believes it is because the protocol calculations are based on the PC boiler, and our heating plant is using Stoker type (Pan, pers. comm.). To determine whether this is the reason for discrepancy, further research is needed. The table also includes the Carbon Dioxide Equivalents, or eCO₂, expressed in the CA-CP summary.

Table 5. Summary of 2005-2006 WKU main campus energy GHG emissions for three different protocols.

<table>
<thead>
<tr>
<th>Greenhouse Gas (GHG) emissions, by source:</th>
<th>By CA-CP protocol, metric tons CO₂</th>
<th>By WBCSD/WRI protocol, metric tons CO₂</th>
<th>By one-time ICSET stack test, coal only, metric tons CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary combustion of coal</td>
<td>9,482</td>
<td>12,374</td>
<td>4,555</td>
</tr>
<tr>
<td>Stationary combustion of natural gas</td>
<td>3,514</td>
<td>3,635</td>
<td>N/A</td>
</tr>
<tr>
<td>Purchased electricity from SERC TVA</td>
<td>44,681</td>
<td>41,130</td>
<td>N/A</td>
</tr>
<tr>
<td>Total CO₂ emissions for energy use</td>
<td>57,677</td>
<td>57,139</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Total carbon dioxide equivalents (eCO₂)</strong></td>
<td>coal and natural gas: 13,075 electricity: 45,001 total: 58,076</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results of the WBCSD/WRI protocol reveal that the greatest source of carbon dioxide emissions is from purchased electricity used on the WKU main campus. GHG emissions can be expressed from several different perspectives: tons per building, tons per square foot, or tons per person for a given time. Looking at energy use from a per-capita perspective allows for a greater understanding of the ecological impacts of our energy use on a personal level. In the 2005-2006 academic year, the 2006 WKU Fact Book states the total full time equivalent 2005 fall enrollment was 15,460 students (full-time equivalency is calculated using the one-third method: full-timers plus one-third of part-timers.) Using results of eCO₂ emissions from the CA-CP protocol, GHG emissions were 3.75 metric tons per student in 2005-2006. This measurement does not include personal energy use off-campus, personal transportation, or other personal sources of GHG emissions so is strictly a measurement of GHG emissions spent for each student on the WKU campus. However, university faculty and staff have a great deal of influence on consumption as well as conservation efforts. The fall 2005 campus population including full time faculty and staff (1,940) and full time equivalent students (15,460) is 17,400 campus community members (CCM) (Fact Book, 2006). Using results of eCO₂ emissions from the CA-CP protocol, GHG emissions were 3.34 metric tons per CCM.
Figure 10. Carbon dioxide emissions by energy source on WKU main campus, using results of WBCSD/WRI protocol. The other methods of measuring emissions do not distinguish coal and natural gas in the results.

Current Energy Conservation Measures

The DFM homepage on the WKU website has an Energy Management link that leads to a page with links to Western Kentucky University Energy Consumption, Why Conserve Energy, Guidelines for Good Lighting, “No” to Halogen Floor Lamps, and WKU Conservation Tips. A copy of the WKU Conservation Tips can be found in Appendix G. Dyer advises that the best ways students can save energy on campus are to turn off lights, turn off computers, and moderation of winter/summer temperatures.

Tom Riley, previous Director of DFM, described some energy conserving measures that the department would like to implement but these are initiatives that involve some changes in behavior and habit by faculty and staff. One such measure is load shedding. There are several buildings on campus that are only 10% to 15% occupied in summer months. If the faculty and staff that work in these buildings over the summer would be willing to move their offices during the break, these buildings could be shut down, saving energy in cooling and lighting.
There are some other lighting initiatives for energy conservation, such as the installation of occupancy sensors for lighting in Diddle Arena bathrooms and auxiliary gymnasiums. The idea to fit the Diddle Arena lights with sensors was born of the need to trade energy use for energy conservation. The chiller used to cool Diddle Arena was originally turned off during the summer months to save energy, but with increased use of the building during summer, building occupants requested the chiller be left on. To help compensate for some of the increased energy use, Charles Harrison, Assistant Director of Facilities proposed placing sensors on some lights in the building. Electronics technicians Herb Hess and Richard Stewart installed Hubbell light sensors in all twelve bathrooms and in two auxiliary gymnasiums. The sensors pick up infrared and sonic and some have photocells to detect daylight. The Hubbell technology used in the gymnasium sensors is new, and WKU is one of the first in the country to use it. According to Harrison, the entire Hubbell system currently in place in Diddle Arena cost about $11,000 to install and is expected to pay for itself in three years. Hess and Stewart also removed much of the unnecessary lighting from entryways and put outside lights on photocells to reduce Diddle Arena's energy consumption further. Resulting savings from these conservation efforts have not yet been determined (Harrison, pers. comm.).

There are also test sensors in two classrooms in Cherry Hall. The sensors replace the common light switch, take about 15 minutes to install, and are about $120 each (Hess, pers. comm.). Depending on the success of these test sensors, all classrooms may be fitted with such sensors. These are not the first attempts at energy conserving lighting. The Engineering and Biological Science building, one of the newest buildings on campus, is fitted with a Payne-Sparkman computer integrated light sensor program. The
program is designed to conserve energy through motion-detected and programmed lighting. The system is not currently being used to its full potential, because much of it does not operate correctly. WKU technicians do not have the training to fix and maintain the system, and Payne-Sparkman technicians are reluctant to do on-site training or repairs (Hess, pers. comm.). It seems that frustration and inconvenience have caused facilities managers to lose interest in the problem, so potential energy savings are unrealized.

No plans are being discussed in DFM for use of solar energy, for lighting, water heating or otherwise, although the university does purchase some Energy Star appliances (see Purchasing section for more on this). No university-wide policy exists regarding turning off lights and computers when not in use. However, some buildings, such as Mass Media and Technology Hall, have building or departmental policies to turn off computer monitors at night. HRL also has policy for efficiency measures during holidays and vacations outlined below. In many buildings, such as the new Engineering and Biological Science building, the light switches for hallways and other common areas are not accessible.

**Contracted Audits**

In 2005, WKU contracted with Sodexho Campus Services and Thermal Engineering Group, Inc. to perform a WKU Main Campus Energy Audit. This audit investigated energy use on the main campus for efficiency and identified opportunities for energy conservation and associated financial savings. The audit was concerned more with financial conservation than environmental conservation and suggested changes in the TVA electrical contract, the expansion of the SLF chill water plant, replacing windows in several buildings, and changing lights to more efficient T8 and T5 bulbs. It
did not mention use of solar or alternative energy or LEED or energy efficient building design.

The University is conducting an Energy Performance Contract (EPC) to be completed this year (2007). This will be a much more aggressive project than the Main Campus Energy Audit completed by Sodexho and Thermal Engineering Group in 2005. The EPC will include a comprehensive evaluation of energy and water use at Western, proposals for conservation strategies including services and capital improvements, and provide assistance and support to help the university carry out proposals included in the contract. The services and capital improvements are provided and financed under the contract, and the contract is funded with a low interest loan, which is guaranteed with energy savings resulting from performance changes. The guaranteed energy savings payback is not to exceed 12 years in duration (a WKU directive). An Energy Performance Contract is a substantial step toward energy and water resource conservation with the goal of saving the university money. AASHE considers the existence of such a program as a sustainability indicator (AASHE Frameworks).

**Kentucky Energy Efficiency Program for Schools (KEEPS)**

KEEPS is a program funded by the Kentucky Governor’s Office of Energy Policy and administered by the Kentucky Pollution Prevention Center. The program is designed to help Kentucky school districts and higher education institutions reduce energy consumption. Schools must apply and be accepted as a participant. Acceptance is determined by level of commitment to improving energy management. Participants are provided with tools, curriculum, training, and coaching via the KEEPS Energy Management and Training System, which is based on the EPA Energy Star program.
Currently, there are five school districts, one independent school, and three colleges/universities with membership. The institutions of higher learning include: Kentucky State University, Thomas Moore College, and WKU. WKU was awarded an “Outstanding Achievement Award” at the Governors Energy Conference in October of 2007. The Energy Management team received the award largely for their detailed illustrations of campus energy use data for public viewing on the Energy Management website. Membership in this program allows for training opportunities, recognition for environmental stewardship, and incentive and support for further improvements.

**Housing and Residence Life**

HRL is renovating older residence halls. Energy conservation renovations being incorporated include using low-flow shower heads, low flush toilets and T-8 lighting. The HRL Office in Southwest Hall has a light motion sensor in its workroom and some other common rooms. All new windows installed are energy efficient double-glazed. Over holidays and vacations, in all dorms except Pearce-Ford Tower, thermostats are moved to efficiency settings, and all electronics and most appliances are unplugged. Resident Hall Assistants go through every room to check for these measures before leaving for breaks. Students have a certain degree of control over resource consumption in their dorm rooms such as keeping their thermostats at steady 72 winter and 74 summer settings, keeping windows shut during extreme outside temperatures, turning off lights and unplugging appliances, and using less water during showers and brushing teeth. “Vampire” electricity is the electricity that lights clock radios, DVD players, keeps electronic components on standby even when power is “off”, and bleeds into cell phone and battery adaptors and chargers when they are not charging. It is easy to keep all of these plugged into a power
strip which can be turned off when a student is not in the room, however, at WKU, housing residents are not allowed to use power strips as they tend to encourage increased energy use and also pose fire hazards from overloading.

**Recommendations for Change**

The most effective and sustainable energy reduction strategy on a university campus is one that is comprehensive, examining and targeting reduction potential from a broad perspective. Initiatives toward a climate neutral campus can range from awareness programs that influence behaviors to energy efficiency in building design to use of renewable energy sources. There are many possibilities for change in energy use on college campuses that result in substantial economic and environmental benefit and provide opportunities for student engagement. WKU does not have to be a "coal campus"; fossil fuel use can be decreased and even eliminated, and WKU can become climate neutral. Incorporating renewable energy or energy efficiency at any point in the campus energy flow reduces both economic and environmental costs and greenhouse gas emissions. Renewable energy could be incorporated as passive solar for lighting, solar water heating, or biomass as a coal or natural gas replacement. Energy efficiency measures can include lighting retrofits, occupancy sensors for heating, cooling, and lighting, or passive solar design for new building. Any one of these initiatives changes the illustration of energy flow on the WKU main campus toward a more sustainable system.
Energy Savings Performance Contract

The Energy Savings Performance Contract (ESPC) already being undertaken is a positive step toward energy conservation on campus. This includes a detailed energy study by an Energy Service Company (ESCO) that will consider all campus energy and water systems, and recommend capital improvement services, upgrades, modifications, and other improvements that will provide the greatest possible energy, water, and operations and maintenance savings. Total project costs are 100% covered by project energy and hard operational savings, and will be paid off in 12 years. If savings do not materialize, the ESCO pays the difference. An ESPC is currently being prepared for WKU, and has been slated for completion by January, 2008.

At the very least, this contract could recommend simple infrastructure changes, such as installation of meters to measure use of energy in individual buildings, sensor lighting, lighting retrofits for lower energy and LED bulbs, which can conserve energy and save money without anyone noticing changes. Yet to go a step further, adoption by WKU of alternative energies such as solar for passive heat, lights, and hot water, and incorporating LEED standards in building design provide learning opportunities for students and models for the community, besides reduced energy use and reduced greenhouse gas emissions.

Physical Changes

Many physical changes can be implemented all over campus to save energy, including lighting upgrades, efficient appliance procurement, and environmental control systems. Most involve an initial investment, but pay off time is relatively short and continued savings can add up to millions of dollars. The University of Michigan
completed energy efficiency projects in 123 campus buildings over a 6 year period, including lighting upgrades, efficient appliance procurement and environmental control systems. The university expects the improvements to save $9.7 million in annual energy costs (The Apollo Alliance and Energy Action, 2004).

Lack of individual building metering was one of the most significant limitations I encountered in compiling data and conducting research for this sustainability audit. In my review of energy systems and audits at many other universities and colleges I found this to be a very common problem. Sub-metering buildings for energy and water use would allow more accurate billing than the current system that is based on square foot percentage of campus area. Other benefits include identification of actual consumption, establishment of base loads and targets for improvement, identification of leaks, and monitoring of conservation efforts. Smart Metering, or interval metering, can capture energy use information and transmit the information on a real-time basis. Energy metering is not a conservation method in itself but is vital component of an effective conservation strategy. After improvement of their metering systems, University of Manchester Institute of Science and Technology, Manchester England, found that more than half of total electricity consumption occurred outside of operating hours (Winsum, et al., 2003). The cost of energy metering is difficult to estimate, as proper metering equipment is determined by scope of project, existing infrastructure, and intended use for data. Texas A&M University installed more that 600 meters at an overall cost of approximately $1.2 million and recovered the investment in savings within five years (McBride, 2002).
One example of a small change that could realize big savings for WKU are “Vending Misers.” Vending machines are inconspicuous energy draws. There are currently 130 cooled soft drink vending machines on campus. If a “VendingMiser” unit was placed on each machine at $179.00 per unit, and installation time of 10 minutes, investment would total about $23,500. This project would result in a savings of 46% in kWh and cost of operation, with a payoff period of less than 18 months. In five years, savings on all machines would total nearly $84,000 (USATech, 2007).

**Renewable Energy**

Incorporating renewable energies into the campus energy flow not only saves money and reduces environmental impacts, it educates the campus community, providing learning opportunities for students and acting as a model for the greater community.

There are opportunities for incorporating solar energy throughout the physical campus. Outdoor lights, such as those that light walkways, the Smith Stadium lights and parking structure lights could be solar powered. Water for hot water use can be generated by solar power as well. According to the U.S. Department of Energy, 24% of energy use in university buildings is for water heating (DOE Building Technologies, 2006). They also estimate that solar water heating can reduce the use of electricity or fossil fuels by as much as 80% (DOE Building Technologies, 2006). If water heating accounts for 24% of WKU’s four million dollar annual energy budget then water heating costs $1,440,000. If heating water with solar power saves 80% of this annual cost, the university could save $1,152,000 by using solar power to heat water. It is difficult to estimate the cost of such a project; solar hot water systems vary in type and cost and project costs vary widely
depending on size, location, and existing infrastructure. Potential savings of millions of dollars certainly make such projects worthy of serious consideration.

There are many examples of small solar projects on college campuses that are used for educational purposes, such as solar on particular buildings or for outdoor lighting. The University of Colorado uses a photovoltaic (PV) system to generate electricity for the UC Environmental Center. The PV system is an educational opportunity for students who can monitor the system’s real time output. WKU engineering students could install such systems on university buildings in cooperation with architecture students, gaining extremely useful experience and skill.

Other examples of alternative or renewable energy use on college campuses include the use of localized wind turbines or purchase of energy generated by wind power and use of coal alternatives. The University of Iowa (UI) is shifting from coal to biomass. Like WKU, UI supplies most of campus heat with coal. Recently, through a partnership with Quaker Oats’ Cedar Rapids Plant, UI began to add oat hulls to their fuel mix. The hulls, a by-product of the Quaker cereal making process, are co-fired with coal. The blend has resulted in savings of thousands of dollars in fuel costs: delivered oat hulls cost about ½ that of an equivalent amount of coal. It has also reduced emissions of GHGs, particulate matter, and VOCs. Since 2004, UI has also been selling emissions offsets on the Chicago Climate Exchange (The University of Iowa, Facilities Management, 2005).

As described in the Central Steam Plant section, the boilers that provide steam production for heat at WKU are outdated and inefficient. The need to update and replace the boiler system provides opportunity for consideration of alternatives. Many universities use combined heat and power (CHP or cogeneration) technology. CHP
systems use the same fuel combustion to produce heat and electricity; steam produced for heat production is used to drive a turbine that produces electricity. CHP fuel savings are typically 35% compared to heat-only boilers and are more efficient than standard power plants (The Apollo Alliance and Energy Action, 2004).

**Demand-side management – conservation efforts**

Demand-side management programs, as described by the U.S. Energy Information Administration (EIA), plan, implement and monitor electric utilities programs designed to encourage consumers to modify their level and pattern of usage. Originally, the objective of these programs was to act as an alternative to new sources of power, but utilities are now using these programs to enhance customer service as well (Dunn, 2002). The idea of reducing demand, rather than increasing supply, seems out of place in a market economy, but ultimately, it saves utility providers money. They can much more cheaply divert unused energy from one customer to another than build new facilities or purchase power from new sources. This concept has obvious social and environmental benefits as well: conservation reduces utility bills, saves resources, and lessens environmental impacts. Demand-side management requires some investment and projects range from free household audits to financial support for physical improvements such as insulation, to conservation awareness campaigns.

The concept of demand-side management could be implemented on college campuses with education and outreach, and while saving the university money, saving resources, reducing emissions and other pollutants, would give students habits that would benefit them throughout their lives. Investment in a conservation program is perhaps one of the most elemental and effective sustainability initiatives.
Policy changes, marketed by a campus-wide campaign to reduce energy consumption, which would include load-shedding, turning off lights and computers, unplugging sources of “vampire electricity”, and allowing thermostat drift, would encourage the entire campus community to get involved. As previously stated, there are 2,100 staff and faculty computers on the WKU campus. These computers are different brands and models, but Dell is the brand purchased by University Purchasing and recommended by WKU information technology. There are many Dell models which use a broad range of watt hours of electricity. The average of watts used by different models is 157 watts for computers and 80 watts for monitors. This is a high estimate, as the average desktop computer is reported to use 65 watts (Bluejay, 2006). There is currently no policy at WKU for turning off computers or monitors at night or putting them into sleep mode. If all 2100 faculty and staff computers run 24 hours per day, 365 days per year, then:

\[
2,100 \text{ computers} \times 237 \text{ watts} \times 24 \text{ hours} \times 365 \text{ days} / 1000 = 4,359,852 \text{ Kilowatt hours per year used by computers. At an average of } 0.06 \text{ per KWh, the total annual cost is } 261,591.
\]

If the computers are turned off when not in use for 16 hours per day during the week, plus 48 hours on weekends, that’s 128 hours per week, or 6,656 hours per year. Turning off faculty and staff computers during nights and weekends (not even including breaks) reduces electricity use dramatically:

\[
2,100 \text{ computers} \times 237 \text{ watts} \times 6,656 \text{ hours per year} / 1,000 = 3,312,691 \text{ Kilowatt hours per year saved. At an average of } 0.06 \text{ per Kilowatt hour, } 198,761 \text{ would be saved}
\]
annually. Additionally, reducing electricity use by 3,312,691 Kwh equates to emissions reductions of 2,062.81 metric tons of CO₂.

It is important to note that this is a theoretical estimate. All faculty and staff computers vary in efficiency and many computers are turned off or put into sleep mode at night (sleep mode averages use of 25 Kwh per computer). This example is meant to illustrate the potential savings that could be realized through policy and behavior changes, which require zero upfront investment.

A good way to initiate conservation marketing would be for WKU to join other college campuses and participate in the *Campus Climate Challenge*. As part of this project, global warming and its solutions can be included in an interdisciplinary manner, across university curriculum, as well as in speaking events, awareness campaigns, and demonstration projects. This is also an opportunity for student involvement and promotes civic engagement. Residence halls and dormitories offer possibility for energy conservation and savings through behavior change. Awareness programs require little investment and can have substantial results. University of Oregon and Oberlin College have impressive outreach programs for increased awareness of energy use and conservation strategies on campus, highlighted in the Campus Profiles below.

**Barriers to Change**

In interviews with DFM employees, I found that the concept of sustainability and energy conservation is part of regular discussion. Unfortunately, DFM staff cannot direct much of their time to sustainability initiatives. They are kept busy with day to day maintenance of the physical campus and constant physical improvements that are usually not designed or conducted with sustainability in mind. At large universities and
institutions such as WKU, energy managers are happy to report that budget and use have not grown at the rate of the university growth. The physical WKU campus has grown dramatically in recent years, but enrollment statistics and energy use statistics do not reflect the physical growth, staying consistent (Figure 8).

There is much literature on adoption of sustainability innovations in industry and agriculture, as well as in organizations like universities. Researchers are investigating barriers to the adoption of innovation such as the inconvenience of using mass transportation, incentives for the adoption of sustainable initiatives such as peer pressure and economic savings, and methods for increasing awareness and education about opportunities for maximizing sustainability. Generally, research findings support the hypothesis that organizational factors (such as organizational resources, organizational innovativeness, and performance monitoring systems) play a key role in the adoption of environmental innovations (Florida et al., 2001). In interviews with Facilities employees, I recognized some possible factors for the lagging adoption of sustainable innovations at WKU that may warrant further research.

The most common misconception I observed in general conversations about sustainability initiatives, and green building specifically, is that it is cost-prohibitive. The US Green Building Council states that LEED building design does not cost more than conventional design and construction, and long-term financial benefits are realized. One problem is that as a state-budgeted institution, there is little room for upfront investment in building design innovations that will pay off and ultimately save energy costs over time. Consequently, performance monitoring systems for adopted innovations are extremely important in building cases for further investment. Despite budget constraints,
a concentrated effort toward financing sustainability initiatives can produce funding for such projects. Many universities and colleges partner with corporate sponsors, secure grant funding, or seek endowments to subsidize sustainability initiatives. The establishment of a sustainability committee or position could support such endeavors. A “Green Issue” of the Alumni magazine or calling attention to growing sustainability initiatives in publications and venues that reach donors could promote awareness.

I also observed in DFM employees a strong commitment to serve the President of the University and unwillingness to risk any chance of disapproval or unrest. Quite simply, the slowness with which WKU is approaching the concept of sustainability is not due to lack of resources, financial or otherwise. Institutions of higher learning do not lack resources in knowledge and skills. Many staff, faculty, and students are simply waiting for leadership. The least expensive and potentially the most effective suggestion for change in the way WKU uses energy is for the President to make it known that he supports such innovation. WKU’s President could make a strong and positive statement by joining other University Presidents in signing the President’s Climate Commitment (Appendix F). Tom Kimmerer, Director of AASHE indicated at a sustainability conference in October 2007 held at the University of Kentucky, that AASHE is very interested in providing support and training to help Kentucky universities and colleges who join in the commitment to work toward climate neutrality. Furthermore, there are many ways to approach this effort such as investing in alternative technologies like solar, conservation awareness campaigns, and green building design. A campus sustainability coordinator or a sustainability committee would simplify efforts toward energy conservation and climate neutrality.
Campus Profiles:

Oberlin College Campus Resource Use Monitoring System

In 2005 Oberlin College faculty and staff designed and created a campus resource use monitoring system, which displays real-time feedback on electricity and water use, allowing students to monitor consumption. The project was funded in part with support of the U.S. Environmental Protection Agency, the U.S. Department of Energy, and the U.S. Green Building Council. Students can visit a website that reports real-time feedback on per person consumption, relative consumption, and environmental and economic costs. It also reports use in individual dormitories, and each semester 18 monitored dorms compete to see which dorm can reduce its electricity use by the largest percentage. The website even allows users to select a currency for expressing per person energy consumption such as watts, conventional and compact fluorescent light bulbs, different types of fossil fuels, hybrid and conventional automobiles, and veggie burgers. Environmental costs can be expressed in currencies such as carbon dioxide, mercury, and money. The feedback website and dormitory competitions have resulted in up to 56% energy use reductions in winning dorms. The website, www.oberlin.edu/dormenergy, is interactive and fun, and has information on where the college’s energy is generated and other information to increase awareness in students.

The University of Oregon Energy Project

The University of Oregon is concentrating efforts on energy conservation through an education and conservation program called the University of Oregon Energy Project: Research, Education and Alternative Energy. The program was developed in 2004 by a group of graduate and undergraduate students selected from the Environmental
Leadership Program, and is sponsored by the University of Oregon and the Eugene Water and Electric Board, each contributing $7,500 in funding. The “Energy Team” started by assessing the University’s energy profile, as well as various energy conservation programs initiated on campus. They researched energy sources for their area and the environmental impacts and the efficiency and benefits of alternative energies. The team then developed an educational outreach campaign to present their findings to the university community. With a goal to reach 25% of the campus community, they led energy tours, presented programs to classes and organizations, and developed a website and on-line presentation for viewing. By conducting before and after surveys, they could determine which parts of the campaign had the most impact, which students were most influenced to change behaviors to save energy, and other degrees of success of the program. The team also initiated a wind power campaign in which they proposed an increase in student fees to support the extra cost of purchasing renewable wind energy. The entire project is described in a cumulative report prepared by the Energy Team, *University of Oregon Energy Project: Research, Education and Alternative Energy*, 2004. Energy savings realized from the project have not yet been published.

Both of the projects described above provided interactive, hands-on learning opportunities for students and realized significant savings in energy and money. Students were empowered to take control of their personal resource use and gain better understandings of how energy is generated, environmental and economic costs, and the operations of their universities. Such programs could be created and supported by WKU and would contribute to the goals of a sustainable campus in decreasing energy use,
increasing awareness, and preparing students for the issues facing the global community today.
3. Water

Water use on campus is managed by WKU DFM. Water use from distributor BGMU is metered at buildings and residence halls, and is read remotely. Data on gallons of water used and price paid is available to view on the DFM website along with energy use statistics. At that site, water use on the main campus is divided into three areas: water used in all buildings including residence halls, water used in residence halls, and water used in the Chill Plant. In one year, from September of 2006 through August of 2007, the campus used 248,049,516 gallons of water at a total cost of $571,714. This is an average of 14,255 gallons per Campus Community Member (CCM) last academic year, or 39 gallons per CCM per day. Water is billed based on a square foot percentage of campus building area. Broken down this way, academic and administration buildings are responsible for 69.6% of the total water bill, Housing and Residence Life is billed for 22.6%, Downing University and Garrett Conference Centers pay 7.1% of the bill, and WKU Restaurant and Catering pays the remaining 0.7% (Utility Breakdown, 2005-2006).

The billing method of percentage of bill based on square foot does not correlate to actual use. According to data on actual gallons of water used, more than a third of the water use on campus is in dorms and residence halls: students living on campus and using water for showering, cooking, clothes-washing and other personal or household uses. Using the square foot area method of billing, HRL pays for less than their share of actual use. This system is an economic disadvantage to the university and supports argument for an improved metering system. Water is also used for irrigation of turf and gardens but common metering structure makes it difficult to determine how much water is used for these purposes.
As residence halls are being renovated, water efficiency measures, such as low flow showers and low flush toilets are being installed (Table 6) (West, pers. comm.). These technologies are the minimum efficiency mandated by current EPA regulations.

The summer of 2007 was unusually dry, resulting in drought conditions and restrictions on water use for Warren County and Bowling Green. One hundred and sixty trees on the main campus were lost to drought (Fear, pers. comm.). In September, a notice was sent to students living on campus to conserve water, with tips and suggestions for doing so (Appendix H).


<table>
<thead>
<tr>
<th>Fixture:</th>
<th>1992 Federal EPAct regulations:</th>
<th>New technology – available today:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low flow shower heads</td>
<td>&lt; 2.5 gallons per minute flow rate</td>
<td>1.5 gallons per minute</td>
</tr>
<tr>
<td>Low flow faucets</td>
<td>&lt; 2.5 gallons per minute flow rate</td>
<td>0.5 gallons per minute</td>
</tr>
<tr>
<td>Low flow toilets</td>
<td>1.6 gallons or less per flush</td>
<td>1.1 gpf, or dual-flush – 0.8 gpf for liquid and 1.6 gpf for solid waste</td>
</tr>
</tbody>
</table>

**Stormwater**

Tim Slattery, a hydrologist for Bowling Green Department of Public Works and Certified Professional in Stormwater Quality (CPSWQ), provided some history on the development of stormwater pollution efforts and specifically detailed efforts in Bowling Green. The 1972 Clean Water Act was enacted to address point source pollution, authorizing the National Pollutant Discharge Elimination System (NPDES) permitting to regulate point sources that discharge pollutants. While this improved water quality, problems persisted so in 1987 the Clean Water Act was amended to address stormwater pollutants. In response to this amendment the EPA developed an unfunded mandate for municipalities to develop stormwater management programs that would meet the standard of “reducing pollutants to the Maximum Extent Practicable (MEP)” (EPA, 2007). Phase 1 required medium and large Municipal Separate Storm Sewer Systems (MS4s, or municipalities with populations of 100,000 or more) to develop programs by 1990. By 2003 Phase 2 programs were required for small MS4s (population greater than 10,000 or population density of 1,000 per square mile).
Bowling Green is a Phase 2 MS4, and the stormwater management program encompasses six control measures for stormwater pollution: Public Education and Outreach, Public Participation/Involvement, Illicit Discharge Detection and Elimination, Construction Site Runoff Control, Post-Construction Runoff Control, and Pollution Prevention/Good Housekeeping (Slattery, pers. comm.). Slattery reports that the City of Bowling Green spends close to one million dollars per year on the program, which is funded by the “occupational tax” paid by people who work in Bowling Green. Slattery says that Bowling Green puts extra funding and effort into its stormwater program because the city has distinct stormwater quality issues due to its location on karst terrain. Bowling Green drains stormwater into well over 1,000 wells that have been drilled into the fractured and eroded limestone karst. The stormwater flows directly into caves and underground rivers, making groundwater especially susceptible to contamination. Bowling Green cooperates with other cities, participating in an MS4 workgroup to standardize guidelines in the area (Slattery, pers. comm.).

Universities and military bases are supposed to be MS4s as well, but WKU is not permitted as an MS4 and the Kentucky Division of Water does not enforce this rule (Slattery, pers. comm.). This means that there are no regulations or ordinances on campus. Dan Chaney, WKU Project Manager for Capital Construction, says that technically, campus stormwater management is regulated by the EPA to control and contain pollutants but these regulations are not typically enforced in any manner. The university is supposed to file a “notice of intent” with the Kentucky Division of Water Quality when disturbing greater than one acre with a construction project. Chaney reports that with the constant construction on campus, there is always at least one acre
(cumulatively) being disturbed. The state EPA and Division of Water Quality do not inspect or enforce this rule so the university rarely files a notice of intent. Though the state rules are not enforced, and the campus is not included in city ordinances, WKU Planning and Construction does try to practice best management for construction project areas by constructing silt fences, construction entrances, and placing tire-cleaning gravel at such entrances. It seems there may be a greater push to try to improve compliance efforts; newly hired Environmental Health and Safety Director, Mark Pendley, has suggested filing a standing notice of intent to cover ongoing construction projects on campus (Chaney, pers. comm.). The university has attempted some best management practices for stormwater runoff described below.

According to Annie Holt, a hydrologist who previously worked in the WKU Center for Cave and Karst Studies, stormwater runoff from most of WKU’s campus has been directed into a large sinkhole basin, the present location of the Egypt Parking Lot at the west end of campus. Stormwater flooding of this sinkhole has been observed for more than 40 years and in 1998, over 80 student vehicles parked in the Egypt Lot were inundated. In 1999, the WKU Center for Cave and Karst Studies received a grant from the City of Bowling Green to investigate the problem, using microgravity techniques. This investigation revealed a large cave below the parking lot, 40 feet below the surface. Further research by the Center for Cave and Karst Studies, evaluating the cave’s capacity to hold stormwater runoff, revealed that the “first flush” of stormwater that contains the most oil, grease, and other contaminants drained immediately and directly into the aquifer and that additional runoff filled the sediment-choked sinkhole during heavy precipitation events (Holt, pers. comm.). Mitigation effort to reduce flooding and reduce groundwater
contaminants consisted of the installation of a retention and filtering device from Vortecnics, Inc., a company that manufactures the Vortechs Stormwater Treatment System. Filtering devices on the unit cleanse the first flush of runoff and storage units hold overflow in case of flooding. According to the Vortecnics brochure, the design is EPA award winning and efficiently removes contaminated sediment, floating hydrocarbons, and debris from surface runoff. Slattery says the "Vortecnics" devices are good at filtering solid waste, but not as effective at filtering other stormwater pollutants such as oils and finer particles. He describes the system as a centrifugal force mechanism: as the water spirals downward, heavy particles are diverted to the middle. Once a year, Bowling Green Public Works vacuums the sediment out of the system. Slattery says they mostly see cigarette butts and larger debris. Slattery does water quality testing at many sites around Bowling Green but none are specific to campus runoff. He says that karst conditions make it difficult to isolate sources of runoff, and that the best way to determine campus stormwater runoff pollutants would be to test surface runoff during a precipitation event.

According to Doug Ault, Director of WKU Planning Design and Construction, there are plans for a permeable concrete parking lot at WKU. The lot under consideration for the project is the Adams Street gravel parking lot, on the northeast side of campus. This project is still in the design phase; engineers have been asked to develop a plan for permeable concrete and other sustainable products for the lot. This is another area of campus that catches a high volume of stormwater runoff, and there is consideration for a wetland-type vegetation strip at the bottom of the lot where water accumulates (Ault, pers. comm.).
While these efforts toward stormwater management on campus are positive steps, WKU could co-permit with the City of Bowling Green with minimal resource input (Slattery, pers. comm.). This would help to ensure best management practices across campus and specifically address issues related to impermeable surfaces, such as parking lots, landscaping related pollutants, and construction related water pollutants.

4. Land

According to the 2006 WKU Fact Book, the number one reason given by incoming students for choosing WKU was the attractive campus. The WKU campus proper is 196 acres and includes 64 buildings and approximately 40 parking lots (these range in size from spaces along the street to parking structures). DFM Grounds Manager Greg Fear reports that of these 196 acres, buildings cover about 28 acres, parking lots and drives and sidewalks cover about 54 acres, and turf or vegetation covers the remaining 114 acres (Appendix I). Therefore, of the 196 acres that comprise the WKU campus, about 58% is permeable surface (turf and gardens) and 42% is impermeable parking lots, sidewalks, roads, and rooftops. With construction and expansion constantly in progress, these numbers are not static. The WKU main campus is surrounded by well established neighborhoods and major street and transportation thoroughfares. Space is constrained and the largest land space issue is parking.

The WKU main campus “green space” consists of lawn (Turf type Tall Fescue blend and Perennial Ryegrass), and gardens. The lawn space is overseen by Greg Fear and lawn maintenance such as mowing and weed eating is done by the Facilities Management grounds crew. The lawn is regularly fertilized with different types of
fertilizer including Ammonium Nitrate and 50% organic fertilizer (Fear, pers. comm.). According to Fear, “very little pesticides (which include insecticides, herbicides, and fungicides)” are used. A contractor sprays for bugs, weeds, and fungi using Integrated Pest Management practices including spot spraying, and spraying when the campus population is away on break and holidays (Fear, pers. comm.).

The WKU Gardens

The WKU Gardens are managed by Gardener Cristin Lanham and a crew of student-employee gardeners. The gardening crew is responsible for preparation, installation, and maintenance of the gardens. Lanham has a budget of approximately $25,000 per year to purchase plants, mulch and fertilizer. Plants are chosen based on availability and maintenance. The gardeners try to use plants that are low-maintenance but high-profile, and favorite annuals include lantana, petunias, sweet potato vine, and impatiens. Each year, part of the budget is used to invest in perennials and the gardeners choose varieties that have proven to work well but also try something new every year.

The WKU gardeners do not try to plant native species in the gardens. Native and non-native plants are selected based on how well they grow, degree of maintenance, and show. They use fertilizer only when necessary and do not use any pesticides.

The Garden Crew has created several theme gardens in the main campus such as habitat gardens for butterflies and hummingbirds. The Butterfly Garden is really an “all bugs” garden, according to Lanham, because all pesticides are banned from this and other habitat gardens. It was planted at the request of a biology faculty member, Albert Meier, who donated funds and uses it as a learning garden. The Biology Department, Tri-Beta biology student club, and DFM also funded the project. The Hummingbird Garden, near
Weatherby Administration Building, was also created with the support of a faculty member, Ann Meade, who donated funds to buy plants (Lanham, pers. comm.). The gardeners created an Herb Garden next to Downing University Center for use by the Fresh Foods Chefs and anyone who cared to pick fresh herbs to use. Aramark provided funding for the herb garden. Chef Holts reports that he uses the herbs regularly (although this is not officially approved by Aramark) and individuals are permitted to use the plants as well. A Songbird Garden has been requested and will feature berry bearing plants and shrubs to attract birds.

The gardeners have ideas for additional gardens and more sustainable gardening. Lanham lists several changes she would like to make toward sustainability, including capturing rainwater and stormwater to use for irrigation, and putting more lawn area into garden space. The gardeners report that the least sustainable aspect of their job is the two 1980’s model trucks they drive.

Lanham has been gardening at WKU for seven years and has observed changes in species tolerance over this time. She notes that annuals such as lantanas and gladiolus are becoming perennials in the milder winters, and that some Kentucky native species and many trees (160 total) did not survive the heat and drought conditions of summer 2007.

The Upper Green River Biological Preserve

The 800 acres that currently comprise the Upper Green River Biological Preserve in Hart County were initiated by a 671-acre purchase in 2003 and 2004 by WKU with funding support from the Kentucky Heritage Land Conservation Fund Board. The Preserve is overseen by Co-directors Ouida Meier, Albert Meier, and Scott Grubbs. The Preliminary Resource Plan for the Preserve included the following actions: (1)
acquisition, (2) capping oil wells and removing tanks and flow lines, (3) eliminating access for gravel mining, (4) eliminating cattle grazing, (5) restoring bottomland forest and riparian corridor, (6) restoring upland forest and barrens, (7) controlling human access to the river from the properties, (8) improving terrestrial biodiversity, (9) stabilizing streambanks, (10) control and eradicate exotic vegetation, (11) prevent introduction of exotic species, (12) prevent commercial extraction of resources (oil, gravel, and biological resources), and (12) monitor local water quality (Meier et al., 2007).

The restoration and management goals for the Preserve provide endless educational opportunity and experience for WKU students. Student employees and volunteers work on such projects as trash and debris removal, native grass and riparian restoration, and invasive species removal. The Preserve is used as an outdoor classroom for Biology, Archaeology, and Folk Studies classes. Students participate in water quality monitoring, cave mapping, biological inventories, and ecological research projects. Several biology graduate research theses are being conducted at the Preserve in Biology, Folk Studies, and Geology disciplines. In fiscal year 2006-2007, 1,303 person-days were documented at the Preserve by WKU faculty, staff, students, and guests on plantings, cleanup, restoration, and other projects (Meier et al., 2007).

Besides the opportunity the Upper Green River Biological Preserve offers students, the restoration and conservation management is significant in improving the ecological integrity of the resource, benefiting the surrounding landowners and citizens, and helping to protect and preserve species and habitats within Mammoth Cave National Park downstream, and the larger Green River watershed. In the Green River Conservation
Reserve Enhancement Program (CREP), Western Kentucky University Center for Biodiversity partners with other organizations and local landowners to restore riparian buffer zones and reforest cleared pasture lands within the Green River watershed. Preserved land and re-establishment of tree cover and riparian buffer zones are also considered carbon offsets and contribute to campus efforts toward climate neutrality.

5. Air

While I have addressed air quality issues in respect to GHGs related to the combustion of coal on campus and indirect sources from purchased electricity, this section will focus on other aspects of university air quality: indoor air quality (IAQ) and other university impacts on outdoor air quality. As a major institution with emissions resulting from fuel combustion, transportation, construction, food services, and other sources, WKU contributes to air pollution and could alternatively contribute to the reduction of air pollutants.

Indoor Air Quality

IAQ problems in universities can vary from building to building and can result from many sources including outdoor pollen and pollution, vehicle exhaust, odors, mold, solvents, toners, lab chemicals and cleaning supplies. For a list of indoor air quality pollutants and their sources, see Table 7, below. IAQ can be improved with adequate ventilation, control or removal of airborne contaminants, and maintenance of temperature and humidity. While preventing problems during building construction is most cost-effective, on a campus with many old buildings, such as WKU, many IAQ problems must be addressed as they develop. DFM and Environmental Health and Safety can work
together to identify the sources of indoor pollutants and take steps to curb them, but identifying IAQ problems usually involves finding or observing abnormal conditions. It is important that those people who are in the buildings regularly; students, faculty, and staff, report any indications of IAQ problems, such as odors or physical symptoms.

Annie Britt is an Environmental Compliance Technician for WKU Environmental Health and Safety. Britt says that for IAQ issues, the department of Environmental Health and Safety operate mostly on a response basis, but that they would like to take a more proactive approach by increasing awareness about air quality issues and letting the campus community know that they are there to help. There is an on-line “Indoor Air Quality Concern” form that can be submitted by faculty, staff, or students accessible from the WKU Environmental Health and Safety webpage (www.wku.edu/Dept/Support/Legal/EHS), but Britt says that most reports of concerns or problems are phoned in by faculty and staff. These are usually reports of odors, most typically mold or musty odors, or physical symptoms suspected to be the result of air quality issues. There is still asbestos in buildings on campus, and there are two trained people that work specifically with any asbestos problems or discoveries. Environmental Health and Safety technicians also perform “exposure assessments” for possible exposure by staff to certain cleaning supplies or other chemicals present on campus. There is also a plan to hire a Lab Safety Officer for WKU.

Radon

Radon is a naturally occurring radioactive gas without color, odor or taste that comes from the radioactive decay of uranium in soil, rock, and groundwater (EPA, 2007). Radon is a known human lung carcinogen and is the second leading cause of lung cancer
in America (EPA, 2007). Radon gets into indoor air primarily from soil under buildings. Radon can be found anywhere but is more likely present in rooms or areas that are in contact with the ground. Radon is found all over the U.S. and EPA has identified areas in the U.S. with the potential for elevated indoor radon levels. The EPA uses five factors to determine radon potential: indoor radon measurements, geology, aerial radioactivity, soil permeability, and foundation type. Warren County is a Zone 1 county, which means that it has the highest potential for indoor radon, with predicted screening levels greater than 4 picocuries (pCi) per liter.

From 1997 to 1999 WKU Environmental Health and Safety conducted mass testing on campus for radon in every building. Radon was discovered at hazardous and high levels in dorm rooms and classrooms, including levels over 100 pCi in the Kentucky Building. These are the only test results available as the results of the mass testing performed from 1997 to 1999 are “missing” and cannot be located by WKU Environmental Health and Safety. Mitigation included the installation of ten ventilation systems during a hands-on training course partially funded by the EPA. Radon testing is currently performed by request only. If a test is requested and results require mitigation, the Department is responsible for the mitigation expense. Britt is currently working with EPA funding on public awareness efforts such as Public Service Announcements and giving away free radon test kits (Britt, pers. comm.).
### Table 7. Sources of indoor air pollutants in universities. Source: Creighton, 1998.

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion by-products: nitric oxide, carbon monoxide, carbon dioxide, particulates</td>
<td>Smoking, un-vented gases, odors coming from air intake vents, heating source, car exhaust</td>
</tr>
<tr>
<td>Biological contaminants: molds, fungi, bacteria, mildew, allergens</td>
<td>Humidifiers, air-conditioners, standing water on roof near intakes, dust mites, cockroaches, rodents</td>
</tr>
<tr>
<td>Asbestos</td>
<td>Wall and ceiling insulation installed between 1930 and 1950, old pipe insulation, some vinyl floor tiles, old fireproof cloth products</td>
</tr>
<tr>
<td>Radon</td>
<td>Soil and rock, seeps into building from natural sources</td>
</tr>
<tr>
<td>Volatile organic compounds (hydrocarbons)</td>
<td>Cleaning products, propellants for aerosols, deodorizers, paints and thinners</td>
</tr>
<tr>
<td>Semivolatile organics: formaldehyde (HCHO), PCBs</td>
<td>New carpeting, furniture, particle board, adhesives, urea formaldehyde, insulation</td>
</tr>
<tr>
<td>Chemicals</td>
<td>Lab experiments, chemicals in teaching and research labs and storage</td>
</tr>
</tbody>
</table>

### Outdoor Air Quality

The Clean Air Act of 1970, amended in 1990, was created to address air pollution, giving the EPA (created in 1970 with the primary role of carrying out the Clean Air Act) authority to implement and enforce regulations reducing air pollutant emissions. The EPA has identified six criteria pollutants that it regulates by setting permissible levels based on human health (primary standards) and prevention of environmental damage (secondary standards). The six criteria pollutants are: particulate matter, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. The EPA identifies particulate matter and ground-level ozone as the pollutants that cause the most widespread health effects.
The Kentucky Division of Air Quality monitors and enforces the Clean Air Act at the state level. The Kentucky Division for Air Quality has operated an air-quality monitoring network since 1967. The network includes 143 monitors in 31 counties. Data from the network is used to demonstrate compliance with meeting ambient air quality standards and to identify pollution trends. The Warren County monitors are in Kereiakes Park and at Oakland Elementary School. There is a monitoring station in Mammoth Cave National Park. Warren County is consistently in attainment for all standards. According to Elizabeth Robb, Kentucky Division for Air Quality, the EPA is considering new standards for ozone and recently lowered thresholds for compliance for particulate matter. If thresholds are lowered for ozone, Warren County may no longer be in compliance. Mammoth Cave National Park scientists are reporting some ozone damage to Kentucky native trees and plants (Elizabeth Robb, pers. comm.).

Heavy-duty trucks and buses account for about one-third of nitrogen oxides emissions and one-quarter particulate matter emissions from transportation sources (EPA, Greenhouse Gas Emissions, 2007). These pollutants contribute to ground-level ozone and other air quality problems. The university shuttles are improving emissions by using 5% biodiesel and could further improve emissions by increasing the biodiesel blend as planned. The WKU Farm agricultural vehicles plan to begin using biodiesel produced by students in the Engineering department. WKU owns 197 vehicles including the shuttle buses, DFM vehicles, and departmental vehicles. A 2007 WKU vehicle list can be seen in Appendix J. None of the WKU vehicles are hybrids and many are older model pick-up trucks and buses.
Recommendations for Change

There are many opportunities to reduce emissions from the college campus. The conventional fuel burning vehicles could be phased out of the university fleet, with policy for replacement by cleaner fuel vehicles such as electric or hybrids. As of November 1, 2007 Sam Smith Toyota of Louisville is “fleeting out all hybrids at $200 over cost plus tax and license with no added dealer fees” (Smith, pers. comm.). Currently, the university fleet of 193 vehicles contains no hybrids or biofuel vehicles, other than the university shuttles, which currently use 5% biodiesel, with plans to increase the blend to 20%. The University of Wisconsin began using 20% biodiesel ultra low sulfur diesel mix in its diesel fleet in 2005. The blend is expected to reduce particulate emissions by 15% and CO$_2$ emissions by 16% (The Apollo Alliance and Energy Action, 2004).

Construction policy on campus could begin to include requirements for construction vehicles to use biodiesel. Grounds equipment that use 2-cycle engines should be phased out to be replaced by electric or 4-cycle engines.

The university could adopt an “idling reduction policy” for delivery drivers, shuttle drivers, and on-campus facilities vehicles to turn their engines off while idling. (Currently shuttle drivers have been observed during 15 minute off-duty breaks leaving their buses on to idle for 15 minute periods.)

Food used in dining services and other items purchased by the university should be locally produced or manufactured whenever possible. According to the Worldwatch Institute, food transportation is among the biggest and fastest-growing sources of GHG emissions worldwide and the average food item in the United States now travels at least
1,491 miles from farm to plate. Food waste should be composted to reduce methane released from food decomposition in landfills.

Commuters should be encouraged to rideshare through the establishment of an effective, easy-to-use rideshare program. First year students required to live on campus should be encouraged to leave their cars at home by providing a car lending program (see Flexcar program under Transportation), bike lending program, and student discount for Bowling Green public transportation. Transportation alternatives are addressed in more detail in the Transportation section.

Alternative energies should be used when possible, such as solar lighting in stadiums and parking structures, passive solar heating in buildings, and solar water heating to reduce dependence on coal for heat and electric. There is a plan on the WKU Farm to use some methane generated from agricultural sources to heat the greenhouses.

A search for radon on the WKU website produces very little information. If there is an EPA funded awareness campaign it is not focused toward the WKU campus community. There is no transparent or obvious information available on the history of radon levels at WKU or on current testing results. Awareness efforts should be focused on the campus community and a testing schedule and test results should be available for public viewing.
6. Solid Waste

Solid Waste Management

University generated solid waste is managed by DFM. Greg Fear, Campus Service Manager, oversees solid waste management and recycling at WKU, as well as grounds, landscaping, gardening and other areas. The solid waste contractor is Monarch Environmental, serving the campus and local community. Solid waste on campus is collected daily from bins ranging in size from small plastic containers to large 30-yard dumpsters. Although the solid waste contract is managed under DFM, it is separated into various accounts for several campus areas. One account, for the DFM, includes all academic and administrative buildings, shuttle stops, parking lots, Diddle Arena, Smith Stadium, and the WKU agricultural farm. The HRL account includes all dorms and residence halls. The Auxiliary Services account includes Downing University Center (DUC) and Garrett Conference Hall, where Aramark Restaurant and Catering Group generates much of the solid waste and includes the University Bookstore at DUC. South Street, the location of brush and construction dumpsters, is a separate account as well. Total solid waste for each of these divisions or accounts is summarized in Table 8. Disposal fees are determined by weight: cost for landfill disposal is $.057 per pound, however HRL is billed differently, as described in the next section.

HRL solid waste is compacted at each residence hall (in 10 compactors) and placed into dumpsters. Each dumpster is billed by “pull”: each time a dumpster is pulled, a standard service charge is incurred. During the residence housing move in and move out months of August, December, and May, extra pulls are arranged, as well as extra dumpsters. Also, during summer renovations of residence halls, extra dumpsters are
placed for construction waste. Solid waste generated in residence housing is not weighed and so cannot be effectively measured; however, Monarch Environmental estimates that each pull averages 0.33 tons. In fiscal year 2005-2006, an estimated 267 tons of solid waste were generated by students living in campus housing. This estimate does not include extra waste generated during move-in and move-out periods, when extra dumpsters are filled and pulled.

Solid waste generated under the DFM account includes all academic, administration, WKU Farm, parking, and stadium waste and is measured by weight. This includes 47 dumpsters, 223 fliptops, 185 Monarch toters, and 1 compactor. In fiscal year 2005-2006, solid waste from these sources totaled 1,191 tons. In fiscal year 2006-2007, solid waste totaled 1,146 tons, down slightly from the previous year, possibly from increased recycling efforts. Increased recycled cardboard and paper totals for 2006-2007 support this theory (Southern Recycling, 2007).

Downing University Center and Garrett Conference Center, which fall under the Auxiliary Services account, generated 705 tons of waste in 2005-2006. The dumpster at the South Street location is a receptacle for construction trash and brush and weight varies widely from month to month, from 4 to 45 tons, depending on season and current projects.

In August of 2007, during Master Plan move-in weekend, GreenToppers sponsored a cardboard drive to divert all move-in cardboard from landfill to recycling. A pallet and signs directing cardboard to recycling piles on the pallets were placed next to each of 11 move-in dumpsters. The goal was to have a GreenTopper volunteer next to each recycling area, to direct students and parents to break down cardboard and stack it
on the pallets. There were not enough volunteers to attend to each area, so much cardboard was thrown into dumpsters and many boxes were placed on the recycling pile without being broken down. While lack of volunteers limited the effectiveness of the project, approximately 7,500 pounds of cardboard were recycled from move-in weekend. Volunteers observed that this was merely a fraction of the actual cardboard generated, and estimate that less than half was diverted from the dumpsters.


<table>
<thead>
<tr>
<th>Campus Area</th>
<th>Division of Facilities Management</th>
<th>Housing and Residence Life</th>
<th>Auxiliary Services (DUC and Garret)</th>
<th>Total for WKU (excluding South Street)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons for 2005-2006</td>
<td>1,191</td>
<td>267</td>
<td>705</td>
<td>2,163</td>
</tr>
</tbody>
</table>

Total waste generated on campus in 2005-2006 was 2,163 tons, not including move-in, move-out, brush, or construction waste (Table 8). At $0.057 per pound, total cost for disposal was more than $246,000 plus some fuel fees. The cost to the environment is difficult to determine, but should include fuel use and greenhouse gas emissions, methane generated in decomposition of organic waste, and landfill space and water quality impacts such as leaching in karst terrain.

The next section addresses recycling at WKU, which is the primary way to reduce both economical and environmental costs of managing and disposing of solid waste. Figure 12 summarizes the solid waste stream on campus, illustrating types of waste and potential for waste to be recycled.
Figure 12. Solid waste stream at WKU main campus. There are many different sources and types of waste generated on the WKU main campus. Much of this waste is recyclable or compostable but is not processed as such and ends up in the landfill.

Recycling at Western Kentucky University

WKU Recycling attempts to capture and recycle cardboard, office paper, and mixed paper generated in academic and administrative buildings. There is currently no program and little economic incentive for collecting other recyclables generated on campus, such as plastic or glass. By comparing total weight of recycled materials (164,550) pounds to total weight of waste sent to the landfill (4,326,000 pounds), I found that 3.8% of waste at WKU was recycled in the 2006 calendar year. The results of a
dumpster audit of 24 hours worth of trash in a dumpster serving three buildings, Mass Media and Technology Hall, Academic Complex, and Health Services, revealed 302 pounds of recyclable materials out of 880 pounds of waste. Approximately 34% of the waste in the dumpster was recyclable: plastic, paper, cardboard, or aluminum.

Inside the buildings, the collection of the cardboard and paper is largely dependent on the efforts of the Building Service Attendants (BSAs). Currently they are the people who bring all cardboard from inside buildings to collection areas in or near each building. The BSAs are also largely responsible for bringing the other items to this area as well. Ideally, faculty, staff, and students would participate in this part of the processing, bringing their own paper and broken down cardboard to pick-up areas. However few people seem to do this or to know that they can do this. There are small blue or grey bins scattered throughout the buildings for office paper, although they are not marked or designated in any way other than having the recycling symbol on the side. Office paper must be bagged, as it is transported in an open truck. There are no specific collection bins for “mixed” paper (newspaper, slick paper, magazines, or catalogs) and this paper must be separated from office paper for collection and transport to Southern Recycling. Most of the larger recycling collection bins supplied by DFM for each building are not easily distinguishable from regular trash cans. WKU staff are not allowed to sort trash from recyclables for health and safety protection. If there is one piece of “trash” in a recycling bin, all is contaminated, considered trash, and thrown away.

The recycling program is currently limited to one small truck and two or three part-time student employees ($7.50 per hour in 2007) who pick up cardboard, office
paper, and newspaper from 48 sites on the main campus, south campus, and WKU Farm and transport it to the local community recycling facility, Southern Recycling, located one mile from campus. In the 2006 calendar year, the WKU recycling truck carried 36,230 pounds of cardboard, 26,910 pounds of office paper, and 14,900 pounds of newspaper to Southern Recycling, in 490 trips (Morrow, Southern Recycling data, 2006). One trip for pick-up around campus, south campus, and the agricultural center is approximately 18 miles. This circuit is made up to six times daily.

There is a 20-foot cardboard recycling receptacle on campus, next to Downing University Center, and maintained by Donny Raines, the shipping and receiving manager for DUC. This bin is usually filled with cardboard generated in DUC from the University Bookstore and Aramark dining services and so is not regularly used by the recycling pick-up crew. In the 2006 calendar year, 86,420 pounds of cardboard were collected in this bin (Figure 13).
In 2006, office paper collection generated $188.57 ($15 per ton), newspaper generated $100.49, and cardboard generated $1,427.41, for a grand total of $1,716.47 for all recyclables delivered by WKU to Southern Recycling. Each time the cardboard bin at DUC is picked up and serviced by Southern Recycling, however (66 times in 2006), there is a freight and fuel charge of $79.50. In 2006, freight and fuel charges for this bin totaled $3,082.32. As freight and fuel charges cost significantly more than revenue generated from recycling on campus, WKU Facilities Management Recycling saw a net loss of $1,365.85 (Figure 14). However, the savings in landfill fees for the DUC cardboard diverted from the waste stream totaled $4,925.94, a net savings of $1,843.62 for WKU. Furthermore, by diverting total recycled materials of 164,460 pounds from the landfill in 2006, a savings of $9,374.22 was realized, resulting in a total net revenue plus savings of
$8,008.37. One way to accelerate savings and revenue would be to earmark these savings from recycling for investment into recycling program improvements.

![Profit generated from recyclables, and costs of cardboard dumpster pulls.](image)

Figure 14. Profit generated from recyclables, and costs of cardboard dumpster pulls. Currently, due to the low value of recyclables, the cost of service for the cardboard dumpster at DUC is more than the revenue generated by delivered recyclables. Source: Recycling invoices from Southern Recycling.

Plastic and glass are currently not recycled because Southern Recycling does not pay for these items. They will however accept these items if separated. While there is not a significant amount of recyclable glass generated on campus, there is much plastic. There are approximately 150 soda machines on the main campus, from which a monthly average of 40,000 total beverages in 20 oz. plastic bottles are purchased (Marshall Gray, pers. comm.). These bottles are not being recycled and are contributing to the solid waste stream. PepsiCo and WKU Purchasing have agreed to a plan to replace all aluminum
machines with plastic container machines. According to PepsiCo, each plastic machine holds only half of the product of an aluminum machine and wherever an aluminum machine is replaced, the vendor will either have to service it twice as often, or two plastic machines will replace one aluminum machine. This increases labor, fuel costs, and energy used to service the machines. Each vending machine uses approx 66 kWhr per week. PepsiCo is making the switch because they claim that more soft drinks are purchased from the plastic bottle machines than the aluminum machines. Sales figures obtained from Auxiliary Services do not support this. Furthermore, location of machines is a large factor in sales volume. Additional information on location of each type of machine would be helpful in determining true factors associated with sales volumes.

Aluminum is worth approximately $0.68 per pound at present and there is some aluminum generated on campus. There are approximately 30 aluminum can dispensing machines, from which an average of 10,000 drinks are purchased monthly. As mentioned previously, these aluminum machines are being phased out. Some aluminum is recycled by BSAs for income to buy items for their group, such as birthday cakes, or other special occasion supplies. The residence halls and dormitories, overseen by HRL, began recycling aluminum in the spring semester of 2007. The efforts are part of the Drive to a Million recycling campaign initiated by Bowling Green Technical College in which area schools can earn money through aluminum recycling efforts. According to Brian Kuster, Director of HRL, the housing aluminum recycling program, which piloted in two residence halls has been successful and has been expanded to include all 15 residence halls beginning fall of 2007.
Additional details about the composition and value of recyclable materials in WKU’s solid waste stream are presented in Chapter 3, Recycling at WKU.
7. Purchasing

“Every product we buy, every car or plane we ride, every item we dispose of effects the environment. We are all the cause of the depletion of our world’s mineral resources, the warming of the earth’s atmosphere, the unrelenting loss of species, the torching of forests, the overgrazing of grasslands, the overharvesting of fish, the contamination of rivers and oceans, and the potentially catastrophic change in the chemistry of our world’s atmosphere.”
- Norman Dean, President, Green Seal. Author, Campus Green Buying Guide.

The WKU Department of Purchasing and Supply Services is under the Division of Financial Affairs. Individuals or Departments have procurement cards for purchases up to $1000. Purchases larger than that must be approved through the Purchasing Department. This decentralized system facilitates ease of purchasing but somewhat limits purchasing guidance or oversight. The WKU Supply Services has created, “A Quick Reference to Western Kentucky University Supply Services: What you should know about the purchasing, receiving, and accounts payable process,” which can be found on their website, for campus faculty and staff. The document, last updated in June of 2007, begins with a Code of Ethics, derived from the Institute for Supply Management standard of purchasing practice. The Code of Ethics includes no reference or statement regarding recycled content, recyclable materials, or minimal packaging. There is no guidance, suggestion, or mention of environmentally responsible purchasing in this document or any other purchasing policies or procedures provided to WKU faculty and staff by the Department of Purchasing.

Ken Baushke is Director of Purchasing at WKU. Baushke rates the Purchasing Department as “average to poor” when it comes to sustainable purchasing but he does recognize sustainable purchasing as a trend in higher education and has identified some opportunities for improvement at WKU. While there are many resources available for
those interested in sustainable purchasing such as the National Association for Educational Procurement which offers training, conferences, workshops, resources, and a remarkably comprehensive sustainability “microsite” on their website, Baushke admits that there is not much focus on sustainable purchasing at WKU. Administration, faculty, and staff do not request sustainably manufactured items or recycled content materials. In fact, the recycled content in university paper products is a requirement of the Commonwealth, not the university. There is currently little consideration of the life-cycle analysis, waste or pollution prevention, or resource efficiency in purchasing decisions. There is no policy for buying Energy Star appliances or electronics.

The Purchasing and Supply Services department does keep a semi-trailer on site for recyclable construction materials (mostly metals) and has recently entered an agreement with Dell to recycle electronics and computer components. The department has also donated computer components to the McConnell Technology & Training Center for a nonprofit refurbishing program. Supply Services also sells used office and classroom furniture on e-bay but Baushke would like to see more re-use of these items on campus through some type of awareness or marketing program. There is a huge warehouse-size room full of used printers, desks, lamps, chairs and other items that could be utilized rather than buying new but, as Baushke says, they are a bit outdated and/or out-of-style.

WKU has a stated policy of working with Kentuckiana Minority Business Council and Kentucky Education Purchasing Consortium to find small, minority, and woman owned business enterprises from which to solicit quotes and bids. This policy is included in the Quick Reference document.
Many campus sustainability audits include use of paper as benchmark data. Since many departments and individuals throughout WKU order or buy paper independently, determining how much paper the campus uses is difficult. Some paper is ordered through WKU Online Printing Services. John Grismore, the WKU Post Office Supervisor, is responsible for ordering paper requested through the WKU Online Printing Services webpage. Grismore reports that paper ordered online through the printing services site totals about one million sheets of paper every 55 days.

Baushke performed a search of all paper ordered by the university, including paper purchased with procurement cards and ordered through the on-line printing service. Baushke estimates that for the fiscal year 2006-2007, the university used 46,757 reams of paper. This means that in 2006-2007, WKU used 23,378,500 sheets of paper: 1,344 sheets per CCM annually, or 64,050 sheets per day for the main campus. The Commonwealth of Kentucky requires that paper used by the university contain minimum 30% recycled content, so that is the default type of paper ordered through the printing services, however there is no way to tell whether individuals or departments that order paper independently buy recycled content.

**Recommendations for Change**

"*Green Purchasing is the method wherein environmental and social considerations are taken with equal weight to the price, availability, and performance criteria that colleges and universities use to make purchasing decisions.*"

-National Association of Educational Procurement

A search on the internet using the key words: "green purchasing by universities" brings up dozens of university green purchasing initiatives. Institutions of higher learning are realizing the benefits of sustainable purchasing policies including waste reduction,
increased value, and healthier product users, to name just a few. WKU is not only missing environmental, social, and economic benefits, but is acting unsustainably by not practicing sustainable purchasing policies.

If recycling is the first step toward sustainability, then source reduction may be the first step toward sustainable purchasing. Source reduction is the first and most effective goal of environmentally responsible solid waste management. Currently, WKU purchasing has no policy for source reduction in purchasing. One example is the gradual movement of all beverage dispensing machines from aluminum to plastic. There is currently no recycling value for plastic and a high value for aluminum. The sustainable choice is aluminum; however, according to the WKU Auxiliary Services, demand for plastic is higher, although average sales figures provided by purchasing do not reflect this (23% of machines dispense aluminum, 25% of sales are from aluminum machines). I suggest the formation of an ad hoc Campus Soft Drink Advisory Committee to investigate this issue and devise a strategy for the responsible management of soft drink packaging waste.

Many universities, such as the University of Colorado and the University of Michigan, have policies for purchasing which support environmental and social sustainability. Western Kentucky University should revise purchasing guidelines to reflect a commitment to source reduction and environmentally and socially responsible purchasing. Guidelines should include purchasing paper products and other products with high post-consumer content, low embodied energy, recyclable within WKU’s existing operation, nontoxic, energy efficient, durable and/or reparable, produced in an environmentally sustainable manner. The decentralized structure of university purchasing
allows for greater flexibility and ease of purchasing supplies but in no way regulates or encourages use of sustainable products. Providing guidance in purchasing without compromising ease is possible. A simple database, accessible to all departments and individuals who purchase items for university use, which lists sustainable resources and links to vendors would make purchasing easier, eliminating the time and stress associated with looking for products and vendors. When a product is needed, the purchaser may simply consult the “green product database” for guidance. The University of Michigan has a model system for green purchasing, which is profiled below.

There are organizations and resources, such as the EPA’s Environmentally Preferable Purchasing Program, that exist to assist universities and organizations in environmentally responsible purchasing. WKU Purchasing agents should take advantage of such opportunities for training and information.

**Campus Profile:**

**University of Michigan Green Procurement**

University of Michigan values Socially Responsible Procurement, defined as “supporting diversity, socially responsible procurement, and sustainability” (University of Michigan, 2007). “The MConnect Program promotes supplier participation that is reflective of the diverse business community, and of the University of Michigan’s desire to procure environmentally friendly products, while remaining focused on socially responsible procurement methodologies. These products are available through campus-wide vendors that support the university’s Environmental Stewardship initiatives” (U of Mich. Purchasing webpage). The University Contracts lists vendors that offer green products. For every product category, there is a list of suppliers. Next to each supplier
there are symbols to indicate that the supplier has recycled products, is a small business enterprise, is minority owned, disabled owned, or women owned business. All of this information is not only easily accessible, but hard to miss, posted on the Procurement Services webpage.
8. Transportation

WKU Parking and Transportation Department provides parking for students, faculty, staff, and visitors to the university, and shuttle service around campus and to and from campus from a satellite parking area at South Campus. According to Alonda Massey, Transit General Manager, WKU funds less than half of the department's operating costs; the majority comes from revenue generated from parking citations and permit sales. The department's new facility and some buses and capital equipment were funded by federal grants. The main campus has 6,679 parking spaces; parking lots cover about 17% of the main campus land surface, and there are two multileveled parking structures. There are nine shuttles, six of which are in service daily during the fall and spring semesters.

The University shuttles transport students around campus and from the Campbell Lane lot at South Campus, where there is ample parking, to the main campus. Monthly data on shuttle miles driven, fuel used, and ridership is in Table 9. For a map of the campus shuttle route see Appendix K. Ridership increased 40% from spring of 2006 to spring of 2007, and Jennifer Tougas, Parking and Transportation Director, attributes this increase to consistency of service. Massey spends time visiting other college campuses to ride on their transit systems, to get ideas, and learn what works. She is in the process of planning to make the shuttle schedule more easily accessible on-line and around campus, including plans for improved signage and extension of routes to include high-density areas of off campus residence. At the beginning of the fall semester, passengers won prizes for riding. Massey reported in October 2007 that the shuttles were carrying more than 15,000 passengers per week on average.
The shuttles began using 5% biodiesel in April 2007 and Tougas plans to increase use gradually to B20 (20% biodiesel). According to Massey the shuttles will be stepped up to 10% in the near future (Massey, October 2007).

Table 9. Campus Shuttle services: miles driven, gallons of fuel used, passengers carried, and hours in service per month. Source: WKU Parking and Transportation.

<table>
<thead>
<tr>
<th>Month</th>
<th>Miles</th>
<th>Gallons</th>
<th>Passengers</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2006</td>
<td>7,826</td>
<td>1,319</td>
<td>19,734</td>
<td>1,058</td>
</tr>
<tr>
<td>January 2007</td>
<td>5,264</td>
<td>1,326</td>
<td>23,232</td>
<td>764</td>
</tr>
<tr>
<td>February</td>
<td>13,744</td>
<td>3,105</td>
<td>54,399</td>
<td>1,257</td>
</tr>
<tr>
<td>March</td>
<td>10,255</td>
<td>2,761</td>
<td>42,785</td>
<td>934</td>
</tr>
<tr>
<td>April</td>
<td>13,775</td>
<td>3,237</td>
<td>51,014</td>
<td>1,260</td>
</tr>
<tr>
<td>May</td>
<td>4,219</td>
<td>1,130</td>
<td>13,181</td>
<td>515</td>
</tr>
<tr>
<td>June</td>
<td>2,478</td>
<td>485</td>
<td>4,942</td>
<td>387</td>
</tr>
<tr>
<td>July</td>
<td>2,259</td>
<td>541</td>
<td>5,170</td>
<td>389</td>
</tr>
<tr>
<td>August</td>
<td>3,610</td>
<td>1,420</td>
<td>18,372</td>
<td>351</td>
</tr>
<tr>
<td>September</td>
<td>16,121</td>
<td>3,806</td>
<td>63,832</td>
<td>1,125</td>
</tr>
</tbody>
</table>

The main campus has 6,679 parking spaces to serve approximately 20,000 students, faculty and staff. Parking lots cover about 17% of the campus proper land surface, including two multileveled parking structures. For a map of WKU parking see Appendix K. Lack of parking is a complaint commonly voiced by all members of the campus community and visitors to the university; however, this is not a situation unique to WKU. Limited space for parking is a problem on most campuses, and some have found creative, economic, and effective ways of addressing the problem. WKU Parking and Transportation staff are working on the problem as well: they believe that the answer to the limited parking availability at WKU is not to build more spaces (Parking Structure #2 was built at a cost of $12,000 per space) but to encourage alternative transportation to and around campus.

The department hired Transportation Analyst Dennis Cain to help with parking and transportation issues. He has sent out surveys to ask WKU drivers questions on
shuttle use, ease of transportation around the university, bike use, and pedestrian and vehicle safety. Cain also conducts other parking lot usage studies. For example, he found in a two-week survey of vehicles pulling into parking structure #2 between 7:30 and 9:00 A.M., 96% of commuters were in single occupancy vehicles.

In the 2006/2007 academic year, the following permits were sold by WKU Parking and Transportation:

STUDENT PERMITS:
- Housing Permits - 3,853
- Commuter Permits - 5,035
- Campbell Lane Commuters - 615

FACULTY/STAFF PERMITS:
- Non-Premium - 1,572
- Premium - 582
- Gated - 241
- University Regents - 22

MISCELLANEOUS PERMITS:
- Disability - 163
- Motorcycle - 99 (must have existing permit to obtain)

As one way of addressing the parking problem, the Department is working to find ways to promote bike riding and ridesharing programs. The department is charged with the responsibility of collecting abandoned and unclaimed bicycles around campus, and recently agreed to give these bikes to GreenToppers Students for Campus Sustainability to refurbish for the development of a bike lending program for the university community and visitors. This project is being overseen by Biology student and bicycling enthusiast Ellen Hagan, for course credit. Parking and Transportation Services Operations Manager Ginny Griffin has been working with DFM Grounds Manager Greg Fear to have additional bike racks installed on campus in response to an increase in bikes on campus in the Fall 2007 semester. There is also a movement by the city of Bowling Green to develop a more bike-friendly city, such as the development of bike lanes around the city and especially around the university.
The Parking and Transportation staff is also working with the city of Bowling Green to coordinate public and university transportation for use by students, staff, and faculty. Passes for Bowling Green Public Transit Go!Buses can be purchased at Western’s parking office at a slight discount of 25 rides for $25.00.

Western Kentucky University Fleet

The WKU fleet of vehicles is currently comprised of 193 vehicles owned or leased by the university for various departments and individuals including the nine shuttle buses, and three all-terrain, four-wheeler type vehicles. Most of the fleet vehicles are large passenger buses and vans or pick-up trucks or SUVs. None are hybrid or biodiesel fueled, except the shuttle buses. Fleet changes in recent years have included discharging most of a contingent of state compact sized cars for travel, and eliminating the use of 15-passenger vans for student travel, requiring departments to rent, purchase, or borrow multi-passenger vehicles for student field trips.

Biodiesel

Biodiesel is defined as mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, which conform to ASTM D6751 specifications for use in diesel engines. Biodiesel refers to the pure fuel before blending with diesel fuel. Biodiesel blends are denoted as "BXX" with "XX" representing the percentage of biodiesel contained in the blend (e.g., B20 is 20% biodiesel, 80% petroleum diesel) (National Biodiesel Board, 2007).

Biodiesel is a domestic, renewable fuel for diesel engines, which is made from vegetable oils, animal fats, or recycled restaurant greases. Biodiesel is made through a chemical process called transesterification. A reaction between animal fat or vegetable oil
with an alcohol such as methanol in the presence of a catalyst produces methyl esters (biodiesel) and glycerin as a byproduct (to be sold for use in soap or other products). Biodiesel is registered with the US EPA as a fuel and a fuel additive under Section 211(b) of the Clean Air Act. Biodiesel can be used in any concentration with petroleum based diesel fuel in existing diesel engines with almost no modification.

Some environmental benefits of biodiesel are that biodiesel contains no sulfur or aromatic compounds, and using a blend of 20% biodiesel reduces carbon dioxide emissions by 15% and produces less particulate matter, carbon monoxide, and sulfur dioxide emissions, all air pollutants under the Clean Air Act (U.S. Department of Energy, 2007). Biodiesel has a positive energy balance: for every unit of energy needed to produce a gallon of biodiesel, 3.24 units of energy are gained (National Biodiesel Board, 2007). Biodiesel degrades about four times faster than petroleum-based diesel fuel when accidentally released into the environment (U.S. Department of Energy, 2003).

Disadvantages of biodiesel, reported by the Union of Concerned Scientists (UCS), include possible increase in nitrogen oxide (NOx) emissions, depending on source and blend, and, while production of biodiesel creates approximately 95% less hazardous waste than petroleum diesel, it produces more than double the amount of non-hazardous waste (UCS, 2007). It is also important to note that current diesels produce 10 to 20 times more toxic particulates than gasoline powered models, more than can be made up for with the use of biodiesel (UCS, 2007). Biodiesel is a cleaner alternative than conventional diesel, but hybrid and fuel-efficient gasoline vehicles offer better emissions performance overall. Some advantages and disadvantages of biodiesel are listed in Table 10.
Table 10. Biodiesel compared with petroleum diesel.
From: EPA website: www.fueleconomy.gov/feg/biodiesel

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestically produced from non-petroleum, renewable resources</td>
<td></td>
</tr>
<tr>
<td>Can be used in most diesel engines, especially newer ones</td>
<td></td>
</tr>
<tr>
<td>Less air pollutants (other than nitrogen oxides) and greenhouse gases</td>
<td></td>
</tr>
<tr>
<td>Biodegradable</td>
<td></td>
</tr>
<tr>
<td>Non-toxic</td>
<td></td>
</tr>
<tr>
<td>Safer to handle</td>
<td></td>
</tr>
<tr>
<td>Use of blends above B5 not yet warranted by auto makers</td>
<td></td>
</tr>
<tr>
<td>Lower fuel economy and power (10% lower for B100, 2% for B20)</td>
<td></td>
</tr>
<tr>
<td>Currently more expensive</td>
<td></td>
</tr>
<tr>
<td>More nitrogen oxide emissions</td>
<td></td>
</tr>
<tr>
<td>B100 generally not suitable for use in low temperatures</td>
<td></td>
</tr>
<tr>
<td>Concerns about B100’s impact on engine durability</td>
<td></td>
</tr>
</tbody>
</table>

The Biodiesel Project

WKU Mechanical Engineering and Math Senior Ryan Simpson’s experience in making biodiesel began at home when his dad began using vegetable oil in his car and farm equipment two years ago. He built a biodiesel processor and uses raw vegetable oil from local restaurants in his hometown of Glasgow, Kentucky. When Jack Rudolph, chair of the agriculture department, approached Simpson’s advisor in engineering, Kevin Schmaltz, with idea of making biodiesel to run the WKU Agricultural Farm equipment from used vegetable oil produced in campus restaurants, Simpson took it on as his senior project. He designed a plan, researched suppliers, and developed a budget. Ogden College is funding the project, although Simpson and Schmaltz think of it more as a loan.

The biodiesel created from the processing system that Simpson and his teammates are building is planned to supply the Agriculture Department’s average 6,500 gallon per year fuel needs. Simpson estimates this will save the department $1.50 to $2.00 per gallon. If the agriculture vehicles use a B20 blend of biodiesel, they can reduce carbon dioxide emissions by 15%.
The processor will be built in an existing structure at the Agricultural Farm, and should be able to change 500 gallons of raw oil to biodiesel in two days. Raw oil is produced on campus, and the team is working with Aramark Dining Services and a Nashville raw oil processor, to get oil supplied free of charge. They are also considering other possibilities for the future, such as growing the oil right on the WKU Farm. This is not the only way they are looking forward. The processing system is scalable, designed for possible expansion to increase production capabilities to 1,000 gallons. It is the team’s hope that the entire campus shuttle fleet could be provided with biodiesel eventually.

The biodiesel project is a great blend of economics, technology, and sustainability. It involves cooperation of students and instructors from Departments of Engineering and Agriculture. Schmaltz hopes that the biodiesel system becomes an example for other universities where all the necessary components to make such a project possible are already in place (Schmaltz, pers. comm.).

**Recommendations for Change**

There is great potential for improved sustainability in WKU Parking and Transportation. Western’s geographic location in a small city within a rural area that has limited mass transit results in a large commuter component of the campus community. WKU could move toward a more car-free culture with the development of a campus-wide carpool permit incentive. Many students, faculty, and staff drive from neighboring towns every day. This is the perfect scenario for a successful ridesharing program, especially in light of current trends of increasing gas prices. Besides decreasing gas costs,
ridesharing incentives could include preferred parking spots and discounted parking permits.

One concern for potential carpoolers and public transportation users is the availability of a car during the day in case they need to run planned or unexpected errands, or in case they need to get home before the end of the workday for some reason. These issues can be addressed with the development of a “ride home” program, in which ride-share participants are guaranteed a ride home in case of emergency, or university establishment of a car borrowing program, such as the one outlined in the “Flexcar” section that follows. Availability of loaner cars also allows students to leave their cars at home (or sell them), providing for greater financial freedom realized from absence of gas costs, insurance, and car payments, and greatly reducing university parking pressures. Rather than investing in additional parking structures to attempt to meet demands that cannot ever be met, an alternative like a car-sharing or borrowing program seems the more sustainable choice.

To further the transition toward being car-free, our campus can become more bike-friendly, by placing additional bike racks and establishing storage and shower opportunities for bike riders. Many campuses are pedestrian only, improving air quality and promoting physical health. This may not be a possibility for WKU as the main campus is intersected by several heavily used streets.

**Big Red’s Bikes**

The creation of the bike lending program by GreenTopper Ellen Hagan is potentially a great service to the campus community and such programs have realized success on other campuses. GreenToppers received abandoned and confiscated bikes
from WKU Parking and Transportation for refurbishment for the program. With some volunteer help from students and members of the Bowling Green League of Bicyclists, Hagan rebuilt the bikes and painted them bright red. The plan for Big Red’s Bikes is to make them available for loan to students, faculty, staff, and visitors to campus.

Unfortunately, Hagan has had difficulty in finding a base for the lending program. She has approached university departments such as the Preston Health and Activities Center, Outdoor Recreation Adventure Center (in Preston), Downing University Center, and Students In Free Enterprise. Logistics such as how the bikes will be rented or borrowed, how they will be maintained, and where they can be stored are difficult to work out, particularly with regard to potential expenses. Hagan has approached the Office of International Programs to see if they would be interested in cooperating with GreenToppers to operate the Big Red’s Bikes program, and the partnership looks feasible and promising.

Additional WKU Parking and Transportation cooperation with BG Public Transit for reduced public transit tickets for faculty, students, and staff and expanded and complementary route scheduling would encourage ridership and decrease parking pressure. According to Massey, such plans are being discussed.

**Campus Profile:**

**The Ohio State University and Flexcar campus car-sharing program**

Ohio State University Transportation and Parking Services, as part of the university’s sustainability program, has partnered with Flexcar to provide a campus carsharing program that began in August 2007. Flexcar provides a total of 20 environmentally friendly cars on campus for use by university faculty, staff, and students,
as well as Columbus residents for hourly use. A simple fee includes gas, insurance, maintenance, parking, and 24/7 emergency service. The cars are conveniently parked at designated spots around campus, providing residents and employees use of a car without having to own or drive on to campus. Studies have shown that members of Flexcar increase their use of public transit and sell or avoid buying cars (Flexcar, 2007). The Flexcar program is a sustainability initiative that reduces number of cars on campus, both university and privately owned.

A Flexcar membership is $35 dollars, annually. Flexcar members reserve cars online or via touchtone phone, use a Flexcard to open the doors, drive the car for their trip, and return it to a reserved parking spot at the end of the reservation. The fee is $8.00 per hour or $55 per day and includes 150 free miles. The “point-click-drive” process and pay-as-you-go model is a natural fit for today’s students and Flexcar provides a diverse fleet, which includes hybrids and SUVs, from which members can choose.

Ohio State University Departments can create their own account and have work-related usage billed to the department. There are distinct programs for 21-plus year old students and undergrads (under 21-year olds must submit a Parent/Guardian Acknowledgment & Consent form), and carpool or rideshare participants get free Flexcar memberships. Flexcar is on many other University campuses including Georgia Tech, Portland State, University of Florida, University of Maryland, and University of Washington.
9. Food and Dining

All dining and catering services at WKU are outsourced to Aramark Services. Aramark’s WKU Restaurant & Catering Group manages all campus restaurants and food vendors. Food and dining options on campus include: the Fresh Food Company where a variety of meal choices are made to order, Garret Food Court, Java City outlets, the Bate Shop that offers convenience-type grocery items, two Subway locations, the RedZone sports-themed restaurant, DUC Food Court where options include Chick-fil-A, Taco Bell, and Pizza Hut, and Freshens/Java City which serves coffee, pastries, and smoothies.

First-year students who are required to live on campus are also required to enroll in either the 19, 14, or 10 (meals per week) Meal Memberships for the entire academic year. Meals can be used in the Fresh Food Company or for ‘Value Meals’ at any of the other dining locations on campus. Dining Dollars, a prepaid debit account, can be purchased to supplement Meal Memberships.

According to Gilbert Holts, Executive Chef, Fresh Food Company serves about 1.5 million meals annually, serving 500-600 at breakfast, 1000 – 1200 for lunch, and 1200 or more for dinner. The Fresh Food Company budget is more than $3 million annually (profit margins unknown). Some Fresh Food Company meals are made to order, as specified by the customer. While there are no dieticians or nutritionists on staff at WKU, recipes are selected from an Aramark e-recipe system, which provides a 10,000-plus recipe bank for schools, hospitals, hotels, and other institutions. Recipes include diabetic, low-sodium, gluten-free, vegan, and vegetarian options. This fall, recipes will be available for students to view on-line, complete with nutritional values. Fresh Food Company policy is to provide vegan and vegetarian options at every meal, and Aramark
planned to develop signage for fall 2007, advertising which selections meet vegan and vegetarian standards.

WKU Restaurant & Catering Group buys all produce from a wholesaler in Nashville, Tennessee. While some produce is locally or organically grown, local producers do not meet the quantity needs of WKU dining services (Holts, 2007). On average, for example, food services use 12-15 cases of head lettuce daily. Increasingly, as requests from customers grow, Aramark is attempting to find sources for organics and locally grown foods. The WKU Gardening Crew planted an herb garden just outside of Downing University Center (DUC) and Chef Holts uses the herbs regularly.

WKU Restaurant & Catering Group does not donate leftover food to any food bank due to liability issues. Some states have laws that release food providers from liability when donating leftover foods but Kentucky does not. There is potential for donation of used oil to the WKU engineering team for use in the biodiesel program, and an oil saving system is being considered for that project.

Many WKU events are catered annually, and the dishes and utensils for these events are usually specified or requested by the event planners. Use of biodegradable utensils, such as the “EarthWorks” corn-made compostable dinnerware used by Mammoth Cave Resort services, is not currently considered as an option. Metal utensils and dinnerware are much more expensive to order for events than disposable plasticware.

The WKU Restaurant and Catering Group currently does no composting and cannot even estimate volume of solid waste generated. They presently have no method for measuring waste generated in food services.
Aramark/WKU Restaurant and Catering has been working on “greening” its image with advertisements in food service areas for reducing your carbon footprint, saving water by not using trays, and similar initiatives. In the October 11, 2007 issue of the College Heights Herald, the Fresh Food Company ran an advertisement stating: “Vegetarian Fare now available everyday.” Also in October, WKU Restaurant and Catering Services posted a survey on campus email including such questions as: how important is locally or organically produced food to you? This is an annual nationwide survey but Tim Colley, Manager of WKU Dining Services says that questions about locally grown food and vegan options have been added only recently.

Aramark food service employees receive regular emails with suggestions and ideas for sustainability awareness activities. One example is the removal of trays for a day to show students that trays are an extra that costs in water and energy. Java City campus coffee shops try to feature at least one fair trade or organic coffee every day and sell “Eco-mugs” which can be used for discounted refills. The retail stores managed by Aramark on campus, such as the Bate Shop, Freshens, and Garret Food Court, are also offering a limited selection of organic choices in prepackaged foods.

Aramark Corporation has recently launched a sustainability campaign called “Green Threads,” to incorporate sustainability into its operations (Colley, pers. comm.). They are working with providers such as Ecolab and Sysco to begin using “green” cleaning products and healthier, low calorie food. The initiatives are more progressive in areas where students vocally exhibit a desire for sustainable dining operations. One change that Colley immediately initiated upon his arrival at WKU Restaurant and
Catering, is the inclusion of beans and rice as a regular menu choice. Because of the high nutritional value of the combination, he feels it is an essential offering for vegetarians.

**Recommendations for Change**

According to the Worldwatch Institute, food transportation is among the biggest and fastest-growing sources of GHG emissions worldwide and the average food item in America now travels at least 1,491 miles from farm to plate. WKU Restaurant and Catering Group could make a greater effort toward finding local sources of food to serve in Fresh Foods and to offer as catering options. There is an entire network of Kentucky farmers and producers called “Kentucky Proud” to make this effort easier. There is also potential for food produced on the WKU farm to be served on campus. Currently there is no consideration of this type of partnership or cooperation. Yale’s Berkeley College obtains nearly half its food from local farmers who practice sustainable farming. The university creates a significant market for sustainable agriculture in the area and the locally grown ingredients have raised the quality and popularity of the dining hall (The Apollo Alliance and Energy Action, 2004).

Fresh Food does a good job of providing dining options for alternative diets such as vegan and vegetarian but does not advertise these options well nor offer a substantial selection of organically or locally grown products. For those students wanting to eat sustainably, WKU Restaurant & Catering could offer greater selection of these options, advertised actively with appropriate signage. Researching and finding sources of locally grown and organically grown food can be a big job. Some colleges and universities have created a position for a person to work on sustainability in campus dining services. Berea
College’s food service is provided by Sodexho. Sodexho has created the position of food sustainability coordinator at Berea, which is described in detail in the profile below.

WKU Facilities Management and Department of Agriculture could partner to establish a composting program. WKU Restaurant and Catering currently has no idea of how much food waste enters the solid waste stream, but food waste volume is estimated by both food service employees and waste management employees to be substantial. Food waste could be diverted from the landfill to a composting program that would benefit the WKU farm, agriculture students, and possibly even generate revenue. This is a program that has been very successful on some university campuses. The Washington State University Composting program is profiled below.

**Campus Profiles:**

**Berea College Sodexho Food Sustainability Coordinator**

The Berea College Local Food Initiative (BCLFI) began in 2004 with faculty, staff, and student participation. The goal of the group was to work with Sodexho, Berea’s food service provider, to use local foods in their cafeteria. While costs and logistics were of concern, the most complex issue was Sodexho’s liability insurance requirements for their suppliers. Sodexho requires $5 million liability coverage of every producer, a barrier to smaller, local producers. The BCLFI did comprehensive research on this and other barriers and in 2005 produced a proposal to the Berea Administrative Committee. One solution was that Berea’s insurance covers college grown products, produced at Berea’s farm, so these products could be used in the cafeteria. Salad greens were almost immediately purchased by Sodexho but meat products took further negotiation. While not all of the foods served in Berea’s cafeteria are locally produced, an ever-growing
selection is. Berea College Food Service Manager, David McHargue, employed by Sodexho, now serves as Sodexho’s coordinator for local foods initiatives at all of Sodexho’s four Kentucky college accounts (Smithson, 2007).

In 2007, Sodexho created the position of Sustainability Coordinator for its Berea operations. The role of this position is to oversee the Sodexho Sustainability Program in all aspects including local food, recycling, energy conservation, and composting of food wastes. Using resources on and off campus, the Sustainability Coordinator works with students, Sodexho staff, and the campus community to get food from local farmers to students’ plates.

The Washington State University Composting Facility

The Washington State University Center for Sustaining Agriculture and Natural Resources began initial planning for the WSU Compost Facility in 1992 with the goals of enabling WSU to manage the manure waste stream generated by animals used for research and teaching responsibly, and to meet state-mandated goals for enhanced recycling and increased landfill restrictions. They identified the following components of their solid waste stream: coal ash, dairy and beef manure, separated beef and dairy solids, dining center food wastes, waste paper, and campus yard wastes. A $314,000 proposal to build the composting facility was fully funded by Business Affairs in 1993. In 1995, the facility received $400,000 to expand, to be repaid by the Compost Facility with funds generated by the operation. At present, the Compost Facility comports approximately 25,000 cubic yards annually on four acres of asphalt surface. Operational equipment includes a 12-foot straddle windrow turner, front-end loader, two large dump trucks, a large mechanical shaker screen, and a belt conveyor to load trucks. There are three full-
time employees, a manager, a heavy equipment operator and truck driver. The Compost Facility currently sells finished compost wholesale to local retailers, is used on the WSU research farms, golf course, and grounds landscaping. Substantial savings are being realized in solid waste costs.

The Compost Facility is associated with many other campus departments including Animal Sciences, Crop and Soil Sciences, Center for Sustaining Natural Resources, Biological Systems Engineering, Dining Services, University Recycling, and Environmental Health and Safety. Students conduct research at the facility, a 400-course-level composting class is offered, workshops and outreach classes are offered for local elementary schools and garden clubs, and tours are conducted regularly.

Western Kentucky University has great potential for such an initiative. Many of the components that ensured the success of the WSU Composting Facility exist at WKU, including the agricultural interest and infrastructure. The WSU project has been a great asset to the university and a potential model for other universities such as WKU.
10. Sustainability in the Curriculum

“If you are thinking a year ahead, sow a seed. If you are thinking ten years ahead, plant a tree. If you are thinking a hundred years ahead, educate the people.”

-Chinese Poet, 500 B.C.

In October of 2007, with approval of the WKU Human Subjects Review Board, an informal email survey was sent to all WKU faculty and staff to inquire about the use of sustainability as a concept in courses at WKU. The survey can be viewed in its entirety in Appendix M. The survey asked for submission of the following information:

1. courses that include sustainability as a theme or concept,

2. how much time is spent on the subject (is it the whole course, or is it one lecture?), and

3. how often those courses are offered.

I also requested anecdotal information about instructors’ experience with such courses or topics in classes, such as enrollment trends and student responses.

The survey resulted in responses from 14 individuals from seven WKU Departments. Table 11 lists the courses and other projects submitted, as well as comments on the degree to which sustainability is included in some courses. This is not a comprehensive list of courses that address sustainability concepts at WKU, as not all instructors that include such courses or concepts in their courses responded here. Here, only information received in response to the survey inquiry is reported.
Table 11. WKU courses that are reported to include sustainability as a concept or theme. The courses listed in this table were submitted in response to a survey sent to WKU faculty and staff requesting information on courses that include sustainability as a concept or theme. This list is not comprehensive, as all instructors did not respond. Source: Christian Ryan-Downing sustainability in the curriculum survey, 2007.

<table>
<thead>
<tr>
<th>College or Department and submitting Instructors</th>
<th>Course</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Architecture &amp; Manufacturing Sciences</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neal Downing, American Institute of Architects</td>
<td>AMS 360 – Architectural Design Studio I</td>
<td>Each project in these courses must address the issues of sustainability and green design as a standard component of methodology.</td>
</tr>
<tr>
<td></td>
<td>AMS 460 – Architectural Design Studio II</td>
<td></td>
</tr>
<tr>
<td>Neal Downing</td>
<td>AMS 261- Construction – Methods and Materials</td>
<td>Sustainability is included as a concept.</td>
</tr>
<tr>
<td><strong>Department of Biology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Michael Stokes, Ph.D.</td>
<td>Biology 113 – General Biology for non-majors</td>
<td>The topics of pollution, population, and recycling were cited as sustainability concepts that are discussed in these courses.</td>
</tr>
<tr>
<td>Michael Smith, Ph.D.</td>
<td>Biology 122 – Biological Concepts: Evolution, Diversity &amp; Ecology</td>
<td></td>
</tr>
<tr>
<td>Philip Lienesch, Ph.D.</td>
<td>Biology 224 – Honors Animal Biology and Diversity</td>
<td></td>
</tr>
<tr>
<td>Steve Huskey, Ph.D.</td>
<td>Biology 315 – Ecology</td>
<td></td>
</tr>
<tr>
<td>Albert Meier, Ph.D.</td>
<td>Biology 369 – Mammoth Cave Internship</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biology 415 – Ecological Methods</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biology 459 – Mammalogy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biology 485 – Conservation and Management of African Wildlife</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biology 497 – Aquatic Ecology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biology 515 – Ecological Concepts</td>
<td></td>
</tr>
<tr>
<td>Ouida Meier, Ph.D.</td>
<td>Conservation Biology Seminar</td>
<td>These are “one-time” courses that included sustainability as a theme throughout.</td>
</tr>
<tr>
<td></td>
<td>Conservation Ethics – Honors Colloquium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marine Biology, Geology and Biology of the Bahamas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Splendor of Coral Reefs – Field Research Methods in Belize</td>
<td></td>
</tr>
<tr>
<td><strong>Department of English</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wes Berry, Ph.D.</td>
<td>English 200-17 Introduction to Literature - Special Section on Health and the Environment for Dept. of Health and Human Services Living and Learning Community</td>
<td>These courses include sustainability as an emphasized concept or theme.</td>
</tr>
<tr>
<td></td>
<td>ENG 399 – Literature, Culture, &amp; Environment / SOC 470 – Environmental Sociology (offered for English or Sociology credit)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>English 495 - Southern Literature</td>
<td></td>
</tr>
</tbody>
</table>
| Center for Math, Science, and Environmental Education | ENVE 520 – Introduction to Environmental Education  
ENVE 580 – Instructional Strategies in Environmental Education – Land Between the Lakes Institute  
ENVE 585 – Special Topics in Environmental Education | These courses focus on environmental literacy, the concepts of systems, and interconnectedness of the natural environment. Sustainability is included as a theme. |
| --- | --- | --- |
| College of Education & Behavioral Science  
Terry Wilson, Ph.D. | SEC 351 – Teaching Strategies for the Secondary School | This course introduces sustainability as a theme for integrating curriculum. |
| Department of Geology and Geography  
John All, J.D., Ph.D.  
Daniel Reader, M.S. | GEOG 210 - Human Ecology  
GEOG 280 – Introduction to Environmental Science  
GEOG 328 - Elements of Biogeography  
GEOG 416 - Remote Sensing  
GEOG 444 - Environmental Ethics in Geography  
GEOG 455 - Global Environmental Change  
GEOG 471 – Natural Resource Management  
GEOG 474 - Environmental Planning  
GEOG 475 – Principles of Global Sustainability  
GEOG 487 - Environmental Law and Ethics | These courses are reported as entirely devoted to sustainability concepts.  
*Geography and Geology instructors also report having 5-10 students working on independent studies involving sustainability and several graduate students working on thesis’ that address the concept. |
| Philosophy & Religion  
Jan Garrett, Ph.D.  
. | PHIL 320 – Ethics  
PHIL 350 – Ethical Theory | These courses include discussions of environmental ethics or provide opportunity for discussions of sustainability issues if there is sufficient interest among students. |
| Jan Garrett, Ph.D. | PHIL 321 – Morality and Business | These courses include moral dimensions of issues including environmental impact. |
| Gordon Ford College of Business  
Leadership Studies Program  
John Baker, Ph.D. | LEAD 200 – Introduction to Leadership Studies  
LEAD 500 – Effective Leadership Studies  
Leadership Studies Certificate Program | These courses include discussion of stewardship of resources as a leader function. |
While the list in Table 11 is mostly limited to course numbers and titles, many of these courses include field trips or are conducted outdoors. In some of these courses, required readings focus on ecological, environmental, and sustainable issues and concepts. Several courses require student projects that require a study of an environmental issue or topic. Some course instructors provided additional insight or information that they granted permission to be reported here.

Neal Downing, Architecture and Manufacturing Sciences Instructor and member of the American Institute of Architects, has formally committed to incorporating sustainability into his courses through the Architecture 2030 "2010 Imperative." Architecture 2030 is a nonprofit, nonpartisan independent organization with the mission to transform the U.S. and global Building Sector from being part of the problem to being part of the solution. Their goal is “to achieve a dramatic reduction in the global-warming causing greenhouse gas emissions of the Building Sector by changing the way buildings and developments are planned, designed and constructed” (Architecture 2030, 2007). The “2010 Imperative” states that ecological literacy must become a “central tenet of design education” and calls upon the faculty to commit to principles such as using design problems that engage the environment and reduce needs for fossil fuels, achieve complete environmental literacy in design education, and by 2010 achieve a carbon-neutral design campus (Architecture 2030, 2007).

Daniel Reader, Instructor in the Department of Geography and Geology reported that in the spring of 2008, the Department will introduce a course, GEOG 475, “Principles of Global Sustainability” devoted entirely to the subject of sustainability. The course has been submitted for approval as a permanent addition to the Environment and
Sustainability track in the Geography major and if approved, will be listed as GEOG 380 and offered annually. Currently Reader incorporates sustainability concepts into classes such as Human Ecology, which uses Jared Diamond’s *Collapse* as the primary reading; Environmental Science, in which emphasis is placed on what practices contribute or detract from environmental sustainability; and Environmental Ethics. Reader describes student responses to presentation of issues of sustainability ranging from “wholehearted enthusiasm and concern to skepticism and stubborn resistance.” Reader observes that “many students find themselves in the position to make personal decisions, or revise their worldviews, based upon information presented in these courses that is often uncomfortable for them.” He also discusses the challenges of presenting such information: “I make every effort to describe current circumstances and reasonable projections in an unbiased way, yet I personally find it impossible to remain entirely stoic in the portrayal of events with such momentous ramifications.” Overall, he observes positive reaction to the courses. Each semester a few students come to him to change their majors to Geography in the Environment and Sustainability track. “The take-home message I hope to convey is that, while there remains hope for achieving a sustainable way of life, the price goes up with each passing day” (Reader, pers. comm.).

Terry Wilson, Director of the Center for Math, Science, and Environmental Education, in cooperation with faculty from the WKU Colleges of Ogden, Health and Human Services, and Education, has developed Environmental Education courses for educators. The courses are designed to provide teachers with an opportunity to earn an Environmental Education endorsement, but students from varying disciplines enroll in his courses. The ENVE 580 course is a 3 hour credit course conducted as an intensive week-
long stay at Land Between the Lakes. In SEC 351, which is a secondary education course for future high school teachers, sustainability is introduced as a theme that can be built into curriculum units.

Wes Berry, Assistant Professor of English and Literature, incorporates sustainability into his courses with writing assignments, field trips, and in his required reading. His cross-listed Literature, Culture & Environment class (English 399 and Sociology 470) takes field trips to Mammoth Cave, the Tremont Institute in the Smokey Mountains, and a “green” farm near Scottsville, Kentucky. The required reading lists for his courses include such works as Lester R. Brown’s *Plan B 2.0: Rescuing a Planet Under Stress & a Civilization in Trouble*, Kentuckians for the Commonwealth’s, *Missing Mountains*, Wendell Berry’s *In the Presence of Fear: Three Essays for a Changed World*, Michael Pollan’s *The Omnivore’s Dilemma: A Natural History of Four Meals*, Ruth Ozeki’s *My Year of Meats*, Bill McKibben’s *Enough: Staying Human in an Engineered Age*, and Ken Lamberton’s *Wilderness and Razor Wire: A Naturalist’s Observations from Prison*.

Derick Strode, WKU International Student Advisor for the WKU Office of International Programs (OIP) responded to my inquiry as well, reporting that the office recycles everything possible, and that they have “deliberate efforts to extend the green message” to their approximately 550 international students. The Director of International Programs, Robin Borczon, acts as the catalyst for the OIP’s green efforts. In their Fall 2007 new international student orientation, new students’ information was placed in reusable shopping bags, rather than the typical plastic bags. The bags were printed with the Office of International Programs logo and the message that “WKU International Students
Recycle,” and students were encouraged to use them for shopping. In orientation, students were informed of how to recycle at WKU and how to get bins from Southern Recycling if they live off-campus. The OIP plans to make this part of their orientation next for the spring semester in January 2008 as well.

At present, the topic of sustainability seems present in courses in which sustainability or environmental conservation is a fundamental concept, as in some natural science courses, or is incorporated into curriculum in courses where instructors feel personally compelled to do so. That it was reported as a theme or concept incorporated into very different types of courses from a diversity of colleges and departments supports the idea that sustainability is an interdisciplinary concept that applies in many areas of study. Several instructors reported that they observed students becoming more interested as they became more aware or informed on the subject, which suggests the possibility that from an academic aspect, WKU may be falling short in providing opportunities for students to be exposed to these concepts. Fortunately, instructors recognize the importance of including ecological literacy in their curriculums. However, 14 respondents is a very small representation of the entire faculty so determining from this survey the extent to which WKU students are being exposed to sustainability concepts is difficult.

**Recommendations for Change**

Because sustainability encompasses a variety of disciplines including science, economics, engineering, geography, geology, education, business, agriculture, sociology, philosophy, religion, law, ethics, health, recreation, nutrition, and many others, it can, and
should be integrated across the university curriculum. An integrated approach could emphasize the interconnections between disciplines and build interdisciplinary skills, intellect, and sense of community on the WKU campus. The WKU Quality Enhancement Plan (QEP) theme is “Engaging Students for Success in a Global Society.” Ecological literacy is essential in preparing students to be productive and engaged citizens of a global society. Each of the ten QEP Initial Action Initiatives provides opportunity for incorporation of sustainability concepts or projects.

Many college students are looking for programs or courses which focus on sustainability and universities are responding to this demand. New York University has established an Environmental Studies major. Arizona State University now has a School of Sustainability which offers Bachelor’s, Master’s and Ph.D. degree programs related to environmental challenges. The ASU School of Sustainability only opened in fall 2007 but it is reported by AASHE that employers are already recruiting the first-year students for jobs upon graduation. Many universities offer sustainability and environmental studies minors. If WKU is going to continue to be a Leading American University with International Reach, sustainability should be incorporated into university academics and operations.

Campus Profile:

University of British Columbia

The University of British Columbia (UBC), Vancouver, B.C. Canada, has a sustainability strategy with 68 specified targets and actions for achieving nine major goals. UBC has achieved Kyoto Protocol targets for GHG emissions reductions while saving $3.8 million in energy costs in three years. The UBC sustainability office employs
seven staff members and ten students and is funded entirely by savings in energy reductions. The institution has developed its own green building assessment program featuring energy efficient lights, bicycle storage, stormwater management, and more. More than 300 courses include sustainability as a concept or theme and several departments have adopted sustainability as a core value.

**Murdoch University**

The Institute for Sustainability and Technology Policy at Murdoch University in Western Australia offers Bachelor degree programs in Sustainable Development and Local Governance and postgraduate certificates or diplomas, Masters and Doctoral degrees in programs such as City Policy, Ecologically Sustainable Development, Asian Sustainable Development, Transport Studies, and Local Governance.

**University of Kentucky**

The University of Kentucky offered over 60 courses that incorporate sustainability as a central theme or concept in 2006-2007. These courses are offered in the College of Agriculture, College of Design, and College of Arts and Sciences. Some course examples are Environmental Chemistry, Food and Food Security in a Changing World, Pollution, Hazards and Environmental Management, Principles of Environmental Law, Sustainable Energy Efficient Building Design, The Sustainable City: Past, Present and Future, and Plants, Soils, and People: A Global Perspective. Furthermore, the College of Arts and Sciences has established an interdisciplinary environmental studies minor for undergraduates with a focus on sustainability.
Conclusion

Western Kentucky University is well-positioned to become more sustainable. This assessment reveals a multitude of opportunities for sustainability initiatives in university operations and academics. Possibilities for increasing sustainability at WKU range from changes in the physical campus to the engagement of campus community members. The data included in this report provide insight into where to focus sustainability efforts and a starting point against which future successes can be measured.

Average annual energy consumption for each campus community member is 4,139 kWh of electricity, 527 pounds of coal, 3,600 cf of natural gas, totaling over 22 million Btus, costing $317 and emitting 3.34 metric tons of greenhouse gas emissions. Additionally, 14,244 gallons of water are used, and 248 pounds of solid waste are generated per campus community member annually.

WKU’s physical growth provides opportunities to incorporate elements of energy efficiency and sustainable design into new buildings and renovations that, if considered from the first stages of planning, are no more expensive than conventional buildings and provide permanent and substantial savings in energy and water. WKU’s use of fossil fuel generated energy resulted in approximately 58 metric tons of greenhouse gas emissions in the 2005-2006 academic year. The university energy costs and carbon footprint can be reduced through numerous initiatives including physical and policy change and awareness and education campaigns that engage students, faculty, and staff. Sustainable building design and construction and energy conservation measures have indirect positive impacts, reducing water use, blending with the natural landscape, and reducing water and air pollutants.
The WKU main campus generates more than 2,100 tons of solid waste annually, of which less than 4% is recycled. Investment into recycling infrastructure improvements can create a program that is economically self-supported through revenue from recyclables and avoided landfill fees. WKU presently has no policy for environmentally responsible purchasing. The main campus uses nearly 64,000 pieces of paper each day and there are over 2,100 staff and faculty computers. Purchasing policy that directs the use of recycled content paper, and energy efficient computers reduce waste, and save money in energy costs. A “green purchasing” guide for faculty and staff could also provide such benefits.

University shuttles have begun to decrease carbon emissions by using 5% biodiesel and plan to increase the blend to 20% for further reductions. Campus and community initiatives such as the bike lending program, addition of bike lanes on streets around the campus, and expansion of shuttle service are progress toward increased sustainability. Further steps could include purchase of hybrid cars for the university fleet and the establishment of a ride-share program for commuters.

According to the Worldwatch Institute, food transportation is the biggest and fastest-growing source of greenhouse gas emissions worldwide. WKU Restaurant and Catering Group could decrease the university carbon footprint while supporting the local economy by using food produced locally. Additionally, WKU food services could reduce environmental impacts and landfill fees by composting food waste.

A survey sent to WKU faculty requesting submissions of courses that include sustainability as a concept or theme resulted in response from individuals in eight university departments and included 42 courses. Ecological literacy is essential in
preparing students to be productive and engaged citizens of a global society. The WKU Quality Enhancement Plan Initial Action Initiatives provide opportunity for incorporation of sustainability concepts and projects.

In the time I spent compiling information for this report, I found it difficult to keep up with newly forming efforts toward sustainability at WKU. While there are increasing attempts toward sustainability on the WKU campus, these efforts are currently preliminary and scattered. Advancement toward a more sustainable campus could be greatly facilitated by several fundamental changes: the visible and active support of university administrators, the creation of a campus wide sustainability advisory committee and the creation of the position of a sustainability coordinator. Furthermore, sustainability must be a guiding force in the WKU Master Plan. These changes set the tone for the entire campus community, encouraging student, faculty and staff engagement and innovation in sustainability initiatives.

Finally, the following areas should be priorities for further investigation: Those buildings with energy meters should be inventory and meters checked for accuracy, existing meters should be read and data recorded monthly. The GHG emissions inventory is incomplete as it stands; investigation into reasons for inconsistencies in calculation protocols and stack test results is crucial. The inventory should include a much broader scope of emissions sources such as transportation and waste generation. The CA-CP protocol is an engaging tool for students and such a project would be appropriate for a class or student group. On-site testing of storm water runoff air quality testing for pollutants could identify campus specific sources of pollutants. Food waste must be measured to identify relative contribution to solid waste stream and potential for more
responsible management such as composting. Elements of transportation such as air travel and average commute of the campus community are important sustainability indicators and require investigation. A more inclusive list of courses that incorporate sustainability as a concept should be generated as the list presented here excludes those courses not submitted in response to my survey. Additionally, there are many other prospective areas of investigation and research, including several indicators not included here such as health and well-being, recreation, volunteerism, diversity, sustainability research and funding, toxic and chemical waste management, and pest management.
CHAPTER II: REDUCE YOUR USE!

Introduction

The REDUCE YOUR USE! Challenge 2007, a resource conservation competition between two dorms was a project that I designed and conducted and was sponsored by GreenToppers Students for Campus Sustainability. The purpose of the project was to increase awareness of the environmental impacts of energy and water use on campus, and for students to find ways to reduce consumption of these natural resources.

Methods and Materials

The first annual REDUCE YOUR USE! Challenge was piloted in Bemis-Lawrence and Barnes-Campbell Halls, twin buildings with the same floor plan and number of residents, about 400 first-year students per hall in double occupancy rooms. These two halls competed to reduce use in their buildings of electricity for the month of October 2007. Before the October competition, efforts to increase awareness about conservation of energy and water in Bemis and Barnes Halls began with the placement of sustainability-themed welcome packets in each room of both halls. The welcome packets were in the rooms when students arrived in August, and contained information on energy conservation, stormwater pollutants, recycling, and other sustainability concepts. A copy of the welcome letter describing the contents of the packets is in Appendix N.

The Reduce Your Use! challenge coincided with a campus-wide awareness campaign focused on global climate change. The global warming awareness campaign is one of four issues under the Political Engagement Project 2007-2008 theme, “The Great Conversation.” Various events within the campaign were co-sponsored by WKU’s Political Engagement Project, GreenToppers Students for Campus Sustainability,
Campus Activities Board, African American Studies, Department of Political Science, and the Cultural Enhancement Series. Events and activities planned to spread awareness and facilitate the conversation included sound-offs with video petitioning to presidential candidates, a screening of Al Gore's *An Inconvenient Truth*, the performance of Cultural Enhancement speaker Jeff Corwin from *Animal Planet*, and the October 23 and 24 screening of the 4-hour CNN special series, *Planet in Peril*, a collaboration between Anderson Cooper, Jeff Corwin, and Sanjay Gupta.

To encourage greater participation in “Reduce Your Use!” I worked extensively with Resident Assistants and Directors for these halls to learn how they could be motivated to conserve energy. The Resident Assistants reacted very positively to the men versus women aspect of the competition and volunteered to make posters, bulletin boards, and to design T-shirts promoting the competition and informing students what they can do on a personal, everyday level, to use resources more conservatively, such as turning off lights, unplugging chargers, powering down computers, resetting thermostats, taking shorter showers, and turning off the water when brushing their teeth. The Resident Assistants also helped to pick prizes. The women overwhelmingly expressed the desire for 24 hour visitation as the grand prize. This was a prize that cost nothing and required a little more work from the Resident Assistants, who were pleased to do it. Unfortunately, this is a prize that HRL Director Brian Kuster was not able to grant. They also asked for a DVD player and DVD library for their dorm lobby and the men voted for a Nintendo Wii for their lobby as a prize.

The men suggested including collection of plastic bottles and paper to recycle as part of the competition (they currently only collect aluminum in the dorms). Because
recycling is an effective way to reduce energy and water use, we decided this was a great component to add. The students were also able to obtain “offsets” for consumption by filling out and submitting “stamp out global warming” postcards, participating in video petitioning opportunities at certain events, and attending the awareness events outlined above.

During the competition, data on energy consumption and points earned in “offsets” were monitored and reported back to students weekly on a poster display in each lobby. Energy conservation competitions at other universities have been more effective with some type of feedback mechanism such as this. Throughout the month of October, students were engaged in programming to maintain interest. Prizes (sweatshirts and throws donated by the University Bookstore) were awarded to Resident Assistants that made the best bulletin boards (as determined by GreenTopper judges) and each week a “Stamp Out Global Warming” postcard was drawn from a box in each building’s lobby, and the person whose name was on the postcard received a sustainable paper notebook (donated by the University Bookstore) and an EcoCup (reusable coffee cup), donated by Java City.

Energy use was measured in kilowatt hours, as reported each week from meter readings from two meters within each building. Recycling was collected and weighed each week at Southern Recycling. Dorm residents collected plastic and mixed paper to recycle, and offsets earned by recycling were 10 kWhr per pound of recycling (taken from rough estimates of how many kilowatt hours are saved from recycling approximately a pound of recycled plastic bottles).
The building that had the lowest use of electricity and earned the most offsets received a grand prize. This dorm will hold the title of REDUCE YOUR USE! Challenge winners for 2007, and received a “Reduce Your Use!” Trophy (created by a WKU art student from completely recycled materials), to be held until the 2nd annual challenge in 2008.

Results and Discussion

Barnes-Campbell Hall, the men’s dorm, was the winning building by only 1,230 kilowatt hours. For the month of October, Bemis, the women’s dorm, used a total of 43,547 kWh and Barnes used 42,317 kWh. Bemis recycled 143 pounds of plastic and paper, while Barnes recycled 145 pounds. Results are shown in Tables 12 and 13. The students filled out about the same number of global warming postcards, about 24 per building, and to my knowledge did not attend any of the offset activities offered on campus (they were instructed to sign in with a GreenTopper volunteer).


<table>
<thead>
<tr>
<th>October 2007</th>
<th>Bemis kWh used</th>
<th>Barnes kWh used</th>
</tr>
</thead>
<tbody>
<tr>
<td>D meter</td>
<td>M meter</td>
<td>D meter</td>
</tr>
<tr>
<td>1st</td>
<td>298,147</td>
<td>2,007,560</td>
</tr>
<tr>
<td>8th</td>
<td>299,545</td>
<td>2,016,561</td>
</tr>
<tr>
<td>15th</td>
<td>301,379</td>
<td>2,026,088</td>
</tr>
<tr>
<td>22nd</td>
<td>303,090</td>
<td>2,035,574</td>
</tr>
<tr>
<td>29th</td>
<td>305,037</td>
<td>2,044,217</td>
</tr>
<tr>
<td>Total</td>
<td>43,547</td>
<td>42,317</td>
</tr>
</tbody>
</table>
Since the Barnes building requested a Nintendo Wii as their grand prize, I gave them information on "greening your Wii" that instructs users on how to change default settings for energy efficiency.

An unanticipated problem encountered was the issue of removing the "loaner" recycling collection bins for plastic bottles at the end of the competition. Resident Assistants voiced major disappointment that the plastic recycling opportunity was being removed. The issue is that there is no one to pick up and process these bottles (I did it as a volunteer during the competition). The Hall Directors and Resident Assistants expressed their intent to work with HRL Director Brain Kuster and DFM Grounds Manager Greg Fear to find a solution to this problem.

A major problem encountered for this project was the lack of reliable baseline data for energy use for each building. Pam West, Associate Director of Facilities for HRL, assured me when I was planning the project that she could provide baseline data, but upon receiving the data, I found that there were several months where data was missing due to a broken meter. Furthermore, where data existed, only one of two meters for each building had been recorded (Table 14). Extrapolation from the partial data available preceding the contest suggests that Bemis may use an average of 13% greater

---


<table>
<thead>
<tr>
<th>Pounds recycled October 2007</th>
<th>Bemis</th>
<th>Barnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8\textsuperscript{th}</td>
<td>55</td>
<td>34</td>
</tr>
<tr>
<td>15\textsuperscript{th}</td>
<td>22</td>
<td>28</td>
</tr>
<tr>
<td>22\textsuperscript{nd}</td>
<td>38</td>
<td>41</td>
</tr>
<tr>
<td>29\textsuperscript{th}</td>
<td>28</td>
<td>42</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>143</strong></td>
<td><strong>145</strong></td>
</tr>
</tbody>
</table>
energy than Barnes. Using the available historic data, the monthly total average of Bemis is 46,871 kWh and the monthly average for Barnes is 40,692 kWh. These averages plus the October data, suggest an 11% greater use for Bemis than Barnes. If this is the case, and Bemis residents use an average of 11-13% greater energy than Barnes, results of the energy conservation competition show a significant reduction in energy use for the Bemis residents for the month of October, as their use for that month was only 3% greater than Barnes. Continued monitoring of meters and collection of data could confirm if this is the case.

Pictures of Reduce Your Use awareness posters, bulletin boards, winners, and recycling efforts are in Appendix O.

Table 14. Baseline data provided for electricity use in Kwh in Bemis-Lawrence and Barnes Campbell Halls from June 2006 to August 2007. Readings were taken the 15th of each month.

Source: Pam West, Assistant Director, Housing and Residence Life. 2007.

<table>
<thead>
<tr>
<th></th>
<th>Bemis readings</th>
<th>Kwh used</th>
<th>Barnes readings</th>
<th>Kwh used</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>1377119</td>
<td>990280</td>
<td>1406032</td>
<td>1014441</td>
</tr>
<tr>
<td>July</td>
<td>1441408</td>
<td>1042815</td>
<td>1482457</td>
<td>1077068</td>
</tr>
<tr>
<td>Aug</td>
<td>1546830</td>
<td>1131547</td>
<td>1562698</td>
<td>1142827</td>
</tr>
<tr>
<td>Sept</td>
<td>1482457</td>
<td>111049</td>
<td>1610206</td>
<td>1175089</td>
</tr>
<tr>
<td>Oct</td>
<td>1546830</td>
<td>1131547</td>
<td>1610206</td>
<td>1175089</td>
</tr>
<tr>
<td>Nov</td>
<td>1562698</td>
<td>1142827</td>
<td>1648426</td>
<td>1201256</td>
</tr>
<tr>
<td>Dec</td>
<td>1694120</td>
<td>1233224</td>
<td>1694120</td>
<td>1233224</td>
</tr>
<tr>
<td>Jan</td>
<td>1732215</td>
<td>1259385</td>
<td>1732215</td>
<td>1259385</td>
</tr>
<tr>
<td>Feb</td>
<td>1779950</td>
<td>meter broken</td>
<td>1779950</td>
<td>1201256</td>
</tr>
<tr>
<td>March</td>
<td>1837404</td>
<td>meter broken</td>
<td>1837404</td>
<td>1259385</td>
</tr>
<tr>
<td>April</td>
<td>1865490</td>
<td>meter broken</td>
<td>1865490</td>
<td>1259385</td>
</tr>
<tr>
<td>May</td>
<td>1901565</td>
<td>meter broken</td>
<td>1901565</td>
<td>1259385</td>
</tr>
<tr>
<td>June</td>
<td>1941534</td>
<td>meter broken</td>
<td>1941534</td>
<td>1259385</td>
</tr>
<tr>
<td>July</td>
<td>1941534</td>
<td>meter broken</td>
<td>1941534</td>
<td>1259385</td>
</tr>
<tr>
<td>Aug</td>
<td>1941534</td>
<td>meter broken</td>
<td>1941534</td>
<td>1259385</td>
</tr>
<tr>
<td>Monthly average</td>
<td>40315</td>
<td>29900</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

While the absence of baseline data make it impossible to determine whether the competition program resulted in reduced consumption of energy, the competition seemed to have increased awareness of hall residents. Bulletin boards were made for each floor and on the last day of the competition, we arrived at Bemis to find a table and laptop set up in the lobby where residents were being encouraged to calculate their ecological footprint. After determining their footprint, they cut “footprints” out of green paper and wrote their footprint results on them and hung them throughout the lobby. This was an activity that I had suggested at the beginning of the contest and I was thrilled to see residents participating and having fun doing it.

The recycling aspect of the competition was a great success, and the resistance and disappointed displayed when we removed the bins was surprising and interesting. I have recently learned that after removing the bin the residents have continued to bring their plastic bottles to the lobby to recycle, and one Resident Assistant is seeking extra credit in his Geology class for taking on the responsibility of recycling the plastic bottles.

I have suggested to HRL that this would be a great annual competition to be expanded to include all the halls. In fact, during the competition I was contacted by another Hall Director that heard about the competition and wanted to challenge another dorm to a Reduce Your Use contest. Whether it will be picked up as a program by HRL or continued by GreenToppers will remain to be seen. Continuation of this project will require all buildings to have working meters that are read and recorded regularly. I have urged the DFM Energy Manager and HRL Director to ensure that this is happening.
CHAPTER III: RECYCLING

Introduction

By comparing total weight of recycled materials (164,550) pounds to total weight of waste sent to the landfill (4,326,000 pounds), I found that 3.8% of waste at WKU was recycled in the 2006 calendar year. Recycling at WKU is very limited, and an often-voiced source of concern and frustration for students, faculty, and staff. As President of GreenToppers Students for Campus Sustainability and WKU Facilities Management Recycling Coordination Intern, I heard frequently from students, faculty, and staff wanting to know how they can recycle on campus. I learned in my experiences in talking with campus sustainability coordinators and recycling coordinators and from my research into campus recycling programs, that recycling is often the first step toward sustainability on campuses and in communities. While recycling can save money by diverting wastes from the landfill and generates revenues received for recyclables, it is not often a profit-generating program. In my research into university recycling programs, I found not one example of a campus recycling program that actually makes a profit. A successful recycling program requires some initial investment, and if the program is well managed and publicly supported, the program may grow to be financially self-supported. At present, responsible waste management through recycling is not usually a profit making initiative, though as landfills fill up space and recyclables become more valuable, it may become so in the future. Generally, university facility managers, city managers and individuals report that their reason for providing recycling opportunities and for recycling personally is simply because it is the “right thing to do.”
Research into the current state of recycling at WKU has revealed some potential changes that could improve the recycling program, increasing the sustainability of the university by decreasing environmental impacts of solid waste while generating economic savings and revenue.

**Methods and Materials**

In my position as WKU Recycling Coordination Intern, I obtained data on waste and recycling weights from invoices and statements from Monarch Environmental, Southern Recycling, as well as data compiled by Greg Fear and Cristin Lanham in WKU DFM. Marshall Gray of WKU Auxiliary Services provided data on vending machine sales. I also obtained information through personal interviews with Paul Gumbley, Buyer for Southern Recycling; staff, Rebecca Morrow and Jamie Neighbors at Southern Recycling; Greg Fear and Cristin Lanham in WKU DFM, and Building Service Attendants in several campus buildings who wish to remain anonymous.

As Recycling Coordination Intern, I worked on methods to increase awareness on campus about the existing recycling program, and investigated ways in which the program could be improved. During the summer of 2007, I made signs for all of the common recycling bins in each building or area of campus, outlining what could be placed in the bin and how recyclables should be prepared for pick-up by the recycling crew. In fall of 2007, the WKU Recycling Crew sent an email to all WKU faculty and staff describing the current recycling program and instructions for recycling at WKU.

To learn how much recycling is being captured and recycled on campus, I directed a dumpster audit performed by the Political Science Senior Seminar class as a
class project to increase awareness about global warming. The project is described in more detail in the section entitled “Garbology.”

I also found potential for increased revenue and efficiency with infrastructure investments such as a cardboard compactor and centrally located compartmentalized community collection bin. Using campus waste and recycling data, I calculated the degree to which these changes could improve the existing program.

**Dumpster Audit or “Garbology”**

**Introduction**

To estimate how much waste being put into the garbage is recyclable, Saundra Ardrey’s Senior Seminar Political Science class conducted a dumpster inventory on October 23, 2007. The project also sought to increase awareness of the state of recycling on campus, and was video-taped for podcast and photographed for use on websites, print media and other publicity venues.

**Methods and Materials**

The dumpster was weighed empty and placed for use by Academic Complex, Health Services, and Mass Media and Technology Hall for 24 hours. The dumpster was moved in front of Academic Complex next to a major walkway to attract interest and attention while the Garbologists were at work. The students wore protective jumpsuits and gloves and went through all the trash in the dumpster, pulling out every recyclable piece of waste. The recyclables were taken to Southern Recycling for weight and processing and the dumpster was weighed with the remaining un-recyclable waste.
Results and Discussion

The “Garbologists” retrieved 302 pounds of recyclables from the dumpster, which contained approximately 880 pounds of waste. Approximately 34% of the waste in the dumpster was recyclable (Figures 15 and 16). At $0.01 per pound for cardboard, $0.0075 per pound for paper and newspaper, $0.00 for plastic, and $0.68 per pound for aluminum, the total value of the recyclables at Southern Recycling was $6.24. Savings realized from avoidance of landfill fees at $0.057 per pound totaled $17.21 for a total revenue/savings of $23.45 for the 302 pounds of recyclables. The remaining 580 pounds of “less easily recycled” waste cost $33.06 in landfill disposal fees (Figure 17).

Figure 15. Breakdown of materials retrieved from dumpster in dumpster audit. Dumpster held 24 hours worth of waste from three buildings: Academic Complex, Health Services, and Mass Media and Technology. Recyclable materials comprised 34% of the total waste in dumpster.
Figure 16. Breakdown of recyclable materials in the dumpster audited.

Figure 17. Value of waste in dumpster audited. Recyclables totaled $6.24 in value and materials not recyclable in our area cost $17.21 in landfill fees.
A single dumpster audit does not serve as an accurate measure of how much recyclable material could be recovered from the main campus. It is a way to begin to explore the potential revenue both from the sale of recyclables and savings in landfill fees that could theoretically be achieved. If the values of this single dumpster audit are applied to the greater campus dumpster contents; if 34% of WKU’s solid waste can be recycled, there is potential to generate a significant savings. A summary of invoices from waste transported to the landfill and recyclables taken to Southern Recycling in calendar year 2006 reveals that only 3.8% of waste from WKU main campus was recycled. To calculate potential savings by extrapolating from the audit I applied the dumpster results to total annual campus waste data, averaged over the past two years. Calculations are in Appendix P and results are summarized in Table 15.

Table 15. Summary of potential revenue if results of the dumpster audit are applied to the greater campus.

<table>
<thead>
<tr>
<th>Material</th>
<th>Cardboard</th>
<th>Office Paper</th>
<th>Newspaper</th>
<th>Aluminum</th>
<th>Plastic</th>
<th>All Recyclables</th>
</tr>
</thead>
<tbody>
<tr>
<td>% in dumpster</td>
<td>6.8%</td>
<td>19%</td>
<td>4%</td>
<td>0.68%</td>
<td>3%</td>
<td>34%</td>
</tr>
<tr>
<td>Potential annual total for WKU (% in dumpster * total campus waste)</td>
<td>158,848 pounds</td>
<td>443,840 pounds</td>
<td>93,440 pounds</td>
<td>15,885 pounds</td>
<td>70,080 pounds</td>
<td>794,240 pounds</td>
</tr>
<tr>
<td>Potential annual revenue as recyclable (total pounds * recycle value) or savings from avoidance of landfill fees</td>
<td>$1,588.48</td>
<td>$4,438.40</td>
<td>$934.00</td>
<td>$10,801.66</td>
<td>$0.00</td>
<td>$45,271.68 saved in landfill fees + recycling revenue = $63,034.22</td>
</tr>
</tbody>
</table>

If the results of the dumpster inventory are extrapolated to the rest of main campus, and WKU Recycling could capture 34% of total annual waste, approximately
$63,034 in savings and recycling could be realized (Table 15). Investment of these savings into the recycling program could provide much needed funding for infrastructure improvements such as bins, a better recycling truck, and a comprehensive awareness program.

Conclusion

The results of the dumpster audit provide an idea of how much recyclable waste is not being captured by the WKU Recycling program. To verify the accuracy of these results, additional audits are necessary. This is a great project for a class or group of students. The Garbology project was not only fun, but attracted the curiosity of the people passing by. The students in the white suits climbing around in the dumpster had three photographers taking pictures of them. Many students walking by inquired what they were doing and the project was filmed for podcast by the class. Awareness projects organized and executed by students offer a great educational opportunity for these students involved and their peers.

Results and Discussion

Increased Awareness

Efforts to increase campus awareness about the WKU recycling program with signs and emailed instruction seemed effective, as we saw recycling volumes increase over previous years. We received about 40 responses to the email, including requests for bins and general positive feedback and simple remarks like, “Bless you!” Since then, WKU Recycling has continued to receive requests for bins that they are unable to keep up with due to collection bins being backordered on the vendor supply side and time
constraints. Though an additional part-time employee was hired for the fall semester, a recycling staff of three part-time student employees cannot currently keep up with the ever-increasing demand for recycling bins and services.

**The Cardboard Compactor**

The main source of recycling revenue on campus is currently from collection of cardboard. Ironically, cardboard collection is also the greatest recycling expense on campus. The existing bin for cardboard collection on campus at DUC is not being fully utilized due to the absence of a compactor. The cardboard collection bin will currently hold approximately 1,300 pounds (0.65 tons) of cardboard. At $20 per ton, the total value of loose cardboard in the full bin is $13. The pick-up fee is $79.50 so pick up for a full bin of loose cardboard costs $66.50 each time (Figures 14 and 15). A cardboard compactor, which can be purchased for $34,000 can compact cardboard to fit six to seven tons in a bin. Compacted cardboard is worth significantly more than loose cardboard, between $50 and $60 per ton. This would also eliminate need for frequent pick-ups and the daily trips made by the crew to Southern Recycling. In addition, the compactor would allow all cardboard collected on campus to be compacted and placed into the cardboard bin, eliminating trips to Southern Recycling, and allowing enough cardboard to be placed into the collection bin to make pick-ups worth more than the $79.50 that they cost (Figure 18). This would generate revenue, and increase efficiency for the recycling program, allowing for expanded services by the recycling crew.
In 2006, without cardboard compactor, 66 pulls at $66.50 net per pull resulted in 86,420 pounds recycled, resulting in a loss of $4,389.00. With cardboard compactor, 6 pulls at $340.00 net per pull allowed for the recycling of 86,420 pounds, bringing in a revenue of $2,040.00.

Figure 18. Realized and potential revenue from cardboard dumpster with and without cardboard compactor. In 2006, 86,420 pounds of cardboard were recycled in the cardboard recycling dumpster outside of Downing University Center. This figure compares the losses realized to the revenue possible with the purchase of a cardboard compactor. Source: 2006 recycling data. Southern Recycling.

Figure 18, while an accurate projection for compactor impact on cardboard collected at DUC, does not illustrate the full potential of savings to be realized by the purchase of a cardboard compactor. Estimating the cost of the 273 trips with cardboard made by the recycling crew to Southern Recycling in 2006 is difficult. This process costs fuel and time and WKU receives only $20 per ton for loose cardboard. If the recycling crew could take all cardboard collected to the compacter, fuel and time saved would allow for expanded recycling services (Figure 19).
Figure 19. Revenue from cardboard transported by WKU recycling crew and potential revenue with cardboard compactor and elimination of trips. In 2006 the WKU Recycling Crew transported 18 tons of cardboard to Southern Recycling in 273 trips. A cardboard compactor would have eliminated the need for transport by the crew and increased value of the cardboard.

The $34,000 investment (plus concrete pad) of the cardboard compactor would pay for itself in 12 years, using 2006 figures, but this estimate is extremely conservative. It does not consider savings in fuel and employee time, nor does it consider the vast amount of cardboard currently not recycled on campus due to infrastructure limitations. For example, a move-in cardboard drive project by GreenToppers in fall of 2007 illustrates potential for increased revenue from cardboard recycling. During MASTER Plan weekend, fewer than a dozen volunteers diverted 7,500 pounds of move-in cardboard from dumpsters. The cardboard was transported to Southern Recycling in 10 trips made in the recycling truck and dump truck, by four employees working an entire day. A cardboard compactor would have eliminated the time and fuel and increased the value of the cardboard collected (Figure 20).
Figure 20. Comparison of revenue results from 2007 move-in cardboard drive with and without cardboard compactor. A cardboard compactor would also have allowed for the collection of substantially more move-in cardboard than was collected, as collection was limited by space and capacity for transport to Southern Recycling.

Without a cardboard compactor, WKU is not realizing the full potential of economic savings of recycling. Investment in a cardboard compactor is a practical and necessary first step in improving the WKU recycling program. Because much of the cardboard is generated at DUC, from Aramark Food Services and the University Bookstore, WKU Auxiliary Services has very recently agreed to purchase a cardboard compactor which will be located at DUC and will accept all campus cardboard.

The Multi-sectioned Collection Bin

DFM does not currently support the collection of plastics, glass, or aluminum due to funding limitations and zero value of plastics and glass as recyclables. A centrally located collection bin which could accept these items and be serviced by Southern would allow for the collection and responsible disposal of recyclable items that are currently not
collected by the WKU recycling crew. This would also provide a service those individuals living on and off campus that do not receive curbside service. Students who live in apartment housing near campus or in campus housing are not able to participate in city curbside service, as Southern Recycling is reluctant to provide bins to apartment dwellers due to difficulty of pick-up at such locations. A campus collection bin would be a convenient way for these individuals to recycle and would provide a service to the community. A collection bin placed in a visual, convenient drop off area would not only be a service to the campus community, but also an image booster for WKU.

As Recycling Coordination Intern, I approached the WKU Student Government Association (SGA) about helping to fund the collection bin as a service to the campus community. The total cost of the bin is estimated at $14,000. SGA has tentatively agreed to pay for half of the cost of the bin, and DFM has agreed to pay for the other half. The bin will be placed in an accessible walk-up or drive-up location in the Service and Supply parking lot. It will be painted bright red, and will be emblazoned with the WKU logo. The existence of this collection bin on campus will allow campus and community members to manage recycling components of their waste stream much more efficiently, and will allow the University to realize ongoing revenue from this effort. This is another example where an initial investment in infrastructure will produce recycling revenue and landfill savings, which together should be earmarked for additional improvements in the recycling program.
Conclusions

At WKU, the lack of recycling infrastructure acts as the main barrier to a successful recycling program. There are limited collection bins and those that exist are poorly distributed and unmarked. This situation lends itself to the problem of contamination. In one building, Engineering and Biological Sciences, BSAs grew so tired of finding trash in the small blue office paper bins, they picked them all up and put them away in a closet. There has been no recycling in this building for over a year. Students, faculty and staff cannot be expected to recycle if there are no collection bins available. Those who fill paper recycling bins faithfully cannot be sure that their bins are not being emptied into the trash dumpster.

Besides the absence of collection bins, there is no education or awareness program to support recycling on campus. Greg Fear hired me in summer of 2007 as Recycling Coordination Intern to work on this project. However, with no budget to buy bins, even the most effective education or incentive program cannot succeed. WKU needs to invest funding into a recycling program to build a convenient and practical infrastructure. Well marked and distinguishable bins should be placed near every trashcan, on every floor of every building. The recycling pick-up crew should have a large, enclosed truck, minimizing necessity of trips to unload at Southern Recycling and the problem of paper blowing out in transport. The need to have all office paper bagged is an issue as the bags cannot be recycled. Bags could be eliminated with the proper collection bins and transport vehicle. Once the infrastructure is established, investment into an education or awareness program can follow.
Western is host to many large-scale events throughout the year, including the Fourth of July music and fireworks display, MASTERPlan, homecoming, and athletic events. Recycling bins should be available and use encouraged during such events to reduce waste. As some faculty, staff, and students began to notice and voice concern over the lack of recycling at such events in emails and calls to Greg Fear and the recycling email address, Fear has begun to provide bins at tailgating and ballgames. The local Pepsi distributor replied to a request for bins at WKU athletic events by providing white barrels with a recycling symbol stencil on the side. Even with provision of bins at campus events, most recyclables end up in the trash cans. Clearly, awareness programs are needed to educate the campus community about the value of recycling and recycling opportunities. Many universities strive for zero-waste events with support from a sustainability coordinator.

All of these initiatives require investments into the recycling program. WKU must realize that recycling is not primarily a profit making venture, but it is a mandatory program for responsible waste management. Initial costs associated with buying the cardboard compactor and collection bin result in money saved through increased recycling revenue from cardboard and aluminum, increased efficiency of current recycling program, and decreased costs for solid waste disposal. Presently, WKU seems reluctant to invest in or provide a budget for their recycling program. If landfill savings and recycling revenue were earmarked for investment into the recycling program, that would, at the very least, provide a minimal budget for collection bins and awareness projects. With allocation of funding for campus improvements stretched to the limit,
funding for recycling program improvements may only come from pressure by the campus community.

**Campus Profile:**

**University of Colorado, Boulder Waste Reduction and Recycling**

University of Colorado (UC) Recycling is one of the oldest and most successful campus waste reduction and recycling programs in the country. Established in 1976, it is currently diverting 37% of total campus waste stream through recycling and composting efforts. UC Recycling operates as a partnership between student government, University of Colorado Student Union (UCSU), and DFM. The UCSU Environmental Center is responsible for conducting training and education programs, processing collected recyclables, and managing contracts for marketing of recyclables. DFM provides containers in campus buildings and collects from the containers. The Department of Housing provides infrastructure and assists with outreach in residence halls.

The UCSU side of the recycling partnership provides opportunities for student involvement; students learn the recycling business through volunteer work, work-study employment, or by earning academic credit. Student workers process recyclables in an intermediate processing facility, assist with outreach, and research resource and waste management and materials marketing. More than 12 academic projects have resulted from the project each year. The DFM side of the partnership provides infrastructure and custodial support for primary collection in buildings. In 1990 the Solid Waste Advisory Board (SWAB) was created to support the recycling program; improving interdepartmental coordination by prioritizing and coordinating campus solid waste
management activities. SWAB is consists of students, faculty, staff, and administrators and meets quarterly.

Revenues generated from the sale of materials are returned to UCSU to help offset expenses. Savings generated in avoided disposal costs help fund DFM’s efforts, and funding from UCSU student fees (about $4 annually per student) fund education and outreach. While UC Recycling is not yet profiting on their recycling program, they are currently recovering nearly half the costs of operating the program, and as their significant infrastructure investment is paid off, the financial aspect will continue to improve.
LEED REGISTRATION & CERTIFICATION FEE SUMMARY*

As of November 15, 2005, for LEED-NC, LEED-CI, LEED-CS, & LEED-EB; as of April 20, 2007, for LEED for Schools:

Registration Fees

<table>
<thead>
<tr>
<th>Charges</th>
<th>Fixed Rate</th>
<th>Members</th>
<th>Non-Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members</td>
<td>$450.00</td>
<td>$450.00</td>
<td>$600.00</td>
</tr>
<tr>
<td>Non-Members</td>
<td>$600.00</td>
<td>$600.00</td>
<td>$600.00</td>
</tr>
</tbody>
</table>

Note: All fees are subject to change. Sorry, no refunds.

Certification Fees

<table>
<thead>
<tr>
<th>LEED-NC, LEED-CI, LEED-CS &amp; LEED for Schools</th>
<th>Less than 10,000 Square Feet</th>
<th>10,000 - 50,000 Square Feet</th>
<th>More than 50,000 Square Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Review</td>
<td>Fixed Rate</td>
<td>Based on Sq. Ft.</td>
<td>Fixed Rate</td>
</tr>
<tr>
<td>Members</td>
<td>$1,250.00</td>
<td>$0.025/Square Ft.</td>
<td>$12,500.00</td>
</tr>
<tr>
<td>Non-Members</td>
<td>$1,500.00</td>
<td>$0.03/Square Ft.</td>
<td>$15,000.00</td>
</tr>
<tr>
<td>Construction Review</td>
<td>$500.00</td>
<td>$0.01/Square Ft.</td>
<td>$5,000.00</td>
</tr>
<tr>
<td>Members</td>
<td>$750.00</td>
<td>$0.015/Square Ft.</td>
<td>$7,500.00</td>
</tr>
<tr>
<td>Construction Review</td>
<td>$1,750.00</td>
<td>$0.035/Square Ft.</td>
<td>$17,500.00</td>
</tr>
<tr>
<td>Members</td>
<td>$2,250.00</td>
<td>$0.045/Square Ft.</td>
<td>$22,500.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LEED-EB</th>
<th>Fixed Rate</th>
<th>Based on Sq. Ft.</th>
<th>Fixed Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Certification Review</td>
<td>$1,250.00</td>
<td>$0.025/Square Ft.</td>
<td>$12,500.00</td>
</tr>
<tr>
<td>Members</td>
<td>$1,500.00</td>
<td>$0.03/Square Ft.</td>
<td>$15,000.00</td>
</tr>
</tbody>
</table>

Note: All fees are subject to change. Sorry, no refunds.

LEED for Core and Shell Precertification

Fees: $2500 for Members or $3500 for Non-Members

LEED for Core and Shell Precertification is a unique aspect of the LEED for Core and Shell program. Precertification provides the core and shell owner/developer with the ability to market to potential tenants and financiers the valuable green features proposed in the building. Precertification is a formal recognition by the USGBC given to a candidate project for which the owner/developer has established a goal to develop a LEED for Core and Shell building. Once a project is registered as a LEED for Core and Shell project, the project team may submit for Precertification. Precertification is granted to projects after the USGBC has reviewed early design stage documentation. Download this PDF for detailed information on how to submit for LEED for Core and Shell Precertification.
Certification fee for projects registered under NC Version 2.1 from November 15, 2002, to November 15, 2005 NOT using LEED Online. Certification fee for projects registered under EB and CI v2.0 before November 15, 2005, NOT using LEED Online. These fees are:

<table>
<thead>
<tr>
<th>Charges</th>
<th>Less than 75,000 Square Feet</th>
<th>75,000 - 300,000 Square Feet</th>
<th>More than 300,000 Square Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed Rate</td>
<td>Based on Sq. Ft.</td>
<td>Fixed Rate</td>
</tr>
<tr>
<td>Certification**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Members</td>
<td>$1,500.00</td>
<td>$0.02/Square Ft.</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>Non-Members</td>
<td>$1,875.00</td>
<td>$0.025/Square Ft.</td>
<td>$7,500.00</td>
</tr>
</tbody>
</table>

Note: All fees are subject to change. Sorry, no refunds.

**Certification fees for projects registered under NC Version 2.0 (prior to November 15, 2002) is $1200 (members) or $1500 (non-members).

*Projects that registered before November 15, 2005, that wish to use LEED-Online are subject to the new certification fee structure and a possible credit towards that new certification fee. For more information please contact us at leedinfo@usgbc.org.
Appendix B. Energy and water use and costs for Western Kentucky University.
www.wku.edu/Dept/Support/FacMgt/Energyhome.htm

<table>
<thead>
<tr>
<th>COAL</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons</td>
<td>5,685</td>
<td>3,226</td>
<td>3,114</td>
<td>4,076</td>
<td>3,892</td>
<td>4,955</td>
<td>4,221</td>
</tr>
<tr>
<td>Cost</td>
<td>$285,980</td>
<td>$216,780</td>
<td>$211,085</td>
<td>$308,699</td>
<td>$378,910</td>
<td>$580,027</td>
<td>$473,748</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BGMU Substation</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwh</td>
<td>62,691,100</td>
<td>56,970,474</td>
<td>54,401,000</td>
<td>62,089,604</td>
<td>62,609,046</td>
<td>66,050,883</td>
<td>72,020,435</td>
</tr>
<tr>
<td>Cost</td>
<td>$3,000,335</td>
<td>$2,874,778</td>
<td>$3,055,265</td>
<td>$3,201,775</td>
<td>$3,331,948</td>
<td>$4,014,288</td>
<td>$4,416,303</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WRECC (FARM)</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwh</td>
<td>2,368,552</td>
<td>2,391,306</td>
<td>2,438,445</td>
<td>2,333,057</td>
<td>2,410,660</td>
<td>2,462,507</td>
<td>2,682,290</td>
</tr>
<tr>
<td>Cost</td>
<td>$156,433</td>
<td>$166,103</td>
<td>$170,396</td>
<td>$174,744</td>
<td>$177,389</td>
<td>$194,126</td>
<td>$221,587</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atmos (Gas)</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCF</td>
<td>154,343</td>
<td>375,556</td>
<td>523,370</td>
<td>491,187</td>
<td>577,481</td>
<td>577,923</td>
<td>439,727</td>
</tr>
<tr>
<td>Cost</td>
<td>$142,283</td>
<td>$261,851</td>
<td>$354,290</td>
<td>$447,772</td>
<td>$579,895</td>
<td>$716,169</td>
<td>$473,287</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atmos (Heat Plant)</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mcf</td>
<td>9,711</td>
<td>26,286</td>
<td>25,218</td>
<td>20,381</td>
<td>57,379</td>
<td>312,106</td>
<td>577,481</td>
</tr>
<tr>
<td>Cost</td>
<td>$95,166</td>
<td>$261,851</td>
<td>$354,290</td>
<td>$447,772</td>
<td>$579,895</td>
<td>$716,169</td>
<td>$473,287</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chilled Water</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>-</td>
<td>$326,542</td>
<td>$275,322</td>
<td>$386,661</td>
<td>$346,507</td>
<td>$226,175</td>
<td>$327,799</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WCWD (FARM)</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Gallons</td>
<td>6,866,410</td>
<td>10,075,740</td>
<td>8,077,900</td>
<td>5,546,720</td>
<td>5,523,330</td>
<td>4,465,770</td>
<td>6,125,150</td>
</tr>
<tr>
<td>Sewage Gallons</td>
<td>5,350,680</td>
<td>8,465,400</td>
<td>4,733,500</td>
<td>3,746,500</td>
<td>4,194,421</td>
<td>2,412,501</td>
<td>3,346,701</td>
</tr>
<tr>
<td>Cost</td>
<td>$30,673</td>
<td>$43,956</td>
<td>$28,689</td>
<td>$21,956</td>
<td>$23,179</td>
<td>$18,591</td>
<td>$25,094</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glasgow Campus</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric kwh</td>
<td>0</td>
<td>0</td>
<td>1,103,200</td>
<td>1,225,600</td>
<td>1,279,200</td>
<td>1,213,600</td>
<td>1,255,960</td>
</tr>
<tr>
<td>Electric Cost</td>
<td>0</td>
<td>0</td>
<td>$44,786</td>
<td>$121,927</td>
<td>$126,140</td>
<td>$132,217</td>
<td>$150,560</td>
</tr>
<tr>
<td>Water &amp; Sewage Gallons</td>
<td>0</td>
<td>0</td>
<td>8,713</td>
<td>12,501</td>
<td>10,709</td>
<td>8,409</td>
<td>15,440</td>
</tr>
<tr>
<td>Water &amp; Sewage Cost</td>
<td>0</td>
<td>0</td>
<td>$2,888</td>
<td>$4,437</td>
<td>$4,833</td>
<td>$5,507</td>
<td>$6,777</td>
</tr>
<tr>
<td>Natural Gas CCF</td>
<td>0</td>
<td>0</td>
<td>4,504</td>
<td>12,273</td>
<td>14,337</td>
<td>10,265</td>
<td>12,283</td>
</tr>
<tr>
<td>Natural Gas Cost</td>
<td>0</td>
<td>0</td>
<td>$2,825</td>
<td>$11,365</td>
<td>$14,329</td>
<td>$14,806</td>
<td>$12,875</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOTAL</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$50,498</td>
<td>$137,729</td>
<td>$145,301</td>
<td>$152,530</td>
<td>$170,212</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other BGMU Electric</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>KWH</td>
<td>3,257,647</td>
<td>3,297,464</td>
<td>3,196,386</td>
<td>3,521,298</td>
<td>3,904,016</td>
<td>5,417,939</td>
<td>6,250,385</td>
</tr>
<tr>
<td>Cost</td>
<td>$242,718</td>
<td>$252,473</td>
<td>$226,662</td>
<td>$229,466</td>
<td>$260,832</td>
<td>$390,254</td>
<td>$457,640</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Electr. (WRECC &amp; OTH.)</th>
<th>00/01</th>
<th>01/02</th>
<th>02/03</th>
<th>03/04</th>
<th>04/05</th>
<th>05/06</th>
<th>06/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>KWH</td>
<td>574,573</td>
<td>506,233</td>
<td>545,515</td>
<td>546,917</td>
<td>553,719</td>
<td>695,535</td>
<td>555,997</td>
</tr>
<tr>
<td>Cost</td>
<td>$26,689</td>
<td>$24,740</td>
<td>$27,281</td>
<td>$29,001</td>
<td>$31,096</td>
<td>$50,136</td>
<td>$34,530</td>
</tr>
</tbody>
</table>

Jonesville Substation
*located by Service Supply
Services:
Service Supply
Keen Hall
Poland Hall
Jones-Jagger
Pearce Ford Tower
Zacharias Hall
Meredith Hall
Barnes Campbell
Bemis Lawrence
Tate Page
Academic Complex
Minton Hall
Smith Stadium

Dogwood Substation
*located by Parking Structure #1
Services:
Southwest Hall
Northeast Hall
Fine Arts Center
Cravens Library
Grise Hall
McLean Hall
Bates-Runner
Parking Structure #1
Public Safety
Physical Plant
Schneider Hall
Craig Alumni
Foundation Building
Weatherby
Rhodes-Harlin Hall
Kentucky Building

Mimosa Substation
*located on Mimosa Alley off Normal Drive
Services:
Helm Library
Potter Hall
Garrett Conference Center
Faculty House
Cherry Hall
Science and Technology Hall
Environmental Sciences and Technology Building
Industrial Education Building

Ogden Substation
*located across from TCCW on State Street
Services:
Rock House

Forest #1
*located on South Street near coal storage
Services:
McCormack Hall
Gilbert Hall
Central Heat Plant
TCCW
TCNW
Planetarium
VanMeter Hall
Gordon Wilson
Engineering and Biological Science

Forest #2
*located on South Street near coal storage
Services:
Diddle Arena
DUC
Parking Structure #2

Own Feed
*meter is located on corner of Normal and Regents
Mass Media
Chill Water Plant

Academic Complex
Bates Hall
Barnes-Campbell Hall
Bemis Lawrence Hall
Central Residence Hall
Chill Water Plant
Cherry Hall
Cravens Graduate Center
Diddle Arena
Downing University Center
East Residence Hall
Environmental Science and Technology
Garrett Conference Center
Gordon Hall
Grise Hall
Helm Library
Fine Arts Center
McClean Hall
Journalism and Technology*
McClean Hall
Meredith Hall
North Residence Hall*
Pearce Ford Tower
Physical Plant
Poland Hall
Potter Hall
Preston Health Center
Service and Supply
South Residence Hall*
Tate-Page Hall
TCCW
TCNW
Van Meter Hall
Weatherby Administration Building
West Residence Hall*
Zacharius Hall

*There is no date on this document but, as can be seen from the names on some of the buildings, this list is due to be updated.
Appendix E. The Talloires Declaration.

**Association of University Leaders for a Sustainable Future**

**The Talloires Declaration**

**10 Point Action Plan**

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.

1994 Updated Version

**Creators and Original Signatories**

Jean Mayer, President  
*Tufts University, U.S.A.*  
(Conference Convener)  
Pablo Arce, Vice Chancellor  
*Universidad Autonoma de Centro America, Costa Rica*  
L. Ayo Banjo, Vice Chancellor  
*University of Ibadan, Nigeria*  
Boonrod Binson, Chancellor  
*Chulalongkorn University, Thailand*  
Robert W. Charlton, Vice Chancellor & Principal  
*University of Witwatersrand, Union of South Africa*  
Constantine W. Curris, President  
*University of Northern Iowa, U.S.A.*  
Michele Gendreau-Massaloux, Rector  
*l’Academie de Paris, France*
Mario Ojeda Gomez, President
Colegio de Mexico, Mexico

Adamu Nayaya Mohammed, Vice Chancellor
Ahmadu Bello University, Nigeria

Augusto Frederico Muller, President
Fundacao Universidade Federal de Mato Grosso, Brazil

Calvin H. Plimpton, President Emeritus
American University of Beirut, Lebanon

Wesley Posvar, President
University of Pittsburgh, U.S.A.

T. Navaneeth Rao, Vice Chancellor
Osmania University, India

Moonis Raza, Vice Chancellor Emeritus
University of New Delhi, India

Pavel D. Sarkisov, Rector
D. I. Mendeleev Institute of Chemical Technology U.S.S.R.

Stuart Saunders, Vice Chancellor & Principal
University of Cape Town, Union of South Africa

Akilagpa Sawyerr, Vice Chancellor
University of Ghana, Ghana

Carlos Vogt, President
Universidade Estadual de Campinas, Brazil

David Ward, Vice Chancellor
University of Wisconsin-Madison, U.S.A.

Xide Xie, President Emeritus
Fudan University, People's Republic of China
Appendix F. The Presidents Climate Commitment.

American College & University Presidents Climate Commitment

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

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

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

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

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

1. Initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible.
   a. Within two months of signing this document, create institutional structures to guide the development and implementation of the plan.
   b. Within one year of signing this document, complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel) and update the inventory every other year thereafter.
   c. Within two years of signing this document, develop an institutional action plan for becoming climate neutral, which will include:
i. A target date for achieving climate neutrality as soon as possible.
ii. Interim targets for goals and actions that will lead to climate neutrality.
iii. Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students.
iv. Actions to expand research or other efforts necessary to achieve climate neutrality.
v. Mechanisms for tracking progress on goals and actions.

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

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

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

Signed,

_____________________________________________________
President/ Chancellor Signature

_____________________________________________________
President/ Chancellor Name

_____________________________________________________
College or University

_____________________________________________________
Date
Please send the signed commitment document to:
Mary Reilly
Second Nature
18 Tremont St., Suite 1120
Boston, MA 02108
or fax to: 320-451-1612
or scan and email to: mreilly@secondnature.org

**WKU Conservation Tips**

**Computers:**

**Screen savers do not save energy but giving your computer a nap does. Enable power management features so your computer monitor and hard drive will go into a low power (blank screen) "sleep mode" when not actively in use.
**Keep all computer equipment off unless in use – especially at night and on weekends.
**Turn off your monitor when you go to lunch or to a meeting.
**Turn off monitors on servers.
**Enable power management features on laser printers and/or turn off laser printers when not actively printing.

**Lights:**

**Turn off unused or unneeded lights.
**Use natural lighting instead of electric lighting whenever possible.
**Try task lighting and reduce overhead lighting.
**If you have a desk lamp, make sure it uses a fluorescent bulb.
**Don’t use table lamps unless illumination from the lamps is actually needed.
**Do not use halogen floor lamps in any campus building. These lamps are very energy wasteful and may pose a safety risk.

**Heating and Cooling:**

**Dress appropriate to the season and keep thermostats set to achieve 68 - 70 degrees in the winter and 74 - 76 degrees for air-conditioned spaces in the summer.
**During the heating season, open blinds, drapes and curtains to let sun in. If no sun, close them to keep the heat in especially at night.
**During the cooling season close blinds, drapes and curtains to block direct sun.
**Use hot water sparingly.

**Windows and Doors:**

**Keep windows and doors closed in heated and air conditioned areas.
**Close vestibule doors when propped open.

**Other Equipment:**

**Purchase only energy-efficient models.
**Turn off all energy consuming office and research equipment when not in use, e.g., copiers, refrigerators, environmental rooms, fume hoods, etc.
Appendix H. Notice to students regarding water conservation during drought conditions. Source: WKU webmail to students-all mailing list.

From: Student Life
<howard.bailey@wku.edu>
WKU Official E-mail:
Subject: Warning - Water Shortage Alert
Date: Thu, 30 Aug 2007 10:54:50 -0500 (CDT)

The on-going drought we are experiencing has intensified and is forcing Bowling Green Municipal Utilities to ask our customers to take necessary precautions. The following conservation tips will help to reduce depletion of the drinking water supply because of non-essential usage:

--- Turn off the water while shaving, brushing teeth, etc. You can save 3 gallons per day!
--- Take shorter showers. One or two minutes can save 5 gallons per day!
--- Fix or report leaky faucets immediately. Can save 20 gallons per day!
--- Don't use the toilet as a wastebasket.
Appendix I. Aerial image of Western Kentucky University.
# Appendix J. Western Kentucky University vehicle list 2007.

**WESTERN KENTUCKY UNIVERSITY**
**OWNED AND LEASED VEHICLES**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MAKE</th>
<th>MODEL</th>
<th>VEHICLE</th>
<th>DESCRIPTION</th>
<th>USE OF VEHICLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>CHEV</td>
<td>PICK UP TRK</td>
<td>PICK UP TRK</td>
<td>Grounds</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>FORD</td>
<td>RANGER PU</td>
<td>RANGER PU</td>
<td>Electrical</td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>CHEV</td>
<td>PICK UP TRK</td>
<td>PICK UP TRK</td>
<td>Building Services</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>CHEV</td>
<td>W3500 Truck</td>
<td>W3500 Truck</td>
<td>Env Health and Safety</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>JEEP</td>
<td>Pickup</td>
<td>Pickup</td>
<td>Env. Health &amp; Safety</td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>Isuzu</td>
<td>Pickup</td>
<td>Pickup</td>
<td>Agriculture Expo Center</td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>INTL</td>
<td>DUMP TRUCK</td>
<td>DUMP TRUCK</td>
<td>Grounds</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>Toyota</td>
<td>Pick Up</td>
<td>Pick Up</td>
<td>Biology</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chevrolet</td>
<td>Pickup</td>
<td>Pickup</td>
<td>P &amp; T</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>CHEV</td>
<td>PICK UP TRK</td>
<td>PICK UP TRK</td>
<td>Micro Computing</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>FORD</td>
<td>Windstar</td>
<td>Windstar</td>
<td>Chemistry Dept</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>DODGE</td>
<td>Caravan</td>
<td>Caravan</td>
<td>Network Computing</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>CHEV</td>
<td>Pickup</td>
<td>Pickup</td>
<td>ISCET</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>CHEV</td>
<td>VAN, 15 PASS</td>
<td>VAN, 15 PASS</td>
<td>HVAC</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>CHEV</td>
<td>VAN</td>
<td>VAN</td>
<td>Lock Shop</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>MAZDA</td>
<td>PICK UP TRK</td>
<td>PICK UP TRK</td>
<td>Painter</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chevrolet</td>
<td>Pickup</td>
<td>Pickup</td>
<td>P &amp; T</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>CHEV</td>
<td>TK C4500</td>
<td>TK C4500</td>
<td>Shipping &amp; Receiving</td>
<td></td>
</tr>
<tr>
<td>1978</td>
<td>INTL</td>
<td>BUCKET TRK</td>
<td>BUCKET TRK</td>
<td>Grounds</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>DODGE</td>
<td>Dakota PU</td>
<td>Dakota PU</td>
<td>Grounds</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>CHEV</td>
<td>PICK UP TRK (S-10)</td>
<td>PICK UP TRK (S-10)</td>
<td>Housing</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>CHEV</td>
<td>TRUCK</td>
<td>TRUCK</td>
<td>Plumbing</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>CHEV</td>
<td>T6500</td>
<td>T6500</td>
<td>WKYU-TV (Sat TK)</td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>DODGE</td>
<td>PICK UP TRK (Dakota)</td>
<td>PICK UP TRK (Dakota)</td>
<td>Electrical</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>GMC</td>
<td>Box Truck</td>
<td>Box Truck</td>
<td>Mobile Heath Unit</td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td>CHEV</td>
<td>Truck 1500</td>
<td>Truck 1500</td>
<td>Farm</td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>DODGE</td>
<td>MAXI WAGON</td>
<td>MAXI WAGON</td>
<td>Maintenance &amp; G Zone</td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>DODGE</td>
<td>VAN, 15 PASS.</td>
<td>VAN, 15 PASS.</td>
<td>Cave &amp; Karst</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>GEM</td>
<td>Truck (Electric)</td>
<td>Truck (Electric)</td>
<td>Communication Dept.</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>CHEV</td>
<td>SUBURBAN</td>
<td>SUBURBAN</td>
<td>Cave &amp; Karst</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Vehicle Brand</td>
<td>Model Type</td>
<td>Department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>---------------</td>
<td>------------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>DODGE</td>
<td>VAN, PANEL</td>
<td>Electrical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chevrolet</td>
<td>Pickup</td>
<td>Fac. Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chevrolet</td>
<td>Bucket Truck</td>
<td>Fac. Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>DODGE</td>
<td>TRUCK</td>
<td>Ed TV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>FORD</td>
<td>F250 Truck</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>Ford</td>
<td>Van</td>
<td>Post Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>FORD</td>
<td>CARGO VAN</td>
<td>Stock Room Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>DODGE</td>
<td>VAN</td>
<td>ICC Zone Maint.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>CHEV</td>
<td>TRUCK</td>
<td>Carpenter Shop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chev</td>
<td>Pickup</td>
<td>Carpenters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chev</td>
<td>Pickup</td>
<td>Carpenters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>Chevrolet</td>
<td>Cheyenne Pickup</td>
<td>Theatre &amp; Dance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>Ford</td>
<td>Cargo Van E-150</td>
<td>College Heights Herald</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>DODGE</td>
<td>Dakota PU</td>
<td>Env. Health &amp; Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>FORD</td>
<td>RANGER PU</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>FORD</td>
<td>F350 Truck</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chevrolet</td>
<td>Colorado Pickup</td>
<td>Facilities Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chev</td>
<td>PU (w/Camper Shell)</td>
<td>Purchasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>FORD</td>
<td>VAN</td>
<td>Alumni Affairs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>CHEV</td>
<td>CARGO VAN</td>
<td>Shipping and Receiving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>DODGE</td>
<td>PICK UP TRK</td>
<td>Recycling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Toyota</td>
<td>Tundra Double Cab SR5</td>
<td>Geography and Geology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>FORD</td>
<td>TRUCK</td>
<td>Grounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>CHEV</td>
<td>DUMP TRUCK</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>GMC</td>
<td>C6500 Truck</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>CHEV</td>
<td>PICK UP</td>
<td>ISCET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>DODGE</td>
<td>VAN</td>
<td>ICC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Chev</td>
<td>Uplander Van</td>
<td>ISCET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>DODGE</td>
<td>PICK UP TRK (DAKOTA)</td>
<td>Zone 5 - Maint.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>CHEV</td>
<td>SILVERADO PU</td>
<td>Facilities Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>DODGE</td>
<td>TRUCK, DAKOTA</td>
<td>HVAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>DODGE</td>
<td>PANEL VAN</td>
<td>Carpenter Shop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>FORD</td>
<td>E250 CARGO VAN</td>
<td>Post Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>INTL</td>
<td>Truck</td>
<td>ISCET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>CHEV</td>
<td>Quad PU</td>
<td>ISCET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1977</td>
<td>FORD</td>
<td>DUMP TRUCK</td>
<td>Grounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>SEDAN</td>
<td>WKU Police</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>FORD</td>
<td>CR VICTORIA</td>
<td>WKU Police</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>FORD</td>
<td>CR VICTORIA</td>
<td>WKU Police</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Ford</td>
<td>CROWN VIC</td>
<td>WKU POLICE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>CHEV</td>
<td>Impala</td>
<td>WKU Police</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>FORD</td>
<td>TAURUS</td>
<td>WKU Police</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>FORD</td>
<td>CROWN VIC</td>
<td>WKU Police</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Make</td>
<td>Model</td>
<td>Department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>----------------</td>
<td>---------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>DODGE</td>
<td>PICK UP TRK</td>
<td>Env. Health &amp; Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>FORD</td>
<td>CROWN VIC</td>
<td>WKU Police</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Hyundai</td>
<td>Sonata</td>
<td>Police Adm Vehicle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Chev</td>
<td>G-Van (12 Passenger)</td>
<td>Intramural-Rec Sports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>GMC</td>
<td>MOBILE</td>
<td>Mobile Heath Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Toyota</td>
<td>FJ Cruiser</td>
<td>Biology Department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>CHEV</td>
<td>PICK UP TRK</td>
<td>Grounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>DODGE</td>
<td>CARGO VAN</td>
<td>Heating &amp; Cooling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>FORD</td>
<td>TRUCK</td>
<td>Env. Health &amp; Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>DODGE</td>
<td>VAN,15 PASS</td>
<td>HVAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>CHEV</td>
<td>ASTRO VAN</td>
<td>Plumbing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>DODGE</td>
<td>VAN, 15 PASS</td>
<td>Spec Events</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>Applied Physics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>Stockroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>Grounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>Auto Shop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>CHEV</td>
<td>S-10</td>
<td>Grounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>Painter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>HVAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>FORD</td>
<td>RANGER PU</td>
<td>Energy Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>FORD</td>
<td>RANGER PU</td>
<td>Pest Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>FORD</td>
<td>RANGER PU</td>
<td>Carpentry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>BUS, 9 PASS</td>
<td>Handicap Suttle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>Roofing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>Carpenter Shop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>VAN, 15 PASS</td>
<td>Grounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>PANEL VAN</td>
<td>Electrical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>FORD</td>
<td>CARGO VAN</td>
<td>Athletics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>CHEV</td>
<td>PICK UP</td>
<td>Building Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>CHEV</td>
<td>PICK UP</td>
<td>Carpenter Shop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>CHEV</td>
<td>PICK UP</td>
<td>Plumbing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1978</td>
<td>GMC</td>
<td>TRUCK</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>CHEV</td>
<td>C30, CREW CAB</td>
<td>Heating Plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>CHEV</td>
<td>PICK UP</td>
<td>HVAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>DODGE</td>
<td>TRUCK</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>DODGE</td>
<td>PICK UP</td>
<td>Spec Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>FORD</td>
<td>PICK UP</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>DODGE</td>
<td>PICK UP</td>
<td>Carpentry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>GMC</td>
<td>Envoy</td>
<td>Water Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>CHEV</td>
<td>VAN</td>
<td>Shipping and Receiving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>CHEV</td>
<td>TAHOE</td>
<td>Biology Department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>CHEV</td>
<td>CORSICA</td>
<td>Env Health and Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>CHEV</td>
<td>PICK UP</td>
<td>Gen Farm Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Make</td>
<td>Model</td>
<td>Department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>----------------</td>
<td>--------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>BLUEBIRD</td>
<td>29 PASSENGER</td>
<td>Admissions Tour Bus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>DODGE</td>
<td>MAXIE VAN</td>
<td>Intramural-Rec Sports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>CHEV</td>
<td>S-10 Pick Up</td>
<td>Heat Plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>CHEV</td>
<td>Van</td>
<td>Ogden College</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>CHEV</td>
<td>SUBURBAN</td>
<td>Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>CHEV</td>
<td>SUBURBAN</td>
<td>Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>CHEV</td>
<td>EXPRESS VAN (8 PASS)</td>
<td>Academic Technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>HONDA</td>
<td>PASSPORT</td>
<td>Community College</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>DODGE</td>
<td>RAM D150</td>
<td>Carpenter Shop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>DODGE</td>
<td>D150 Pickup</td>
<td>Grounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>DODGE</td>
<td>D250 Pickup</td>
<td>Grounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>CHEV</td>
<td>1500 PICK UP</td>
<td>Shipping &amp; Receiving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>DODGE</td>
<td>1500 PICK UP</td>
<td>Farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>CHEV</td>
<td>C25 SILVERADO QUAD</td>
<td>Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>FORD</td>
<td>E150 Van</td>
<td>Bookstore</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>DODGE</td>
<td>Sprinter</td>
<td>Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>CHEV</td>
<td>VENTURE LS VAN</td>
<td>Chemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>CHEV</td>
<td>PU C1500 C19</td>
<td>Chemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>FORD</td>
<td>Box Truck E350</td>
<td>Chemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>CHEV</td>
<td>Pick Up</td>
<td>General Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>CHEV</td>
<td>Pick Up</td>
<td>General Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>HONDA</td>
<td>Element</td>
<td>Journalism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Toyota</td>
<td>Tiger PU Truck</td>
<td>Facilities Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Toyota</td>
<td>Tiger PU Truck</td>
<td>Facilities Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Toyota</td>
<td>Tiger PU Truck</td>
<td>Facilities Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Toyota</td>
<td>Tiger Cargo Van</td>
<td>Facilities Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>FORD</td>
<td>TAURUS</td>
<td>Talent Search</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>FORD</td>
<td>TAURUS</td>
<td>Talent Search</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>FORD</td>
<td>TAURUS</td>
<td>Talent Search</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>FORD</td>
<td>TAURUS</td>
<td>Upward Bound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>CHEV</td>
<td>VENTURE</td>
<td>Ed TV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>CHEV</td>
<td>VENTURE</td>
<td>Public Radio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>DODGE</td>
<td>VAN</td>
<td>Telephone Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>FORD</td>
<td>PICK UP</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td>CHEV</td>
<td>ASTRO VAN</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Pontiac</td>
<td>Gran Prix</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>FORD</td>
<td>TAURUS</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>CHRYSLER</td>
<td>PT CRUISER</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>GMC</td>
<td>Sierra</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>CADILLAC</td>
<td>CTS</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>BUICK</td>
<td>Rendezvous</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>HONDA</td>
<td>Accord LX</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>GMC</td>
<td>Yukon XL Denali</td>
<td>Hilltopper Ath Found.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2005 GMC Yukon Hilltopper Ath Found.
2004 Lincoln Town Car Hilltopper Ath Found.
2005 GMC Yukon Hilltopper Ath Found.
2005 Toyota Camry Hilltopper Ath Found.
2005 Honda Pilot Hilltopper Ath Found.
2007 BUICK LaCrosse Hilltopper Ath Found.
2005 FORD Explorer Hilltopper Ath Found.
2006 Ford Explorer Hilltopper Ath Found.
2005 Chevrolet Malibu Hilltopper Ath Found.
2005 Pontiac Gran Prix Hilltopper Ath Found.
2006 BUICK Rendezvous Hilltopper Ath Found.
2006 BUICK Rendezvous Hilltopper Ath Found.
2006 BUICK Rendezvous Hilltopper Ath Found.
2006 BUICK Rendezvous Hilltopper Ath Found.
2006 DODGE Charger Hilltopper Ath Found.
2005 BUICK Rainier CXL President
2006 Toyota Highlander Vice Pres. For Dev.
2005 CX Gator P & T
2005 CX Gator P & T
2004 Hyundai Sonata Alumni Affairs
2006 DODGE Charger WKU Police
2006 Pontiac Gran Prix WKU Police
2007 Honda Ridgeline WKU Police
2005 Yamaha Rhino 660 Biology
2006 LODGE BUMPER 20' TRAILER IS CET
2007 FOREST RIVER 12' TRAILER IS CET
2006 Gillig 38 PASSENGER Bus Shuttle Bus
2006 Gillig 38 PASSENGER Bus Shuttle Bus
2005 Gillig 38 PASSENGER Bus Shuttle Bus
2000 BLUEBIRD 34 PASSENGER Shuttle Bus
2000 BLUEBIRD 34 PASSENGER Shuttle Bus
2005 Gillig 38 PASSENGER Bus Shuttle Bus
2005 Gillig 38 PASSENGER Bus Shuttle Bus
2003 BLUEBIRD 44 PASSENGER Shuttle Bus
2004 BLUEBIRD 42 PASSENGER Shuttle Bus
Appendix L. Survey sent to faculty and staff requesting information on sustainability in the curriculum.

Dear Colleagues,

Below is a request by a graduate student for information about elements of sustainability in the courses you currently teach or have taught at WKU. It's an informal survey, but one I hope you will take the time to respond to: this descriptive information will complement the baseline data she has worked hard to gather throughout the university. Unless requested otherwise, the information you provide will also be posted on the Greentoppers website (http://www.wku.edu/green) for general student access. Thanks very much for your help.

Dear WKU Faculty,

I am completing a research project on sustainability at Western Kentucky University that examines baseline data regarding a variety of indicators, including energy use, waste management, purchasing policies, transportation, and other parameters. I am also interested in reporting the current extent to which sustainability is included in the curriculum.

I would appreciate receiving from you information about:
1. courses that include sustainability as a theme or concept,
2. how much time is spent on the subject (is it the whole course, or is it one lecture?), and
3. how often those courses are offered.

I would also appreciate anecdotal information about your experience with such courses or topics in classes, such as enrollment trends and student responses. Please email responses or contact me with questions or comments.

Thank you very much for your time.

Sincerely,
Christian Ryan-Downing
Biology Graduate Student
Appendix M. Student Declaration for Campus Sustainability. Source: WKU GreenToppers Students for Campus Sustainability.

Student Summit Declaration for Sustainability in Higher Education

As students from Kentucky colleges and universities, we have convened to establish an ethic of sustainability that we expect to be adopted on our campuses. We define sustainability according to the Brundtland Commission of 1987, which concluded that sustainability is "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Kentucky colleges and universities should accept their responsibility to:

- Recognize the urgent need for a commitment to sustainable practices
- Acknowledge their vital leadership roles in their communities and act as models of responsible environmental stewardship
- Use their human and technical capacities as well as their institutional operations to improve the quality of life in the communities which they serve
- Create and maintain inter-institutional and community partnerships
- Be accountable to students and the society at large for adhering to these principles
- Produce environmentally literate citizens through an interdisciplinary approach to environmental education.

We believe that it is the responsibility of institutions of higher learning to cultivate values that are conducive to promoting this ethic.

-From Campus Community Partnerships for Sustainability Second Annual Conference, 20-22 April 2007

The ideas in the above Declaration and the initiatives outlined in the addendum that follows are supported by The Talloires Declaration: University Presidents for a Sustainable Future and Western Kentucky University's Quality Enhancement Plan.

Addendum for Western Kentucky University, by the GreenToppers

At Western, we would like to see the following initiatives toward sustainability on our campus:

A campus-wide sustainability committee that would provide structure and support for university sustainability initiatives. The committee would be composed of administrators, faculty, staff, and students who would work together to encourage and implement interdepartmental sustainable practices in the curriculum, research, outreach, and operations.

A campus sustainability office and Coordinator to facilitate projects, relationships, and access to resources and funding sources, and to work with the aforementioned committee as well as promote community outreach and partnerships.

Integration of sustainability into basic curriculum, crucial to the preparedness of our students to manage the local and global environmental and social problems we face as a society at present, and as a core competency for all students.

A concerted effort toward campus-wide recycling. For a leading American University, recycling is mandatory. This requires the support of administrators, faculty, and staff. At
present, the recycling effort at Western can be improved in the following areas: infrastructure, education, and university policy regarding purchasing of recyclable and recycled materials, and waste management.

A **commitment to reduced energy and water consumption, and minimizing waste** through building, and grounds and landscaping policy changes, which are expected to lead to long-term cost savings. We recommend that WKU building policy be changed to mandate that all new and renovated buildings use standard LEED (Leadership in Energy and Environmental Design) principles, which should result in no additional cost. Additional efforts might include a campus-wide policy to turn off lights and computers at night and when not in use, use of Energy Star technology wherever possible, and sustainable practices in construction, landscaping, and grounds keeping, such as use of recycled materials, green spaces and native plant landscaping.

A **proactive policy to reduce carbon emissions** through energy conservation and efficiency practices and renewable energy sources. We recommend that Western join other campuses in becoming a signatory of the American College & University Presidents Climate Commitment and Talloires Declaration, and in implementing conservation strategies and renewable energy technologies, for curricular enhancement and research, partnership building opportunities, and as a model for students and our communities.

**Continued efforts to make university transportation more sustainable** including extension of student transit service, increased use of biodiesel in university shuttles and buses, purchase of fuel efficient hybrid vehicles, encouragement of bicycling on and around campus with development of bike paths and strategic placing of bike racks, lockers, and showers, and a ride-share program for commuters.

We believe Western has the knowledge, expertise and resources in place to become a real leader in Education for Sustainable Development but we are not realizing this potential. Our curriculum and operations should reflect the strength of our commitment and seriousness with which we desire and expect change in the policies and attitudes of our institution.

We recognize that some of these initiatives will require initial upfront investment, but will also result in long-term savings and increased aesthetic and environmental appeal for students and other public constituencies. We recommend that a student “green fee” be considered as a source of funding for some of these projects. Funding this initiative should not be a barrier. Additional potential funding sources are numerous, and may include a revolving loan fund, where cost-savings from reduced energy and water use are put back into the fund to support more sustainability projects, grant sources, private donors, and other revenue streams.

From the relationships we have already formed in researching sustainability at Western and the potential for projects and progress, we have found an enormous amount of interest in, and support for, sustainability initiatives. For example, the Parking and
Transportation group recognizes that the solution to the parking problem is not to build more parking spaces, but a better system for supporting sustainable alternatives, and are actively working on such projects. Individuals in Facilities Management are eager to implement more energy efficient policies, but need university support and campus-wide education to do so. Those behind the breathtaking landscaping at Western are strongly supportive of communicating a more holistic ethic of land space use through their work. WKU’s partner in food services, Aramark, has a corporate policy supporting new sustainability initiatives that they would like to more fully implement on campus.

Finally, Western is home to a very large number of students, faculty, staff, and administrators who would love to use the opportunity of implementing sustainability practices to engage more creatively, thoughtfully, and actively with each other and with the wider community.

The existing strengths of our current centers, departments, programs, and classes can certainly be harnessed to address and fulfill the need for greater sustainability in our campus and our world. Some of these centers, programs and classes already have some focus on sustainability issues. A policy of strongly supporting sustainability efforts at Western would allow the creation of a remarkable set of open-ended opportunities by many different individuals and groups on campus. We are eager to see this happen soon, and look forward to a more sustainable campus.

References and online access:

*The Talloires Declaration: University Presidents for a Sustainable Future*
http://www.ulsf.org/programs_talloires.html

*Engaging Students for Success In a Global Society: A Quality Enhancement Plan for Western Kentucky University*
http://www.wku.edu/qep/

*American College & University Presidents Climate Commitment*
http://www.presidentsclimatecommitment.org/
Appendix N. Welcome letter in sustainability-themed welcome packets. Source: WKU GreenToppers Students for Campus Sustainability.

GreenToppers - Students for Campus Sustainability welcomes you to Western!

This bag is our way of saying hello, and introducing you to ways to living and learning a little greener for a healthier campus and planet! In your bag you will find that many campus and community organizations want to help you go green!

GO BG Transit has given you a pass for a free ride on Bowling Green’s GoBus! This is a great way to get around Bowling Green, plus it’s easy on you and easy on the planet.

Housing and Residence Life has given you a magnet to remind you that we recycle at Western. You will find blue recycle bins for your aluminum cans in your room and in the lobby. When you move in and out between semesters, GreenToppers will be there to help you recycle your cardboard boxes and other packing material.

WKU Department of Biology and Center for Biodiversity Studies welcomes you with a pen made completely from recycled materials. You don’t have to be a biologist to know that this pen is environmentally friendly.

WKU Restaurant and Catering Group created a special ice cream just for Western students. The flavor is Big Red Rumble, and it is made at Chaney’s Dairy Barn, just a short drive down the road. Locally made means better for the environment, and everyone knows Chaney’s makes the best ice cream! Bring your coupon into DUC Food Court, Garret Food Court, or Bate Shop store for a great snack for late night studying.

The City of Bowling Green is built above caves and underground rivers. To make sure our water stays clean, Bowling Green works hard to eliminate water pollution. The cups and magnets in your packet are part of the “Keep it Clean Bowling Green!” campaign, to remind citizens to do their part in keeping our water clean.

Tennessee Valley Authority provides power for Kentucky, Tennessee, and beyond. With their “Green Power Switch” Program, TVA is working to generate more renewable energy powered by wind and sun. You can help reduce your energy consumption (and carbon footprint) at Western by using the compact fluorescent light bulb provided by TVA for your desk lamp.

Student Life Foundation, The Center for Environmental Education, and GreenToppers provided the great canvas bags your goodies came in. Whether you use the bags for laundry or books, you will look good carrying your bag, because everyone knows, going “green” is great for your image and the planet. GreenToppers use their bags for groceries, instead of those crazy plastic bags you see blowing around all over the place.

If you would like to learn more about living green, become a GreenTopper! We meet every other Tuesday at 6:00 (first fall meeting will be September 11 at 6:00 in DUC 308)
and do all kinds of great projects to promote a more sustainable campus. You can learn more about GreenToppers at our website: www.wku.edu/green.

One more thing... In October, we will be having an energy conservation competition between Bemis and Barnes – boys versus girls kind of competition. Girls have a reputation for using more energy than boys – girls, we challenge you to change your reputation. You will be hearing more about this soon – ways to conserve energy in your dorm, the rules of the game, and prizes (over and above the fact that you have drastically reduced your dorms’ ecological footprint).

Be seeing you around,

GreenToppers

This letter was printed with support from WKU Facilities Management/Sodexho and SIFE (Students in Free Enterprise) on 30% recycled content paper.
Appendix O. Pictures from Reduce Your Use! Conservation competition between Bemis-Lawrence and Barnes-Campbell Halls in October 2007.

Bulletin board made by Residence Assistant.

Recycling area in hall lobby.
Poster made by GreenToppers.

Resident Assistants of winning hall, posing with their grand prize and trophy.
Appendix P. Calculations for determining potential revenue from capturing all recyclables on campus, using results of single dumpster audit.

The average total of solid waste from fiscal year 2005-2006 and 2006-2007:

\[ \frac{1,191 \text{ tons} + 1,146 \text{ tons}}{2} = 1,168.5 \text{ tons} \]

\[ 1,168.5 \text{ tons} \times 2000 \text{ pounds/ton} = 2,336,000 \text{ pounds of solid waste} \]

34% of 2,336,000 pounds = 794,240 pounds recyclable

\[ 794,240 \times 0.057 \text{ for landfill fees} = $45,271.68 \text{ saved in landfill fees!} \]

Plus, revenue generated from recyclables:

Cardboard comprised 6.8% of the material in the dumpster. If cardboard is 6.8% of total waste on campus then 6.8% *

\[ 2,336,000 \text{ pounds} = 158,848 \text{ pounds} \]

\[ 158,848 \times 0.01 \text{ (average value as recyclable)} = $1,588.48 \text{ revenue from Cardboard.} \]

Office Paper comprised 19% of total material in dumpster.

\[ 19\% \times 2,336,000 = 443,840 \text{ pounds} \]

\[ 443,840 \times 0.01 \text{ (average value as recyclable)} = $4,438.40 \text{ revenue from Office Paper.} \]

Newspaper comprised 4% of total material in dumpster.

\[ 4\% \times 2,336,000 = 93,440 \text{ pounds} \]

\[ 93,440 \times 0.01 \text{ (average value as recyclable)} = $934.00 \text{ revenue from Newspaper.} \]

Aluminum comprised 0.68% of the total material in the dumpster.

\[ 0.68\% \times 2,336,000 = 15,885 \text{ pounds} \]

\[ 15,885 \times 0.68 \text{ (average value as recyclable)} = $10,801.66 \text{ revenue from Aluminum.} \]

Plastic is worth zero as a recyclable so no potential revenue at this time.

So potential revenue from recyclables =

\[ $1,588.48 \text{ (Cardboard)} + $4,438.40 \text{ (Office Paper)} + $934.00 \text{ (Newspaper)} + $10,801.66 \text{ (Aluminum)} = $17,762.54 \]

Recyclables revenue $17,762.54 + savings at landfill $45,271.68 = $63,034.22
LITERATURE CITED


Orr, D. Rating colleges. Conservation Biology. 1999


Smith, Sammy. Fleet Internet Sales, Toyota of Louisville, 2007


Sodexho Campus Services and Thermal Engineering Group, Inc. Western Kentucky University Main Campus Energy Audit. 2005.


Website resources:


