Greenhouse Gas Emissions Inventory

A comparative survey of emissions from year 2006 through 2009

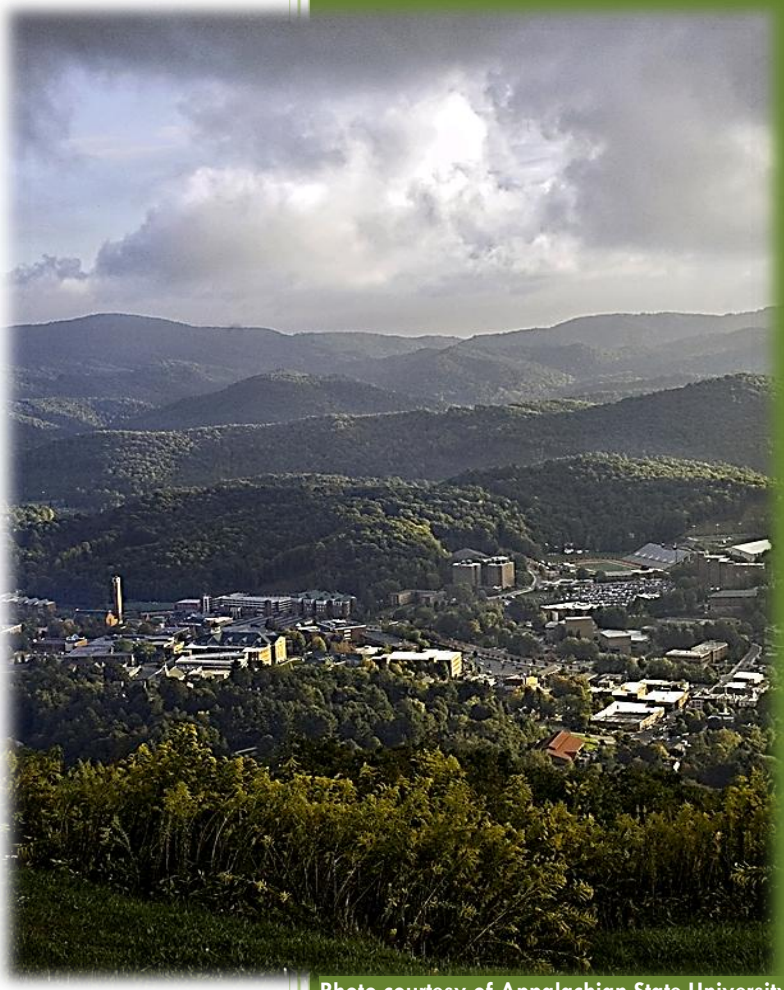

Photo courtesy of Appalachian State University

sustain Appalachian

Appalachian State University
Office of Sustainability
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For more information about Appalachian State University's Greenhouse Gas Inventory, please visit the ACUPCC Reporting Systems page at http://acupcc.aashe.org/, or the Office of Sustainability website at www.sustainability.appstate.edu.

NOTE:

This document contains language of a technical nature relating to the measurement of greenhouse gas emissions on a college campus. A basic understanding of these concepts is assumed.

For more information about Appalachian State University's Greenhouse Gas Inventory, please visit the ACUPCC Reporting Systems page at http://acupcc.aashe.org/, or the Office of Sustainability website at www.sustainability.appstate.edu.

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American College & University
Presidents Climate Commitment

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Table of Contents

Report from the Appalachian State University Office of Sustainability to the American College and University President's Climate Commitment

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1. Abstract

This document explains Appalachian State University's greenhouse gas emissions based on an inventory from the year beginning July 1, 2005 (FY 2006) through June 30, 2009 (FY 2009). Clean Air-Cool Planet's Campus Carbon Calculator (CCC) Version 6.4 was the tool selected to guide us through the inventory process. From FY 2006 to FY 2008 emissions increased. Appalachian saw the highest recorded output of greenhouse gases during FY 2008. Beginning in FY 2009 emissions dropped 6% from FY 2008 levels.

Although not working under a climate action plan directive, Appalachian is undergoing efforts to reduce emissions. According to a future projections module in CCC, the output of greenhouse gases will continue to decrease until about 2035 at which time major greenhouse gas emissions emitters, such as purchased electricity, will level out. Currently we have several renewable energy installations and a forest preserve creating offsets for some of our emissions. No offsets are currently purchased. At present, Appalachian is drafting a first climate action proposal outlining a path to net zero greenhouse gas emissions.

II. Introduction

Appalachian State University is situated in a dynamic geological landscape, an area rich in bio-diversity, and experiences a yearly climate of all four seasons. As a result of the natural beauty found in the surrounding area, the University has a long history of respecting the environment and implementing sustainability-oriented educational programs. Environmental stewardship and social responsibility is woven throughout all levels of Appalachian, from incoming First Year Seminar classes all the way to the Chancellor's office.

Appalachian's commitment to protecting the natural environment was reconfirmed on Earth Day 2008 when Chancellor Kenneth E. Peacock proudly signed the American College and University Presidents' Climate Commitment (ACUPCC, 2010). Chancellor Peacock said, "I can't think of a more appropriate day to sign this agreement than on Earth Day." Becoming a signatory of the ACUPCC means that Appalachian pledges to create an institutional action plan for climate neutrality, net zero greenhouse gas (GHG) emissions, known as a Climate Action Plan.

> *"I can't think of a more appropriate day to sign this {the American College and University President's Climate Commitment} than on Earth Day."*
> *-Chancellor Kenneth E. Peacock*

This report marks the completion of Appalachian's second GHG inventory. However, this is the first report with multi-year data, which will help illustrate trends of emissions associated with Appalachian during the fiscal years (FY) of 2006 through 2009. This survey attempts to summarize and bring meaning to the data gathered throughout all years of study.

Figure 1: Chancellor Kenneth E. Peacock signing the ACUPCC on Earth Day 2008. Photo courtesy of Appalachian State University

Between FY 2006 and FY 2008, Appalachian began to shift away from the "business as usual" approach of the past, which had resulted in a steady increase of emissions. During FY 2009 the Physical Plant began implementing energy saving measures.

Emissions in FY 2009 dropped 6% from FY 2007 levels, or the equivalent of eliminating 12,323,660 miles driven by gasoline fueled vehicles (See Figure 1.1, Page 6; Figure 2.1, Page 6; Table 1.1, Page 7). The largest portion of emissions reduction was due to decreased electricity usage. However, air and ground travel, augmented use of bio-fuels, increased composting, and on-campus renewable energy projects also contributed to a reduction in greenhouse gas emissions.

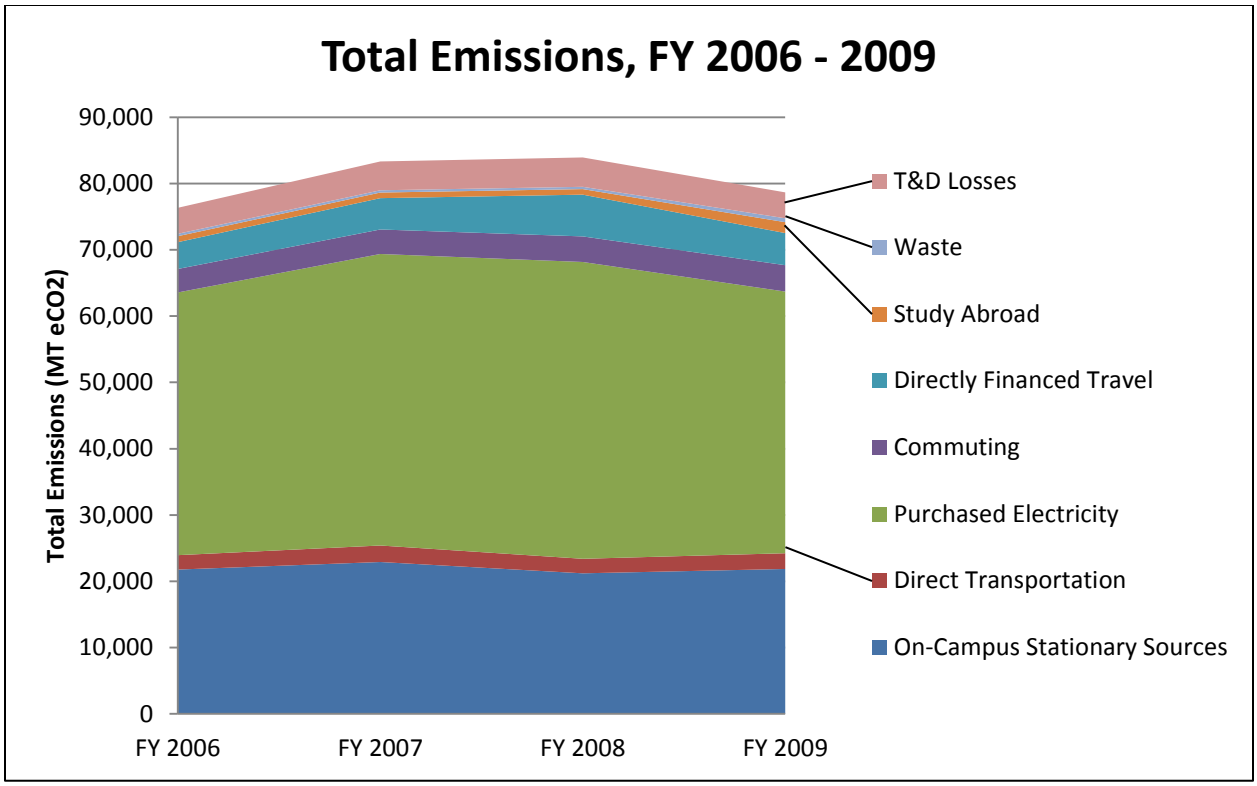


Figure 1.1 : Total Emissions

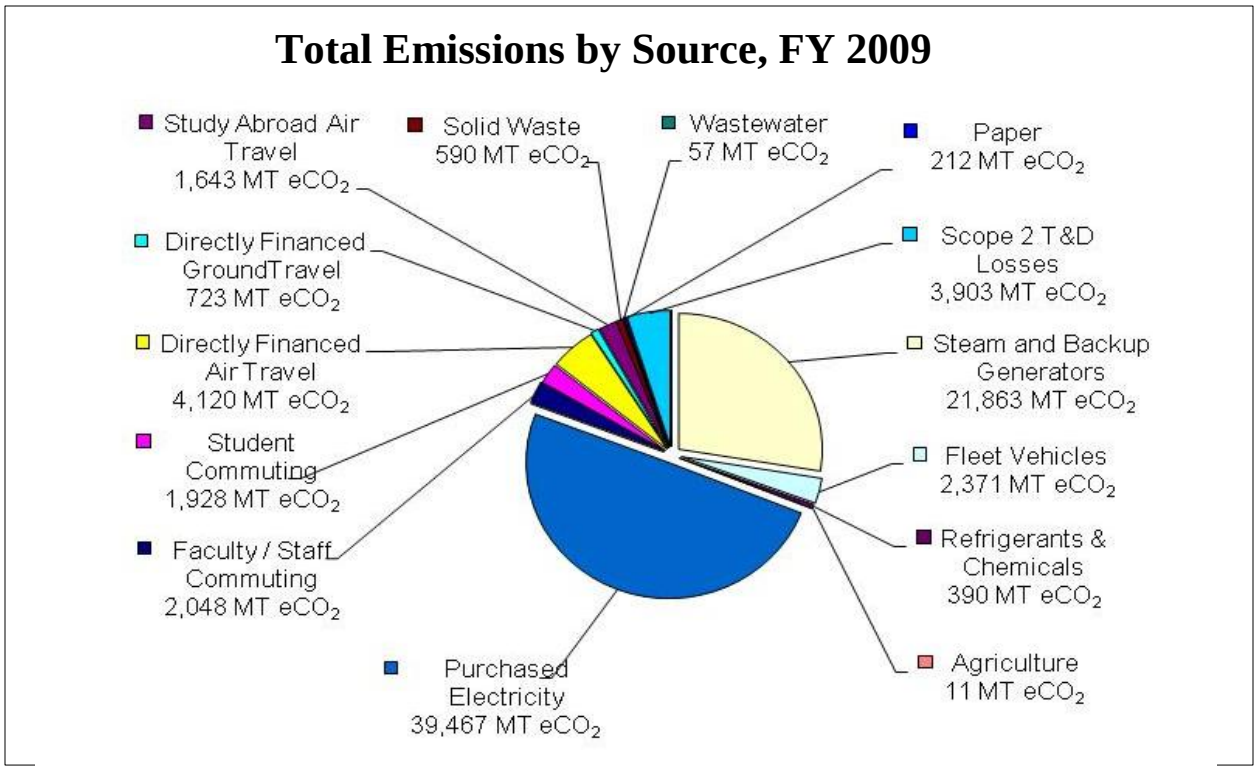


Figure 2.1 : Total Emissions by Source

Annual Emissions, FY 2006-2009					
Scope	Emissions Source	FY 2006 MT eCO2	FY 2007 MT eCO2	FY 2008 MT eCO2	FY 2009 MT eCO2
Scope 1	Steam and Backup Generators	21,774.3	22,914.5	21,208.4	21,863.6
	Fleet Vehicles	2,172.9	2,486.2	2,189.2	2,371.9
	Refrigerants/ Chemicals	394.3	125.1	76.3	390.7
	Agriculture	-	7.3	1.5	11.0
Scope 2	Purchased Electricity	39,623.4	43,968.1	44,767.3	39,467.6
Scope 3	Faculty/Staff Commuting	1,879.9	1,953.1	2,021.8	2,048.0
	Student Commuting	1,662.2	1,745.2	1,833.7	1,928.5
	Directly Financed Air Travel	3,383.3	4,018.8	5,531.1	4,120.7
	Directly Financed Ground Travel	661.3	707.9	767.3	723.4
	Study Abroad	901.9	842.9	836.6	1,643.6
	Solid Waste	361.7	341.5	346.0	590.0
	Wastewater	60.0	60.5	62.0	57.4
	Paper	-	-	-	212.4
	Scope 2 T&D Losses	3,918.8	4,348.5	4,427.5	3,903.4
Total Scope 1 Emissions		24,341.5	25,533.1	23,475.4	24,637.1
Total Scope 2 Emissions		39,623.4	43,968.1	44,767.3	39,467.6
Total Scope 3 Emissions		12,829.1	14,018.5	15,828.0	15,227.4
All Scopes		76,794.0	83,519.7	84,070.7	79,332.1
Offsets	Forest Preserves	-68	-68	-68	-68
	Composting	-19.2	-19.2	-33.1	-40.4
	Renewable Energy	0	-0.3	-1.3	-4.3
Total Offsets		-87.2	-87.5	-102.4	-112.7
Net Emissions		76,706.8	83,432.2	83,968.3	79,219.4

Table 1.1 : Annual Emissions

III. Understanding the Terminology

Appalachian utilized the Clean Air – Cool Planet Campus Carbon Calculator, Version 6.4. The Campus Carbon Calculator (CCC), a calculator tool recommended by ACUPCC, is a comprehensive tool which attempts to account for all emissions sources (Clean Air – Cool Planet, 2008). In addition to monitoring emissions sources, the CCC also takes into account programs and initiatives that offset greenhouse gases, such as generating renewable energy or purchasing carbon credits.

For the purposes of this report a fiscal year consists of the period from July 1st – June 30th of the following year. For example, FY 2006 represents the time frame of July 1st 2005 – June 30th 2006. Fiscal year 2007 would then contain the time from July 1st 2006 – June 30th 2007, and so on.

This report presents data which has been collected from all emissions sources related to Appalachian from FY 2006 through FY 2009.

The CCC is divided into four sections and each is defined as:

Scope 1

Emissions sources directly owned or controlled by the institution. For Appalachian this includes on-campus energy sources such a steam plant, direct transportation associated with the fleet vehicles, refrigerants and other chemicals, and emissions from agriculture-related activities, such as fertilizers and farm animals.

Scope 2

Any indirect emissions associated with purchased electricity, steam and chilled water are included in Scope 2. Appalachian does not generate the electricity it uses, rather receives it indirectly from the grid from Investor-Owned Utilities, Duke, Progress, and the Tennessee Valley Authority. The emissions generated from the production of electricity are directly related to campus energy consumption and are therefore included the carbon footprint. Appalachian does not purchase any steam or chilled water. Hence, there are no Scope 2 emissions for those activities.

Scope 3

Information collected in Scope 3 pertains to emissions and/or facilities which are neither owned nor operated by the university, but are directly financed by the institution, such as waste disposal and commercial air travel. Scope 3 emissions also include student, faculty, and staff commuting, directly financed travel, study abroad air travel, solid waste, waste water, paper purchasing, and electricity transmission and distribution losses.

Offsets

Offsets are activities which help to reduce the amount of emissions associated with the university, such as composting, establishing forest preserves, generating renewable energy, and purchasing carbon credits.

The CCC assesses the global warming potential (GWP) for many GHGs. GWP is a measure of each gas's contribution to climate change relative to that of carbon dioxide. The GWP of these gases have been determined by the Intergovernmental Panel on Climate Change (IPCC) based on the length of time molecules stay within the atmosphere and the amount of infrared radiation, or heat the molecules can contain. The CCC primarily tracks carbon-dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

In order to account for the differences in GWP of the various gases, the CCC relates all of the gases to carbon dioxide, which is said to have a global warming potential of one (See Table 2.1, Page 9). The annual amount of GHGs is presented as metric tons of carbon dioxide equivalent, or MT eCO_2. To derive a carbon equivalent (eCO_2), multiply the amount of gas released by its GWP. E.g. 2 metric tons of

methane X 23 GWP = 46 MT eCO_2. In other words, one molecule of methane is 23 times more potent than one molecule of CO_2 over the same time frame.

The next section, *Methodology*, outlines very specific ways in which data was collected, methodology was improved and how, within each category, emissions changed. Realizing that some may not find value in this section, it suffices for those readers to skip ahead to section *2009 and beyond* beginning on page 19.

II. Methodology

There were several ways in which the process of data acquisition was improved from the first GHG inventory to the second. Yet, the process can be polished even more. As we learn more about what is required to understand our emissions, tracking methods will improve as well.

Specifically for Appalachian, Scope 3 has consistently been the most challenging scope for which to gain reliable information, especially regarding student, faculty, and staff commuting mileage and directly financed travel. Gathering accurate data for these activities was difficult and more time consuming to acquire because mileage records are not currently maintained.

Global Warming Potential			
Greenhouse Gas	100 Year GWP	Emissions Source at ASU	% of ASU's Emissions
Carbon Dioxide (CO2)	1	Electricity, Transportation, & Steam	99%
Methane (CH4)	23	Solid Waste, Agriculture, Transportation, & Steam	<.02%
Nitrous Oxide (N2O)	296	Electricity, Transportation, & Fertilizers	<.002%
Hydrofluorocarbons (HFC)	12 - 9,400	Refrigeration	<.001%
Perfluorocarbons (PFC)	6,500	Not used at ASU	0
Sulfur Hexafluoride (SF6)	23,900	Not used at ASU	0
(100 Year GWP used by CCC)			

Table 2.1 : Global Warming Potential

To make strides to improve data acquisition regarding commuting, the Office of Sustainability developed a transportation survey which was sent to over 20,000 people within the university, including students, faculty and staff. From the survey, statistical and valid averages were used to determine the average miles traveled per week and year by campus commuters.

To gain more accurate information regarding directly financed travel, the Controller's Office generated a sample report. The sample report provided files that were audited to determine the mileage and mode of transportation used both in the United States and abroad. The Controller's Office also provided the total budget for air and ground travel. This information was used to extrapolate to the larger community regarding directly financed travel with a 95% confidence level.

Another area of difficulty was tracking electricity use for off campus buildings which are outside Appalachian's area of operational control. Appalachian leases approximately 14 buildings, but because these buildings are not controlled by Appalachian, the Energy Manager does not track energy usage. To further complicate the matter, in some instances, Appalachian does not lease the entire building, but only a portion of the space. Still, in other cases, the lease payment includes the utility fee, which is part of a larger bill for the entire building (very hard, if not impossible, to interpolate the energy usage for Appalachian's portion in these instances).

IV. Results

Scope 1

The emissions sources in Scope 1 include the steam plant and backup generators, fleet vehicles, chemicals and refrigerants, and agriculture. For FY 2009, Scope 1 accounts for 31%, or 21,800 MT eCO_2, of Appalachian's total annual emissions. Of this 31%, 28% are from steam production and generators, while the remaining 3% are from fleet vehicles (See Figure 3.1). Activities related to agriculture, chemicals, and refrigerants account for 401 MT eCO_2, or less than one percent of the total emissions.

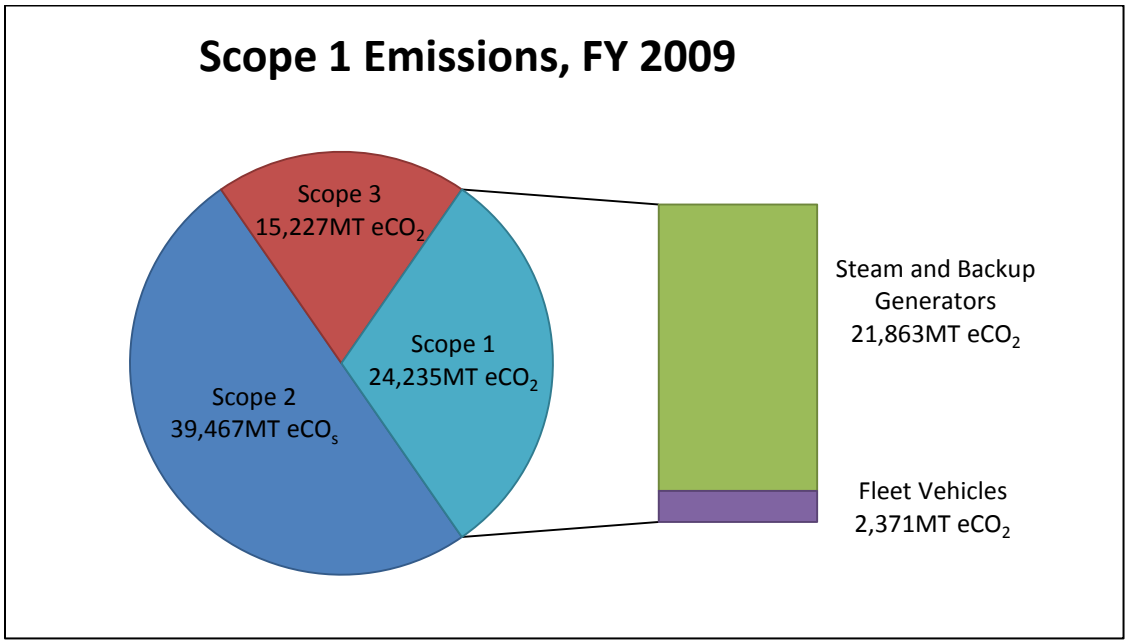


Figure 3.1 : Emissions

Between FY 2006 and FY 2008 the amount of distillate oil #2 purchased decreased by 85 % from 67,000 gallons in FY 2006 to 10,000 gallons in FY 2008. This reduction was caused by the need to repair a damaged storage tank. Between FY 2008 and FY 2009, the tank was repaired and fuel purchasing increased to over 154,000 gallons. This increased use caused emissions from on-campus stationary generation to increase by 3% (See Figure 4.1, Page 11).

Scope 1 emissions increased despite a 4% reduction in the amount of natural gas used by the steam plant for space and water heating (See Figure 4.1, Page 11). The reduction in natural gas is the result of improvements being made on the steam distribution infrastructure to increase the condensate return rate.

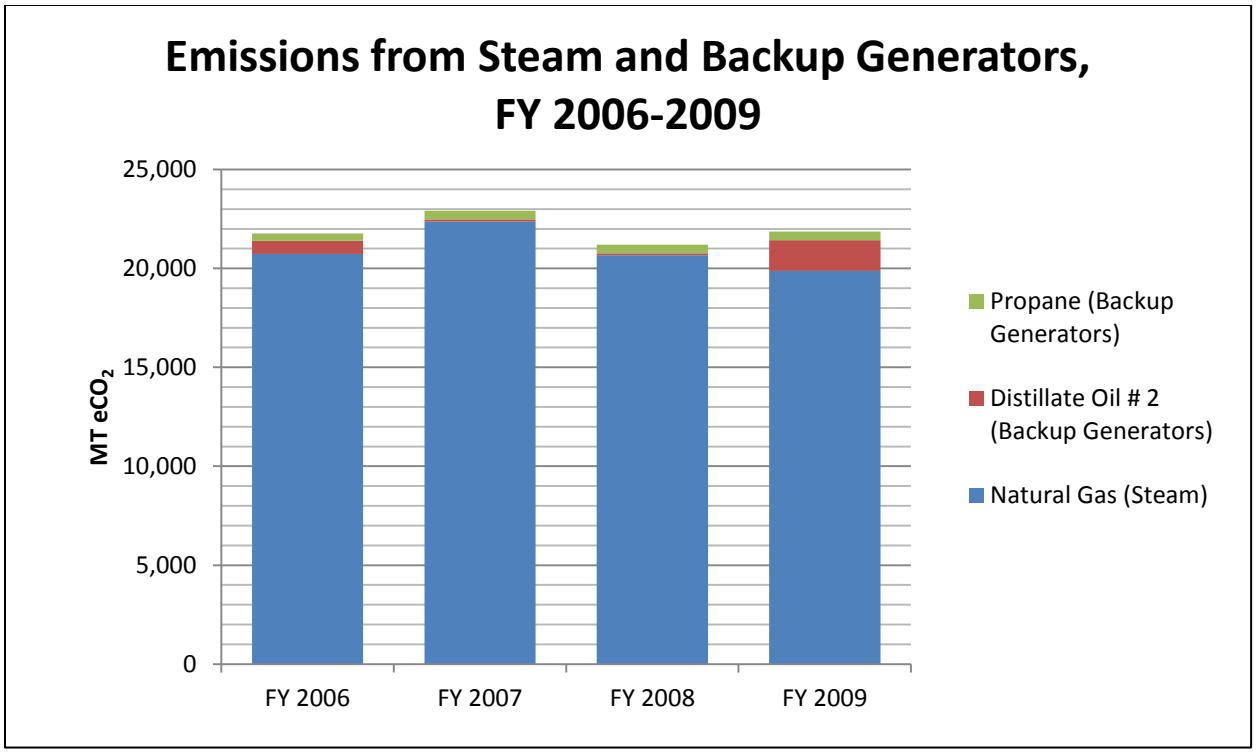


Figure 3.2 : Emissions from Steam and Backup Generators

Over the past four years, as part of a $25 million dollar Infrastructure Renewal Project, Appalachian has increased the amount of steam returning to the steam plant from a low of 8% to over 40% in FY 2009. The Physical Plant's ultimate goal is to increase the return rate to 80%. According to Appalachian's Energy Manager, for every one percent increase of condensate returning to the steam boiler there is a savings of $10,000 dollars per year.

Figure 2: Construction along River Street to improve the steam
by Jordan Paris.

Of Scope 1 emissions, 3% were generated by fleet vehicles through combusted fuel. Fleet emissions have remained steady over the past four years despite a 20% increase in the amount of gasoline and diesel fuel used by Appalachian (See Figure 5.1, Page 12). Overall fuel use has increased by nearly 70,000 gallons from FY 2006 to FY 2009. However, the resulting emissions have only increased by 2.5 metric tons (See Figure 6.1, Page 13). This can be explained by the increased use of bio-fuels, such as ethanol (E 10), and bio-diesel (B 20). During FY 2007 Appalachian began purchasing E 10 and B 20. Since FY 2007, all gasoline fleet vehicles use E10, except when gas is purchased off-campus. Diesel fleet vehicles use B 20, except during the winter months when the bio diesel mix is reduced because of concerns about the bio diesel gelling due to the cold.

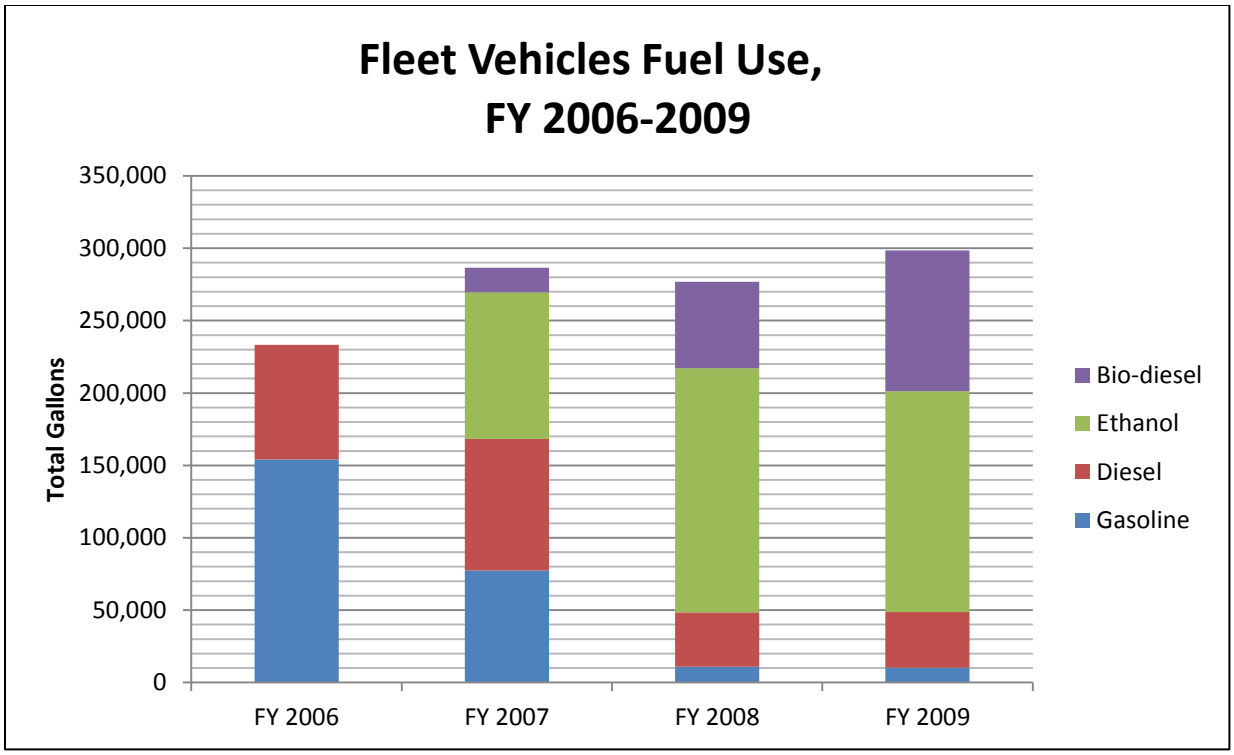


Figure 3.3 : Fleet Vehicle Fuel Use

University fleet running on bio-fuels due to a project by the Appalachian State University Renewable Energy Initiative.

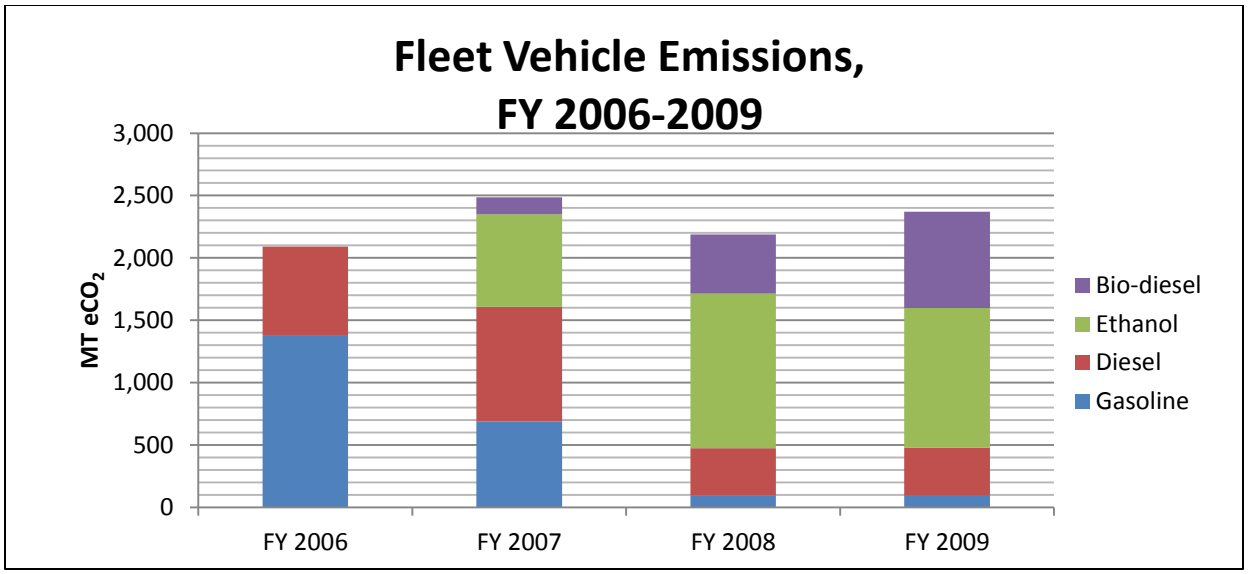


Figure 3.4 : Fleet Vehicle Emissions

Scope 2

Purchased electricity for Appalachian peaked during FY 2008 with the consumption of over 73 million kilowatt hours. Then during FY 2009, many initiatives were enacted to help reduce energy consumption. These conservation measures saved over 8 million kilowatt hours of electricity. The resulting emissions reductions represent a 3% drop from FY 2008 to FY 2009. Purchased electricity remains the largest source of greenhouse gases and accounts for 50% of Appalachian's annual emissions, 39,467 MT eCO_2 (See Figure 2.1, Page 6).

Emissions from a coal fired power plant. Approximately 60% of North Carolina's electric energy comes from coal.

Appalachian's Energy Manager created an Energy Conservation Plan to encourage individuals and departments to adjust their thermostats to 68 degrees Fahrenheit during the winter months and 78 degrees Fahrenheit in the summer months. The plan also suggests office lights and computers to be turned off at night and on weekends. In the past, many of these appliances were left on, which wasted a significant amount of electricity. Six buildings have undergone lighting retrofits to replace T-12 lamps with more efficient T-8 lamps.

Over during FY 2009 winter break, the campus was effectively put into a "deep sleep," meaning that all buildings were powered down to the minimum amount of electricity required to maintain basic operations. During those four days there was an avoided cost of over $221,000 on utility expenses. The aforementioned efficiency measures has helped reduce energy consumption by 12%, or 8,000,000 kilowatt hours between FY 2008 and FY 2009 (See Figure 4.1, Page 14).

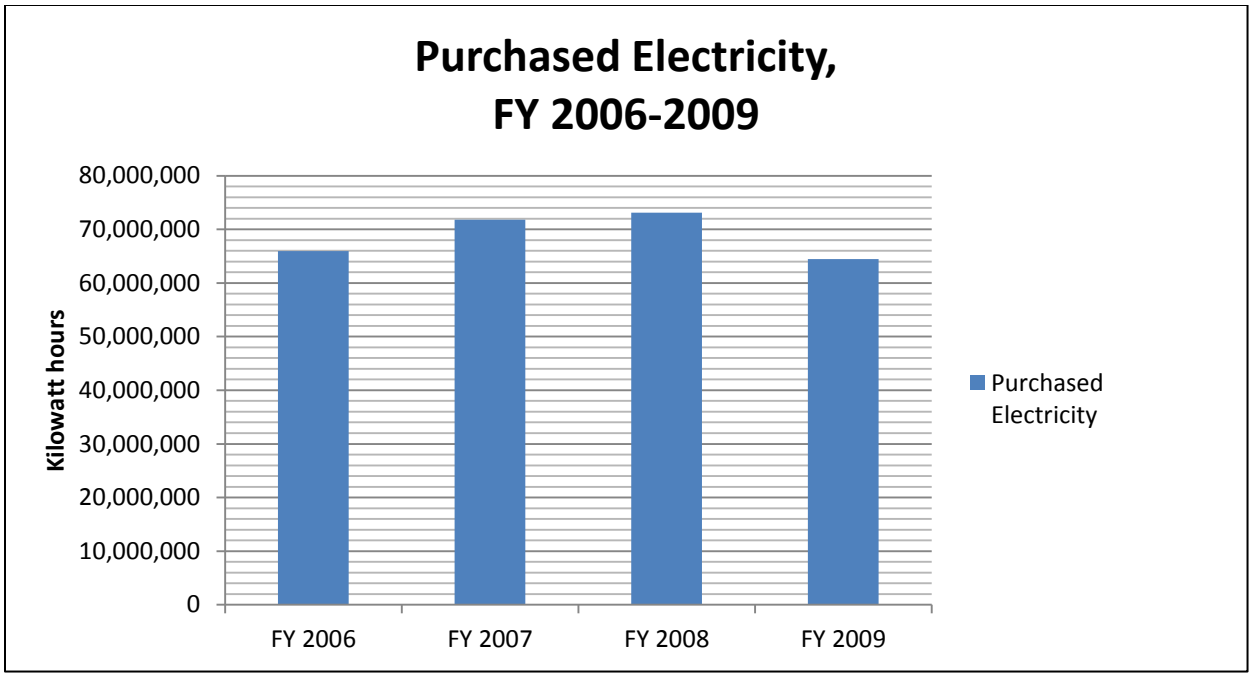


Figure 4.1 : Purchased Electricity

Scope 3

Emissions generated from this scope account for 19% of total FY 2009 emissions (See Figure 2.1, Page 6). Between FY 2006 and FY 2008 emissions increased on average by 10%. However, emissions were reduced in FY 2009 by 3.8%, 600 MT eCO_2 (See Figure 5.1). The reduction in FY 2009 was caused by a decrease in directly financed travel, likely stemming from budgetary constraints.

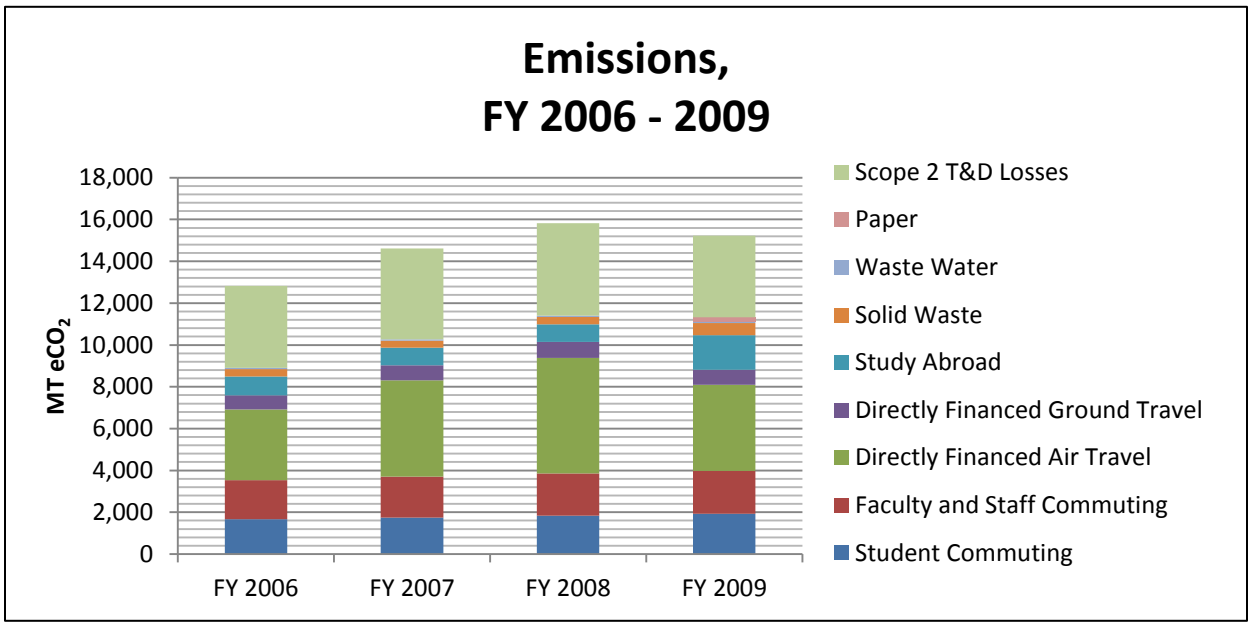


Figure 5.1 : Emissions

Commuting

To determine emissions for student, faculty and staff commuting, the Office of Sustainability created a transportation survey to gather information about commuter habits, including miles traveled per trip, number of trips per year, and mode of transportation. From this information, statistical averages were extrapolated. The survey revealed faculty and staff are responsible for emitting more greenhouse gases than students because they tend to live further from campus, thus less likely to utilize public transportation.

Based on the survey results, the average distance traveled to campus is 8 miles for faculty and 12 miles for staff. The survey results indicate that students live on average 3.5 miles from campus and they use public transportation at higher rates than faculty and staff. Faculty and staff commuting produced 3% of the total emissions, while student commuting was responsible for producing 2% of Appalachian's emissions (See Figure 2.1, Page 6).

Directly Financed Travel

To determine emissions from directly financed outsourced travel a survey of travel expense documents was conducted. With this information it was possible to calculate the number of miles traveled per year and the associated emissions. Appalachian directly financed 5.3 million miles of air travel which accounted for 4,123 MT eCO_2, 5% of the total emissions during FY 2009. This was a reduction of 1,410 MT eCO_2 from the previous budget year.

Emissions for directly financed ground travel have remained steady, accounting for 1% of emissions. There was a slight reduction in emissions from directly financed ground travel between FY 2008 and FY 2009 of 30 MT eCO_2 because 123,000 fewer miles were driven. It was determined that Appalachian financed just under 2 million miles of ground travel during FY 2009. The primary modes of ground travel financed were personal mileage reimbursement and chartered buses, followed by taxis/ferry/rental cars.

Study Abroad

For some study abroad trips, students are required to purchase their own tickets. In these instances, the Controller's Office has no record of these ticket purchases or the associated cost. To account for the air mileage associated with those trips, the Director of International Programs provided a record of the number of students in each class and its destination. With this information it was determined that this type of study abroad travel contributed an additional 450,000 air miles during FY 2009. However, the majority of emissions associated with study abroad are accounted for in directly financed travel. The increase in emissions associated with study abroad can be attributed to an increase in the number of international exchange students studying at Appalachian.

Solid Waste

Emissions associated with solid waste have increased by 1% despite a reduction of waste totaling 55 tons between FY 2006 and 2009 (See Figure 6.1, Page 16; Figure 6.2, Page 16). Appalachian's solid waste in FY 2008 totaled 2,254 tons and produced 346 MT eCO_2. In FY 2009, Appalachian produced 2,099 tons of solid waste and the associated emissions were 590 MT eCO_2.

An Appalachian State University ASU Recycles employee, John Taylor, at the Recycling Processing Center. Photo courtesy of Appalachian State University

The increase in emissions results from a change in landfill facilities where Appalachian's waste is disposed. Prior to FY 2009, waste was sent to a facility which generates and uses the landfill gas, methane, to generated electricity. However, between FY 2008 and FY 2009, Watauga County began sending Appalachian's waste to Foothills Environmental Inc. in Lenoir, NC. At this facility the gas produced within the landfill is flared to destroy the methane but no electricity is generated. This shift in waste disposal facilities, which have different operational systems to control methane, has caused Appalachian's solid waste emissions to increase by 1%.

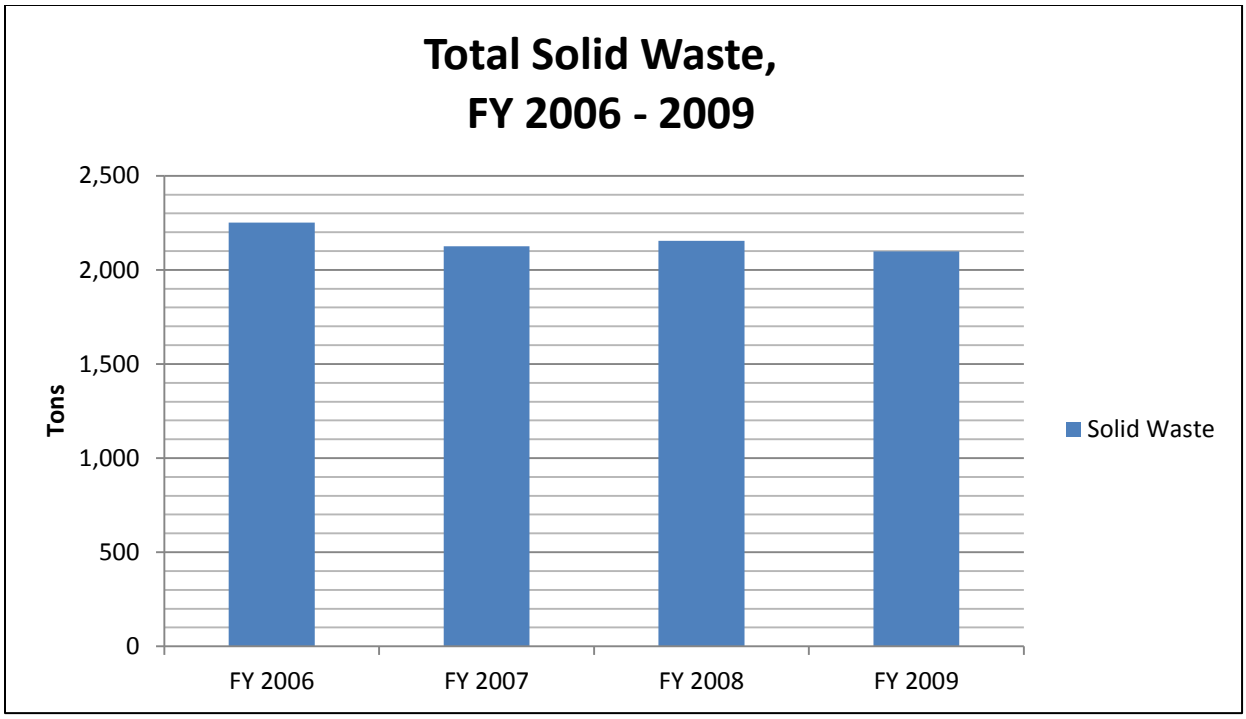
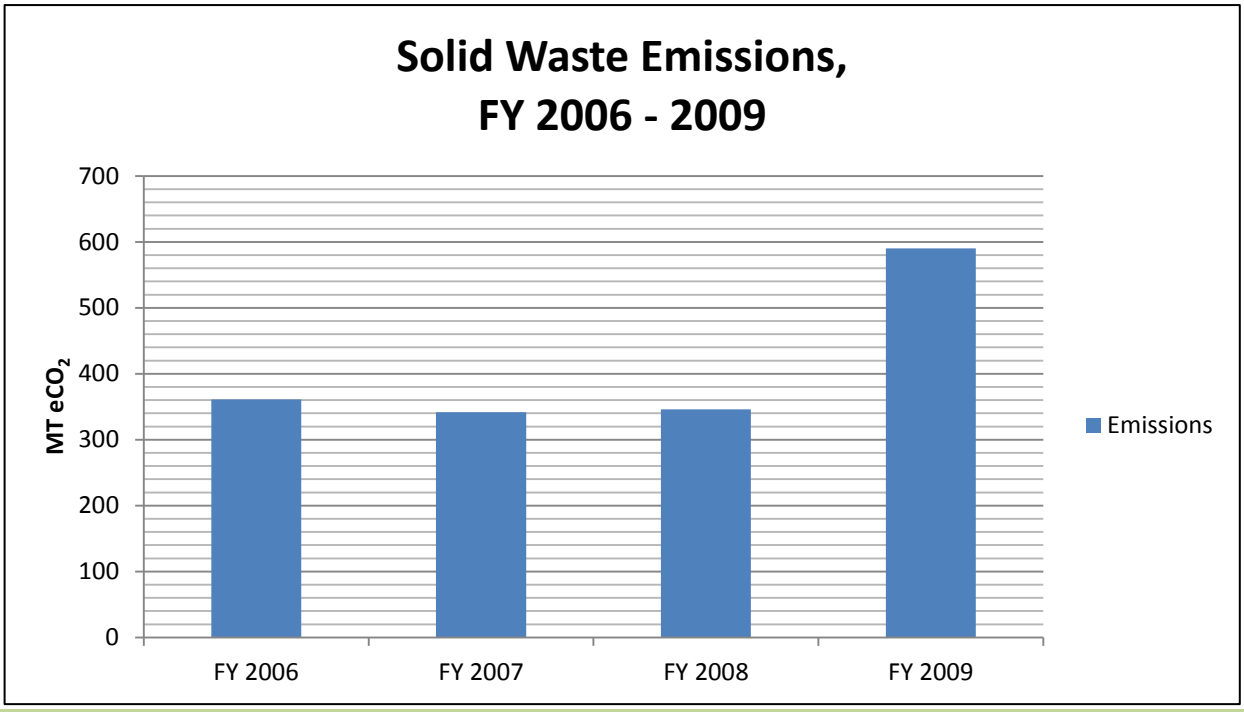


Figure 6.1 : Solid Waste



Waste Water

Waste water peaked during FY 2008 at just over 128,000,000 gallons. During FY 2009, there was a 5% reduction in water use totaling 5,397,841 gallons (See Figure 8.1). During FY 2009, waste water contributed 57 MT eCO_2 to Appalachian's carbon footprint. Emissions from waste water make up less

than one percent of the total. This reduction was achieved through the installation of over 300 low-flow shower heads and 1,000 sink facets aerators.

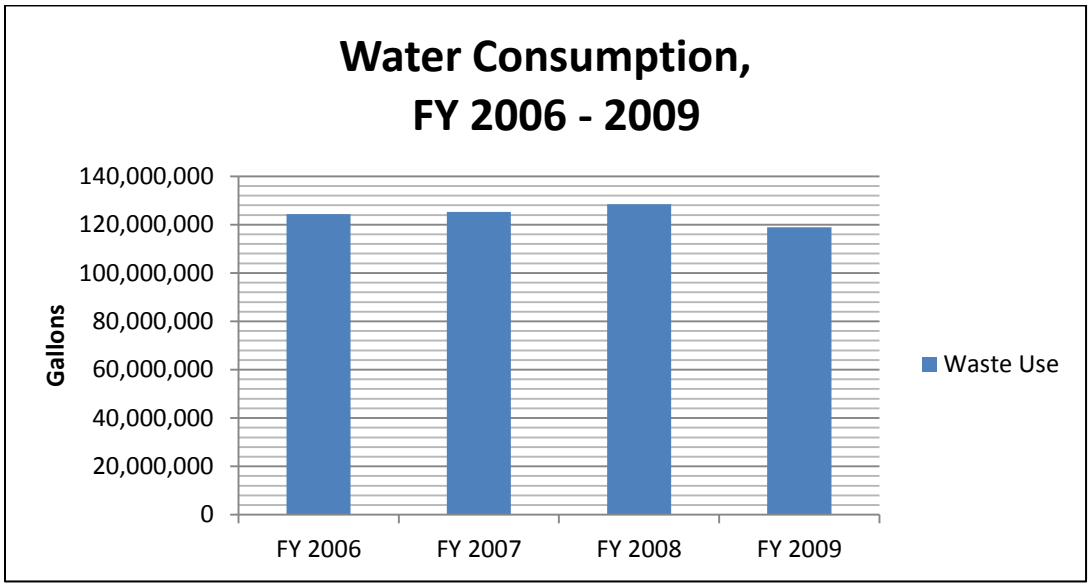


Figure 8.1 : Water Consumption

Paper

Records for paper purchasing do not exist before FY 2009 because of current record keeping. The Purchasing Department began tracking paper purchases in FY 2009 and will continue to do so in the future. Information from FY 2009 shows paper purchasing accounts for less than 1% of the total emissions (See Figure 2.1, Page 6).

Electrical Transmission Losses

The remaining emissions from this scope are the result of transmission and distribution (T&D) losses from purchased electricity. Electricity is produced elsewhere and transmitted, via the electrical grid. As the electricity flows through high voltage transmission lines, some of the electricity is lost in the form of resistance.

Figure 6: Utility transmission lines

T&D losses and their associated emissions account for 5%, 3,900 MT eCO_2, of Appalachian's total emissions (See Figure 1.1, Page 6; Figure 2.1, Page 6). According to the Energy Information Administration (EIA), "in 2007, national-level losses were 6.5% of total electricity disposition." (EIA, 2010)

Offsets

During FY 2009 Appalachian State University claimed offsets which help reduce total emissions by over 102 MT eCO_2 (See Table 1.1, Page 7; Figure 9.1). These emissions offsets were achieved primarily through the commitment to preserve the University Woods, the largest green space, 68 acres, in the city limits of Boone, as well as composting and the increased generating capacity of renewable energy infrastructure on campus.

The University Woods was logged in the early 1900s and has since been left to regenerate. Based on the information published by the Environmental Protection Agency (EPA), forest management areas practicing reforestation can sequester between 0.3 - 2.1 MT of CO_2 per acre per year for 120 years, (EPA, 2006). Given the age of the trees located in the University Woods and the weather conditions, it is estimated that this area can sequester 1 metric ton of carbon per acre per year. Therefore, each fiscal year 68 MT of eCO_2 are offset by forest preserves.

In addition to forest preserves, Appalachian is also able to offset emissions through composting organic matter. During FY 2009, the Physical Plant composted 105 tons of food and yard waste, an increase of 19 tons from FY 2008, which helped to offset 40 MT of eCO_2.

Between FY 2006 and FY 2009, the installed capacity of renewable energy on the campus of Appalachian State University has increased from 0 to 7.1 kilowatts. Part way through FY 2007, a 1.7 kilowatt photovoltaic (PV) system was installed by the student-led Renewable Energy Initiative (www.rei.appstate.edu). A second 1.4 kilowatt PV system was installed on Katherine Harper Hall during FY 2008. Combined, during FY 2009, these two systems produced 2,170 kWh of renewable energy and offset 1.3 MT eCO_2. In the beginning of FY 2009, a 4 kW PV system was constructed. During the system's first year, it produced over 4,000 kWh of electricity and helped to offset 4 MT of eCO_2.

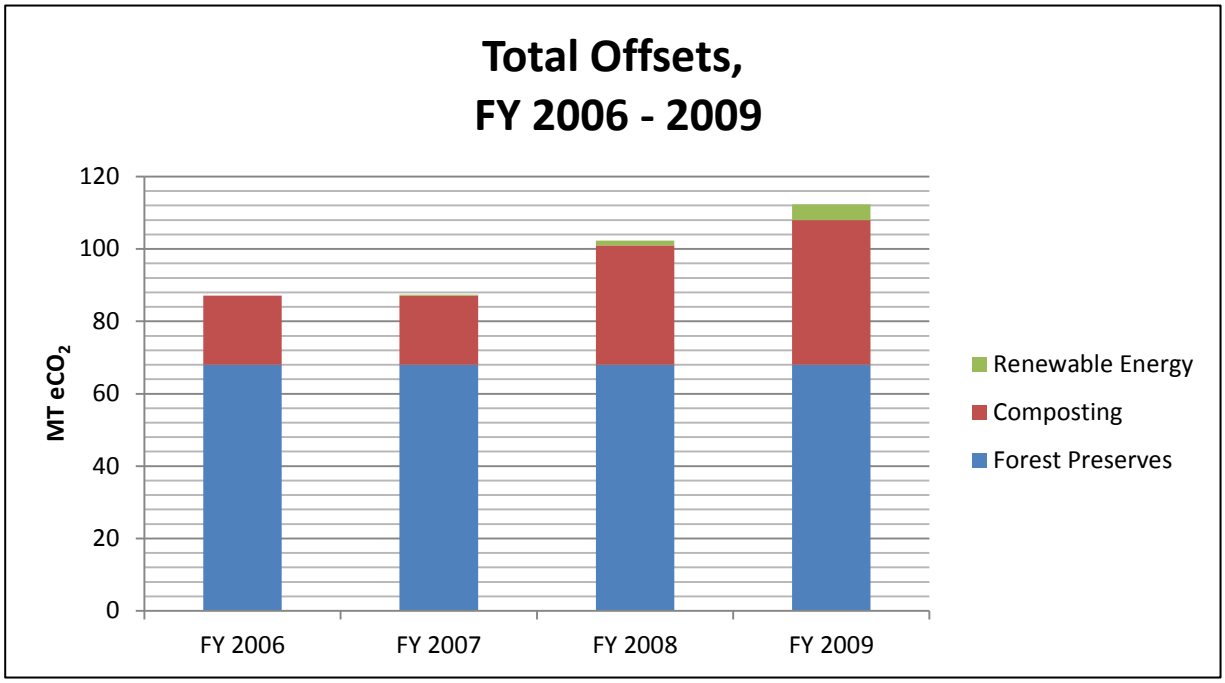


Figure 9.1 : Total Offsets

Figure 7: Harper Hall PV
Photo by Crystal Simmons

Figure 8: Biodiesel PV
Photo by Crystal Simmons

Figure 9: Raley PV
Photo by Crystal Simmons

2009 and Beyond

Information gathered over the previous four years has demonstrated Appalachian's current emissions trends. Based on this historic data, it is possible to infer future projections of emissions. However, this information does not take into account construction changes that will end, e.g., steam line repairs, performance contracts, etc. Moreover, this time period is pre-climate action planning.

According to the projected emissions from the CCC, Appalachian will continue to see reductions in Scopes 1 & 2 until approximately 2035, at which point will reach equilibrium. However, Scope 3 emissions will continue to increase, primarily, because of travel (see Figure 10.1).

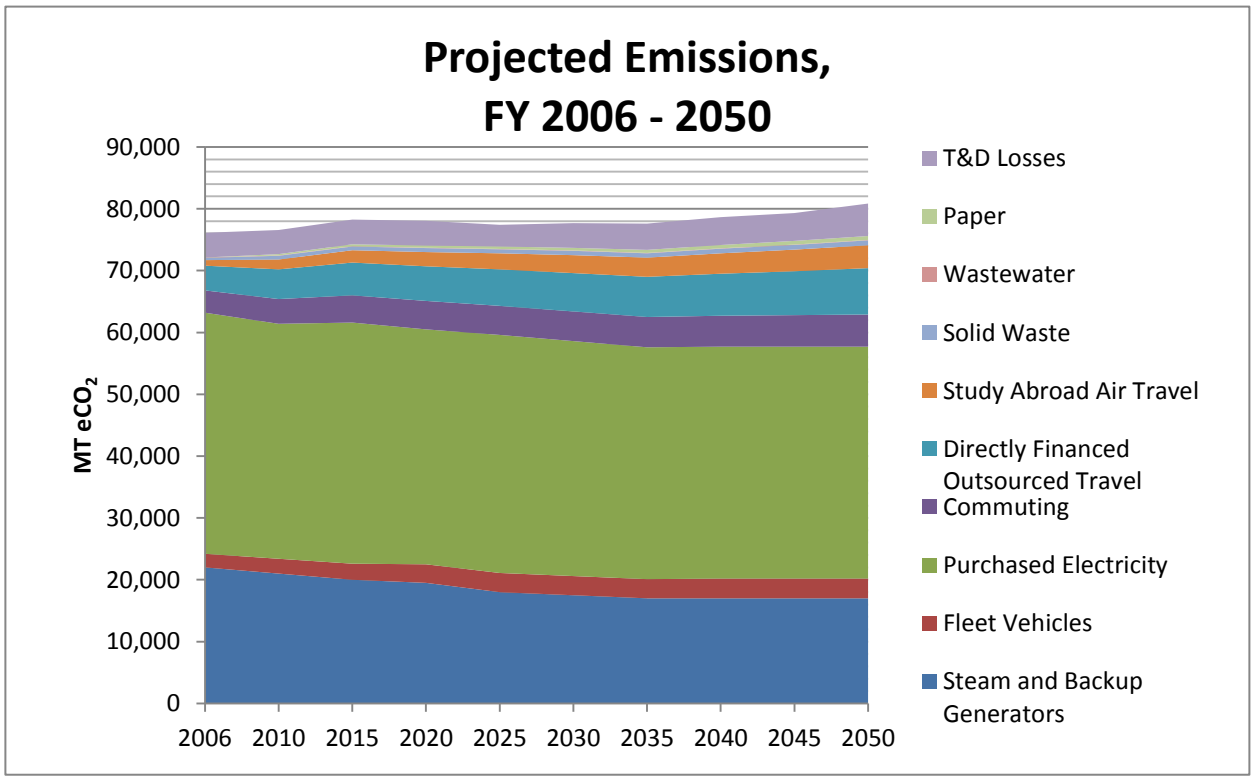


Figure 10.1 : Projected Emission

Scope 1 emissions associated with steam and backup generators will continue to decline as additional improvements to the steam distribution infrastructure are made. In addition to these improvements, the coming years will see a decreased demand on natural gas for steam generation due to two solar thermal (ST) system installations during FY 2010 and one more currently under design. The first ST system installed is on Frank Residence Hall, providing over 14% of the annual energy needs for the entire building including cooling, while the second system is located on the Plemmons Student Union, expecting to offset up to 60% of the hot water needs for two dining facilities housed within the student union.

Based on historical data, fleet vehicle fuel consumption will increase. However, due to an increased use of bio-fuels, emissions from fleet vehicles remain at a steady level.

Emissions from **Scope 2**, purchased electricity, will also continue to drop as additional buildings are retrofitted with energy efficient lighting and appliances. All new buildings and renovations are required to be Leadership in Energy and Environmental Design (LEED) Silver or greater certified. So, over the next forty years based on projections continuing these efforts, emissions from purchased electricity will decline, and then will begin to level out.

A Northern Power Systems North Wind 100 Wind turbine generator located on the campus of Appalachian State University. Photo courtesy of Appalachian State University

Scope 3 emissions are projected to increase in almost every activity but are primarily due to financed travel. Appalachian is committed to providing students with a quality education, and realizes that opportunities to travel in country and abroad greatly enhance the educational experience. With this realization and with a deeper understanding of the implications of travel on Appalachian's emissions, a robust system of offsets must be developed. Further, a Climate Action Plan will develop strategies for dealing with the third largest culprit of emissions in Scope 3, commuting.

Offsets will also continue to increase through additional composting initiatives and renewable energy projects. Currently only pre-consumer food waste is composted and all post-consumer food waste is sent to the landfill. Post-consumer composting and air travel offset programs are being studied. The generating capacity of on campus renewable energy projects will also continue to increase. In FY 2010, Appalachian installed North Carolina's largest wind turbine, a 100 kW machine projected to generate roughly 147,000 kWh annually at this wind site, and offsetting an additional 200 MT eCO_2.

II. Summary

The desire to be a steward of the environment has set Appalachian on a path towards climate neutrality, while also creating a unique opportunity to serve in a leadership role in the University of North Carolina school system and beyond. At Appalachian, we believe institutions of higher education have the responsibility to demonstrate successful strategies for mitigating greenhouse gas emissions which can be replicated throughout other sectors of society.

Figure 11: Students studying the climate.
Photo courtesy of Appalachian State University

The trends during FY 2006-2008 show a steady increase in emissions. In FY 2008, Appalachian State University's greenhouse gas emissions peaked at 83,968 MT eCO_2.

The following year, FY 2009, emissions were reduced by 6%, or 4,748.9 MT eCO_2, despite an increase in the number of students and employees (See Table 1.1, Page 7). The primary cause of these emissions reductions can be attributed to reduced electricity consumption and electricity's associated T&D losses, and university funded air travel.

Figure 12: A pig living at the Sustainable Development Research Farm. Photo courtesy of Appalachian State University

In an attempt to bring some comparative context to these figures and this analysis, (see Table 4.1, Page 22). Each of the universities listed have their own unique campus mission, infrastructure and climate circumstances, thus direct inferences from this table without further investigating these differences could lead to false conclusions.

Appalachian remains committed to being a leader in sustainability and to continuing its efforts of good stewardship in the environment in which it thrives. As Appalachian meets the challenges of climate change we hope to transfer the knowledge and education gained along to our students, helping to prepare them for the climate and environmental challenges beyond college in industry. This process should be transparent and transferable, leading by example for other sectors of society to follow.

To date, Appalachian has gained momentum in its efforts to reduce emissions without the implementation of an institutional action plan leading to climate neutrality. Energy conservation and reduction initiatives

have contributed considerably to the reduction achievements witnessed in 2009. In May 2010, two years after becoming a signatory of the ACUPCC, Appalachian State University will have the first Climate Action Plan complete, in accordance with the requirements of the ACUPCC. As additional strategies are enacted to guide emissions activities, we expect to see GHG emissions associated with Appalachian State University continue to decline.

University Comparisons, FY 2009						
College/ University State	Student Population	Sq.Ft. in Millions	Heating/Cooling Degree Days	Total MT eCO_2	MT eCO2 per student	kg eCO2 per Sq.Ft.
Elon University North Carolina	5,628	1.4	6,144/411	39,428	7	20.6
Appalachian State North Carolina	16,610	5	6,896/345	79,219	4.7	15
Towson University Maryland	21,177	4.3	Not Available	82,039	3.8	19
NC State University North Carolina	32,382	15	3,300/1,484	270,069	8.3	18
UNC Chapel Hill North Carolina	26,300	18.4	4,631/741	569,169	21.6	31

Table 4.1 : University Comparisons

VI. Referenced / Recommended Reading

1. American College and University President's Climate Commitment. (2010). *Text of American college and university president's climate commitment.* Retrieved on January 29, 2010 from: http://www.presidentsclimatecommitment.org/about/commitment

2. Clean Air – Cool Planet. (2008). *Climate action toolkit*. Retrieved on January 29, 2010 from: http://www.cleanair-coolplanet.org/toolkit/inv-calculator.php

3. Energy Information Administration. (2009). Frequently asked questions – electricity. Retrieved on February 9, 2010 from: http://tonto.eia.doe.gov/ask/electricity_faqs.asp#electric_rates2

4. Environmental Protection Agency. (2006). *Carbon sequestration in agriculture and forestry*. Retrieved on January 29, 2010 from: http://www.epa.gov/sequestration/rates.html

V . Glossary

Agricultural Sources: Fertilizer use and animals

Directly Financed Outsourced Travel: Travel paid for directly by the university

Direct transportation sources: All fuel used in university-owned vehicles

Offsets: Methods which work to sequester or negate carbon emissions

On campus stationary sources: All fuel used on campus, excluding vehicle fuel use

Purchased electricity: Emissions associated with electricity purchased off campus

Refrigerants and other chemicals: Perfluorocarbon (PFC), Hydrofluorocarbon (HFC), and SF_6 emissions

Scope 1 Emissions: These are emissions sources which are directly owned or controlled by the institution. For ASU this also includes emissions from our steam plant.

Scope 2 Emissions: For ASU these are indirect emissions associated with purchased electricity. NRL&P purchases the vast majority of their electricity from grid resources primarily provided by Duke Energy.

Scope 3 Emissions: Emissions and/or facilities which are neither owned nor operated by the university, but are directly financed by the institution.

Study abroad air travel: Mileage of air travel from study abroad programs