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DUQUESNE UNIVERSITY

ONE STEP AT A TIME:

Reducing Duquesne's Carbon Footprint

Baseline Inventory of Greenhouse Gas Emissions: Findings and Policy Options

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I. EXECUTIVE SUMMARY

The Inventory

In 2007, the Center for Environmental Research and Education completed the first greenhouse gas (GHG) emissions inventory of Duquesne University. This inventory sought to identify all sources of GHG emissions and the contribution of each source.

Duquesne's inventory, which was completed using data from calendar year 2006, measured GHG emissions resulting from all University activities and operations, including the following sources: cogeneration plant, purchased electricity, auxiliary boilers for heating, commuter travel by students, faculty, and staff, University air travel, campus vehicle fleet, and solid waste disposal.

Methods

Data on the above sources were gathered from numerous offices: Facilities Management, Travel, Student Affairs, Commuter Affairs, Environmental Health and Safety, Institutional Research, and Parking and Traffic Management.

The collected information was then compiled in a database and associated emissions were calculated using software developed by Clean Air – Cool Planet (CA-CP). Because different greenhouse gases have different warming potentials, the software tool converts all emissions to units of carbon dioxide equivalent (CO_2e).

Results

Total GHG emissions at Duquesne University in 2006 were 48,400 tons CO_2e, of which 69 percent, or 33,800 tons CO_2e, were produced from electricity and heating. The remaining 31 percent, 14,600 tons CO_2e, resulted from transportation.

Commonly used metrics for reporting emissions at institutions of higher education are tons per student per year (tons CO_2e/student/year), tons per square foot of building space, and tons per operational dollar. For Duquesne, these metrics are equal to 4.8 tons CO_2e/student/year, 28 pounds per square foot of building space, and 2.28 pounds per operational dollar.

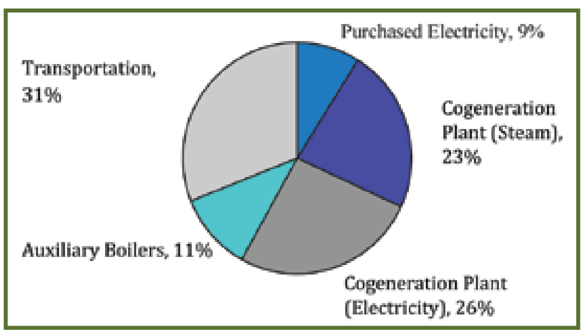

Figure 1: Emissions by Source

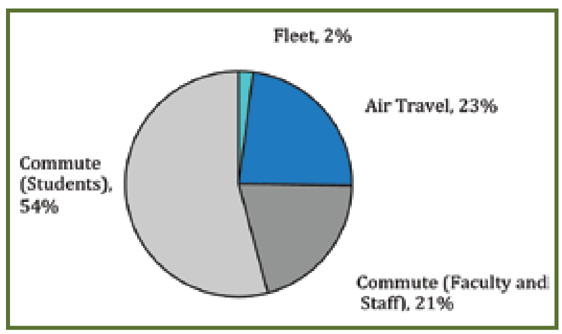

Figure 2: Emissions Resulting from Transportation

While the cogeneration plant's heat and electricity generation accounts for almost half of total emissions at Duquesne, transportation was the second largest source of emissions, accounting for an additional 31 percent. Daily commutes by students, faculty, and staff use over one million gallons of fuel per year, and represent a significant opportunity for change. Future analysis of commuting and travel habits and trends will provide the basis for addressing transportation-related GHG emissions.

Discussion

Duquesne's carbon footprint is equal to 4.8 tons CO_2e /student/year. Emissions at institutions of higher education are highly variable due to a number of factors, including climate zone (heating and cooling days), functions (medical and research centers), regional fuel mix, physical plant infrastructure, endowment, campus layout, commuter population, levels of climate change awareness, and emissions reductions measures.

How Does Duquesne Compare?

Table 2 illustrates the wide range of carbon footprints among American universities and colleges. This range is due in part to the factors discussed above, but also reflects the energy management decisions made by school officials.

Table 2: Comparison of tons CO_2e/student/year

Institution[1]	Tons CO_2e/student/year
Tufts University	2.4
University of California Santa Barbara	2.5
Rice University	3.0
College of Charleston	4.1
University of Colorado at Boulder	4.4
DUQUESNE UNIVERSITY	**4.8**
University of New Hampshire	5.3
Tulane University	5.5
University of Vermont	5.5
Utah State University	7.3
Harvard University	9.7
Penn State University	10.5
Wellesley College	11.5
Carnegie Mellon University	12.4
Middlebury College	16.5
Harvard University	17.6
Oberlin College	18.5
Massachusetts Institute of Technology	22.6
Duke University	31.6

Why Is Duquesne's Electricity Footprint Relatively Small?

The on-campus cogeneration plant supplies roughly 80 percent of the University's electricity. It reduces the University's carbon footprint because it uses cleaner-burning natural gas (rather than coal) as its energy source, and uses would-be waste heat in an efficient process that produces steam and chilled water for heating and cooling. Without the co-generator, Duquesne would purchase all of its electricity from the grid, resulting in a carbon footprint of 6.4 tons CO_2e/student/year, or 25 percent greater than current levels.

In contrast, if all of the electricity purchased by the University to make up the 20 percent of demand not satisfied by the cogeneration plant were renewable, or "green," its carbon footprint would be 4.4 tons CO_2e/student/year, or 8 percent lower than current levels. A recent commitment to all renewable purchased energy has made this statistic a reality.

Past Energy Efficiency Improvements

In addition to using a cleaner source of energy, Duquesne University has also taken steps to improve energy efficiency on campus, including:

- Extensive lighting efficiency upgrades across 14 campus buildings;
- Installation of occupancy sensors to control lighting;
- Installation of water conservation devices in residence halls that resulted in saving 17,252 gallons of water in 2006;
- Roofing upgrades that incorporate better insulation and reflective coatings; and
- Installation of new fans, pumps, and motors with variable speed drives.

Planned Next Steps

A GHG inventory can be a crucial first step toward reducing an organization's environmental footprint, but is also a valueless endeavor if it is not followed by implementation of emission-reduction strategies. Duquesne has made continuing efforts to advance a sustainable energy "economy" for the campus. Planned projects include:

- Evaluating all new construction and renovation projects for incorporation of LEED® ("green building") certification;
- Installing occupancy sensors for lighting in Administration Building;
- Energy-efficient lighting upgrades in Canevin Hall;
- Optimization of Energy Center operation;
- A project funded by The Heinz Endowments to support collaboration with Carnegie Mellon University and the University of Pittsburgh;
- GHG Inventory Software Workshop for neighboring colleges and universities;
- A campus climate information website;
- Ongoing biennial GHG emissions inventories;
- Further engagement of student groups such as Evergreen and Net Impact;
- Sociology class survey of commuter habits to refine inventory data; and
- Sustainable MBA program research on corporate "carbon footprint" assessments.

Future Goals

The most valuable outcomes of this study will be to provide the University with useful information; enlighten students, faculty, and staff; and serve as a catalyst for the development of a comprehensive strategy for campus sustainability. The University must continue to look at its operations, curriculum, investment strategies, and budget priorities through the lens of sustainability. In addition to the projects noted in the prior section, these four prospects present themselves:

- Purchase increasing quantities of renewable electricity
- Install renewable energy generation equipment
- Ensure that institutional mechanisms are developed to integrate sustainability into the curriculum
- Address transportation footprint through further study and innovative actions to reduce emissions.

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II. ACKNOWLEDGEMENTS

A report of this size does not come together without the support of a number of key partners both within and outside the University. First and foremost among these collaborators are three people without whose involvement this project would not have been completed. They are:

- Guy Zupo, *Manager, Energy and HVAC Systems, Facilities Management*
- Rod Dobish, *Director, Building Services and Operations, Facilities Management*
- Jennifer Andrews, *Clean Air-Cool Planet University Program Coordinator*

In addition, we appreciate the support of our University Administration and the following members of the Duquesne community: George Fecik, Steven Schillo, David Seybert, Robert Volkmar, Bryan Mattrazzo, Bill Zilcosky, Coleman Griffin, Nancy Eberle, James Ritchie, Amy Boots, Luci-Jo DiMaggio, Genny Hughes, Lisa Mikolajek, Dan Donnelly, and Karen Kidosh.

III. THE CONTEXTUAL FRAMEWORK

The Science behind Global Climate Change

Certain gases in the atmosphere, principally carbon dioxide, methane, and water vapor, trap some of the heat generated by incoming solar light energy instead of allowing it to be immediately re-radiated into space. This natural process, known as "the greenhouse effect", stabilizes the Earth's temperature; without it, the average global temperature would be about 60° F colder[2].

Elevated carbon dioxide and methane concentrations as a result of fossil fuel combustion and land use changes have intensified the greenhouse effect. In fact, studies by the National Oceanic and Atmospheric Administration (NOAA) and the National Air and Space Administration (NASA) state that the 10 warmest years on record have occurred since 1990.

In addition, the average global temperature has been increasing by 0.32°F per decade since 1970, an approximate 1°F increase between 1970 and 2007[3]. The Intergovernmental Panel on Climate Change (IPCC) has concluded with a very high degree of scientific certainty that rising temperatures are almost certainly the result of human activities[4].

Long-term climatological evidence further supports this assertion. Scientists studying atmospheric CO_2 trends and ice core samples over 1 million years old report these significant findings:

- historical atmospheric carbon dioxide concentrations average 280 parts per million, with some small natural fluctuation (ranging from 250-320 ppm);
- fluctuations in temperature over millennia correlate with fluctuations in CO_2 concentrations; and
- since roughly 1750 (beginning of modern industrial era), carbon dioxide concentrations have increased steadily, and at unnatural rates—from 260 ppm to current readings of 385 ppm4.

Temperatures have already increased 0.6°C globally since the late 19th century, and more acutely in polar regions, where an increase of as much as 3°C has been observed. This is especially significant due to the role of the polar regions in reflecting rather than absorbing sunlight. In effect, as more ice melts, less sunlight is reflected by the white surfaces and is instead absorbed by the dark blue ocean. Visual evidence of this warming trend already exists. Additionally, climatic feedback loops may be developing: thinning sea ice, retreating glaciers, rising sea level, migration of species towards poles, acidification of the ocean, and changing weather patterns including drought and desertification. All of these phenomena are considered *highly likely* to continue through the next century[4].

Confronting Global Climate Change

The release in 2007 by the Intergovernmental Panel on Climate Change (IPCC) of its *Fourth Assessment Report* (FAR) moved climate science and policy discussions quite strikingly forward. Regardless of the depth of such findings, standing alone they do little good if they do not inform action. However, signs of change have been mounting. Even before the release of the FAR, focus on climate change in the media, government, and the public at large increased dramatically. Examples of increasing climate concern include the Stern Report in the U.K., the Regional Greenhouse Gas Initiative in the states of the Northeastern U.S., bipartisan state climate policies in California, and the National Conference of Mayors Climate Protection Initiative. The business community was forced to pay attention to climate change through such initiatives as the U.S. Climate Action Partnership, the Investor Network on Climate Risk, and the Carbon Disclosure Project, all aimed at promoting or inducing corporate action on carbon emissions.

While these actions are crucial to confronting climate change for the well-being of future generations, many obstacles exist. The scale and complexity of climate change can be overwhelming. Several governments have been resistant to taking action on the national and international levels. Resistance to act can be attributed to the fact that the cost of a climate protection measure belongs solely to the entity taking action, yet the benefits are shared by the global community. National governments, including that of the U.S., have not taken significant action to decrease GHG emissions from this fear of supporting "free-riders". In the absence of leadership from the federal government, local governments and institutions of higher education have become leaders in taking steps to confront global climate change.

Higher Education Responds to Climate Change

> *Whatever their stated purposes, colleges and universities have played a major role in the industrialization of the world in the belief that the domination of nature, on balance, was a good thing. The reality, however, has changed. [Institutions of Higher Learning] must now decide whether or not the institution and its graduates move the world in more sustainable directions.*
>
> — David Orr, *Earth in Mind*[5]

In recent years, institutions of higher education have begun to use sustainability metrics to more closely monitor their environmental footprints. Assessing the carbon component of those overall footprints has taken center stage in those examinations. Acting on their local contributions to global climate change has presented institutions of higher education with numerous opportunities, including increased interdisciplinary teaching, learning, and research; reduced energy costs; amplified student outreach and awareness; improved collaboration between faculty, administration, and staff; and enhanced institutional reputations.

Evidence of this recent shift can be found in the emergence of a number of regional and national sustainability organizations, the Association for the Advancement of Sustainability in Higher Education (AASHE) foremost among them. AASHE is dedicated to advancing sustainability through educational resources, training opportunities, and professional networking to colleges and universities across the United States and Canada.

This trend is further demonstrated by the American College and University Presidents Climate Commitment, to which, as of March 2008, over five hundred colleges and universities across the U.S. had become signatories. Under this agreement, schools commit to move toward carbon neutrality; complete a full greenhouse gas inventory within one year of signing the commitment and update the inventory every other year thereafter; develop an action plan to reach neutrality; and make all inventories, policies, and reports publicly available through AASHE.

Pittsburgh Climate Protection Initiative

In 2006, the Mayor and City Council created the *Pittsburgh Climate Protection Initiative* and, with technical assistance from Clean Air—Cool Planet (CA-CP), completed a preliminary greenhouse gas inventory for the City. The *Green Government Task Force* (GGTF) was formed, co-chaired by Mayor Luke Ravenstahl, State Senator Jim Ferlo, City Councilman William Peduto, and Green Building Alliance (GBA) Executive Director Rebecca Flora, to identify ways for the City to reduce GHG emissions. Mayor Ravenstahl also signed the U.S. Conference of Mayors Climate Protection Agreement.

Duquesne University has been involved in the *Pittsburgh Climate Protection Initiative* from its inception. A representative of the Center for Environmental Research and Education was invited to be a member of the GGTF Energy Subcommittee. Additionally, a graduate student at Duquesne has been involved in the research and writing of the City's *Climate Action Plan*, to be presented to City Council for adoption. The plan will specify a target for reduction of GHG emissions and lay out measures that the City will undertake to reduce emissions.

Administrators of most of the major colleges and universities in Pittsburgh have agreed to participate in reducing the community's carbon footprint. As the first institution in Pittsburgh to complete a total campus GHG emissions inventory, Duquesne found itself in a position to assist neighboring schools in undertaking similar endeavors. Toward that end, CERE held a regional workshop in February 2008 on using the CA-CP software tool to conduct emissions inventories.

Solar America Cities

In 2007, Pittsburgh became one of 13 cities designated by the U.S. Department of Energy as a partner in its *Solar America Cities* program. CERE's Dr. Stan Kabala serves on the project's local steering committee aiming to install solar photovoltaic electricity equipment on a series of City facilities. In conjunction with this project, CERE is exploring installation of a solar photovoltaic electricity generation project on Duquesne's campus.

IV. METHODS

In early 2006, Duquesne's Manager of Energy and HVAC Systems attended a training session sponsored by the Pennsylvania Consortium for Inter-Disciplinary Environmental Policy on the use of the CA-CP GHG inventory software for universities and colleges. Later that year, CERE and Facilities Management agreed to employ the tool to measure Duquesne's major GHG emissions.

Emissions and Scope

The data entered into the software was organized into the following categories:

- Purchased electricity;
- Stationary sources, including the on-campus natural gas-fired cogeneration plant and other auxiliary boilers;
- Transportation, including daily commute for students, faculty, and staff, the University vehicle fleet, and paid University air travel; and
- Solid waste.

The inventory software also categorizes emissions by functional scope:

Scope 1: Sources owned or controlled by Duquesne University, e.g., cogeneration plant, auxiliary boilers, campus fleet;

Scope 2: Purchased energy, e.g., electricity;

Scope 3: Indirect emissions from sources outside University controlled by an outside entity, e.g., landfill gas from solid waste, releases by commuting autos and air travel.

Data Collection and Entry Process

The inventory process included the following steps:

- Contacting the offices of Facilities Management, Procurement, Parking and Traffic Management, Institutional Research, Environmental Health and Safety, and Travel to gather crucial data and information;
- Entering data into the software for analysis of energy use and resulting emissions; and
- Confirming and validating data, assumptions, and calculations to ensure that findings would be as accurate as possible.

Purchased Electricity and the Cogeneration Plant

Data on the amount of electricity purchased was provided by the Facilities Management Department. In addition, Facilities Management also provided information on the amount of natural gas consumed by the cogeneration plant and the amount of energy and steam produced.

Efficiency values for the cogeneration plant came from average efficiency values provided by the Environmental Protection Agency's *Climate Leaders* "Indirect Emissions from the Purchase or Sale of Electricity and Steam". The campus Energy Center operates at 50-60 percent efficiency in regard to total energy output. In general, electricity generation occurs at 35 percent efficiency, while the process to generate steam for heating and cooling is about 80 percent efficient.

Auxiliary Boilers

Auxiliary boilers are used in Mendel Hall, A.J. Palumbo Center, and the Tamburitzans Building. Other buildings on campus are heated by steam produced by the cogeneration plant.

Transportation

Commuter Habits

Calculating the campus commuter habits required several assumptions. Data on daily commuting by University faculty and staff came from the 2006 *University Fact Book*, which denotes all faculty and staff by zip code. Total miles traveled by all employees were divided by the number of employees, yielding an average one-way trip of 7.4 miles.

Statistics from a 2005 U.S. Census Bureau report[7] were used to estimate the percentage of employees traveling by car alone, carpooling, bus, or light rail. It was assumed that employees drove to and from campus once each day, with faculty commuting 189 days per year (9 months), and staff commuting 226 days per year (allowing for two weeks vacation and university holidays).

The student commuter population was estimated through the known number of on-campus residents and parking permits sold. Once the population was established, the City commuter patterns were used to estimate mode of travel percentages. It was assumed that students traveled an average distance of five miles per trip, two trips per day, for an average of 171 days per year. Summer school students were assumed to be commuters for the 48 days of the summer semester.

Emissions Tool (CA-CP calculator)

The CA-CP calculator uses emission factors to convert raw data into meaningful outputs. While not the first of its kind, the CA-CP software was specifically developed for use by universities and colleges. Emissions factors used in the software were often established by nationally recognized government entities including the U.S. Department of Transportation, Department of Energy, and Environmental Protection Agency, among others. Use of normalized software allowed Duquesne to benchmark its findings against those of other institutions of higher learning across commonly measured metrics such as pounds or tons of CO_2e per operating dollar, building square footage, employee and student population, and endowment.

Assumptions

It was necessary to make some assumptions when direct information was not available. Assumptions are stated in the methods section and were made with the advice of the University Program Coordinator at CA-CP. Future assessments will attempt to better refine data, reducing or eliminating the need for assumptions.

Baseline Year

Based on available data, calendar year 2006 was used as the baseline year for calculation. The data available for this year most accurately represents campus energy usage.

Square Footage

Of Duquesne's estimated total building space of over three million square feet, roughly ten percent is considered research space. This figure was estimated by dividing each building on campus into its major uses.

Campus Fleet

The campus fleet consists of vehicles from six departments: Facilities Management, Public Safety, Support Services, Admissions, Executive Office, and Spiritan (Trinity) Hall. Emissions could be quantified for only Facilities Management, Public Safety, and Support Services. Average monthly fuel bills for those departments were converted to gallons of gasoline at $3.00 a gallon. Estimations for the remainder of the fleet were made based on communications with those departments.

Air Travel

Total dollar outlays for University air travel data were available from the Office of Travel. These data represent only the travel of student groups and faculty scheduled by the University. Groups using separate procurement cards and later submitting invoices could not be accounted for in the current project scope. Monetary data was converted to miles traveled using conversion factors calculated by the Bureau of Transportation Statistics of the U.S Department of Transportation[8].

Solid Waste

The decomposition of solid waste produces methane gas (CH_4), a very powerful heat-trapping gas. The release of this gas was accounted for in Duquesne's inventory by gathering waste hauling records from Facilities Management and entering the amount of waste produced into the software.

Refrigerants

Gases used for refrigeration (e.g., CFC) are potent greenhouse gases in the atmosphere. While some refrigerants are used on campus, they were not included in this inventory because the amount of refrigerants used on campus greatly declined upon installation of the cogeneration plant ten years ago.

V. RESULTS

Total GHG emissions at Duquesne University in 2006 were 48,400 tons CO_2e, of which 69 percent, or 33,800 tons CO_2e, were produced from electricity and heating. The remaining 31 percent, 14,600 tons CO_2e, resulted from transportation.

Commonly used metrics for reporting emissions at institutions of higher education are tons per student per year (tons CO_2e/student/year), tons per square foot of building space, and tons per operational dollar. For Duquesne, these metrics are equal to 4.8 tons CO_2e per student per year, 28 pounds per square foot of building space, and 2.28 pounds per operational dollar.

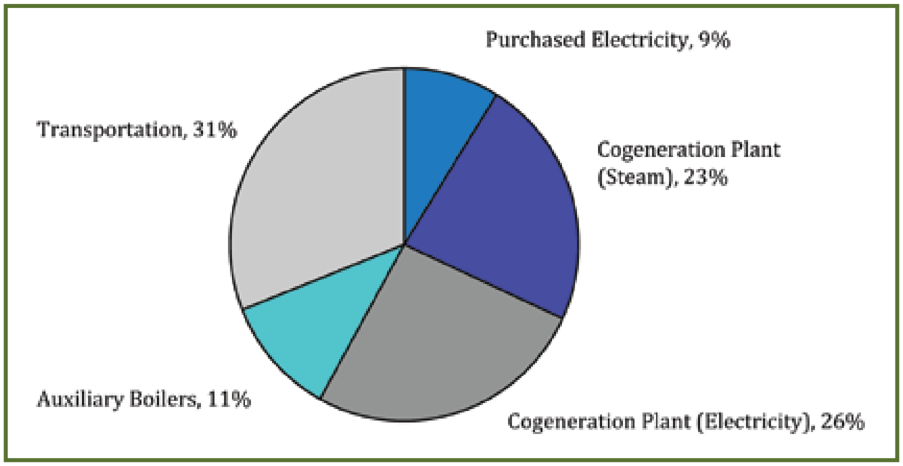

Figure 1: Emissions by Source

While the cogeneration plant's heat and electricity generation accounts for almost half of total emissions at Duquesne, transportation was the second largest source of emissions, accounting for an additional 31 percent. Daily commutes by students, faculty, and staff use over one million gallons of fuel per year, and represent a significant opportunity for change. Future analysis of commuting and travel habits and trends will provide the basis for addressing transportation-related GHG emissions.

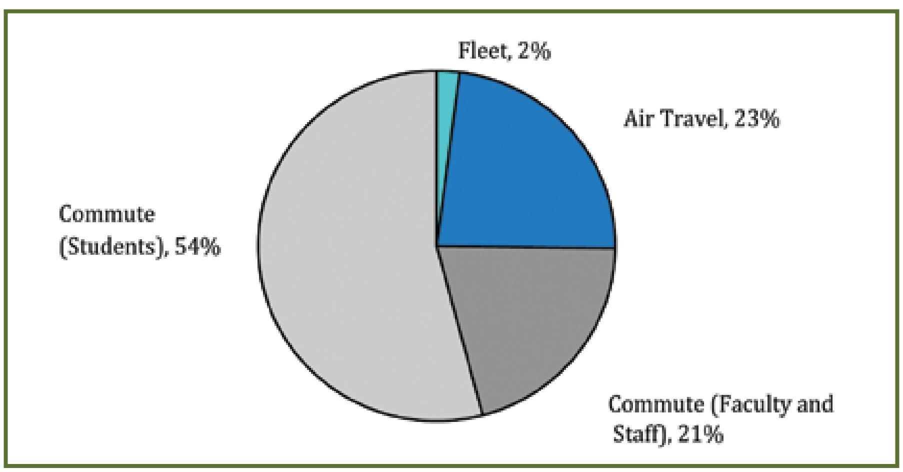

Figure 2: Emissions Resulting from Transportation

Purchased Electricity

In 2006, Duquesne University purchased 11,393,404 kWh of electricity, 38 percent of which came from renewable energy sources. Purchased electricity accounted for 4,240 tons CO_2e*.

The Cogeneration Plant

The cogeneration plant produced an additional 33,551,000 kWh, using 407,280 MMBtu of natural gas. The cogeneration plant also produced 239,836 MMBtu of steam for heating several buildings on campus.

Auxiliary Boilers

Auxiliary boilers on campus used to heat buildings not served by the cogeneration plant steam loop used 95,954 MMBtu of natural gas in 2006. Total emissions from stationary sources (auxiliary boilers and cogeneration plant) were 29,307 tons CO_2e.

Transportation

In 2006, student, faculty, and staff logged over twenty three million miles traveling on and off campus—resulting in nearly one million gallons of fuel consumed. In addition, the campus fleet consumed another 27,500 gallons of fuel (17,500 gallons of gasoline and 10,000 gallons of diesel). Air travel accounted for an additional three million miles. In total, transportation activities contributed 13,768 tons CO_2e to the University's carbon footprint.

Solid Waste

Duquesne has produced about 1,300 tons of waste per year in each of the last five years. Despite growth of the student body and expansion of the campus, waste generation has remained roughly the same. The University's solid waste is sent to a landfill which recovers the methane produced (8,787 kg) and uses it for electricity generation in the community, in effect reducing the University's carbon footprint for waste disposal to 220 tons CO_2e. Duquesne would be releasing 1,210 additional tons CO_2e/year if the captured methane were simply released into the atmosphere. The University can further reduce emissions resulting from solid waste by expanding the commingled recycling program, composting food and landscaping waste, and adopting more aggressive environmentally responsible purchasing policies.

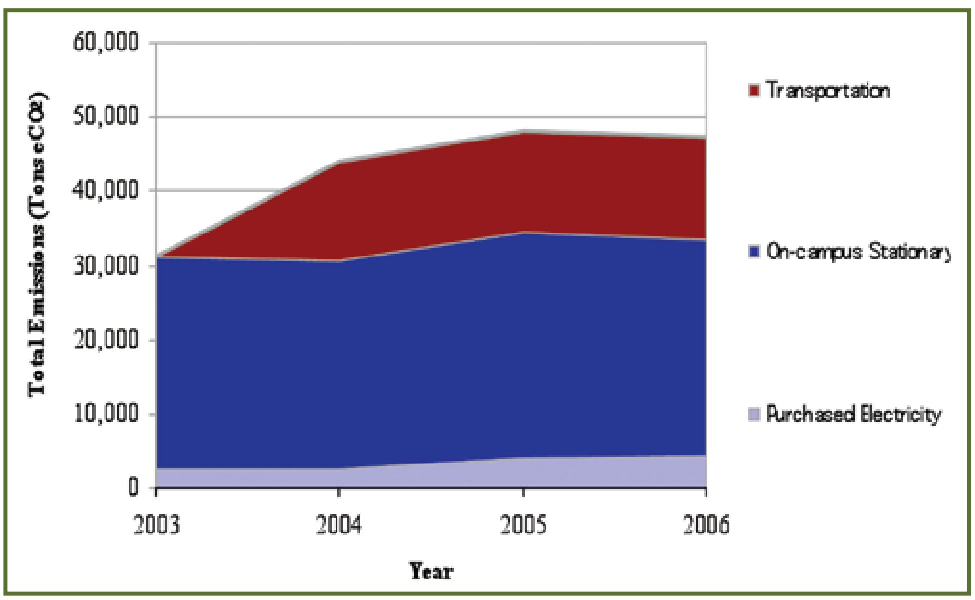

Figure 3: Emissions by Source

*As of December 2007, Duquesne University began procuring all purchased energy from renewable sources.

VI. DISCUSSION

Duquesne's carbon footprint is equal to 4.8 tons CO_2e /student/ year. Emissions at institutions of higher education are highly variable due to a number of factors, including climate zone (heating and cooling days), functions (medical and research centers), regional fuel mix, physical plant infrastructure, endowment, campus layout, commuter population, levels of climate change awareness, and process and progress toward reductions. Table 1 highlights some of these factors for Duquesne University.

Table 1: Duquesne University Demographics

Setting	Urban
Acreage	48 Acres
Students	10,368
Residents	3,553
Faculty	880
Programs	174
Schools	10
Budget	$217 Million

How Does Duquesne Compare?

Table 2 illustrates the wide range of carbon footprints amongst American universities and colleges. This range is due in part to the factors discussed above, but also reflects the energy management decisions made by school officials.

Table 2: Comparison of Tons CO_2e/student/year

University[1]	Tons CO_2e/student/year
Tufts University	2.4
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Rice University	3.0
College of Charleston	4.1
University of Colorado Boulder	4.4
DUQUESNE UNIVERSITY	**4.8**
University of New Hampshire	5.3
Tulane University	5.5
University of Vermont	5.5
Utah State University	7.3
Harvard University	9.7
Penn State University	10.5
Wellesley College	11.5
Carnegie Mellon University	12.4
Carleton College	13.2
Smith College	13.8
Middlebury College	16.5
Harvard University	17.6
Oberlin College	18.5
Massachusetts Institute of Technology	22.6
Duke University	31.6

Signs of Change at Duquesne

> *The primary benefit to adopting sustainable practices—from constructing green buildings to recycling paper to using wind power—is to develop a campus that is more energy efficient, healthier for its occupants, and easier on the environment.*
>
> —George Fecik, Director, *Facilities Management Department*

Duquesne has undertaken a series of initiatives to improve the environmental performance of its campus. For instance, Facilities Management includes energy efficiency improvements in all renovation projects, including the installation of efficient lighting and occupancy sensors that automatically turn off lights when rooms are not in use. Additionally, all new construction and renovation undertaken on campus will be considered for LEED (Leadership in Energy and Environmental Design) certification.

As of December 2007, Duquesne University began procuring all of the electricity it purchases (20%) from renewable sources.

These steps, and many more, are supported by the Facilities Management Department's Sustainability Committee, and reflect the University's commitment to "a detailed and environmentally responsible vision for the future development of the campus" as stated in the Department's *Strategic Plan*.

Climate change and sustainability have also been increasingly integrated into the campus community through academic programs and student involvement. The Environmental Science and Management Masters program, housed in the Center for Environmental Research and Education, incorporates climate change science and policy considerations into its curriculum. In 2007, a *Sustainable MBA* program was launched by the Palumbo School of Business, an initiative which led to the program being ranked 8th in the world by the Aspen Institute's *Beyond Grey Pinstripes*. Duquesne's two student environmental groups have also become more active in the 2007-2008 school year. *Evergreen* and *Net Impact* provide avenues for student outreach, expanding their efforts, roles and capacity as positive organizing forces. Additionally, both the *Duquesne University Times* and the *Duquesne Duke* regularly feature articles focusing on "green" aspects of the University community.

While Duquesne has taken significant steps to improve its environmental performance, these efforts represent only a small portion of what is possible at a university whose very identity is defined by its dedication to service and ethics. The *Recommendations* section of this report presents next steps in the immediate, mid-term, and long-term time frames.

Approaches

Speaking generally, the University's options for reducing its carbon footprint fall into three categories:

- Financial approaches include purchasing all electricity from suppliers of renewable electricity and purchasing carbon offsets.
- Infrastructure approaches include implementing an ongoing and aggressive program of investing in energy efficiency projects, installing renewable energy equipment on campus, and engaging in carbon sequestration projects such as tree-plantings on university property.
- Behavioral approaches will address carbon emissions through changes in the way community members manage their residences, purchase food and other goods, and travel.

Financial Approaches

In December 2007, Duquesne University began buying all of its purchased power from renewable sources. The University has so far not considered the purchase of carbon offsets as a means of reducing its carbon footprint. Carbon offsetting is generally accomplished by purchasing credits, which are invested in renewable power sources, such as wind farms, or in sequestration, such as forest preservation. While this does not reduce emissions, it does provide a carbon "sink" that draws carbon dioxide from the air. As a university with relatively small land holdings, (even including Vincentian Academy), Duquesne is constrained in the extent to which it can use land under its control to sequester carbon by way of plantings.

Infrastructure Approaches

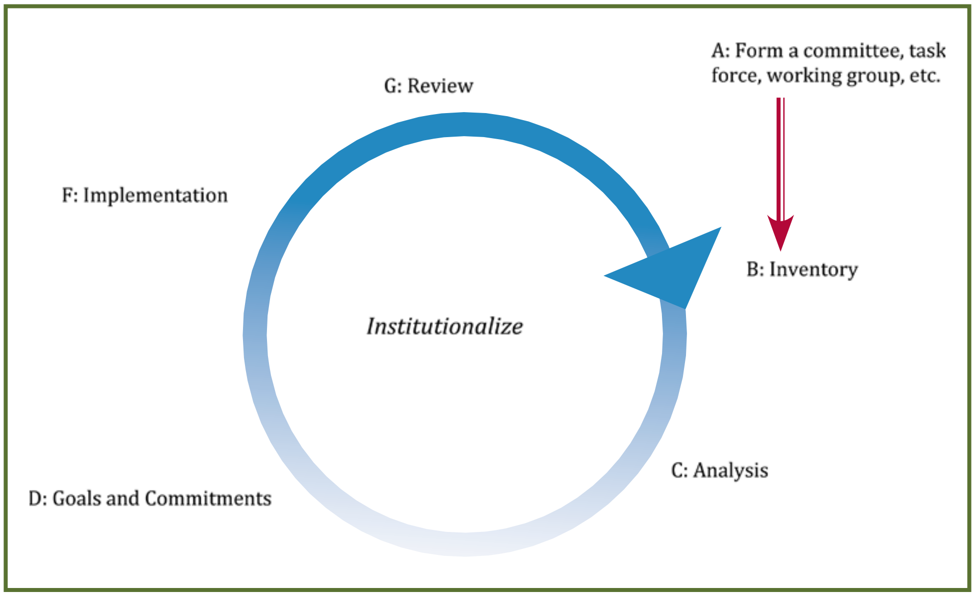

Figure 4: Next Steps for Duquesne University

Our findings suggest the University undertake a process in which it can work toward continuous environmental improvement while setting and achieving goals that can be implemented over various time scales. A president-appointed, high-level task force should be formed to prepare such recommendations for Duquesne during 2008 (Step A). Having the president's support from the start and involving high-level decision makers is vital to making environmental sustainability a part of Duquesne's culture.

In reference to the above diagram, Step B has been completed, and CERE is already working with Facilities Management to analyze and benchmark the findings as they relate to other institutions. This team is also using the inventory software to examine potential short-term reduction strategies (Step C). While this informal collaboration between Facilities Management and CERE has been invaluable, developing and committing to University-wide goals (Step D) necessitates the involvement of more stakeholders.

Once goals for emissions reduction measures and environmental sustainability have been set, proper resources must be available for implementation (Step F). Finally, in order to achieve continuous environmental improvement, the campus carbon footprint along with process and project successes and failures must be periodically reviewed (Step G).

Figure 5: The need for sustainability-oriented organizational infrastructure

As outlined below, the University has a number of resources already at hand to carry out any sustainability- related initiatives, but needs a formal organizational structure and identity from which it can operate. Each university is different, but institutions making comprehensive changes generally do so with top administrative support.

Presidential Commitment:

Commission a task force including:

- Faculty
- Staff
- Students

Leader: VP or Provost

Task: Develop or incorporate a vision, set of guiding principles, and infrastructure from which to pursue comprehensive sustainability strategy.

Potential Sub-committees

Transportation	Student Life
Research	Purchasing
Vision	Operations
Diversity	Waste
Funding	Curriculum

CERE: *Facilitator and coordinator:*

Develop campus sustainability reports

Coordinate sub-committee meetings

House part-time sustainability coordinator

Champion campus efforts

Engage external stakeholders

University Resources

Public Affairs:
Announce initiatives, commitments, and successes

Multimedia and Journalism:
Provide Web site support and design

Sociology:
Develop and conduct surveys

Student Organizations:
Generate student interest and capacity, implement projects

Sustainable MBA Program:
Develop economic analysis of potential projects

External:
AASHE, NACUBO, APPA

Behavioral Approaches

Finally, behavioral approaches include addressing carbon emissions through changes in the way community members live, travel, and make purchases. For example, emissions resulting from transportation can be reduced through decreased traveling, ridesharing, and use of public transportation and non-motorized travel. Further, awareness-raising campaigns could change energy use and waste disposal behavior in the residence halls, classroom and research buildings, offices, and support facilities. Figure 6 illustrates the interaction between financial, infrastructure, and behavioral approaches.

Transportation Improvements

The University's positive record of accomplishment in power generation and building management emphasizes the need to address the role of transportation in its overall carbon footprint. Energy efficient vehicles are only part of the solution. Equally important is the need to change travel and commuting habits to reduce miles traveled alone in private vehicles.

Renewable Energy Potential

Duquesne University enjoys roughly a half mile of permanently unobstructed south-facing solar exposure along the edge of the Bluff, overlooking the Monongahela River—a situation unique in Pittsburgh or any other city—as well as several acres of flat rooftop. Both are perfect locations for solar hot water and photovoltaic installations. It is conceivable that such devices could be installed on the cliff below campus as well. As of May 2008, CERE and Facilities Management are exploring the feasibility of a solar project involving several partners, including Duquesne Light, the City of Pittsburgh, and the International Union of Operating Engineers, Local 95.

The location of the campus more than 200 feet above the river on an unobstructed bluff also presents the potential for installation of wind turbines designed expressly for densely developed urban settings like that surrounding the campus.

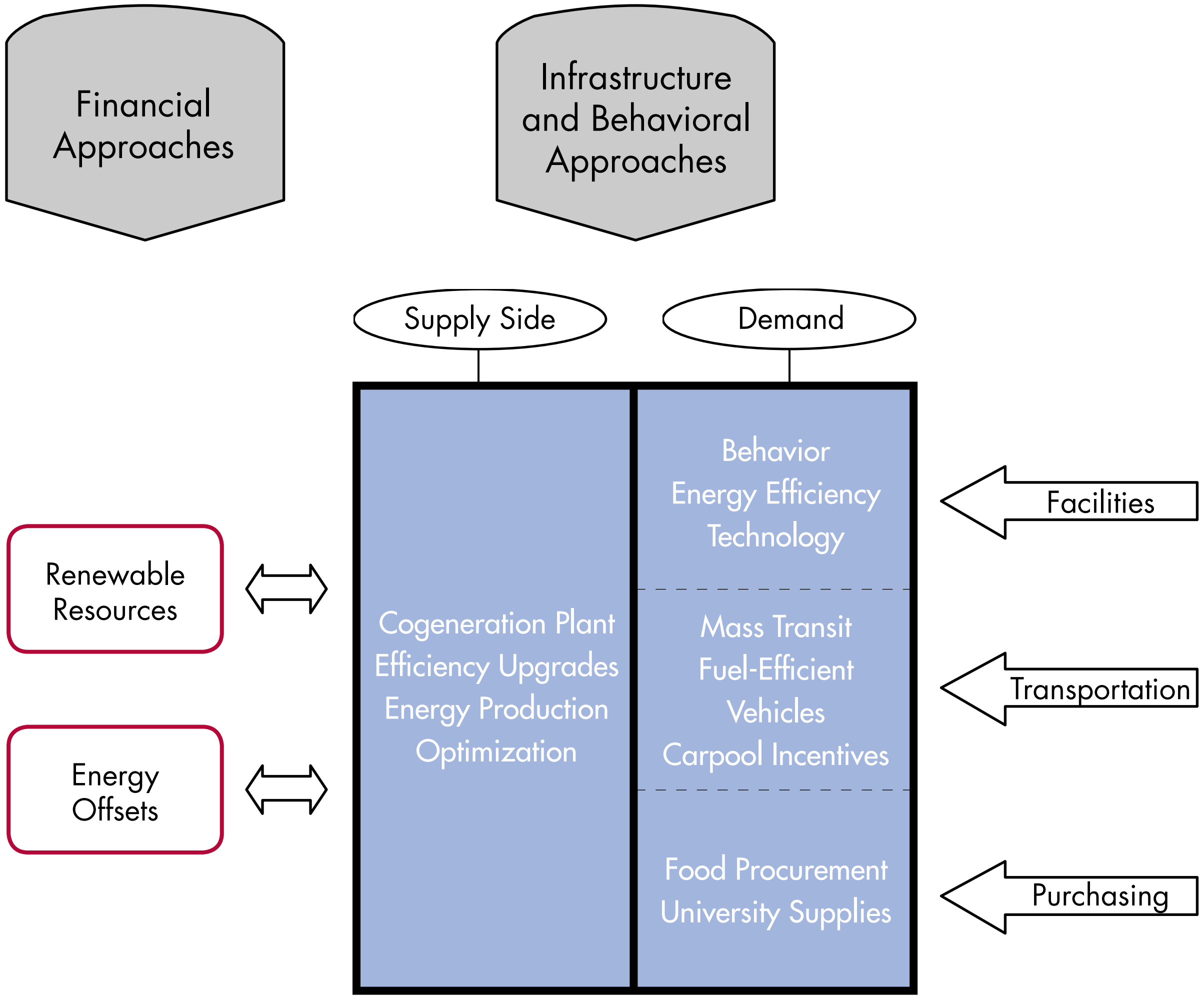

Figure 6: Financial, Infrastructure, and Behavioral Approaches

VII. POLICY RECOMMENDATIONS

Duquesne has positioned itself to become an influential community resource that exemplifies the continuing trend toward sustainability in the region. Opportunities exist for Duquesne to provide guidance and technical assistance to other universities, the private sector, and local government. In order to act in this capacity, Duquesne must establish a comprehensive approach to addressing emissions and sustainability on its own campus first. Measuring our GHG emissions and announcing the results is the first step. Bringing together existing resources across campus and developing an action plan are necessary next steps towards creating a campus vision for sustainability.

As a Catholic and Spiritan University, Duquesne strives to educate students so that they can better the world in which they live and work. The effects of global climate change will be particularly harsh to the poor and disadvantaged of the world. Educating students on the science of climate change and ways to live more sustainably while in college and beyond is crucial to maintaining curricular relevance and competitive advantage. Incorporating environmental sustainability into the culture of the Bluff is a natural extension of Duquesne's existing mission of education for the mind, heart, and spirit.

As mentioned in previous sections of this paper, institutionalization of environmental sustainability has begun to occur, but has not yet been fully integrated into the University culture. The following recommendations are offered as a means to achieve this integration, and should be evaluated in terms of financial and technical feasibility.

Immediate Recommendations (1-2 Years)

- Commit the University to a multi-year emissions reduction strategy with specified reduction targets and deadlines.
- Become a signatory to the American College & University Presidents Climate Commitment.
- Announce publicly the results of the first emissions inventory along with associated achievements derived from projects that have already reduced emissions over the past ten years.
- Appoint a Presidential committee to manage the process of necessary research, implementation, and measurement to reach commitments, facilitated and coordinated by the Center for Environmental Research and Education.
- Establish a comprehensive campus greening committee with representation from administrators, students, and faculty, drawing from the Bayer School and other schools, Facilities Management, EHS, and Commuters and Transportation.
- Join the Association for Advancement of Sustainability in Higher Education (AASHE) and other relevant national organizations.
- Comprehensively analyze transportation trends and work with the City to implement more energy-efficient transportation options for students, faculty, and staff.
- Identify low-cost opportunities- "low-hanging fruit"- for further emissions reductions from both facility upgrades and behavior change.
- Engage faculty in facilitating student-led research and projects as both coursework and service learning.
- Link mission-related elements to the ethical imperative of intergenerational equity, an action that might merit a committee unto itself.
- Adopt a policy that all future new construction and renovation on campus will achieve LEED certification.
- Engage in joint campus climate action programs with peer institutions in southwestern Pennsylvania.
- Convene a regional symposium on climate change action by institutions of higher education.
- Provide outreach and technical assistance to the region's middle-size municipalities through the Inter-Municipal Environmental Forum (IMEF) to inventory and reduce greenhouse gas emission by making fiscally sound investments in operations and facilities.

Mid-term Recommendations (2-3 Years)

- Adopt a comprehensive University policy on "greening" that includes not only operations but also activities and functions across the institution, e.g., residence, outreach, research, teaching (reward structure/interdisciplinary credit), and identity.
- Formally commit to long-term carbon minimization strategy.
- Adopt the Association for Advancement of Sustainability in Higher Education's (AASHE) Sustainability indicators reporting tool.
- Establish policies to address the climate impact of University investment and purchasing that take into account the performance of vendors and contractors.
- Increase the University's influence in the region by purchasing locally produced food and locally manufactured equipment and technology and investing in regional firms that provide such goods and services.
- Reward faculty commitments to service and inter-disciplinary non-traditional research projects and methods.
- Conduct a comprehensive analysis of opportunities for renewable energy installations (solar thermal and photovoltaic electricity) on campus in environmental, financial, and public relations terms.

Long Term Recommendations (3-5 Years)

- Design and test a new institutional and curricular paradigm for higher education in the region.
- Establish and staff an Office of Sustainability and Integrative Research.
- Develop a decision-making tool for "greening" that incorporates financial return on investment analysis based on full cost accounting as well as evaluations of the pedagogical and public information values of "environmental" initiatives.
- Continue to develop a code of conduct and commitment to principles of environmental sustainability.

Appendix A: Glossary of Key Terms

For the purposes of this paper:

Carbon dioxide equivalent (CO_2e):

A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as "tons of carbon dioxide equivalents." The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP.

Carbon Footprint:

The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO_2).

Cogeneration:

Production of two useful forms of energy such as high-temperature heat and electricity from the same process. For example, while boiling water to generate electricity, the leftover steam can be sold for industrial processes or space heating.

Fossil Fuel:

A general term for buried combustible geologic deposits of organic materials, formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in the earth's crust over hundreds of millions of years. See coal, petroleum, crude oil, natural gas.

Greenhouse Gas:

Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs). See carbon dioxide, methane, nitrous oxide, hydrochlorofluorocarbons, ozone, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride.

LEED Certification:

A voluntary national standard for developing sustainable, high-performance buildings.

Photovoltaic Cell:

A semiconductor device that converts the energy of sunlight into electric energy.

Renewable Resource:

A resource replenished by natural processes at a rate comparable or faster than its rate of consumption by humans or other users. Solar radiation, tides, winds, and hydroelectricity are examples.

Appendix B: Duquesne Inventory Data

EMISSIONS BY SOURCE, 1998-2006 (Tons CO_2e)										
	Fiscal Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
	Purchased Electricity	8,467	4,708	5,015	5,722	5,266	2,467	2,540	4,107	4,243
ON CAMPUS STATIONARY	Non-Cogen			4,819	5,068	4,145	4,352	3,966	5,755	5,588
	Cogen Electric			13,130	12,642	13,066	13,544	13,628	12,878	12,449
	Cogen Steam			12,134	11,759	11,294	10,739	10,459	11,739	11,271
	Total			30,082	29,469	28,504	28,635	28,052	30,371	29,307
TRANSPORTATION	Fleet							283	283	283
	Student Commuters							6,837	7,037	7,226
	Faculty/Staff Commuters							2,758	2,839	2,829
	Air Travel							3,429	3,429	3,429
	Total							13,307	13,588	13,768
	Agriculture									1
	Solid Waste					217	227	222	208	222
TOTAL EMISSIONS				35,097	35,191	33,987	31,329	44,121	48,274	47,541

PURCHASED ELECTRICITY	
Year	**kWh**
1998	14,095,925
1999	7,837,024
2000	8,348,307
2001	9,525,765
2002	8,766,514
2003	8,213,332
2004	8,458,035
2005	11,028,660
2006	11,393,404

AUXILIARY BOILERS	
Year	**Natural Gas (MMBTU)**
2000	82,741
2001	87,019
2002	71,163
2003	74,722
2004	68,096
2005	98,818
2006	95,954

COGENERATION PLANT, 2000-2006			
Year	**Natural Gas (MMBTU)**	**Electricity Produced (kWh)**	**Steam Produced (MMBTU)**
2000	433,783	34,152,643	249,230
2001	418,987	33,107,566	243,166
2002	418,273	33,307,665	238,560
2003	416,964	33,620,720	210,504
2004	413,585	33,227,836	201,357
2005	422,677	33,370,980	240,212
2006	407,280	33,551,000	239,836

STUDENT COMMUTE DURING SCHOOL YEAR									
Year	**# of Students**	**Commuting by Car (%)**	**Driving Alone (%)**	**Carpooling (%)**	**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Total Fuel Consumed (gallons)**
2004	8,806	50	80	10	2	171	5	12,799,521	579163.8462
2005	9,040	50	80	10	2	171	5	13,138,913	594520.9615
2006	9,276	50	80	10	2	171	5	13,481,939	610042.5
		Commuting by Bus (%)			**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Total Diesel Fuel Consumed (gallons)**
		10			2	171	5	1,505,826	37958.18928
		10			2	171	5	1,545,755	38964.68907
		10			2	171	5	1,586,111	39981.9651

*** *Note:*** An error was made in the calculation of the transportation emissions. The percentage of students, staff, and faculty carpooling or driving alone should reflect the percentage of total population commuting in this manner, rather than the percentage of individuals commuting by car. Because results had already been reported when this error was uncovered, the transportation results have not been corrected, but are actually slightly lower than reported. This error will be corrected in subsequent inventories.

STUDENT COMMUTE DURING SUMMER SCHOOL									
Year	**# of Students**	**Commuting by Car (%)**	**Driving Alone (%)**	**Carpooling (%)**	**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Total Fuel Consumed (gallons)**
2004	3,363	80	90	10	2	48	5	153352800	69390.40724
2005	3523	80	90	10	2	48	5	160648800	72691.76471
2006	3641	80	90	10	2	48	5	166029600	75126.51584
		Commuting by Bus (%)			**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Total Diesel Fuel Consumed (gallons)**
		10			2	48	5	161424	4069.104097
		10			2	48	5	169104	4262.698107
		10			2	48	5	174768	4405.473689

FACULTY COMMUTE									
Year	**# of Faculty**	**Commuting by Car (%)**	**Driving Alone (%)**	**Carpooling (%)**	**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Total Fuel Consumed (gallons)**
2004	1,374	90	80	15	2	189	7.4	336293370	152,169
2005	1,400	90	80	15	2	189	7.4	342657000	155,048
2006	1,386	90	80	15	2	189	7.4	339230430	153,498
		Commuting by Bus (%)			**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Total Diesel Fuel Consumed (gallons)**
		10			2	189	7.4	384335.28	9688.152087
		10			2	189	7.4	391608	9871.479565
		10			2	189	7.4	387691.92	9772.764769
		Commuting by Light Rail (%)			**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Electricity Consumption (kWh)**
		2			2	189	7.4	76867.056	26403.52127
		2			2	189	7.4	78321.6	26903.15122
		2			2	189	7.4	77538.384	26634.11971

STAFF COMMUTE									
Year	**# of Staff**	**Commuting by Car (%)**	**Driving Alone (%)**	**Carpooling (%)**	**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Total Fuel Consumed (gallons)**
2004	841	90	80	10	2	226	7.4	2391030.28	108191.4154
2005	875	90	80	10	2	226	7.4	2487695	112565.3846
2006	880	90	80	10	2	226	7.4	2501910.4	113208.6154
		Commuting by Bus (%)			**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Total Diesel Fuel Consumed (gallons)**
		10			2	226	7.4	281297.68	7090.826285
		10			2	226	7.4	292670	7377.494648
		10			2	226	7.4	294342.4	7419.65176
		Commuting by Light Rail (%)			**Trips/ day**	**Days/ Year**	**Miles/ Trip**	**Total Distance (miles)**	**Electricity Consumption (kWh)**
		2			2	226	7.4	56259.536	19324.92192
		2			2	226	7.4	58534	20106.19106
		2			2	226	7.4	58868.48	20221.08358

GREENHOUSE GAS EMISSIONS BY SOURCE, 1998-2006 (KG)

CARBON DIOXIDE EMISSIONS

	Purchased Electricity	Natural Gas for Cogeneration Plant	Natural Gas for Auxiliary Boilers	University Fleet (Gasoline)	University Fleet (Diesel)	Faculty/Staff Business Air Travel	Student Programs Air Travel	Faculty/Staff Commute (Gasoline)	Faculty/Staff Commute (Diesel)	Student Commute (Gasoline)	Student Commute (Diesel)	Faculty/Staff Commute (Electric)
1998	7,656,159											
1999	4,256,656											
2000	4,534,358	22,900,005	4,368,012									
2001	5,173,891	22,118,903	4,593,853									
2002	4,761,506	22,081,210	3,756,793									
2003	2,230,523	22,012,106	3,944,678									
2004	2,296,978	21,833,724	3,594,882	152,469	99,938	1,602,288	1,504,079	2,268,393	167,685	5,650,538	420,010	12,419
2005	3,713,914	22,313,704	5,216,739	152,548	99,938	1,602,288	1,504,079	2,332,795	172,382	5,816,108	432,004	15,830
2006	3,836,742	21,500,875	5,065,544	152,548	99,938	1,602,288	1,504,079	2,324,887	171,817	5,972,633	443,597	15,779

METHANE EMISSIONS

	Purchased Electricity	Natural Gas for Cogeneration Plant	Natural Gas for Auxiliary Boilers	University Fleet (Gasoline)	University Fleet (Diesel)	Faculty/Staff Business Air Travel	Student Programs Air Travel	Faculty/Staff Commute (Gasoline)	Faculty/Staff Commute (Diesel)	Student Commute (Gasoline)	Student Commute (Diesel)	Landfilled Waste with CH4 Recovery and Electric Generation
1998	77											
1999	43											
2000	46	2,288	436									
2001	52	2,210	459									
2002	48	2,206	375									8,551
2003	23	2,199	394									8,966
2004	23	2,182	359	30	5.67	16	15	453	10	1,130	24	8,781
2005	37	2,230	521	30	5.67	16	15	466	10	1,162	25	8,207
2006	39	2,148	506	30	5.67	16	15	464	10	1,193	25	8,787

NITROGEN DIOXIDE EMISSIONS

	Purchased Electricity	Natural Gas for Cogeneration Plant	Natural Gas for Auxiliary Boilers	University Fleet (Gasoline)	University Fleet (Diesel)	Faculty/Staff Business Air Travel	Student Programs Air Travel	Faculty/Staff Commute (Gasoline)	Faculty/Staff Commute (Diesel)	Student Commute (Gasoline)	Student Commute (Diesel)	Synthetic Fertilizer
1998	134											
1999	74											
2000	79	46	9									
2001	90	44	9									
2002	83	44	8									
2003	39	44	8									
2004	40	44	7	10	3	18	17	156	4	389	11	
2005	65	45	10	10	3	18	17	160	4	400	11	
2006	67	43	10	10	3	18	17	160	4	411	11	4

Appendix C: Works Cited

1. Association for the Advancement of Sustainability in Higher Education. "Campus Greenhouse Gas Emissions Inventories."

   http://www.aashe.org/resources/ghg_inventories.php. Accessed 6.13.08

2. U.S. Environmental Protection Agency. "Climate Change Kids Site."

   http://epa.gov/climatechange/kids/greenhouse.html. Accessed 6.13.08.

3. U.S. Environmental Protection Agency. "Temperature Changes."

   www.epa.gov/climatechange/science/recenttc.html. Accessed 6.13.08.

4. Intergovernmental Panel on Climate Change. (2007) Climate Change 2007: *The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning (eds.)] and *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)].

5. Orr, D.W. (1994). *Earth in Mind: On Education, Environment, and the Human Prospect.* Washington: Island Press.

6. U.S. Environmental Protection Agency. *Indirect Emissions from Purchases/Sales of Electricity and Steam.* (October, 2004).

   http://www.epa.gov/stateply/documents/resources/indirect_electricity_guidance.pdf. Accessed 6.13.08.

7. U.S. Census Bureau, Public Information Office. (2007) *Most of Us Still Drive to Work: Alone: Public Transportation Commuters are still Concentrated in a Handful of Large Cities.*

8. U.S. Department of Transportation. Bureau of Transportation Statistics.

   www.bts.gov. Accessed 6.13.08.

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