Greenhouse Gas Emissions at Washington College 2009

Briggs Cunningham
Climate Action Coordinator
The Center for Environment & Society
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BACKGROUND

In 2007 President Baird Tipson of Washington College joined other presidents of higher education institutions in signing the American College & University Presidents Climate Commitment (ACUPCC). This effort is geared toward making campuses across the country more sustainable, and to mitigate global warming by garnering institutional commitments to reduce and ultimately neutralize greenhouse gas emissions. Also, this project seeks to accelerate the research and educational efforts of these institutions in order to help equip our society for the stabilization of the earth's climate.

Participants in the ACUPCC have committed to take real, meaningful action to eliminate their contribution to global warming by:

- establishing an institutional structure to oversee the development and implementation of the school's program to comply with the ACUPCC;
- completing an emissions inventory within one year;
- establishing a climate action plan within two years that includes a target date and interim milestones for becoming climate neutral;
- taking immediate steps to reduce greenhouse gas emissions by implementing at least two of a list of seven tangible actions while the climate action plan is being developed;
- integrating sustainability into the curriculum and making it a part of the educational experience; and
- making their inventory, climate action plan, and progress reports publicly available.

The Center for Environment & Society (CES) was tasked with coordinating this effort at Washington College. A President's Climate Action Committee was formed in the Fall of 2007 and is comprised of faculty, staff, students, and community members (see Appendix I for the full list). After receiving grants from several sources (Town Creek Foundation, Chesapeake Bay Trust, and Shared Earth Foundation), the Committee filled the position of Climate Action Coordinator, which is responsible for coordinating the College's work in fulfilling the ACUPCC mandates. The first of these commitments was to complete an inventory of Washington College's greenhouse gas emissions (ghges), a copy of which can be found at the following location: http://acupcc.aashe.org/?page=13.

This inventory of greenhouse gas emissions at Washington College begins with a definition of greenhouse gases, an overview of how they are measured, and an explanation of why it is important to do so. The report describes the different sets of data that were used in preparing the inventory, including all emission sources on campus, and it includes tables and figures relating to ghges. This is the third step in the longer process of reducing the College's carbon footprint and follows the preparation and implementation of a comprehensive climate action plan for Washington College, which can be found here: http://acupcc.aashe.org/cap/313/.

GREENHOUSE GASES

It is widely known that both natural as well as human-made greenhouse gases (ghgs) exist in Earth's upper atmosphere (Figure 1). These natural gases prevent some solar radiation from reflecting off the earth's surface and into space, thereby retaining heat and allowing the surface of the planet to stay warm enough for fauna and flora to thrive. But, by adding gases made by humans (most of which are directly related to the burning of fossil fuels) into the atmosphere, more heat is trapped and retained, warming the earth. We have reached a point where human emissions of greenhouse gas emissions have upset the balance and threaten to dramatically increase temperatures, with far-reaching impacts upon global ecosystems. If a way to reduce human-kind's production of ghgs is to be found, then a baseline of how much we produce over a period of time must first be established, which can then help determine the appropriate steps needed to neutralize them.

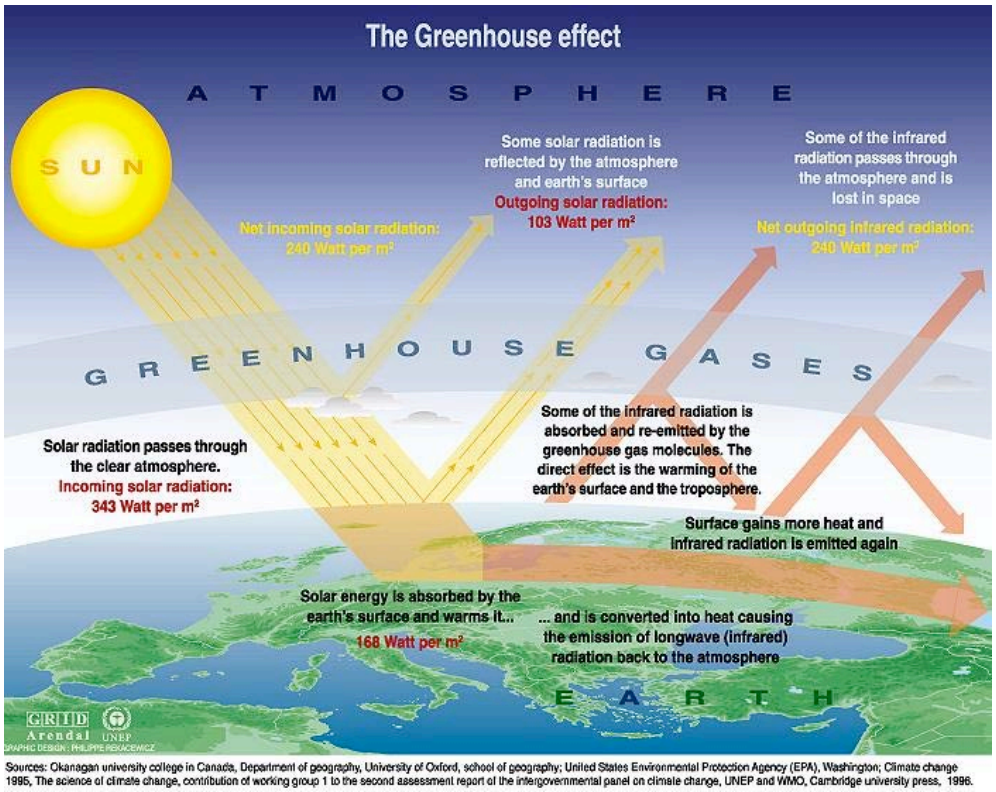

Figure 1. Greenhouse gases (United Nations Framework Convention on Climate Change).

In 1996, the International Panel on Climate Change (IPCC) presented its guidelines for measuring greenhouse gas emissions. Quantifying gases and creating a greenhouse gas emissions inventory can be complex because there are so many different types of greenhouse gases, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Each of these has a different impact upon the atmosphere, or a different "global warming potential" (GWP). N_2O, for example, has 310 times the global warming potential of CO_2, so a simple measurement of each set of emissions does not yield an accurate picture of their impact. A common approach to measurement therefore takes the various greenhouse gases and their GWPs and converts them into carbon dioxide equivalents (eCO_2). Carbon dioxide equivalents often are expressed as "metric tons of carbon dioxide equivalents." In the U.S., it is more common to express these measurements in "short tons." A short ton is equal to 0.907 metric tons, and this is the convention used here.

METHODOLOGY

Emissions calculator

Several organizations have developed greenhouse gas emissions calculators that assist groups such as Washington College in taking their ghge inventories. For this project, the *Campus Carbon Calculator* developed by Clean Air-Cool Planet (cleanair-coolplanet.org) was used. Clean Air-Cool Planet offers its calculator at no charge and provides a *User Guide* to help organizations wend their way through the process. The calculator takes raw data from various emissions sources and automatically converts them into quantities measured in short tons of carbon dioxide equivalents (see Figures 2 below for the College's 2009 results).

The following items comprise the typical emissions sources on a college campus: purchased electricity, stationary sources (e.g., on-campus boilers and burners), transportation (college fleet, student commute, faculty and staff commute, and air travel), agriculture, solid waste, and refrigeration. If each of these sources is tracked and quantified, the emissions calculator can produce an accurate picture of the total greenhouse gas emissions for an institution. The Clean Air-Cool Planet application is widely accepted as a reliable tool for such projects and has been used by other colleges and universities around the country. It therefore is used in the ongoing project of measuring Washington College's greenhouse gas emissions inventory.

Data Input

The Climate Action Coordinator enlisted the services of a student interns at CES to assist in the collection of raw data. Much credit goes to Kate McKelvey '11 for her resolve in finding the pertinent data and parsing it out in a meaningful way. Other staff at the College were also very helpful in the process, notably: Reid Raudenbush, Jennifer Bershon, Peggy Fulton, Marla Thomas, and Dale Trusheim.

While the ACUPCC recommends that a baseline be established for each inventory starting in the year 2000, it was discovered that some of the College's records for years earlier than 2006 were not readily accessible, and some critical data were completely absent for earlier years. In addition, many emissions sources had to be tracked by purchases and invoices, some of which had to be requested specifically from vendors. After several false starts, it became clear

that the data for years prior to 2006 were insufficient to permit a reliable and complete inventory. For the College's first inventory, data from years 2006 & 2007 were used to make the final calculations. The ACUPCC recommends taking an inventory every other year after the initial calculations, so results for 2009 are also presented here. The following discussion of emissions sources follows guidelines laid out by the ACUPPC and the Clean Air-Cool Planet calculator.

EMISSIONS SOURCES

For tracking purposes, nine primary sources of greenhouse gas emissions were examined at Washington College: purchased electricity, stationary sources such as on-campus boilers and burners, student transportation, faculty and staff commuting, air travel, agriculture, solid waste, and refrigeration. Carbon dioxide equivalents for each of these categories are summarized in Table 1 for 2006 to 2009. While data was unavailable for one of these categories, air travel, it has been included as a category because it is our intent to collect such data in the future.

Washington College — Overview of Annual Greenhouse Gas Emissions 2006-2009 — Measured in short toms of eCO2

Year	Purchased Electricity	Stationary Sources	Transportation				Agriculture	Solid Waste	Refrigeration
			College Fleet	Students	Fac/Staff	Air Travel			
2006	9712	4889	143	43	1912	n/a	5	120	30
2007	9962	5562	139	41	1868	n/a	5	130	98
2009	11215	5048	129	21	1490	n/a	5	101	97

Table 1. Overview of annual greenhouse gas emissions 2006-2009, by source.

Figure 2 is a printout of the data summary for 2009 ghges from the Clean Air – Cool Planet calculator. On these figures, the various emission sources are listed on the left. The first data column ("Energy Consumption") shows a calculation of energy from the kilowatt hours, mileage figures, or other data collected for each emission source. The software then calculates the resulting amounts of CO_2, CH_4, N_20 and other gases, giving measurements in kilograms in each of the next four columns. In the final two columns, these emissions are converted to CO_2 equivalents, measured in short tons and metric tons.

Using the data from Table 1 and Figure 2, the various sources of emissions may be examined in greater detail.

MODULE	Summary							
WORKSHEET	Overview of Annual Emissions							
UNIVERSITY	Washington College							
Select Year -->	2009	Energy Consumption	CO_2	CH_4	N_2O	Other Chemicals	eCO_2	eCO_2
		MMBtu	kg	kg	kg	kg	Short Tons	Metric Tonnes
Purchased Electricity		122,102	10,172,342	3	5		11,215	**10,174**
Purchased Steam/Chilled Water		-	-	-	-		-	-
Stationary Sources		60,652	4,545,046	1,002	38		5,048	**4,579**
	Non Co-Gen	60,652	4,545,046	1,002	38		5,048	**4,579**
	Co-Gen Electric	-	-	-	-		-	-
	Co-Gen Steam	-	-	-	-		-	-
Transport Total		20,673	1,451,598	289	99		1,640	**1,488**
	University Fleet	1,627	114,540	22	7		129	**117**
	Student Commuters	265	18,630	4	1		21	**19**
	Faculty/Staff Commuters	18,780	1,318,428	263	91		1,490	**1,351**
	Air Travel	-	-	-	-		-	-
Agriculture Total		-	-	-	14		5	**4**
Solid Waste		-	-	3,984	-		101	**92**
Refrigeration						4	97	**88**
Total		**203,427**	**16,168,986**	**5,278**	**157**	**4**	**18,105**	**16,425**
Offsets							**(3)**	**(3)**
	'Green' Electric Credits						-	-
	Composting						**(2)**	(2)
	Forest Preservation						**(1)**	(1)
Net Emissions							**18,102**	**16,423**

Figure 2. Summary of 2009 greenhouse gas emissions, Clean Air-Cool Planet GHGE Calculator

Purchased Electricity

Washington College gets all of its electricity transmitted through equipment operated by Delmarva Power, which also supplies the electricity for the outer buildings from power plants that generate power by burning coal, oil, or natural gas, or from nuclear sources. Of all of Delmarva's energy sources, 50% come from coal, 36.2% from nuclear, 0.3% from oil, 10% from natural gas, .2% from hydroelectric, and 3.3% from renewable sources. Electricity supply for the main part of campus is generated by Suez Energy, which operates power plants that also burn coal, oil, natural gas, or from nuclear sources in similar ratios as above.

The newer buildings on the north end of campus rely solely on electricity for heating. While all of the buildings use electricity for lighting, the newer buildings also use electricity for temperature control and for heating water. All of the campus' air conditioners run on electricity, as do the washers, dryers, and other appliances. In addition, two new residence halls came on line in August, 2008, and their geothermal HVAC systems are powered by electricity. The new dining hall came on line in Fall 2009, and also utilizes a geothermal HVAC system.

In 2009, the College purchased 14,970,069 kilowatt hours of electricity from Delmarva Power and Suez Energy, which represents a 15% increase from 2008 (12,988,279) and a 12.5% increase from 2007 (13,298,543). It is critical to keep track of this source, as it accounts for more than half of all of the College's greenhouse gas emissions, 62% in 2009 (compared with 55.9% in 2007).

Stationary Sources/Oil

The older buildings on campus are heated by steam that is generated in the College's main power plant. The College has three steam boilers that rotate throughout the year, two in

winter and one in summer. The winter boilers burn #6 oil to produce steam, which is then pumped through underground pipes to the buildings. The #6 oil is a "residual" oil, which means it is a by-product of the process of distilling crude oil into fuel. It is a heavy, viscous oil that can easily congeal if not properly pre-heated, and when burned it produces a heavy smoke that contains high amounts of pollutants, particularly sulfur dioxide. Because of these undesirable characteristics, #6 is relatively inexpensive in comparison to other fuels. The summer boiler burns #2 oil (which is a light, "distillate" fuel oil) to provide the steam for the hot water systems in the older buildings. Each building has its own boiler room that regulates the heat and hot water for that facility.

In 2009, the College purchased 219,501 gallons of #6 residual oil (a reduction of 76,760 gallons from 2007, or 25%), and 177,435 gallons of #2 distillate oil (an increase of 29,579 gallons, or 20%). These sources account for 28% of all of the College's ghges. Measured in carbon dioxide equivalents, emissions from these sources decreased by 9% from 2007 to 2009.

Stationary Sources/Gas

Propane gas is used primarily for the stoves and ovens in the dining hall. The College purchased 37,599 gallons of propane in 2009, an increase of 24,522 gallons compared to 2007. Emissions from this source increased by 35% over the two years, but is a minor contributor to the College's overall ghge inventory.

Transportation/College Fleet

Both gasoline and diesel are used in the College's vehicle fleet, as well as in buildings and grounds equipment. While data was collected on the amount of fuel used in a given year by the College's fleet, it did not include all of the rented vehicles (vans, cars, buses) that were used throughout the year for various special purposes (e.g., athletics, field trips, alumni events). In 2009, the College purchased 12,061 gallons of gasoline (compared to 13,138 in 2007, or a decrease of 8.5% in emissions), and 941 gallons of diesel (859 gallons in 2007, or an increase of 11.5% in emissions). Gasoline and diesel use at the College makes up a tiny fraction of its overall emissions inventory.

Transportation/Commuters

In determining the commuter miles for students, faculty, and staff, zip codes were obtained from the College's Human Resources department, and the distances were plotted by the GIA Laboratory between homes and the campus. The ACUPCC does not require accounting for miles driven by students to and from campus at the beginning or end of terms, nor during break periods. Only a small fraction of the student population lives within daily commuting distance of the campus, so student commuting was estimated at one percent of the student population making a roundtrip commute of 20 miles each day. It also was assumed that students do not do as much driving once they are at the College because the campus is relatively compact, and those miles do not count toward the College's ghge inventory as they are not a central component of the College's operations.

For faculty and staff who live more than 75 miles from school, it was assumed that they made trips three times a week, on average. For those staff and faculty who live closer than 75 miles, it was assumed they made the commute on a daily basis. For those with a Chestertown zip code, their commute was calculated by taking the distance across town and dividing in half. It is

difficult to know exactly how many people walk or bike to work each day, so these figures may be overestimated. The total number of commuting miles driven by all of the faculty and staff is estimated at 3,342,571 miles for 2009, representing a decline of 20% compared to 2007 (which may reflect a reduced number of faculty and staff overall). This translates into a reduction of 378 Short Tons of eCO_2.

Air Travel

Data on staff air travel could not be collected at this point, primarily because there is no central database for these records at the College. Each department maintains its own records for air travel, usually in each employee's files or in departmental reimbursement requests. In order to determine actual miles flown, almost all employee files would have to be examined, which would be a daunting process. In addition, air travel is used for job candidates, speakers, and other official visitors. It is hoped that a central air travel database for all College employees will be established in the near future. Overall emissions figures would be higher were air travel factored in.

Agriculture

The College does not have agriculture or animal husbandry programs, but it does apply a small amount of synthetic fertilizer on its grounds. This source accounts for a tiny fraction of the College's overall ghge inventory.

Solid Waste

The College collects its solid waste in plastic bags that are then deposited in compactor/roll-off units. The largest unit can hold up to five tons of solid waste. They are collected roughly twice a week and driven to a landfill outside of Easton that is operated for Kent, Queen Anne's, Talbot and Caroline Counties by a state agency, the Maryland Environmental Service. Operation of the landfill includes collecting and burning of the landfill's gas, which is typically composed of methane (50%) and carbon dioxide (50%). The College collected 357 tons of solid waste in 2009, compared to 460 in 2007, representing a decrease of 33 Short Tons of eCO_2.

Refrigeration

The College uses refrigerants in its Dining Hall operations, which accounts for a small fraction (roughly a half of one percent or less) of the College's overall ghge inventory.

OFFSETS

Washington College has yet to develop a comprehensive program of carbon offsets. The College instituted a composting program several years ago at the dining hall and is slowly growing that effort, composting a total of nine tons of food scraps in 2009 (compared to seven in 2007). There is no plan in place for purchasing Green Electric Credits. However, through the GIS Laboratory, in 2007 the Center for Environment & Society initiated an extensive study of the campus tree inventory and has produced a report that examines the amount of carbon sequestration that results from 160 newly planted trees on campus in 2009. According to the

calculations using the USDA "iTree" software, an additional 1.1153 Short Tons of eCO_2 were sequestered because of these plantings.

CHARTING OUR PROGRESS

Some sense of how energy consumption and, by extension, greenhouse gas emissions have increased since 2001 may be gained simply by charting the College's expenditures on energy (Figure 3). These are not, of course, perfectly correlated with increased energy usage, as energy costs have risen over time. Nevertheless they demonstrate increasing demand, more than doubling in cost over the last 9 years, and show that Washington College can reduce its operating costs substantially if it can reduce its energy consumption.

Figure 3: Energy costs at Washington College from 2001 to 2009.

These figures also are important because data from 2006 to 2009 show that energy, while not the largest portion of the College's operating budget, is one of the largest sources of greenhouse gas emissions on the campus.

The more detailed data collected for 2006 to 2009 makes it possible to examine each source of emissions as a proportion of overall emissions, as shown in Figure 4.

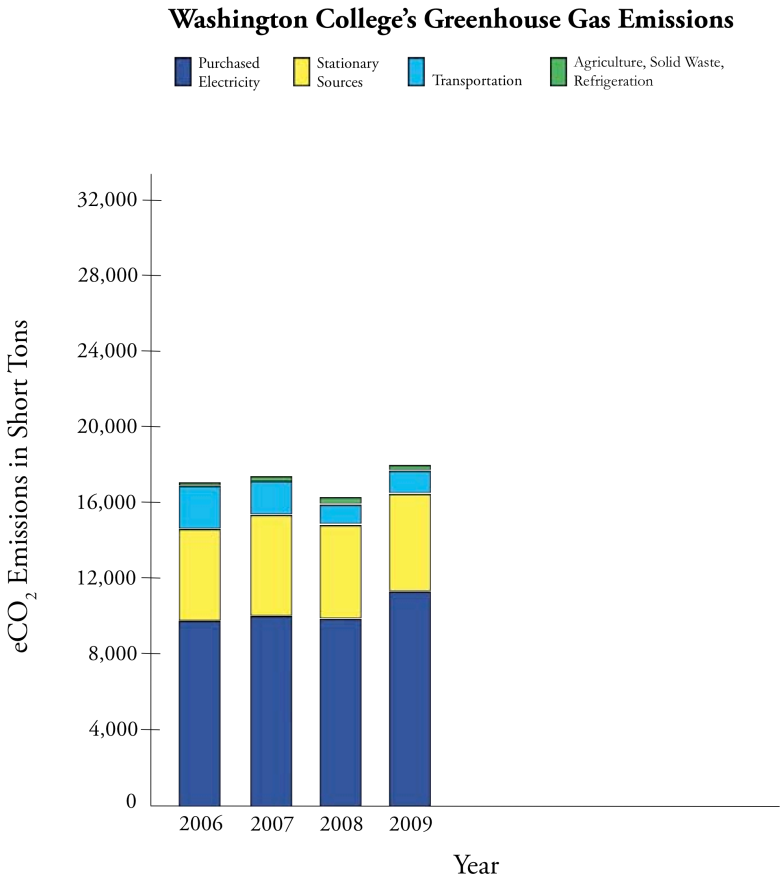

Figure 4. Total greenhouse gas emissions by source.

DISCUSSION & RECOMMENDATIONS

Various trends and conclusions may be drawn from the analysis. Total greenhouse gas emissions rose by only 1.8% from 2007 to 2009 (although they dropped 6.4% from 2007 to 2008), for a couple of likely reasons: the Gibson Arts building was renovated and came on line in Fall 2009, and the new Hodson Dining facility was completed and came on line also in Fall 2009. Enrollment was up from previous years, and with the addition of the new residence halls in 2008, more students were encouraged to live on campus than before.

It also is clear that a significant increase in purchased electricity (up roughly 12.5% from 2007 to 2009) is responsible for the increase of Washington College's greenhouse gas emissions. The bulk of the electrical generation comes from coal-fired plants (50%), so decreasing electrical consumption and finding cleaner sources of electrical power hold the greatest potential for decreasing emissions at the College. Other ways to reduce usage include: installing motion sensors in bathrooms, locker rooms, hallways, labs and classrooms; replacing light bulbs with light-emitting diodes (LEDs) or compact fluorescents (CFLs); replacing antiquated hvac systems with geothermal systems; installing a ground-mount solar collection system; and improving the quality and quantity of energy-saving reminders to students, faculty and staff.

Tracking and achieving reductions in electrical consumption will likely require monitoring of consumption on a building-by-building basis on the campus. Over the past several years, however, the *George Goes Green* program has clearly demonstrated the difficulty – in fact the impossibility – of measuring and tracking consumption in this fashion due to outmoded and nonfunctional electrical meters on many buildings. This problem must be addressed. Other possible mechanisms for reducing emissions include the use of solar panels, wind, and design innovation in new buildings to maximize both natural light and passive solar heating to reduce heating costs.

Stationary sources constitute the second largest source of emissions on campus. This impact could be lessened, at great cost, by shifting from #6 to #2 oil. A biofuel, made mostly of corn waste, was tested in the College's #2 boiler in January, 2010. It is hoped that this fuel will replace the #2 oil this year. In addition, the expanded use of geothermal systems, passive solar heating, alternative fuel sources and other options should all be considered.

Other sources of ghges are much smaller compared to the foregoing sources, but should nevertheless be addressed. Faculty and staff commuting, for example, contributes 8% of the total emissions and could be reduced by encouraging car-pooling, exploring affordable housing closer to campus, and other avenues. Because of the recent spike in global fuel prices, people are driving smarter, but this is no reason to be complacent. Were the College to establish a bike-share program, staff would have even more incentive to leave the cars behind for short commutes.

The amount of solid waste going into landfills probably could be cut in half without much difficulty, and trimmed by 75% with a greatly improved recycling effort. The College initiated a modest recycling program, starting in Fall 2008, and hired a Research Associate at the Center for Environment & Society to coordinate its operations. The recycling program was expanded in 2009 to include the whole campus. However, if the College were to incorporate the recycling program into its budget (and regular administrative operations), it could reduce its carbon footprint even more and avoid costs associated with waste removal. On the plus side, in 2010 phone books for staff and faculty were provided only on request, and not automatically provided for everyone, as before. In 2009, the College ordered 425 phone books; in 2010, that number was reduced to 200, thereby saving costs associated with printing, transporting, and recycling them.

One portion of the inventory is incomplete, and that is air travel. While this emission source has been calculated as relatively low at some other campuses (22% of all transportation at Carleton College, or 2% of the campus's total emissions, for example [http://apps.carleton.edu/curricular/ents/assets/Carleton_GHG_emissions_inventory.pdf]), it can be quite substantial. The University of Pennsylvania calculates air travel as contributing 8% of total emissions (http://www.aashe.org/resources/documents/PennGreenhouseGasReport.pdf). Likewise, the estimates for mileage and resulting emissions from faculty and staff commuting, as well as for student vehicles, is probably inaccurate and underestimated in this inventory. Central reporting systems and databases for employee air travel and vehicle miles driven by faculty, staff, and students would allow a more complete picture of Washington College's greenhouse gas emissions to emerge. The College also does not currently track the number of miles driven in rental vehicles, a potentially important gap.

How does Washington College compare with other institutions? One means of comparing institutions is to calculate eCO_2 emissions on a per student basis (another approach

does it for all residents, including staff and faculty, while a third approach looks at emissions per square foot of campus buildings). Washington College's total eCO_2 emissions were 18,105 short tons in 2009, which divided by 1,300 full-time students results in a per-student emission of 13.9 short tons of eCO_2. It is difficult to reliably compare this figure with the per student emissions of other institutions. Although the Association for the Advancement of Sustainability in Higher Education (ASHE) lists inventories from 39 institutions, these are not all comparable to Washington College. The inventories range in date from 1990 to 2009, and the institutions range in size from small liberal arts colleges to large state universities. Other variables such as the number of commuters also may skew the results.

With these caveats in mind, three comparable institutions may serve as a rough guide to Washington College's current impact relative to its peers. The data are taken from institutional reports available on the ASHE web site (http://www.aashe.org/resources/ghg_inventories.php). Where an institution reported emissions in metric tons, these have been converted to short tons. In 2009, Bryn Mawr College recorded a per student emissions figure of 10.8 short tons of eCO_2. St Mary's College report showed a result of 12.7 short tons per student in 2008. Sweet Briar College's 2008 report yielded 18 short tons per student. The average per student emission of this sample is 13.8 tons, placing Washington College, with 13.9 tons per student, at about the average. The sample is very small, however, and a more reliable comparison could be determined with a more exhaustive investigation.

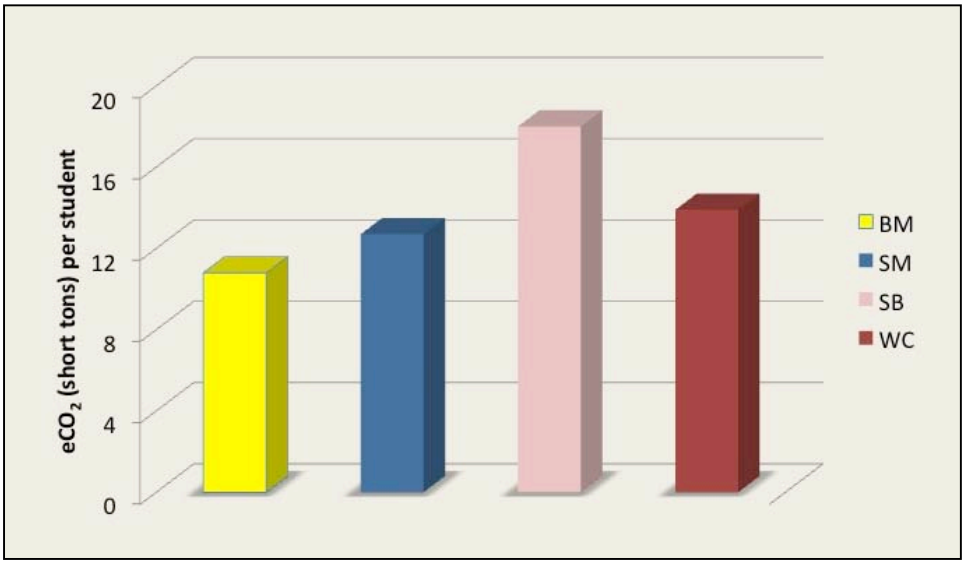

Figure 5. eCO_2 in short tons per student for Bryn Mawr College (BM), St. Mary's College (SM), Sweet Briar College (SB), and Washington College (WC).

Climate Action Planning

This report provides a baseline of data for 2006 to 2009, allowing Washington College to better assess its carbon emissions and plan for the future. The next step in the process will be for the Washington College President's Climate Action Committee to review the results of this greenhouse gas emissions inventory and continue refining certain elements of its comprehensive climate action plan for the College. While examining the data and recommendations made in

this report, the Committee should be innovative and expansive in its outlook and should do its best to predict future trends, thereby continuing the process of bringing the institution into a carbon neutral position by 2050.

This report was prepared by Briggs Cunningham, Climate Action Coordinator at the Center for Environment & Society (CES), and the President's Climate Action Committee. Important contributions in data gathering were made by CES intern Kate McKelvey ('11). The report was edited by Dr. John L. Seidel. The Climate Action Committee gratefully acknowledges the assistance and support of a wide variety of staff members and faculty at Washington College, including: Peggy Fulton and Marla Thomas of the Business Office; Dale Trusheim of the Dean's Office; Reid Raudenbush of Buildings & Grounds; and Jennifer Bershon of the Registrar's Office.

APPENDIX I

Washington College President's Climate Action Committee

Dr. Mitchell Reiss, College President
Dr. John L. Seidel, Committee Chair, Director of the Center for Environment & Society
Briggs Cunningham, Climate Action Coordinator, Center for Environment & Society
JoAnn Fairchild '84, Senior Program Manager, Center for Environment & Society
Tara Holste '07, Research Associate, Center for Environment & Society
Dr. Anne Marteel-Parish, Assistant Professor of Chemistry
Dr. Leslie Sherman, Associate Professor of Chemistry and Environmental Studies
Dr. Brian Scott, Assistant Professor of Economics and Environmental Studies
Dr. Mindy Reynolds, Assistant Professor of Biology
Stewart Bruce, GIS Program Coordinator
Reid Raudenbush, Director of Physical Plant
Laura Johnstone Wilson, Director of Campus Events
Darnell Parker, Director, Office of Multicultural Affairs
Jim Gatto, Chestertown Planning Commission
Jennifer Endicott, Office Coordinator, Center for Environment & Society

APPENDIX II

Glossary

Stationary Sources = Amounts of Residual Oil (#6), Distillate Oil (#2), and Propane that is used on campus.

Energy Consumption in MMBtu = One Million Btus. A Btu is the quantity of heat required to raise the temperature of one pound of water one degree of Fahrenheit at or near 39.2 degrees Fahrenheit.

CO_2 in kg = Carbon dioxide emissions measured in kilograms. CO_2 is a colorless, odorless, non-poisonous gas that is a normal part of the ambient air, and a product of fossil fuel combustion. Although carbon dioxide does not directly impair human health, it is a greenhouse gas that traps terrestrial (i.e., infrared) radiation and contributes to the potential for global warming.

CH_4 in kg = Methane emissions measured in kilograms. CH_4 is a hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 21. Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.

N_2O in kg = Nitrous oxide measured in kilograms. N_2O is a powerful greenhouse gas with a global warming potential most recently evaluated at 310. Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

eCO_2 = Carbon dioxide equivalents. 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 "metric tons of carbon dioxide equivalents (MTCDE)."

Short tons = Common measurement for a ton in the United States. A short ton is equal to 2,000 lbs or 0.907 metric tons.

Metric tons = Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs or 1.1 short tons.