Carbon Footprint of the University of Maryland, College Park: An Inventory of Greenhouse Gas Emissions, 2002-2008

November 2009
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(Cover Photo by John Consoli)
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PREFACE

This report is an update to the Inventory of Greenhouse Gas Emissions, 2002-2007 and includes corrections to baseline data for the period Fiscal Year (FY) 2002-2007 as well as data for FY 2008. The American College and University Presidents’ Climate Commitment (ACUPCC, Presidents’ Climate Commitment, or the Commitment), to which the University of Maryland is a charter signatory, requires that participating institutions conduct biennial greenhouse gas inventories. Although not required by the Commitment, the University chose to conduct an inventory update to refine its data collection methodology and determine whether progress was being made to reduce campus greenhouse gas emissions. The FY 2008 inventory update identified data from the 2002-2007 report requiring correction. Thus, this report is being reissued as a stand-alone volume covering FY 2002 – 2008 and replaces the FY 2002-2007 report issued in June 2008.

ACKNOWLEDGEMENTS

The work spanning 2007-2009 to inventory the campus’ greenhouse gas emissions was supported by many members of the campus community whom the authors would like to thank for their contributions. Doug Duncan, former Vice President for Administrative Affairs, provided financial support for the study and current Vice President Ann Wylie has supported the process through her active participation on the Climate Action Plan Work Group and her continued leadership on climate action and sustainability. The Office of Sustainability has offered essential support and consultation throughout the project. The authors would also like to thank the GHG Taskforce which provided essential input on the first inventory and have, in many cases, served as advisors for this update.

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In addition, the authors gratefully acknowledge the following individuals for assisting with locating data and sharing their insight on campus operations:

Frank Allnutt, Director, Research & Education Centers, College of Agriculture & Natural Resources; Chris Banko, Allied Waste; John Belushi, Annapolis Junction; Terry Brenner, Assistant Director, Facilities Planning; Edward Brown, Residential Facilities & Building Systems; Terry Brenner, Facilities Planning; Lindsay Callahan, University Barn Manager; Nicola Corbin, Manager of Marketing & Public Affairs, Dep. of Transportation Services; Kevin Curtis, Dep. of Environmental Safety; David Davitaia, Assistant Director of Operations, Dep. of Transportation Services; Pat Dollar, Manager, Solid Waste & Recycling; Catherine Doyer.
Business Manager, Financial Services; Sandra Dykes, Assistant Director of Administrative Services, Building & Landscape Services; Chuck Edwards, CHP Plant Director; Steven Edwards, Director, Maryland Fire & Rescue Institute; Darryl Flick, Head of Prince George’s Waste Management Division, Brown Station; Kurt Flick, Research Analyst; Ann Geronimo, Director, Research Development; Ken Gertz, Associate Vice President for Research Development; Shoshana Griffith, Program Assistant, Office of International Education Services; Carol Hearle, Campus Environmental Planner; Erika Heilig, Coordinator, Financial Services; Jim Hope, Utilities Information Manager, Financial Services; Erin Iverson, Manager, Office of Extended Studies; Jerry Joy, Manager of Administrative & Maintenance Support, Building & Landscape Services; Chris Leween, IT Coordinator, Dep. of Transportation Services; George Long, Manager, Golf Course Grounds; Beverly Malone, Assistant to the Director, Department of Transportation Services; Joel Manspeaker, Manager, Building & Landscape Services; Jeremy Menna, Assistant Manager of Operations, Inter-Collegiate Athletics; Aleksey Molokin, Student Supervisor, Facilities Maintenance; Bill Monan, Assistant Director, Building & Landscape Services; James Pence, Zone Supervision, HVAC Systems; Karen Petroff, Nutrient Manager, Building & Landscape Services; Larry Preston, Manager, Logistical Support Section, Maryland Fire & Rescue Institute; Don St. Armand, Shuttle Coordinator, Dep. of Transportation Services; Hilary Sazama, Manager, Office of Extended Studies; Armand Scala, Manager, Shuttle-UM; David Shaughnessy, Manager, Utility Assessments, Financial Services; Brenda Testa, Director, Facilities Planning; and Greg Thompson, Assistant Director, Dining Services Maintenance.
EXECUTIVE SUMMARY

This report is a summary of greenhouse gas emissions for the University of Maryland, College Park (UM, the University) for the fiscal years (FY) 2002 to 2008. This report contains significant updates to the FY 2002 to 2007 inventory released in June 2008. The greenhouse gas (GHG) inventory of the College Park campus is intended to provide a baseline for the development and implementation of future GHG emission reduction strategies. Going forward, biennial updates conducted on a calendar year basis will help the University evaluate the efficacy of its GHG reduction strategies and track progress toward the long-term goal of carbon neutrality.

Background

On May 22, 2007, University of Maryland President Mote signed the American College and University Presidents’ Climate Commitment (ACUPCC, Presidents’ Climate Commitment, or the Commitment), which is a pledge to reduce campus GHG emissions and achieve carbon neutrality. Carbon neutrality is defined as reducing greenhouse gas emissions as much as possible and offsetting any remaining emissions so that net emissions to the atmosphere are zero. Within one year of signing the Commitment, all signatories must inventory their GHG emissions to determine the baseline from which progress will be measured and inventories must be conducted every two years thereafter, with milestone reporting in off years.

Process & Methodology

The University administration, in collaboration with the Office of Sustainability, reviewed potential external and on-campus options and selected the Center for Integrative Environmental Research (CIER) at the University of Maryland to conduct and coordinate the inventory. CIER brought together a team of on-campus experts to advise the process. A Campus Greenhouse Gas Inventory Taskforce (GHG Taskforce) was charged to assist in the completion of the inventory including selection of the physical boundary (i.e. organizational boundary), scope of emissions (i.e. operational boundary), and study period.

The College Park campus and two of its larger satellite programs (Maryland Fire and Rescue Institute and the Maryland Agricultural Experiment Station farms) were selected as the focus of the inventory, comprising a total of 394 buildings and representing 13.4 million square feet of building space. The most recent seven fiscal (July 1 through June 30) years 2002–2008 were included in the study period based on data availability. The GHG inventory scope included emissions associated with electricity and steam consumption, fuel use, commuting, air travel, campus transportation, agricultural releases, solid waste management, and fugitive refrigerant releases.

A standardized greenhouse gas calculator (Campus Carbon Calculator version 6.2, Clean Air-Cool Planet, New Hampshire) was used to calculate the emissions associated with campus...
operations and activities. The calculator enabled easy data entry and conversion of the collected data on emissions to their carbon dioxide equivalent based on global warming potential.

Findings

**Total GHG Emissions**: During the FY 2002-2008 period, the University’s GHG emissions or carbon footprint, ranged from a low of 306,300 metric tons of carbon dioxide equivalent (MT-CO$_2$e) in FY 2002 to 311,345 MT-CO$_2$e in FY 2008, peaking at 319,100 MT-CO$_2$e in FY 2003. Fiscal Year 2008 emissions are equivalent to the GHGs emitted by 52,950 cars$^1$ or sequestered by 93,500 acres of Maryland forest$^2$ in a year. Annual emissions reported in this update are 30,000-50,000 MT-CO$_2$e less than previously reported, due to data collection and accounting improvements that are detailed below.

![UM Carbon Footprint](image)

E.S.1 Total University greenhouse gas emissions, FY 2002-2008, associated with energy use, transportation, agriculture, solid waste, and refrigerant releases.

**Major Sources of Emissions**: The inventory clearly demonstrates that the major sources of GHG emissions were from the electricity and steam produced by the campus co-generation plant, purchased electricity, and transportation including the daily commuting of the campus community, air travel, Shuttle-UM, and the University fleet. In FY 2008, these sources collectively accounted for 95 percent of the campus’ GHG emissions.

**CHP Plant Contribution**: The on-campus Combined Heat and Power Plant (CHP) was responsible for 41 percent of total GHG emissions in FY 2008.

**Transportation Contribution**: Transportation contributed 31 percent of total GHG emissions in FY 2008, with sources including student, faculty, and staff commuting, employee business travel (air travel and ground transportation), Shuttle-UM, and other fleet vehicles.

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$^1$ Assuming a car traveled 15,000 miles/year * 0.045 gallons/mile * 0.00871 MT-CO$_2$e/gallon = 5.88 MT-CO$_2$e/year.

$^2$ Assuming an acre of mature trees absorbs 3.33 MT-CO$_2$e per year (Duke University study conducted by the Nicholas School of the Environment and Earth Sciences; 2003).
- **Commuting Contribution:** Commuting to and from campus was estimated to contribute 15 percent of total GHG emissions.

- **Other Sources of Emissions:** GHG emissions from small stationary sources, solid waste, refrigerant releases, and agricultural operations together comprised 5 percent of total GHG emissions in FY 2008.

![Pie chart showing contributions of major sources to University GHG emissions for FY 2008.](image)

**E.S.2** Contribution of major sources to University GHG emissions for FY 2008.

![Pie chart showing detailed breakdown of University GHG emissions by source for FY 2008.](image)

**E.S.3** A detailed breakdown of University GHG emissions by source for FY 2008.

- **Trends in GHG Emissions:** Total campus GHG emissions (MT-CO$_2$e) increased 4.2 percent in FY 2003, but decreased by 2.4 percent over the period of FY 2003-2008. Despite growth in the number of faculty, staff, and students (the campus community) and growth in the amount of occupied building space, per capita GHG emissions (MT-CO$_2$e per campus community member) and emissions per area (MTCO$_2$e per square foot of total building space) decreased by 3.9 and 4.9 percent, respectively.

- **Reasons for Reductions:** A substantial portion of the reduction in total GHG emissions over the study period was due to the installation of the Combined Heat & Power Plant (co-generated steam and electricity), which began operation in FY 2004. Additionally, the
reduction can likely be attributed to facilities renovations such as lighting retrofits, HVAC enhancements, and window replacements. The decline, particularly from FY 2005-2007, was also attributed to the decrease in gasoline consumption by student commuters and an associated increase in Shuttle-UM ridership as more students resided closer to campus in response to growth of on- and near-campus housing.

**GHG Emissions Avoided:** An investment in the CHP plant enabled the University to avoid 60,000 MT-CO\textsubscript{2}e of emissions annually (20 percent of current emissions).

**GHG Emissions Projections:** Without serious efforts to mitigate campus GHG emissions, campus emissions in FY 2020 could be 26 percent higher than in FY 2008 based on an annual growth in energy use projection of 2 percent per year.

**For Future Inventories**

- The commuting calculations were based on estimates of average commute distances by commuter type (faculty, staff, and students) and assumed an average fuel economy for commuter vehicles and number of days on campus per year for each commuter type. Currently, the Office of Sustainability and CIER are working with the Department of Transportation Services to develop a better modeling tool for tracking commute distance, fuel economy, and commuter behavior.

- The accuracy and breadth of future campus GHG inventories can be improved by reporting monthly data on electricity consumption, which would better support the development of electricity-focused mitigation strategies.

- The inventory did not include an estimate of GHG emissions associated with the consumption of materials and supplies (e.g., paper, food, bottled water). However, future inventories should include this category of carbon emissions so that mitigation efforts directed at modifying campus purchasing protocols can be evaluated and monitored.

**Climate Action Planning**

Data from the first GHG Inventory, 2002-2007, indicated that mitigation strategies should focus on reducing the major sources of greenhouse gases, which included electricity consumption, steam use (for heating and cooling), daily commuting by the campus community, and air travel. The findings from the inventory were used by the Climate Action Plan Work Group\textsuperscript{3}, a diverse

\textsuperscript{3} For a list of Climate Action Plan Work Group members, see http://www.sustainability.umd.edu/CAP_WG_members.pdf
group of more than 50 faculty, staff and students representing 35 different schools, departments, and offices, charged with developing the University’s Climate Action Plan. In drafting the plan, the Climate Action Plan Work Group considered the full range of mitigation options with significant focus on strategies within the major source categories listed above. The plan was endorsed by the University Senate and President Mote and submitted to the ACUPCC in September 2009.

**Next Steps - Implementation**

The University’s Climate Action Plan contains over 40 strategies that will set the campus on a path toward carbon neutrality. With the plan drafted, the campus is turning its attention to implementation. A number of projects are underway that will help the campus reduce its greenhouse gas emissions. Some examples of current efforts include:

- **Energy Performance Contract** – beginning in 2009, the University will replace failing equipment in nine campus buildings with more energy efficient technology that will eliminate over 71,000 MT-CO\(_2\)e and save nearly $30 million dollars in energy costs over the next 15 years.
- **Campus hallway lighting retrofit and other lighting retrofits** – Hallways across campus use 80 percent less energy than they did prior to 2008 due to a project combining energy efficient fixtures with reducing lighting to sufficient levels. Other spaces such as the Eppley Recreation Center West Gym and Ritchie Arena have received lighting retrofits that reduce emissions and save money.
- **LEED Silver New Buildings and Major Renovations** – In 2007, the University selected this as an early “tangible action” under the Presidents’ Climate Commitment. The campus has a policy that all new campus construction and major renovations will be built to at least the U.S. Green Building Council’s LEED (Leadership in Energy and Environmental Design) Silver standard or equivalent. As of summer 2009, two green campus buildings are under construction with strong potential for Gold ratings.
- **Energywise UM** – a pilot effort is underway with 3 campus buildings to make building occupants more aware of their energy use and provide strategies and incentives to conserve energy and save money.
- **Hybrid buses** – The Department of Transportation Services is purchasing 4 hybrid replacement buses for 2010 delivery. Hybrid buses use 30 percent less fuel than conventional buses so the campus will see emission and fuel reductions from this technology.
- **Electric vehicles** – Motor Transportation Services has purchased several electric vehicles and trucks and is exploring solar recharging stations around campus.
- **Information Technology** – UM is working to virtualize hundreds of computer servers across campus by 2012, saving nearly 1,000 MTCO\(_2\)e annually thereafter.
- **Live and Work in College Park** – In partnership with the City of College Park and the College Park – University Partnership, funding has been secured to incentivize University employees and others working in College Park to purchase foreclosed homes within the city limits. This reduces the number of empty homes in the city and will reduce traffic and commuting-related emissions.
I. BACKGROUND: CLIMATE COMMITMENT

In May 2007, the University of Maryland (UM) joined the American College and University Presidents’ Climate Commitment (Presidents’ Climate Commitment or the Commitment), a coalition of colleges and universities concerned about the impacts of global warming and dedicated to reducing their institutions’ greenhouse gas emissions. As a Charter signatory, the University of Maryland demonstrated its commitment to addressing the issue of climate change and agreed to reduce and ultimately neutralize its greenhouse gas emissions. Carbon neutrality is defined as having no net emissions after minimizing the carbon footprint as much as possible and offsetting the remaining emissions\(^4\). In July 2007, the University created an Office of Sustainability, reporting to the Vice President for Administrative Affairs, which facilitates the development of sustainable policies and practices on the College Park campus. As part of the Commitment (see Appendix), all signatory institutions are required to conduct a greenhouse gas inventory that must be updated every two years. Furthermore, as a signatory, the University agreed to increase research on climate change and expand the educational curriculum to incorporate environmental sustainability. In June 2008, the University completed its first GHG inventory and finalized its Climate Action Plan for release in September 2009.

State of Maryland Collaborations

All University System of Maryland (USM) institutions have signed the Commitment and in 2008, USM also created a new position of Vice Chancellor for Environmental Sustainability to help oversee a system-wide sustainability initiative to develop policies, practices, and programs that will make the university system a national leader in institutional responses to the challenges of global climate change.

The State of Maryland has also recognized the potential problems associated with global warming and has been proactive in initiating steps to decrease GHG emissions within the state. A Climate Change Commission for the State of Maryland has worked to develop a climate action plan for the State and Governor O’Malley pledged to reduce Maryland’s energy consumption by 15 percent by 2015 with the program *EmPOWER Maryland*. Maryland is also aiming to reduce emissions from major power generators through the Northeast Regional Greenhouse Gas Initiative (RGGI), a cooperative agreement among ten Northeastern and Mid-Atlantic States. RGGI creates a cap-and-trade system with an auction of emissions allowances that could generate significant revenue, a portion of which is likely to be reinvested in energy efficiency programs in the state to help reduce electricity demand. In addition, the Governor is supportive of efforts to calculate State agencies’ environmental footprint, including carbon emissions. This is being rolled out in late 2009 and will have a range of implications for the campus.

International Collaborations

At the international level, in 2007 the Intergovernmental Panel on Climate Change (IPCC)\(^4\)\footnote{American College and University President's Climate Commitment draft Implementation Guide. \url{http://www.presidentsclimatecommitment.org/pdf/ACUPCCdraftIG.pdf}.}
released its fourth assessment report outlining climate change findings. The IPCC Fourth Assessment report stated that the “warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.” Scientists have reached a consensus that the global climate has changed and that this change was heavily influenced by human activities (Figure 1). Higher temperatures can be one manifestation of climate change that could affect the global life support system in a number of possible ways: alter agricultural production, redistribute precipitation patterns affecting human water supplies, change conditions for biomes, reduce biodiversity, raise sea-level, fuel more storms, and increase threats to human health. Human activities that lead to global warming include but are not limited to the burning of fossil fuels, the combustion of solid waste materials, agricultural operations, deforestation, and population growth.

(a) Atmospheric concentrations of carbon dioxide, methane and nitrous oxide over the last 10,000 years (large panels on left) and since 1750 (inset panels on left). Measurements are shown from ice cores (symbols with different colors for different studies) and atmospheric samples (red lines); (b) Observed changes in global average surface temperature, global average sea level from tide gauge (blue) and satellite (red) data, and Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values.

Figure 1. (a) Atmospheric concentrations of carbon dioxide, methane and nitrous oxide over the last 10,000 years (large panels on left) and since 1750 (inset panels on left). Measurements are shown from ice cores (symbols with different colors for different studies) and atmospheric samples (red lines); (b) Observed changes in global average surface temperature, global average sea level from tide gauge (blue) and satellite (red) data, and Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values.

Campus Inventory

This report summarizes the University of Maryland’s greenhouse gas emissions for the fiscal (July 1-June 30) years 2002-2008. The purpose of this greenhouse gas inventory of the College Park campus is to provide a revised baseline that can help guide the development and implementation of future strategies for emission reductions and to track progress toward the University’s long-term goal of carbon neutrality.

There are a number of greenhouse gases (carbon dioxide, methane, nitrous oxide, and halocarbons) of concern that trap Earth’s radiation and elevate global temperatures. These gases each differ in their ability to trap heat in the atmosphere, and therefore, estimates of GHG emissions reported by the inventory are presented in metric tons of carbon dioxide equivalents. Carbon dioxide equivalents account for the Global Warming Potential (GWP) of each gas (see table 2 in the methodology section for further detail). Further details on the methodology for the study are provided in the next section.
II. INVENTORY METHODOLOGY

Scope & Emission Sources

Prior to conducting the University’s inventory, the operational and organizational boundaries were clearly and rigorously defined. The rules and guidelines that constituted these boundaries were strictly followed for relevance, completeness, consistency, and accuracy.

University Operational Boundary – Activities referred to as University GHG emissions included all those outlined in the WRI/WBCSD GHG protocol (Box 1, Figure 2). Scope 1 emissions were associated with on-campus stationary sources, including the University co-generation plant, the University fleet (gasoline, diesel, compressed natural gas), Shuttle-UM, agricultural activities (fertilizer application, manure management, enteric fermentation), and fugitive emissions from hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs) from HVAC systems. Scope 2 emissions included purchased electricity. Scope 3 considered GHG emissions associated with students and faculty/staff commuting in personally-owned vehicles, air travel for university-related activities, and landfill emissions that resulted from University generated solid waste.

Box 1 ‘Scoping’ Sources of Emissions & Operational Boundaries

The World Resources Institute (WRI) in collaboration with the World Business Council for Sustainable Development (WBCSD) established a set of standards that enable organizations to define the operational boundaries for their GHG accounting and reporting endeavors. Identification of operational boundaries helps institutions to scope their sources of emissions providing accountability for the prevention of ‘double counting’. The WRI/WBCSD Greenhouse Gas Protocol defined three scopes as follows:

**Scope 1: Direct emissions**
These are all direct GHG emissions produced by facilities owned and controlled by the organization (e.g., production of electricity and steam, vehicle fuel consumption and fugitive emissions).

**Scope 2: Indirect emissions from purchased electricity and steam**
Includes all emissions associated with purchased electricity, heat or steam. Scope 2 emissions physically occurred at the facilities where the energy was generated and not at the user site.

**Scope 3: All other indirect emissions.**
Includes all emissions from outsourced activities. Such emissions may have resulted from the activities of community members in the institution but occurred at sources owned and controlled by another organization (e.g. air travel, solid waste management, commuting activities).

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Table 1 summarizes sources of GHG emissions by scope and greenhouse gas type.

<table>
<thead>
<tr>
<th>Emissions Source</th>
<th>Scope</th>
<th>GHG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary sources:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-generation</td>
<td>1</td>
<td>CO₂, N₂O, CH₄</td>
</tr>
<tr>
<td>Non-cogeneration (e.g., kitchen)</td>
<td>1</td>
<td>CO₂, N₂O, CH₄</td>
</tr>
<tr>
<td>University vehicle fleet</td>
<td>1</td>
<td>CO₂, N₂O, CH₄</td>
</tr>
<tr>
<td>Shuttle-UM</td>
<td>1</td>
<td>CO₂, N₂O, CH₄</td>
</tr>
<tr>
<td>Campus agriculture</td>
<td>1</td>
<td>N₂O, CH₄</td>
</tr>
<tr>
<td>Refrigerant releases</td>
<td>1</td>
<td>HFCs, HCFCs</td>
</tr>
<tr>
<td>Purchased electricity</td>
<td>2</td>
<td>CO₂, N₂O, CH₄</td>
</tr>
<tr>
<td>Air travel</td>
<td>3</td>
<td>CO₂, N₂O, CH₄</td>
</tr>
<tr>
<td>Student, faculty, &amp; staff commuting</td>
<td>3</td>
<td>CO₂, N₂O, CH₄</td>
</tr>
<tr>
<td>Solid waste management</td>
<td>3</td>
<td>CH₄</td>
</tr>
</tbody>
</table>

The off-campus activities of community members (e.g., energy consumption from student and faculty/staff off-campus housing) were considered outside the scope of this study. Also, upstream GHG emissions associated with the production of materials (e.g., office paper), equipment (e.g., electronics), and infrastructure (e.g., construction materials) used by the University were not included. The GHG protocol (WRI/WBCSD 2004) requires organizations to account for Scopes 1 and 2, but leaves Scope 3 optional. The University of Maryland inventory took an aggressive approach in defining campus emissions and included a number of Scope 3 emissions such as commuting. As carbon accounting methods improve and additional Scope 3 emission protocols become available, the scope of the campus inventory can be expanded as appropriate.

University Organizational/Spatial Boundary –Selection of the organization/spatial boundary was based on two simple guiding principles. These are:
1) University operations located within the state of Maryland, and
2) Buildings owned and controlled by the University or for which the University paid the electric-power bill.

This definition includes the main College Park campus (i.e., facilities supported by University steam and power distribution loops), all off-campus University-owned buildings for which electricity consumption was funded by the University, the operations of the Maryland Fire & Rescue Institute (MFRI), and Maryland Agriculture Experiment Station farms (MAES). The latter is a component of the College of Agriculture and Natural Resources and operates Research and Education Centers at eight facilities located throughout the State: Beltsville, Clarksville, College Park, Upper Marlboro, Keedysville, Poplar Hill, Salisbury and Wye.

The study organizational/spatial boundary includes 394 buildings representing 13.4 million square feet of building space. It did not include buildings/operations where the University was a tenant. Also, it does not include: Graduate Hills & Garden Apartments, the ‘Graham Cracker’ Sorority houses, South Commons, ground leases, the University of Maryland University College, USM Universities at Shady Grove, and the Beltsville MAES facility (owned and funded by the U.S. Department of Agriculture).

The inventory covers a period of seven years from FY 2002-2008 because data were not available across all emission categories for earlier years.

Calculation of GHG Emissions

To develop a complete GHG emissions inventory, activity data (e.g., fuel consumed, kWh electricity purchased, air miles traveled, etc.) was multiplied by an emissions factor (e.g., kg CO₂/kWh, kg CH₄/kWh, etc.) to yield emissions for that activity by specific GHG type. Each GHG type was converted to its carbon dioxide equivalent based on its global warming potential relative to CO₂ (Table 2). All emissions were reported in a common unit of measurement, namely, Metric Tons of Carbon Dioxide Equivalent (MT- CO₂e). For example, one metric ton of methane is equal to the emission of 23 metric tons of CO₂. This normalization enabled each GHG type to be compared based on its global warming potential.

Table 2. Global Warming Potential and Atmospheric Lifetime⁷ of Greenhouse Gases.

<table>
<thead>
<tr>
<th>Greenhouse Gas (GHG)</th>
<th>Atmospheric Lifetime (Years)</th>
<th>Global Warming Potential (100 Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide (CO₂)</td>
<td>50-200</td>
<td>1</td>
</tr>
<tr>
<td>Methane (CH₄)</td>
<td>9-15</td>
<td>23</td>
</tr>
<tr>
<td>Nitrous Oxide (N₂O)</td>
<td>120</td>
<td>296</td>
</tr>
<tr>
<td>HFC 134A</td>
<td>15</td>
<td>1,300</td>
</tr>
<tr>
<td>HCFC 404A</td>
<td>&gt;48</td>
<td>3,260</td>
</tr>
<tr>
<td>Sulfur Hexafluoride (SF₆)</td>
<td>3200</td>
<td>23,900</td>
</tr>
</tbody>
</table>


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Inventory Procedure & Data Sources

The project team conducted the campus GHG inventory using a standardized greenhouse gas calculator (Campus Carbon Calculator version 6.2, Clean Air-Cool Planet\(^8\), New Hampshire, USA). The calculator enabled easy entry and conversion of collected data to its carbon dioxide equivalent based on global warming potential. The Campus Carbon Calculator inventoried all six greenhouse gases outlined by the Kyoto treaty. It adapted protocols established by the Intergovernmental Panel on Climate Change (IPCC) for national-level GHG accounting for use at an academic institution. The calculator is a Microsoft Excel workbook comprised of a series of spreadsheets that compute estimates of GHG emissions associated with campus activities (energy use, agriculture, refrigerants, solid waste management) and produce charts and graphs that illustrate changes and trends in emissions over time. What follows is a brief description of the procedures used to acquire and calculate each of the required data for all sources of campus GHG emissions.

**Institutional Data** – Financial budgets; student, faculty, and staff community membership numbers; and total building square footage were required by the Campus Carbon Calculator to estimate some energy-use categories and to describe per capita GHG emissions. Institutional data were gathered from official records and University offices on campus. Research and operating budgets were obtained through personal communication with the Associate Vice President for Research Development and the Office of Research Administration and Advancement. Budget records were obtained from the Department of Budget and Fiscal Analysis. Budgetary data was entered into the Campus Carbon Calculator and adjusted for inflation, using the Consumer Price Index. Student, faculty, and staff population numbers were acquired from the Office of Institutional Research and Planning (IRPA). Total building square footage was based on boundary definitions defined above and data were obtained from Facilities Planning.

**Purchased Electricity** – Nearly half of the University’s electricity consumption was purchased from commercial power companies (e.g., Reliant Energy Solutions East, LLC). Purchased electricity data was available for each fiscal year (FY 2002-2008) and was provided by the Energy Office, Facilities Management. Additional data included monthly invoices of buildings and facilities that were not supported by the campus distribution loop and that had their own electricity meters. These included on-campus and off-campus buildings with separate accounts, MFRI facilities, and the MAES facilities. Annual data measured in kWh entered into the Campus Carbon Calculator were converted to GHG emissions using the University’s fuel-mix\(^9\) specific emission factors for CO\(_2\), CH\(_4\), and N\(_2\)O. The University did not purchase any steam or chilled water.

**On-campus Stationary Sources** – The University’s on-campus stationary sources of GHG emissions include the Combined Heat and Power plant (CHP) which burns natural gas and

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\(^8\) A non-profit organization based in NH dedicated to finding and promoting solutions to global warming. [http://www.cleanair-coolplanet.org/](http://www.cleanair-coolplanet.org/). Clean Air-Cool Planet’s (CA-CP) calculator is the tool of record for most of the 600+ signatories of the Presidents Climate Commitment.

\(^9\) FY 2008 Purchase Electricity Fuel Mix: 56.2% coal, 7.3% natural gas, 33.9% nuclear, 0.3% oil, 2.3% renewable energy; resulting in an emission factor of 0.58 kg CO\(_2\)/kWh, 7.8E-6 kg CH\(_4\)/kWh, and 2.4E-5 kg N\(_2\)O/kWh.
fuels\(^{10}\) used in kitchens, laboratories, and emergency electric generators. The University’s CHP plant produces both steam and electricity. It meets all of the University’s heating demand, about half of its electricity demand, and provides some chilled water for air conditioning. CHP fuel use data were provided by the Energy Office, Facilities Management.

Vehicle Fleet – The inventory calculator categorized the vehicle fleet by fuel type (i.e., gasoline fleet, diesel fleet, natural gas fleet). Annual fuel use, measured in gallons, was provided by the University office that operated the fleet and/or controlled the fuel-servicing station. The Department of Business Services and Motor Transportation Services provided gasoline dispensation records for the motor pool fuel island, privately-owned vehicle mileage\(^{11}\), and the campus fuel card program (Voyager Fuel Card). In March 2007, Motor Transportation Services started offering ethanol (E85) to the campus community. Motor Transportation Services also provided Compressed Natural Gas (CNG) dispensation records for the two dedicated vehicles in the University fleet. CNG data (gallons) were converted to MMBtu’s of natural gas to comply with the inventory format. Other gasoline purchases considered in the inventory include grounds equipment managed by Building & Landscape Services, golf course equipment, the MFRI fleet managed by facilities other than the headquarters in College Park, and agricultural equipment used by the Maryland Agricultural Experiment Station. Diesel dispensation records were collected from the Department of Transportation Services, which controls the main campus diesel pump that supplies the University Shuttle bus fleet (Shuttle-UM), Dining Services equipment, and the MFRI College Park facility. Other purchase records included golf course equipment, heavy equipment for grounds keeping, all MFRI facilities excluding College Park, and the Maryland Agricultural Experiment Station diesel fleet.

Commuter Traffic – Quantifying the GHG emissions from commuter traffic proved to be one of the most challenging tasks. The goal of the commuter traffic component of the calculator is to estimate GHG emissions associated with annual miles traveled to and from campus by University students, faculty, and staff. Due to a lack of transportation-related surveys, data on commuter behavior (e.g., carpooling, single occupancy vehicles, and commute distance and frequency) was not available. To estimate commuters’ contributions to the campus carbon footprint, a new protocol was developed (Box 2). The CA-CP Carbon Calculator breaks down University commuting by community member (i.e., student, faculty, staff) and by mode of transportation (i.e., privately-owned vehicle, bus, METRO rail, and commuter rail). Shuttle-UM ridership (including Park and Rides) was accounted for along with the University vehicle fleet because diesel dispensation records are aggregated for the entire campus. Metro Bus, Metro Rail, and other commuter rail and bus ridership were not included due to lack of data. Therefore, the only category separately reported was commuting by a privately-owned vehicle. These data

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\(^{10}\) #2 fuel oil/diesel, natural gas, and propane.

\(^{11}\) The University System of Maryland allows employees to drive their personal vehicles for business purposes. The University of Maryland College Park reimbursed its drivers for privately-owned vehicle (POV) miles. According to the Corporate Average Fuel Economy (CAFE), the average MPG for a standard passenger car was 27.5 miles per gallon (MPG), while it was 22.2 MPR for light trucks. The average of these two figures was 24.85 miles per gallon. CAFE was the sales weighted average fuel economy, expressed in miles per gallon (MPG), of a manufacturer’s fleet of passenger cars or light trucks with a gross vehicle weight rating (GVWR) of 8,500 lbs. or less, manufactured for sale in the United States for any given model year. POV gallons were calculated using CAFE MPG and POV miles.
(percent commuting by vehicle) were obtained by comparing DOTS parking permit applications against campus community member numbers (students, faculty, and staff).

The GHG Inventory Team developed a model to estimate total commuting by University’s students, faculty and staff. The model is based on the number of parking permits, distance from campus, average fuel economy, percentage of population carpooling, and number of annual commuter trips. The number of single-occupancy commuters was assumed equal to the number of parking permit holders. Details about the model are included in Box 2 below.

**Box 2. University Commuter Traffic GHG Modeling Tool**

The model is based on parking permit applicants’ “home” ZIP codes as reported to DOTS.

**Student Assumptions**
2. Students commute 160 days per year.
3. In 2008, the average distance per trip (one-way) is 16.6 miles. This is the mean distance between the parking permit holder’s ZIP code and College Park.
4. Total miles traveled = # student commuters x 2 trips per day x 16.6 miles x 160 days per year.
5. Resident permits and miles associated with running daily errands are not included.
6. Summer school students are not included.

**Faculty/Staff Assumptions**
1. 6 percent of the total faculty/staff population carpool (in 2 person carpools). *Source: 2002 DOTS survey.*
2. Faculty and staff commuters drive to campus 215 days per year.
3. In 2008, the average distance per trip (one-way) is 15 miles for faculty and 16.3 miles for staff. This is the mean distance between the parking permit holder’s ZIP code and College Park.
4. Total miles traveled = [(total faculty x percent driving alone)+((total staff x percent carpool)/2)] x 2 trips per day x 15 miles x 215 days per year + [(total staff x percent driving alone)+((total staff x percent carpool)/2)] x 2 trips per day x 16.3 miles x 215 days per year.
5. Miles associated with running daily errands were not included.

Some ZIP codes were great distances from campus, indicating that permit holders registered for a permit with a non-local address. To avoid overestimating the commuting footprint, ZIP codes that were more than 50 miles or 70 minutes from campus were replaced with the average distance to campus for that segment.

Total miles were converted into gallons using the average fuel economy assumed by the Calculator of 22.1 mpg. Gallons of fuel were converted into emissions by the Carbon Calculator. This modeling tool was helpful for estimating the magnitude of commuting but would not necessarily be sensitive to changes implemented as mitigation strategies. A better inventory method should be developed that will be more sensitive to campus conditions and commuting behavior.
Air Travel – Air miles data was provided by the Department of Business Services (DBS) and the Study Abroad program. DBS data included information collected from the University’s Travel Management System/Expense Statements, the University Travel Card payment system and the University’s Contract Travel Agency for Athletic travel. The Study Abroad program provided travel itineraries that listed time of travel, number of student travelers, and destination. Total air miles were determined by adding the distance traveled between airports (domestic and international) for each trip and multiplying it by the number of University travelers.

Agriculture – The agriculture section of the Carbon Calculator inventories methane emissions from the guts of ruminant animals (e.g. dairy cows) by microbial action, a process called enteric fermentation, and manure decomposition from barn animals. The inventory also includes nitrous oxide emissions that were released from animal waste and the application of nitrogen fertilizers on fields and grounds. The Campus Carbon Calculator converts agriculture data in the form of annual head counts of barn animals and total fertilizer applied into methane and nitrous oxide emissions, respectively. Animal head count records of the University’s barn were provided by the barn manager in the Department of Animal and Avian Sciences. Herd sizes of dairy cows, beef cows and swine varied throughout the year so an average annual size was used. Animal agriculture information also includes a poultry population (Upper Marlboro facility), a dairy cow herd (Clarksville facility) and a beef cow herd (Wye facility) managed by the Maryland Agricultural Experiment Station. Data on fertilizer applied to campus grounds and fields were provided by Building & Landscape Services, the golf course, inter-collegiate athletics, and Maryland Agricultural Experiment Station personnel.

Solid Waste – Data on the amount of solid waste generated by the campus were provided by the manager of solid waste and recycling. Waste receiving facilities in the region were contacted to find out how they specifically disposed of the campus waste. The waste generated by the University was either land-filled with no methane recovery or land-filled with methane recovery for flaring. Solid waste management data assumed emission factors based on average composition of solid waste.

Refrigeration and other Chemicals - Under U.S. Environmental Protection Agency (EPA) regulations, universities are required to keep track of all fugitive refrigerant emissions. Therefore, data on refrigeration and other chemicals were readily accessible. The Associate Director of HVAC systems for the University provided the information needed for the inventory. In addition, information on the amount of refrigerant released from dining services and residential facilities was also collected. Three out of the seven gases reported were CFCs. However, the IPCC and EPA suggest that GHG inventories should not account for CFCs since they are being phased out by the Montreal Protocol and Clean Air Act Amendments of 1990\textsuperscript{12}; thus CFCs were excluded from the inventory.


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Methodology Updates & Improvements

The FY 2008 GHG inventory was conducted primarily to update and improve the data collection protocols established with the first inventory. A number of improvements were incorporated in this update including:

- The fuel mix-specific emission factor for purchased electricity was updated and corrected in the latest version of the CA-CP Carbon Calculator.
- Air mile totals for the past fiscal years were adjusted downwards due to improved data gathering software developed by DBS personnel. Previously DBS was not able to separate purchased air travel tickets from those that were actually flown. Previously, tickets that were returned for refunds were counted as miles flown and contributed to the air travel footprint. The newly developed software matches travel requests against expenses paid so unused tickets are not counted toward the campus’ carbon footprint.
- Air Travel was expanded to include student trips organized by the University’s Study Abroad program
- Since the FY 2008 inventory was conducted, MTS started collecting fuel consumption data on a fiscal year basis to match the Carbon Calculator format.
- For FY 2008, DOTS adopted a more accurate method of tallying parking permits issued to students, faculty, and staff. In previous years, temporary and replacement permits were included which led to an inflation in parking permit numbers. As a result, the number of personal vehicle commuters and the emissions associated with their activities were overstated. Unfortunately, corrections could not be made for FY 2002-2007. CIER and the Office of Sustainability are working with DOTS to develop better methods of gathering commuter data (e.g., average fuel economy of personal vehicles and commute frequency). In effect, the average commuting distance was updated.

Collectively, data collection refinement and Carbon Calculator updates contributed to a significant decrease in annual GHG emissions over figures reported in the first inventory.
III. CAMPUS GHG EMISSIONS

Campus Overview

During FY 2008, there were 33,319 full-time equivalent (FTE) students, 3,785 faculty, and 4,974 staff at the University for a total community membership of 42,078 people. Campus community membership increased during the study period at less than 1 percent per annum (Figure 3).

![Figure 3. Full time equivalent campus membership for FY 2002-2008.](image)

The University of Maryland main campus occupies a total of 1,250 acres of land in Prince George’s County with about 250 buildings that house the 14 schools and colleges at the University as well as residence halls, dining facilities, libraries, offices, athletic facilities, and performance centers. Furthermore, the College of Agriculture and Natural Resources manages the Maryland Agricultural Experiment Station that occupies an additional 1,300 acres of land throughout the State. In FY 2007, the University’s building space, including its satellite programs, occupied 394 buildings totaling 13.4 million square feet. During the study period, space was added at an average annual rate of 124,000 sq. ft. Additions include the Research Greenhouse Complex (66,370 sq. ft.), the Mowatt Lane Parking Garage (502,031 sq. ft.), the Jeong H. Kim Engineering Building (161,896 sq. ft.), and the Bioscience Research Building (139,869 sq. ft.).

Trends in Total GHG Emissions and GHG Emission Intensity Indices

Generally, the University GHG emissions profile over the inventoried years decreased as much as 30,000-50,000 MTCO₂e, since the last report\(^{13}\), partly because data collection protocols were

improved. There was also a downward trend over the corrected years in the study period, as detailed below. In FY 2008, the University’s total GHG emissions were approximately 311,345 MT-CO$_2$e, 2,322 MTCO$_2$e less than the previous year; the majority of the emissions came from on-campus energy use (purchased electricity and co-generated electricity and steam) and transportation. For perspective, FY 2008 emissions are equivalent to the amount of GHG emitted by 52,950 cars$^{14}$ or the amount sequestered by 93,500 acres of Maryland forest.$^{15}$ Figure 4 shows the University’s total emissions in metric tons of carbon dioxide equivalents (MT-CO$_2$e) from FY 2002-2008. Emissions decreased from 319,072 MT-CO$_2$e in FY 2003 to 311,345 MTCO$_2$e in FY 2008, which was a decrease of 2.4 percent, despite a growth in the number of campus community members.

![UM Carbon Footprint](image)

**Figure 4.** Total University greenhouse gas emissions, FY 2002-2008, associated with on-campus energy use, transportation, agriculture, solid waste and refrigerant releases.

The University’s total energy use (including transportation) increased from FY 2002-2005, peaking in FY 2005 at 4.86 trillion Btu’s (Table 3) then decreased between FY 2006 and FY 2008 period. The recent reductions could be attributed in part to new utility conservation measures implemented by the campus. Despite a reduction in total energy use from FY 2006-2008, utility expenditures increased because the price of natural gas rose. More aggressive efforts to reduce electricity consumption helped minimize the effect of accelerating energy prices. In addition, a reduction in the number of parking permits, particularly for students, translated into less commuting, which also contributed to a lower total energy use.

Total emissions at the University peaked in FY 2003 and continued to decrease through FY 2008, the last year of the study (Table 3). This reduction in emissions was mostly due to the

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$^{14}$ Assuming a car traveled 15,000 miles/year * 0.045 gallons/mile * 0.00871 MTCO$_2$e/gallon = 5.88 MT-CO$_2$e/year.

$^{15}$ Assuming an acre of mature trees absorbs 3.33 MT-CO$_2$e per year (Duke University study conducted by the Nicholas School of the Environment and Earth Sciences; 2003).
switch to the on-campus co-generation plant and its gradual improvement in efficiency during its ‘break-in’ period from FY 2004-2006\(^6\). The 2.4 percent decrease in emissions over the six year period (FY2003-2008) was also attributed to other campus investments in energy efficiency (e.g., campus lighting, window replacements HVAC enhancements, etc.) and to a reduction in gasoline consumption by student commuters as more students resided closer to campus in response to the growth on- and near-campus housing.

Table 3. University trends in energy use, GHG emissions, and GHG emissions intensity indices.

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<tbody>
<tr>
<td><strong>Energy use &amp; emissions</strong></td>
<td></td>
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<tr>
<td>Total energy use (trillion Btu)</td>
<td>4.64</td>
<td>4.77</td>
<td>4.79</td>
<td>4.86</td>
<td>4.78</td>
<td>4.75</td>
<td>4.72</td>
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<td>Change from previous year</td>
<td>2.8%</td>
<td>0.4%</td>
<td>1.5%</td>
<td>-1.6%</td>
<td>-0.6%</td>
<td>-0.6%</td>
<td></td>
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<tr>
<td>Total MT-(\text{CO}_2)e emissions</td>
<td>306,333</td>
<td>319,072</td>
<td>316,678</td>
<td>318,527</td>
<td>317,558</td>
<td>313,667</td>
<td>311,345</td>
</tr>
<tr>
<td>Change from previous year</td>
<td>4.2%</td>
<td>-0.8%</td>
<td>0.6%</td>
<td>-0.3%</td>
<td>-1.2%</td>
<td>-0.7%</td>
<td></td>
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<tr>
<td><strong>Emissions intensity indices</strong></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Students (FTE)</td>
<td>31,002</td>
<td>31,956</td>
<td>32,424</td>
<td>32,111</td>
<td>32,637</td>
<td>32,467</td>
<td>33,319</td>
</tr>
<tr>
<td>Energy use (MMBtu/capita)</td>
<td>117.2</td>
<td>117.4</td>
<td>117.6</td>
<td>120.6</td>
<td>116.6</td>
<td>115.8</td>
<td>112.2</td>
</tr>
<tr>
<td>Emissions (MT-(\text{CO}_2)e/capita)</td>
<td>7.7</td>
<td>7.9</td>
<td>7.8</td>
<td>7.9</td>
<td>7.7</td>
<td>7.6</td>
<td>7.4</td>
</tr>
<tr>
<td>Total Area (million sq. ft.)</td>
<td>12.5</td>
<td>13.1</td>
<td>13.1</td>
<td>13.2</td>
<td>13.2</td>
<td>13.2</td>
<td>13.4</td>
</tr>
<tr>
<td>Energy use (000’s Btu /sq. ft.)</td>
<td>371.1</td>
<td>364.9</td>
<td>366.5</td>
<td>366.8</td>
<td>361.2</td>
<td>359.1</td>
<td>353.1</td>
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<tr>
<td>Emissions (kg-(\text{CO}_2)e/total sq. ft.)</td>
<td>24.5</td>
<td>24.4</td>
<td>24.2</td>
<td>24.1</td>
<td>24.0</td>
<td>23.7</td>
<td>23.3</td>
</tr>
</tbody>
</table>

Over the study period, there was a total decrease of 3.9 percent in per capita GHG emissions (Figure 5) and a decrease of 4.9 percent in emissions per square foot of total building space (Figure 6). To provide a more accurate measure of emissions normalized by building area, emissions per square foot of conditioned space was computed (Figure 6). Unconditioned space included multi-level parking garages, barns, sheds, and storage buildings on campus, MAES and MFRI, which represented about 15 percent of total campus building space. Emissions per square foot of conditioned space followed similar trends totaling 27.3 kg-\(\text{CO}_2\)e/sq. ft. in FY 2008, representing an overall 0.4 percent reduction from FY 2002. GHG emissions and GHG emission intensity indices continue to decrease despite campus growth.

\(^6\) Personal communication with Joan Kowal, Energy Manager, Facilities Management.

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Figure 5. Per capita GHG emissions at the University of Maryland (MT-CO\textsubscript{2}e per community member: students, faculty and staff).

Figure 6. Emissions intensity (kg-CO\textsubscript{2}e per square foot) of total building space and conditioned (heated & cooled) space.

GHG Emissions by Source

Campus GHG emissions associated with energy use (purchased electricity, on-campus stationary sources, and transportation) accounted on average for more than 95 percent of total emissions (Figure 7). The remaining 5 percent were produced by agricultural activities (e.g., animal agriculture and nitrogen fertilizer application), solid waste management, refrigerant releases, and stationary sources. In FY 2004, the CHP plant came on-line which enabled the University to decrease its use of purchased electricity. Figures 8 and 9 show that the majority of GHGs emitted by the campus in FY 2008 came from the UM CHP Plant (41 percent), purchased electricity (23 percent), and transportation (31 percent). These results suggested that the largest opportunities for reducing campus GHG emissions are related to natural gas use, electricity consumption, commuting, and air travel.
Figure 7. Trends in University emissions by source, FY 2002-2008.

Figure 8. Contribution of major sources to University emissions for FY 2008; total GHG emissions = 311,345 MT-CO$_2$e
Purchased Energy & On-Campus Stationary Sources

The University purchased electricity from Reliant Energy, which used a fuel mix of 56.2 percent coal, 7.3 percent natural gas, 33.9 percent nuclear, 0.4 percent oil and 2.2 percent from renewable energy sources. The GHG emissions associated with electricity consumption were computed by estimating the amount of each fuel type used. Reliant Energy’s mix produced 582 grams-CO₂e per kWh generated. In FY 2008, consumption of purchased electricity was responsible for emitting 70,922 MT-CO₂e, roughly 23 percent of total GHG emissions. This is 6,050 MTCO₂e more than the previous year. Figure 8 shows that purchased electricity was the third largest source of GHG emissions after all transportation sources and co-generation. Purchased electricity provided 100 percent of the University’s electricity demand prior to FY 2004.

The campus CHP plant came online in FY 2004 to produce more than 50 percent of the University’s electricity demand. According to the 2007 University of Maryland Sustainability Report⁷, the plant was capable of producing all the steam required for heating, 90 percent of electric power demand in winter, and about 50 percent in summer. In addition to heating space and domestic water, the plant is used in the summer to produce a portion of the chilled water required for air conditioning. The power plant has two gas turbines (11 MW each), a steam driven electric turbine (5 MW) and two heat recovery steam generators. The plant operates at a total energy efficiency of 65-70 percent (i.e., steam and electricity output per total energy input), compared to 35 percent for coal-fired power generators, and uses about 16 percent less fuel than typical purchased electricity¹⁸. In 2005, it won an EPA Energy Star Award. In FY 2008, the plant

was responsible for 127,108 MT-CO₂e that was allocated between electricity and steam generation. This was 3,037 MTCO₂e less than the previous year.

If the University had purchased all of its electricity in FY 2008 (at the power generator’s 2008 fuel mix) instead of using the CHP facility, campus GHG emissions would have been higher by 20 percent, indicating that campus emissions were significantly reduced by the switch to co-generation in FY 2004. Trends in energy use associated with procurement of off-site electricity showed a rapid decline in FY 2004 as the CHP came online that year generating nearly half the electricity demand. The plant continued to support campus demand over the inventoried years. (Figure 10a). Trends in GHG emissions associated with power and steam consumption, however, decreased over the study period (Figure 10b). This trend appears to be the result of on-site generation in lieu of purchasing off-site coal-fired electricity.

![Graph](a)

**Figure 10.** Purchased electricity and the University’s CHP Plant contribution to energy consumption (a) and emissions (b).

Non-CHP stationary sources of GHG emissions, which included fuels consumed during daily operations (e.g., cooking, emergency generators, etc.), produced about 5,039 MT-CO₂e (FY
2008). This is 263 MTCO$_2$e higher than in FY 2007; accounting for 2 percent of total GHG emissions.

**Transportation**

The University GHG inventory divided transportation activities into Shuttle-UM, University fleet, student commuting, faculty/staff commuting, and air travel. In FY 2008, transportation activities collectively emitted 97,764 MT-CO$_2$e, accounting for 31 percent of total emissions (Figure 8 and 9). Figure 11 attributes transportation emissions to each of its main sources.

![Transportation Emissions by Source (FY 2008)](image)

**Figure 11.** Transportation related GHG emissions by activity (campus fleet, Shuttle-UM, student commuting, faculty/staff commuting, and business air travel) for FY 2008.

*University Fleet* – The University owns and maintains a fleet of Facilities Management (FM) vehicles, motor-pool vehicles, fire and rescue vehicles, and agricultural machinery; the vast majority burn gasoline and diesel 19. In FY 2008, the University Fleet emitted 4,598 MT-CO$_2$e, contributing roughly 2 percent of total University GHG emissions and 5 percent of transportation-related GHG emissions.

*Shuttle UM* – The University bus transportation service (Shuttle-UM) represents an extensive network of routes that serve the immediate campus and nearby residential and commercial districts. Total ridership in FY 2002 was estimated at over 1.2 million rides. Ridership grew rapidly during the study period, reaching a total of over 2.3 million rides in FY 2008 (Figure 12). In March 2005, the University conducted a pilot test to see if it could run Shuttle-UM on a mixture of bio-diesel and petroleum-diesel fuel (‘B20’, 20 percent bio-diesel and 80 percent petroleum). Due to warranty-related problems, Shuttle-UM decided to run buses on 5 percent bio-diesel (‘B5’). The Shuttle-UM Fleet had a 48 percent increase in GHG emissions during FY

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19 The Campus Carbon Calculator used emission factors 0.009 MTCO$_2$e/gallon and 0.01 MTCO$_2$e/gallon for gasoline and diesel, respectively.
2002-2008, which corresponded to campus growth and expansion of bus operations. In FY 2008, Shuttle-UM emitted 2,296 MT-CO\textsubscript{2}e accounting for 0.7 percent of total University emissions and 2 percent of total transportation-related emissions.

![Shuttle-UM Ridership](image)

**Figure 12.** Shuttle-UM ridership, FY 2002-2008.

**Commuting (Students, Faculty, & Staff)** – The University of Maryland, College Park is a major commuter campus. According to the Office of Institutional Research and Planning’s Commuter Affairs survey, in 2002, 75 percent of students lived off-campus. A model (Box 2 above) was developed to estimate emissions from campus commuting activities based on average commuter habits (e.g., distance covered per trip and number of commuting days per year). This component of the inventory accounted for emissions produced by community members commuting by a personal vehicle only. METRO rail, commuter rail (e.g. MARC), and other regional transit options were omitted due to lack of mode share data.

In FY 2008, students commuting by a privately-owned vehicle were responsible for 26,412 MT-CO\textsubscript{2}e, representing 8 percent of total emissions and 27 percent of transportation-related emissions. Faculty and staff commuting by a personally-owned vehicle emitted 21,992 MTCO\textsubscript{2}e, representing 7 percent of total emissions and 23 percent of transportation related emissions. GHG emissions associated with student commuters fluctuated throughout the inventoried years, showing a net decrease of 11 percent over the seven-year period. This may have been due to the completion of student housing on and near campus. Table 4 illustrates a possible correlation between the increase in number of beds on and near campus, the number of parking permit purchased, and Shuttle UM ridership. As previously noted, in FY 2008 DOTS adopted a new accounting method for tracking the number of parking permits issued to students, faculty, and staff. In previous years, temporary and replacement permits were counted in campus totals, which led to an inflation in parking permit numbers.
Table 4. Student beds\(^{20}\) on and near campus, Shuttle-UM ridership and student parking permit data\(^{21}\).

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<tbody>
<tr>
<td>Increase in # beds</td>
<td>N/A</td>
<td>N/A</td>
<td>149</td>
<td>345</td>
<td>1,107</td>
<td>936</td>
<td>336</td>
</tr>
<tr>
<td>on/near UM</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Shuttle-UM ridership</td>
<td>1,224,757</td>
<td>1,465,600</td>
<td>1,392,753</td>
<td>1,497,071</td>
<td>1,660,447</td>
<td>2,030,816</td>
<td>2,340,828</td>
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<tr>
<td># student parking</td>
<td>17,077</td>
<td>17,660</td>
<td>17,466</td>
<td>18,622</td>
<td>17,781</td>
<td>16,056</td>
<td>12,333(^{22})</td>
</tr>
<tr>
<td>permits purchased</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

There is certainly a connection between more on- and near-campus student housing, Shuttle-UM ridership, and the number of student commuter parking permits, but the recent change in parking permit accounting practices makes it difficult to draw any definitive conclusions. Trends indicate that more students are living closer to campus and making use of Shuttle-UM. This is encouraging for the campus carbon footprint and will need to be tracked going forward.

Air Travel – Air travel GHG emissions were calculated for flights taken by University faculty and staff for business reasons, air travel by athletic teams, and air travel for some student programs including the Study Abroad program. The Inventory did not include travel paid by individuals, for which they were reimbursed by non-University organizations and the University of Maryland College Park Foundation. In FY 2008, the campus community flew just over 54.7 million passenger-miles, which with an emission factor for jet fuel\(^{23}\) provided by the Campus Carbon Calculator, yielded 42,461 MT-CO\(_2\)e, 10 MTCO\(_2\)e higher than the previous year. Air travel-related emissions accounted for roughly 14 percent of total GHG emissions and 43 percent of transportation GHG emissions.

Agriculture

GHG emissions resulting from agricultural activities were in the form of methane produced by the decomposition of animal excreta, enteric fermentation, and nitrous oxides released with fertilizer application to fields and grounds. The University operates an on-campus barn that manages minor animal agricultural operations. On-campus GHG-producing agricultural activities also included the application of organic and synthetic fertilizer to the campus grounds, athletic fields and golf course. The University’s College of Agriculture and Natural Resources manages a total of eight Maryland Agricultural Experiment Station farms across Maryland that host a series of agronomic, research, extension, and integrated pest management projects. A few house large animal populations.

\(^{20}\) Source: Department of Resident Life and Off-Campus Housing Services.

\(^{21}\) Source: Department of Transportation Annual Report. http://www.dots.umd.edu/about%20us/annualreports.html

\(^{22}\) Change in student commuter parking permit totals from FY 2007 to FY 2008 is in part due to an accounting change whereby beginning in FYI 2008, temporary and duplicate student commuter parking permits were no longer counted in campus totals. This correction could not be calculated for prior inventory years.

The University’s animal herd consisted of 280 dairy cows, 360 beef cows, 25 sheep, 8 horses, and a variable number of broiler chickens, which ranged from 19 to 3,400. Fertilizer application to grounds, athletic fields, the golf course, and agricultural lands totaled an average of 352,000 pounds of synthetic fertilizer (30 percent nitrogen) and 3.5 million pounds of organic fertilizer (0.5 percent nitrogen). Emissions associated with animal agriculture and fertilizer applications were 2,025 MT-\(\text{CO}_2\)e in FY 2008, 144 MTCO\(_2\)e more than the previous year. GHG emissions associated with agricultural activities accounted for less than 1 percent of total emissions.

**Solid Waste Management**

Solid waste disposal produces methane gas emissions during the decomposition of organic matter by methanogenic bacteria. The University landfilled all of its solid waste generated for disposal. The waste was trucked to landfills where 50-80 percent of it was disposed without any methane recovery, while the balance was landfilled with methane recovery and flaring. In FY 2008, solid waste landfill practices produced 4,486 MT-\(\text{CO}_2\)e, 508 MTCO\(_2\)e less than the previous year; accounting for 1 percent of total campus GHG emissions. FY 2008 solid waste emissions were 10 percent less than FY 2007, despite generating 10 percent more waste. The reason is that the campus diverted a higher percentage of the waste to land-filling with methane recovery and flaring, a process that generates fewer methane emissions.

The University has a program where food waste from the Diner and South Campus Dining Hall is composted off-campus. About 19 metric tons of food waste was generated on a monthly basis and composted.\(^{24}\) Potential emission offsets were not included in the inventory since composting did not take place within the organizational boundary of the campus and emission credits may be taken by the composting facility. However, if credit eligibility for off-site emissions reductions were resolved, composting offsets may be included in future inventories.

**Refrigerants and Other Chemicals**

In response to EPA mandated reporting guidelines, the University tracked the usage and fugitive emissions of refrigerants. The University used multiple refrigerants to meet cooling demands: HFC-134a, 404a, HCFC-22, 123, CFC-11, CFC-12 and CFC-113. In FY 2008, emissions resulting from refrigerant releases were 4,005 MT-\(\text{CO}_2\)e, accounting for 1 percent of total GHG emissions. Over the years, the inventory showed a 48 percent net increase in emissions associated with these refrigerants, peaking at 4,732 MT-\(\text{CO}_2\)e in 2005 (Figure 13). FY 2008 refrigeration-related emissions were 1,257 MTCO\(_2\)e higher than the previous year due to the release of larger quantities of HFC404a and HCFC-22, potent greenhouse gases that have a Global Warming Potential of 3,260 and 1,700 respectively.

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\(^{24}\) Personal communication, Greg Thompson, Assistant Director, Dining Services.
Figure 13. Trends in UM Refrigeration over the study period (FY 2002-2008).
IV. PEER INSTITUTIONS

A number of large institutions have signed the Presidents’ Climate Commitment including several of the University’s aspirational peer institutions. Comparing GHG emissions associated with activities from different academic institutions presented several challenges because comparable institutions differed in physical size, community size, infrastructure, and climate, as well as the scopes selected for their inventories. The larger the variation in these measures, the less robust and meaningful any comparison will be.

The University of North Carolina, Chapel Hill (UNC) emerged as the closest comparison with the University of Maryland (UM) based on size and climate zone. However, the team found it informative to compare the University with several other large schools which also had data readily available – the University of California, Berkeley (UCB), the University of California, Los Angeles (UCLA), and the University of Michigan (UMICH). These peers demonstrate a range in factors such as size and climate (Table 5).


<table>
<thead>
<tr>
<th></th>
<th>Total building space (sq. ft.)</th>
<th>Community size</th>
<th>Heating Degree Days / Cooling Degree Days&lt;sup&gt;25&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>UM</td>
<td>13,365,000</td>
<td>41,000</td>
<td>4553/1325</td>
</tr>
<tr>
<td>UNC</td>
<td>17,500,000</td>
<td>37,428</td>
<td>3249/1294</td>
</tr>
<tr>
<td>UCB</td>
<td>15,675,971</td>
<td>49,138</td>
<td>2857/142</td>
</tr>
<tr>
<td>UCLA</td>
<td>28,029,531</td>
<td>41,511</td>
<td>1317/684</td>
</tr>
<tr>
<td>UMICH</td>
<td>29,950,000</td>
<td>75,717</td>
<td>6586/691</td>
</tr>
</tbody>
</table>

Total campus space, community size, and climate of UNC was similar to the University, while the latter three institutions differ in both size and climate. UCLA is larger in space and has a different climate, but it is similar in community size. UMICH is significantly larger in both space and community size and also has a different climate. Heating Degree Days and Cooling Degree Days provide a measure of the differences in climate among the schools. The definition of the organizational boundary for UNC and UCB was similar to the one used for the University. UNC did not account for GHG emissions associated with their hospital activities, whereas, UMICH and UCLA included their hospital complex. Furthermore, UMICH did not include scope 3 emissions (e.g., commuting, air travel, and solid waste).

Table 6 compares GHG emissions in FY 2007 across all 5 institutions. FY 2007 was selected due to data availability.

<sup>25</sup> Heating Degree Days (HDD) and Cooling Degree Days (CDD) are indices designed to reflect energy demand and are summations of negative differences and positive differences, respectively, between the mean daily temperature and the 65°F base or reference.
Table 6. Total GHG emissions data for select institutions.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Emissions MT-CO$_2$e FY 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>UM</td>
<td>313,667</td>
</tr>
<tr>
<td>UNC</td>
<td>518,469</td>
</tr>
<tr>
<td>UCB*</td>
<td>206,720</td>
</tr>
<tr>
<td>UCLA</td>
<td>338,718</td>
</tr>
<tr>
<td>UMICH**</td>
<td>653,000</td>
</tr>
</tbody>
</table>

* In 2006, UCB started purchasing electricity from PG&E (1 percent coal; 42 percent natural gas; 12 percent nuclear; 20 percent hydro; 12 percent renewable). Prior to 2006, UCB purchased their power from Arizona Public Services (38 percent coal).
** U. Michigan GHG inventory includes scope 1 and 2 emissions only. The inventory did not include methane emissions, commuting, air travel, and solid waste. Inventory also includes hospital operations.

**UNC:** According to UNC’s ACUPCC GHG inventory progress report, total GHG emissions increased from 405,000 MT-CO$_2$e in FY 1998 to 518,000 MT-CO$_2$e in FY 2007; an increase of 28 percent. In FY 2006, UNC took a pledge to reduce per capita carbon dioxide emissions by at least 60 percent by 2025. Currently, UNC offsets roughly 81,000 MTCO$_2$e through selling electricity to the institution’s hospital, composting, and recycling operations.

**UCLA:** Documentation of historical trends was unavailable. UCLA’s main sources of GHG emissions are the on-site power plant contributing 52 percent; 32 percent from purchased electricity and 16 percent from transportation. UCLA did not track fugitive emissions and solid waste operations.

**UCB:** UCB realized a 20 percent reduction in total GHG emissions between FY 2002 and FY 2006. In 2002, the university purchased electricity from Arizona Public Services, which used a relatively high coal content (38 percent) in its power mix. In 2006, UCB switched to PG&E, which used 1 percent coal in its mix, reducing campus GHG emissions significantly.

**UMICH:** Direct emissions (scope 1) showed a net decrease of 2 percent between FY 2004 and FY 2007. Total emissions, including purchased electricity (scope 2), increased 13 percent between those years. The reason for this difference is that UMICH purchased about half of its power from generators using high levels of coal in the fuel mix. The university’s co-generation facility used natural gas for the majority of its fuel needs. In addition to the large community size and building space, the school experiences many more Heating Degree Days than the other schools due to colder winter periods.
Table 7. Emission intensity indices normalized by community member size, building space, research dollars, Heating Degree Days (HDD), and Cooling Degree Days (CDD) for FY 2007.

<table>
<thead>
<tr>
<th>Institution</th>
<th>MT-CO$_2$e/capita</th>
<th>kg-CO$_2$e/sq.ft. total building space</th>
<th>kg-CO$_2$e/research $^*$</th>
<th>MT-CO$_2$e/HDD</th>
<th>MT-CO$_2$e/CDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>UM</td>
<td>7.6</td>
<td>23.7</td>
<td>0.8</td>
<td>68.9</td>
<td>236.7</td>
</tr>
<tr>
<td>UNC</td>
<td>13.9</td>
<td>29.6</td>
<td>0.8</td>
<td>159.6</td>
<td>400.7</td>
</tr>
<tr>
<td>UCB</td>
<td>4.2</td>
<td>13.2</td>
<td>0.3</td>
<td>72.4</td>
<td>1,455.8</td>
</tr>
<tr>
<td>UCLA</td>
<td>8.2</td>
<td>12.1</td>
<td>0.4</td>
<td>257.2</td>
<td>495.2</td>
</tr>
<tr>
<td>UMICH</td>
<td>8.6</td>
<td>21.8</td>
<td>0.7</td>
<td>99.1</td>
<td>945.0</td>
</tr>
</tbody>
</table>

*Research dollars was defined as all financial funding the institution received for its research endeavors.
V. PROJECTIONS TO 2020

Future campus GHG emissions for three “Business-as-usual” models were projected (Figure 14) so the impact of mitigation strategies proposed by the campus Climate Action Plan Work Group could be fully assessed. Each model was based on simple projections of observed or hypothesized trends.

The “Emissions Trends” model extrapolated historical trends in the campus GHG emissions during the FY 2002-2008 period. This scenario projected that if the average annual increase in emissions (0.23 percent per year) persisted, campus GHG emissions would be 2.8 percent higher in FY 2020 than in FY 2008 (Figure 14). The “Community Growth” model was based on the observed trend in community growth during the FY 2002-2008 study period and the observed community emissions rate (7.4 MT-CO\textsubscript{2}e per capita). Community membership grew at an average annual rate of 0.9 percent, which translated into about 356 new members each year. According to this model, the University’s GHG emissions would be 10 percent higher in FY 2020 than in FY 2008 (Figure 14). The “Energy Use” model was based on a forecast by the campus energy manager that total energy consumption could increase at 2 percent per year\textsuperscript{26}. According to this model, GHG emissions would be 26 percent higher in FY 2020 than in FY 2008. None of these scenarios assumed the implementation of any mitigation strategies.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{Projected_Growth_of_UM_GHG_Emissions_for_3_Scenarios}
\caption{Projections of future campus emissions based on three different assumptions.}
\end{figure}

\textsuperscript{26} Personal communication with Joan Kowal, Energy Manager, Facilities Management.
VI. SUMMARY OF FINDINGS & RECOMMENDATIONS

The completion of the University greenhouse gas (GHG) emissions inventory is an important step in the University’s implementation of the Presidents’ Climate Commitment signed by President Mote. This inventory serves as a revised baseline for evaluating mitigation strategies developed by the Climate Action Plan Work Group. This inventory and future updates will enable the University to refine its goals and milestones and track progress going forward.

Summary of Findings

In FY 2008, the campus emitted just under 311,350 MT-CO₂e, which is equivalent to the carbon emitted by 52,950 cars or sequestered by 93,500 acres of Maryland forest annually. The inventory clearly demonstrates that the major sources of emissions came from the electricity and steam produced by the campus CHP plant, purchased electricity, and transportation. Together these major sources accounted for 95 percent of the campus’ GHG emissions in FY 2008.

Total campus GHG emissions peaked in FY 2003 at 319,100 MT-CO₂e and continued to decline subsequently by 2.4 percent, largely due to the start-up of the on-campus co-generation plant. The co-generation investment reduced annual campus emissions by 60,000 MT-CO₂e (20 percent of total emissions), which offset an increase in the number of community members and the total area of building space on campus. The University’s Climate Action Plan outlines over 40 technology investments and innovative behavior-change strategies that will be needed going forward to counterbalance the expected growth of the University.

Another potential contributor to the decline in emissions was an increase in on- and near-campus student housing, an increase in Shuttle-UM ridership, and some reduction in the number of student commuter parking permits. From 2002-2008, Shuttle-UM ridership nearly doubled to just over 2.3 million trips annually (Figure 12), and student housing on and in close proximity to campus increased by approximately 2,800 beds (Table 4). The data suggest that additional increases in local housing for students, faculty, and staff may reduce transportation-related emissions as community members decrease miles traveled or switch to lower carbon-producing modes of commuting to campus. A local housing strategy has the added benefit of enhancing University investment in the local community and supporting the transformational change outlined in the University’s 2008 Strategic Plan.

Recommendations

The following recommendations focus on how to improve future GHG inventories and offer suggestions for where best to direct campus greenhouse gas mitigation strategies.

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27 Assuming a car traveled 15,000 miles/year * 0.045 gallons/mile * 0.00871 MTCO₂e/gallon = 5.88 MT-CO₂e/year
28 Assuming an acre of mature trees absorbs 3.33 MT-CO₂e per year (Duke University study conducted by the Nicholas School of the Environment and Earth Sciences; 2003).
Greenhouse Gas Inventory:
The following should be considered for improving the accuracy and breadth of future campus GHG inventories:

- Electricity and steam (for heating and some air conditioning) consumption were responsible for 64 percent of GHG emissions in FY 2008. A large portion of electricity consumption occurred during the summer for air conditioning. Future inventories should gather and report monthly data on electricity and steam use to better support the development of more targeted mitigation strategies.
- Commuting to and from campus in personal vehicles was estimated to contribute 15 percent of total GHG emissions. The model developed by the inventory team estimated commuting levels based on the number of commuter parking permits and estimated a commuter’s travel distance based on their home ZIP code. It assumed an average fuel economy of 22.1 miles per gallon for personal vehicles driven to campus. In order for the campus to include the benefits of new technologies (e.g., more fuel efficient and electric vehicles) a more robust system for calculating the collective commuter carbon footprint is needed. A better system for tracking commuting that includes commuter frequency and vehicle fuel economy would improve the accuracy and sensitivity of the inventory and would help identify transportation-related mitigation strategies that would lead to the most cost effective GHG emissions reductions. As future GHG inventories are better able to incorporate commuter behavior and vehicle fuel economy, the need to track commuter parking permits as a key metric will diminish.
- The inventory did not include an estimate of GHG emissions associated with the consumption of materials and supplies (e.g., paper, food, bottled water). However, future versions of the Carbon Calculator may have expanded capabilities to estimate GHG emissions associated with purchasing. Future inventories should make use of improved versions of the Carbon Calculator.

Mitigation Strategies
Mitigation strategies for the University of Maryland should be focused on its major sources of GHG emissions, which were electricity consumption, steam use, and transportation (daily commuting of the campus community, air travel, and University fleet). Together these sources accounted for 95 percent of emissions and offer the largest potential for mitigation efforts. While there are many actions proposed by the Climate Action Plan Work Group to achieve carbon neutrality, some important strategies for consideration include:

Energy conservation of electricity and steam consumption:
- Lower energy consumption of existing buildings through operational changes, such as greater use of HVAC and lighting set-backs, expanded use of high efficiency lighting and energy-use reporting to individual units and buildings.
- Require new buildings to be lower energy consumers through improved design (e.g., implement LEED Silver as a minimum standard and require a minimum number of energy efficiency points as part of the certification process).
- Promote improved personal behaviors (e.g. powering down computers and switching off other unneeded electronic equipment and lighting).
Explore feasibility of state support for “carbon neutral” new buildings through increased energy efficiency; renewable applications on-site; and renewable energy procurement. Could also consider operations and maintenance cost savings over a 15 year period to help finance the upfront investment.

Lower carbon-emissions associated with electric power consumption:
- Evaluate the potential for, and implement alternative power sources on campus.
- Purchase renewable energy and the associated Renewable Energy Credits from off-site renewable energy projects, preferably located in Maryland.
- Evaluate the procurement of low-carbon produced energy and/or carbon offsets.

Transportation management:
- Reduce commuter traffic in general.
- Institute aggressive carpool and vanpool programs with a specific focus on employees.
- Expand incentives and infrastructure for community members to use Shuttle-UM, Metro Rail and other regional transit, carpooling, walking, and biking.
- Expand Shuttle-UM routes including Park and Rides for longer distance commuters.
- Expand bicycle infrastructure on campus (e.g., secured parking, bike lanes, etc.).
- Increase on- and near-campus housing for students and near-campus housing for faculty and staff.
- Support the Metro Rail Purple Line that is scheduled to connect New Carrolton and Bethesda Metro Stations and pass through campus.

Air Travel:
- Reduce air travel and associated GHG emissions through greater use of virtual meetings (web and video conference). One example is to reduce job candidate air travel by screening candidates first via a video conference.
- Evaluate the procurement of carbon offsets for air travel. Funds could be used on campus to reduce the carbon footprint of University operations or to support local initiatives.

Other carbon reduction opportunities:
- Prioritize and evaluate potential campus projects for lowering carbon emissions (e.g., on-site composting or processing of waste food oil for use as biodiesel on campus).

Next Steps
As noted above, the information in this inventory update will be used by campus stakeholders to prioritize strategies outlined in the Climate Action Plan, to track progress, and refine goals and milestones going forward. A number of campus units have already begun to implement strategies that will reduce the campus’ emissions and additional efforts will begin in earnest after the finalization and submission of the plan in fall 2009.

The Presidents’ Climate Commitment requires that participating institutions conduct GHG inventories every two years. It should be noted that future campus GHG inventories will be based on the calendar year and not the fiscal year. This change is being made to accommodate
new reporting requirements by the U.S. Environmental Protection Agency and the State of Maryland, both of which require calendar year reporting. The next campus GHG inventory will cover calendar year 2009 and will be issued in 2010.
VII. APPENDIX

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.

(continued...)
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.

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,

[Signature]

President/ Chancellor Signature

C. D. Mote, Jr.
President/ Chancellor Name

University of Maryland
College or University

May 22, 2007
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 & email to: mreilly@secondnature.org