

Warren Wilson College Greenhouse Gas Emissions Inventory 2008-2009 Academic Year



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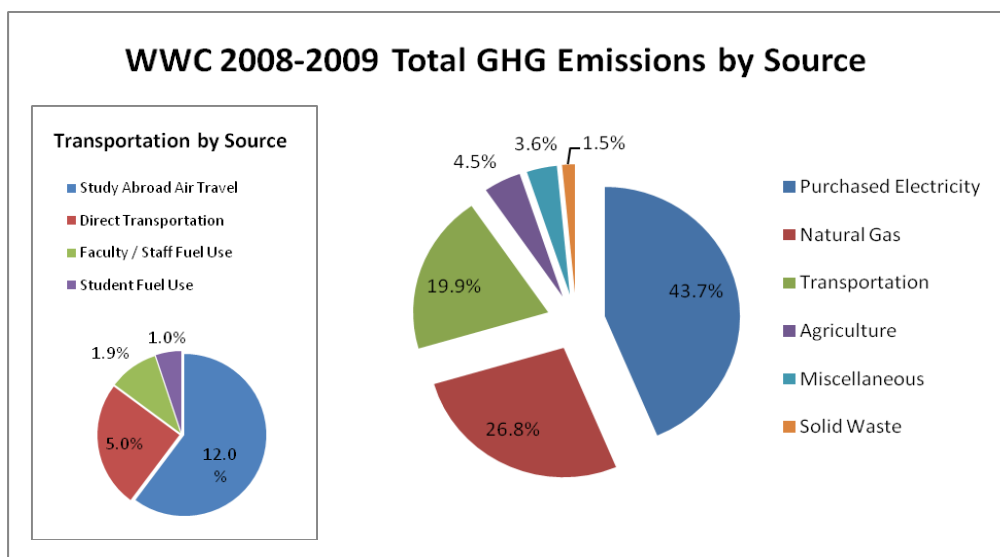
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I. Executive Summary

The 2008-2009 Warren Wilson College Greenhouse Gas Emissions Inventory marks the fifth consecutive inventory compiled by Warren Wilson College (WVC) students under the supervision of the Environmental Leadership Center's Education Director. This initiative is supported by WVC's Triad education model that requires students to successfully complete their academic obligations, work fifteen-hours per week as the College's core labor force taking care of everything from repairing plumbing to growing campus food to writing this inventory, and complete 100 hours of meaningful service learning prior to graduation. The delivery of this academic, work and service mission makes WVC a distinctive institution in higher education.

With each successive inventory more detailed trend data is garnered; data that helps WVC better understand the extent of its climate impact and develop strategies to reduce it. WVC is a Leadership Circle signatory of the American College and University Presidents Climate Commitment (ACUPCC), and signed on in 2007 at which time it instituted policies and procedures to begin to more actively eliminate greenhouse gases from campus operations and functions. In 2008-2009 the College's Climate Action Plan (CAP) was developed by a committee of students, staff and faculty under the leadership of the campus' Chief Sustainability Official. The CAP was fully executed at the beginning of the 2009-2010 academic year, hence this inventory does not reflect results achieved through CAP implementation. The goals of the CAP are, however, conveyed throughout this inventory and serve as the benchmarks upon which WVC will measure future climate action success. The complete document can be found at www.warren-wilson.edu/~elc by clicking on *Climate Action Plan*.

The WVC greenhouse gas emissions inventory monitors campus usage and emissions for electricity, natural gas, international flights, student and employee commuting, vehicle fleet use, solid waste stream, agriculture operations, and miscellaneous emissions from used motor oil furnace, blacksmithing coke, propane, un-recovered refrigerants, and paper purchasing.



The 2008 - 2009 Greenhouse Gas Emissions Inventory lends further data to support three trends over the past five academic years (2004/05-2008/09) that give cause for celebration:

- Overall total campus per capita emissions are down nearly 10%, with the downturn beginning in 2008 - 2009;
- Electricity per capita emissions (the largest source on campus) are down nearly 14%;
- Natural gas per capita emissions (second largest source) are down 8%.

These trends mean that each individual student and employee is doing a better job reducing energy use. Campus population, however, just like global population, continues to increase. When looking at emissions totals not adjusted per capita, the findings are sobering:

- Overall total campus emissions are UP nearly 3.5%;
- Electricity emissions are DOWN 0.8%;
- Natural gas emissions are UP nearly 5.5%

In addition, the inventory process brings to light key areas where improved campus energy use data collection is needed - data is currently insufficient or not available as a result of either lacking infrastructure or process:

- Sub-meter all buildings for natural gas use;
- Track miles traveled and mode of transportation for all College-related travel;
- Track campus water usage;
- Track all building's energy efficiency improvements data to support return on investment calculations;
- Centralize campus purchasing and data collection to improve the quality of purchased product emissions data (such as paper and food).

Clearly there is work to be done. Results of Year 1 Climate Action Plan implementation will be tabulated over the coming months, and will hopefully indicate campus emissions improvements. By inspiring students and employees to change energy use behaviors, developing and executing sound energy efficiency policy, and continuing to measure and disseminate emissions data, Warren Wilson College will continue to be a national leader in the fight to reduce global greenhouse gas emissions.

Stan Cross
Education Director
Environmental Leadership Center
May 2010

II. 2008-09 Greenhouse Gas Emissions Inventory Final Report

A. Introduction

The Warren Wilson College Greenhouse Gas Emissions Inventory 2008-2009 is the fifth annual emissions inventory the college has produced. It is now possible to examine five-year trends of Warren Wilson's energy use, energy costs, and GHG Emissions, which provides a broader picture of the college's environmental impact. With this enhanced knowledge, Warren Wilson College can set accurate goals for emissions and energy use reductions.

This is also the first inventory to be conducted after filing WWC's Climate Action Plan with ACUPCC, which aims to reduce WWC's overall greenhouse gas emissions to 80% less than its 2007 levels by 2020. This goal will be accomplished in two phases. Phase 1 aims for a 40% carbon emissions reduction from 2007 levels during 2009 to 2014. This goal will be accomplished in a three-part process:

- 1) Achieve a 25% total reduction in electric use campus-wide at 5% per year, from 2009 to 2014, based on a combination of behavior changes and retrofits;
- 2) Achieve a 50% total reduction in transportation carbon footprint from 2009 to 2014 based upon fleet upgrades, use of alternative transportation, and meaningful voluntary carbon offsets for faculty/staff business and commuter travel, international programs, service learning, and student driving;
- 3) Achieve a 20% reduction in natural gas carbon emissions based on gradual upgrades of heating/cooling systems, building envelopes, and installation of geothermal and high functioning systems.

The figures reported in this inventory are invaluable to the college's efforts to monitor progress of the Climate Action Plan.

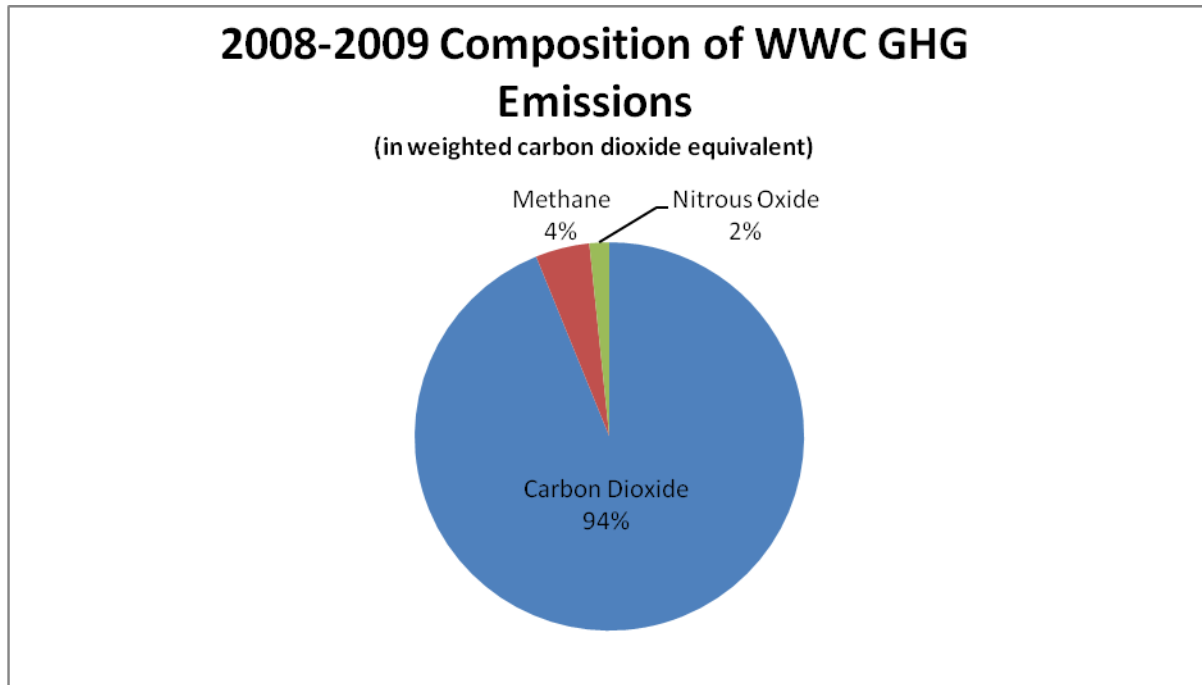
This inventory examines the following sources of GHG emissions: Electricity; Natural Gas; Transportation (International Flights and Fuel Use); Solid Waste; Agriculture; and Miscellaneous which includes the Used Motor Oil Burner, Escaped Refrigerants, Paper Consumption, and Blacksmithing Coke. In this inventory, 'per capita' trends are based upon the entire population of the campus (students, staff and faculty combined), and 'per capita' in residence halls.

In the 2007-2008 Greenhouse Gas Emissions Inventory, the college chose to transition from its own custom-made emissions template to the Clean Air—Cool Planet Campus Carbon Calculator, which is a standardized, nationally-utilized and well-known tool. In this 2008-2009 inventory, the transition was made complete; old data, whenever possible, was imported into the Calculator to yield new

totals for past years' figures. The Calculator computes emissions in either pounds or metric tonnes (MT) of carbon dioxide equivalents (eCO_2). Nitrous oxide and methane "are more potent greenhouse gases than carbon dioxide in regard to climate change, so by using the measurement of eCO_2 , a valid comparison can be made across sources of different types of emissions."¹

Figure 1.1, below, depicts the relative composition of Warren Wilson College's GHG Emissions by total amount.

Fig. 1.1



B. Total Emissions

Table 1.1, below, depicts total GHG Emissions for Warren Wilson College over the past five years.

Table 1.1

WWC Annual Greenhouse Gas Emissions				
	Carbon Dioxide Emissions (MT)	Methane Emissions (MT eCO₂)	Nitrous Oxide Emissions (MT eCO₂)	Total GHG (MT eCO₂)
2004-2005	4,560	154	35	4,782
2005-2006	4,850	136	37	5,215
2006-2007	4,469	214	30	5,337
2007-2008	5,162	208	74	5,536
2008-2009	4,473	215	79	4,951

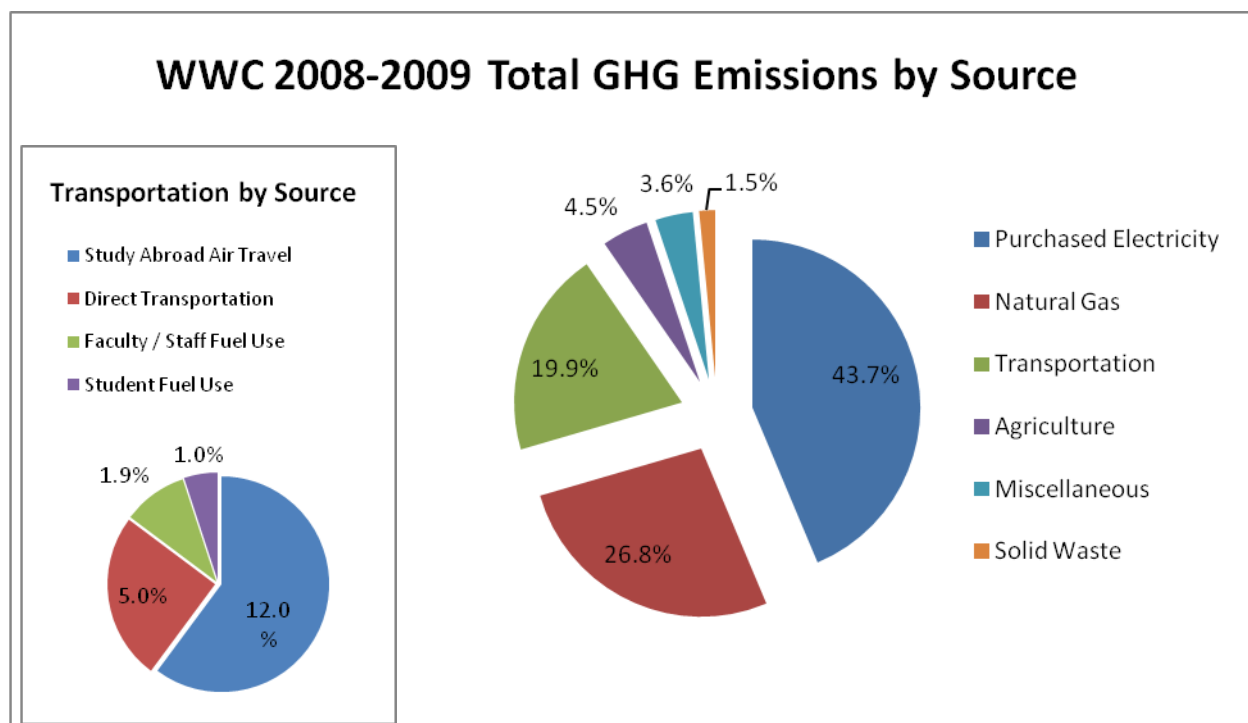
It is important to note that the figures in Table 1.1 differ from those reported in previous inventories, and are to be considered the most accurate figures to date. For this inventory, the raw values from all previous inventories were imported into the Clean Air-Cool Planet Campus Carbon Calculator, which systematized emissions calculations and generated new totals. These totals allow for the most accurate comparison of the college's emissions from year to year. Unfortunately, raw data for the college's paper consumption and student/staff/faculty driving practices are not available for the academic years of 2004-2005, 2005-2006, and 2006-2007, so the corresponding Total GHG values are missing these emissions totals.

In the five years between academic years 2004-2005 and 2008-2009, total GHG emissions at Warren Wilson College increased 3.5%. During this time, the total campus population grew by 14.7% (from 986 to 1,131, for all students, staff, and faculty). During this period, the total square footage of campus buildings that are inventoried increased by approximately 6.13%. In comparison to last year (07-08), total GHG emissions decreased by 10.6%.

The college's carbon dioxide emissions are primarily the result of its electricity and natural gas consumption, while methane emissions are the result of solid waste production and agricultural

practices. The majority of the college's nitrous oxide emissions come from agricultural operations. Figure 1.2, below, breaks down by source Warren Wilson College's total GHG emissions.

Figure 1.2



Electricity is Warren Wilson College's chief source of GHG emissions; it is followed by natural gas and transportation, respectively. These three sources amount to 90% of the college's annual GHG emissions. Transportation emissions result from study abroad air travel, the campus vehicle fleet ("direct transportation") and fuel use from commuting to the college. All together, agriculture, solid waste, and miscellaneous sources (including refrigerants, paper consumption, and blacksmithing coke) produce slightly less than 10% of the total GHG emissions. From 2004-2005 to 2008-2009, total GHG emissions increased by 169 metric tonnes (3.5%).

Warren Wilson College began purchasing Renewable Energy Credits (RECs) for its electricity use in the 2005-2006 academic year. The current provider of these credits is Renewable Choice, located in Colorado. The college is mandated by ACUPCC to purchase RECs for 15% of its electricity use, but chooses to purchase RECs for 100% of its use. As a result, for every kilowatt-hour WWC consumes it purchases a kilowatt-hour generated by a renewable wind energy source.

Figures 1.3 and 1.4, below, depict the five year trend of Warren Wilson College's annual GHG emissions, with and without RECs.

Figure 1.3

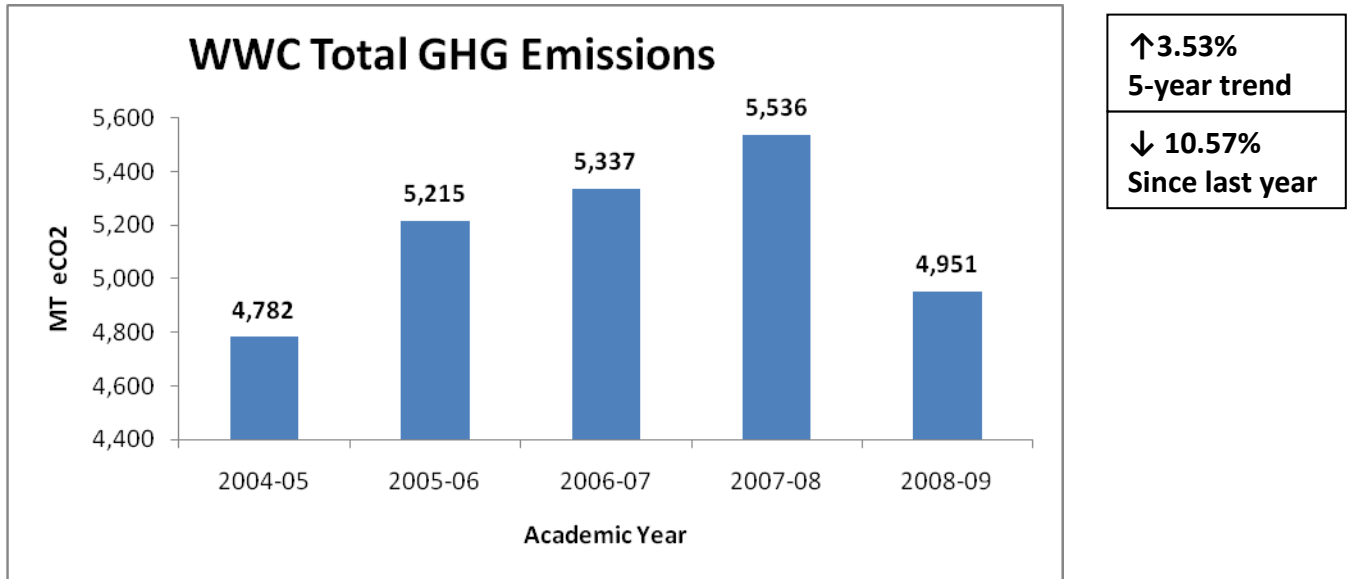
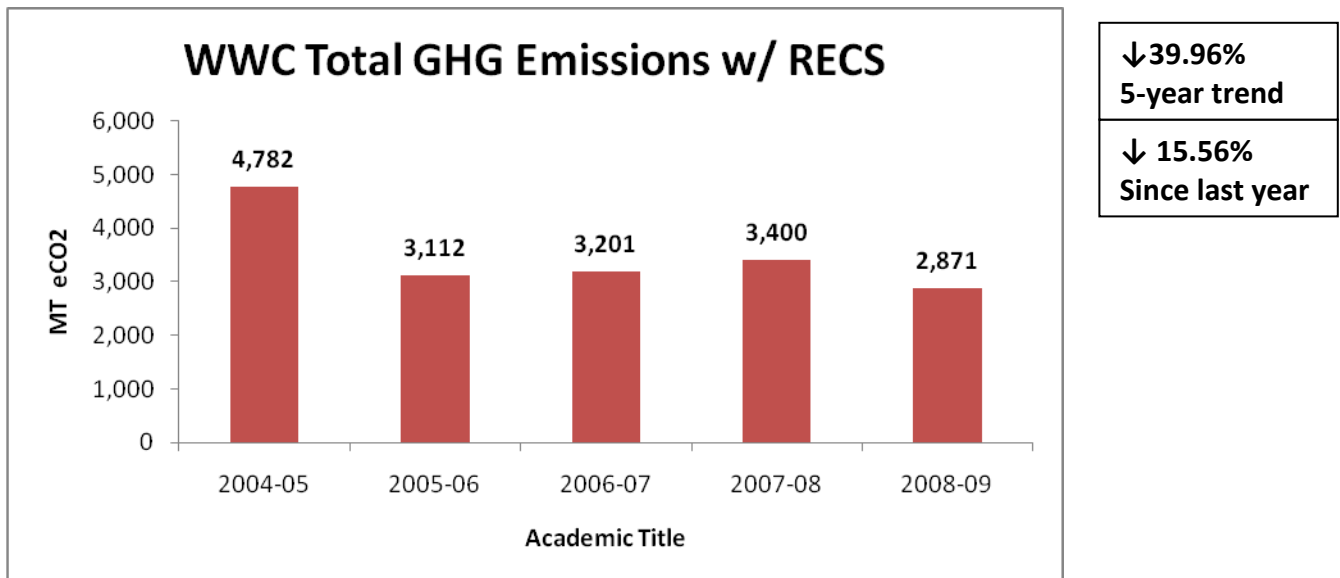


Figure 1.4



Although total greenhouse gas emissions for the college increased by 3.53% from 2004-2005 to 2008-2009, when RECs are factored in, there was an almost 40% decrease in GHG emissions within the same time-span.

C. Total Energy Costs

Total energy costs for all of the previous inventoried years have been updated for inclusion in this year's inventory. In 2008-2009, the college spent \$637,380 on energy (including electricity, natural gas, and fuel used by the Campus Vehicle Fleet), which is a 12.97% increase from 2004-2005, or a cost increase of \$73,150. In addition to these direct energy costs, WWC also spent \$19,712 on RECs for electricity. While some of the total cost increase can be attributed to increased energy use, much of it is instead the result of inflation. The Clean Air-Cool Planet Campus Carbon Calculator adjusts energy costs for inflation, producing new figures which allow for a more accurate comparison among years. Figures 1.5 and 1.6, below, depict the five year trend of total energy costs in both actual dollars and dollars adjusted by the Calculator for inflation. For 2009-2010 Progress had an 11% increase and is likely to have two more. The calculator will not be accurate for such a significant increase so beware in the next inventory of using it.

Figure 1.5

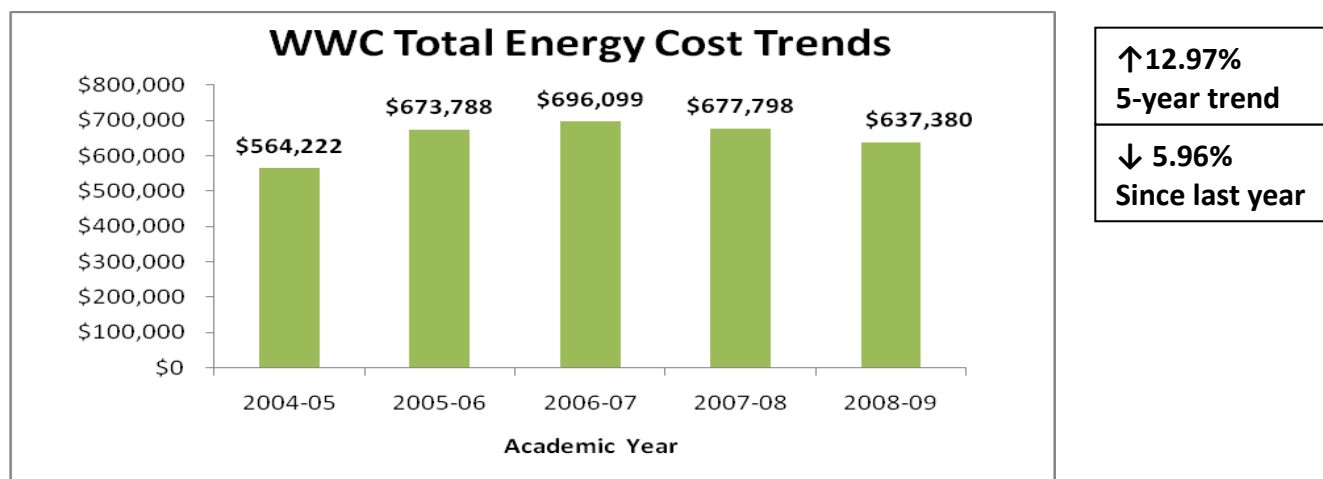
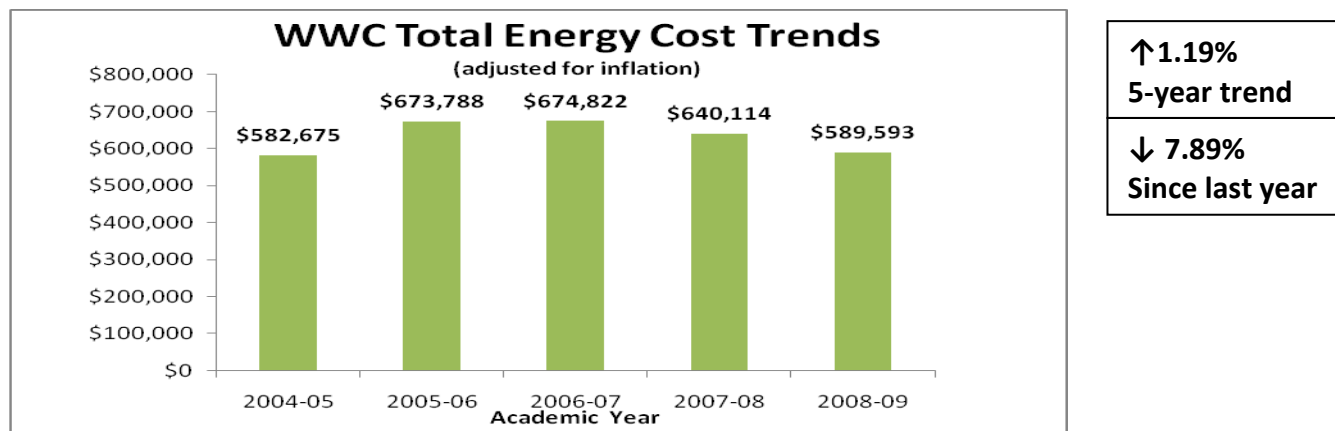


Figure 1.6



III. The Three Major Emissions Sources

A. Electricity

Climate Action Plan Goal: ↓25% of 2007 GHG emissions by 2014

Electricity consumption is the largest source of greenhouse gas emissions at Warren Wilson College. The college purchases its electricity from Progress Energy, which utilizes a variety of energy sources. The precise percentage of electricity generation from each source was factored into the Clean Air–Cool Planet Campus Carbon Calculator to ensure that the correct emissions factors were used in all calculations for this inventory.

The breakdown of electricity generation sources for Progress Energy is depicted below, in figure 2.1.

Figure 2.1

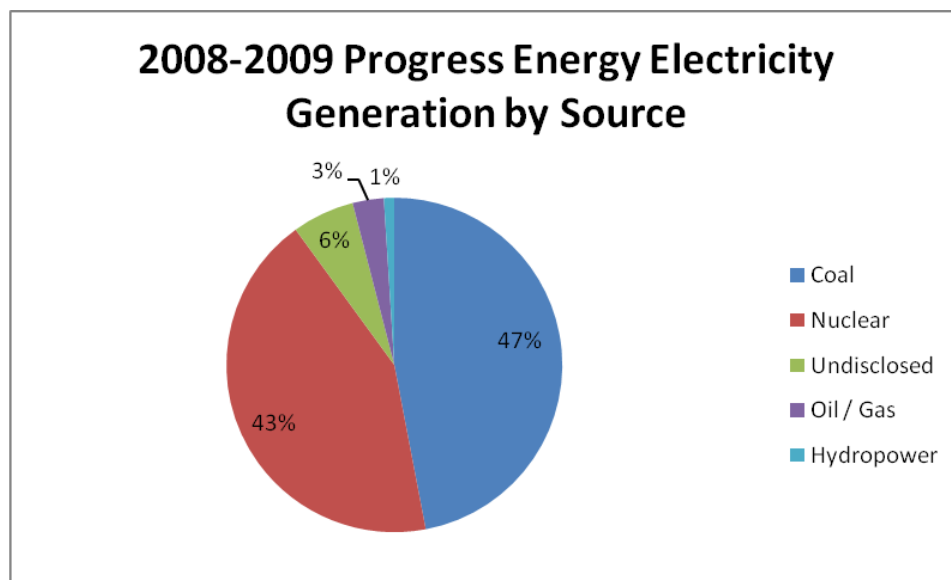


Table 2.1, below, depicts Warren Wilson College's total electricity consumption, costs, and resulting GHG emissions over the past five years.

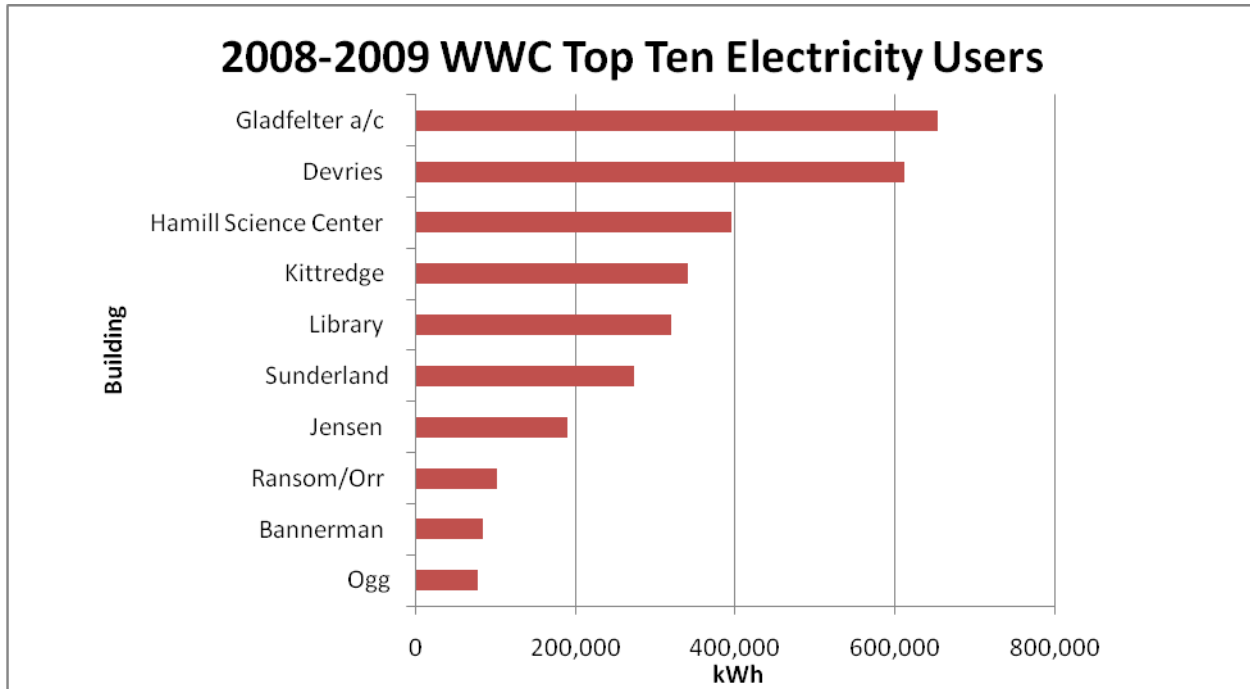
Table 2.1

Electricity Use by WWC						
	Total Use (kWh)	Total Use per capita (kWh)	Costs	Costs per capita	Electricity GHG Emissions (MT eCO₂)	Electricity GHG Emissions per capita (MT eCO₂)
2004-2005	4,337,732	4,399	\$298,831	\$303	2,087	2.1
2005-2006	4,333,775	4,187	\$311,186	\$301	2,091	2.0
2006-2007	4,403,183	4,242	\$342,123	\$330	2,127	2.0
2007-2008	4,426,319	4,114	\$344,432	\$320	2,124	2.0
2008-2009	4,312,467	3,812	\$349,732	\$309	2,070	1.8

From 2004-05 to 2008-09, annual electricity usage dropped by 0.58%, even though the campus population increased by 14.70% (from 986 to 1131). However, despite the slight drop in usage, the amount of money spent annually on electricity rose by 17.03%.

Figure 2.2, below, depicts the total electricity consumption of the college's top-consuming buildings.

Figure 2.2



Note: Although Orr Cottage is LEED Gold Certified, it is metered together with Ransom, and the combined electricity usage of these buildings ranks them in the top 10 of total electricity consumers.

Gladfelter's air-conditioning system consumes about 15% of the total electricity used by the college, making it the single largest user. This has been a trend over the last five years, but it is still a significant figure, given the system is used for only a few months in a year, and it is not tied to Gladfelter's lighting. Devries Gymnasium is the second largest consumer of electricity on campus, followed by Hamill Science Center, which is commonly referred to as Morse and Witherspoon. Sunderland is the only residence hall in the top ten ranking of electricity users, which is logical, since it houses the most students of all residence halls on campus. Sunderland is also at the top of the residence hall list in terms of greatest electricity consumption per capita.

Figure 2.3, below, depicts the breakdown of electricity consumption per capita of the college's residence halls.

Figure 2.3

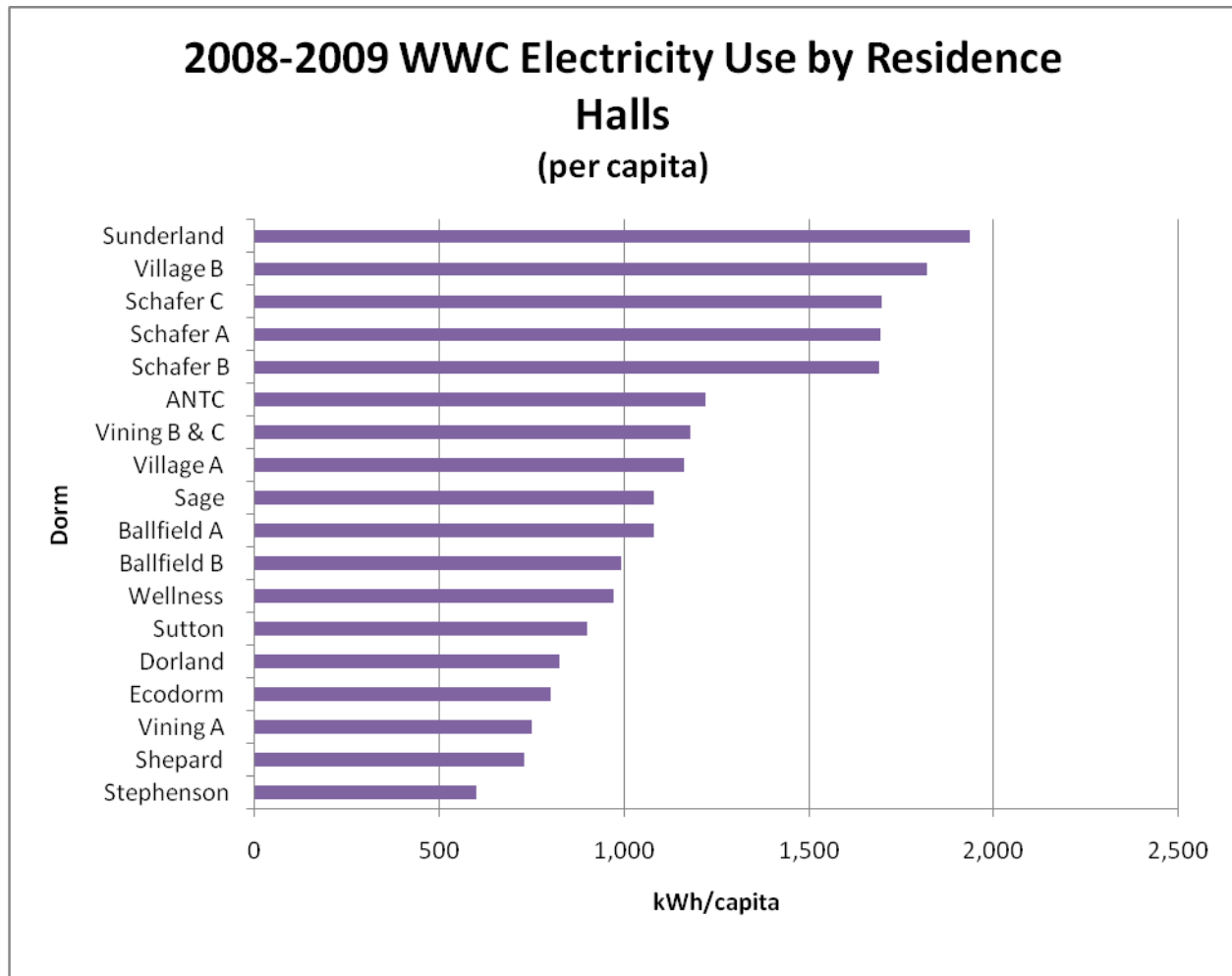


Figure 2.4, below, depicts the breakdown of electricity consumption per capita of the college's non-residential buildings.

Figure 2.4

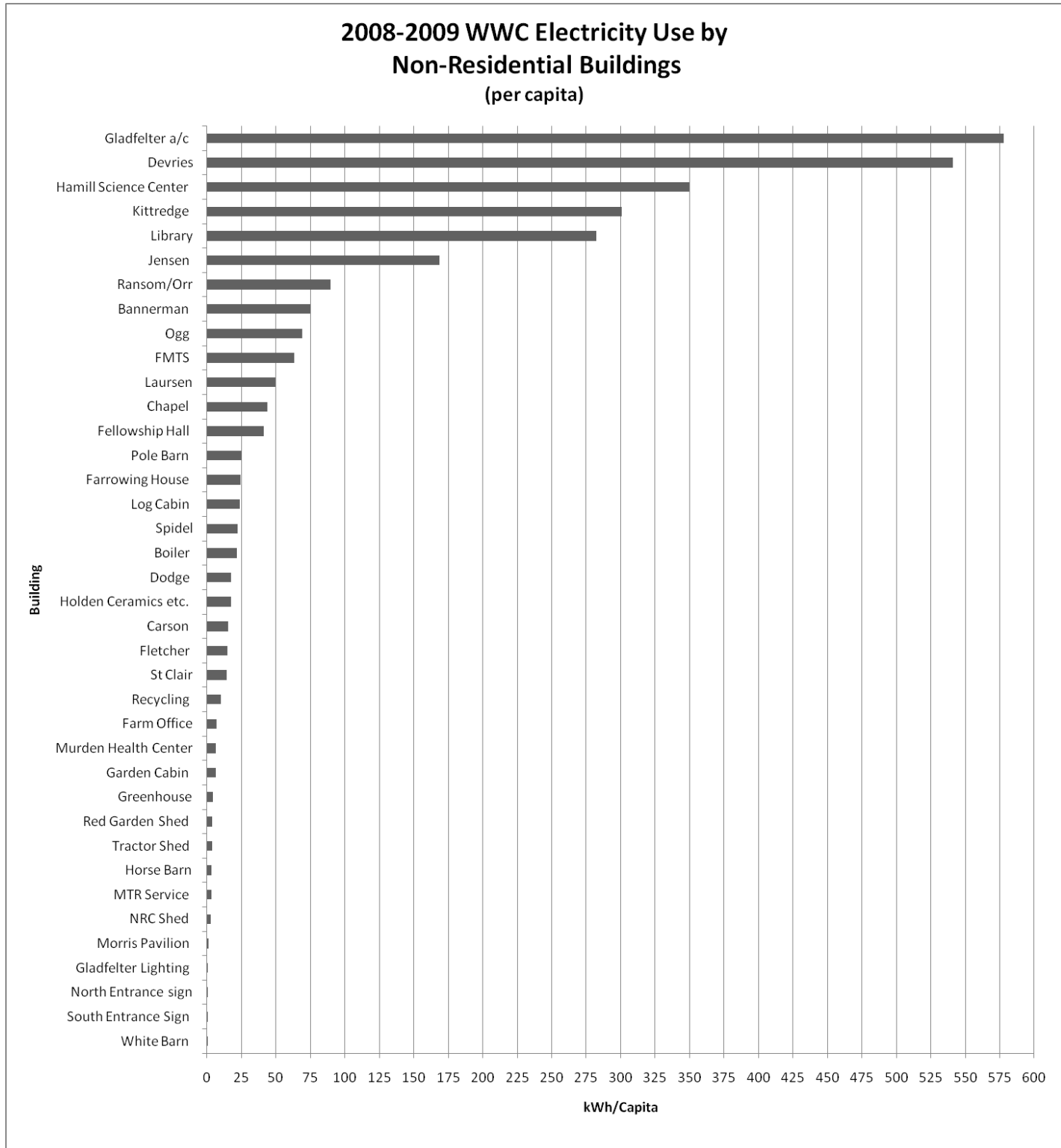
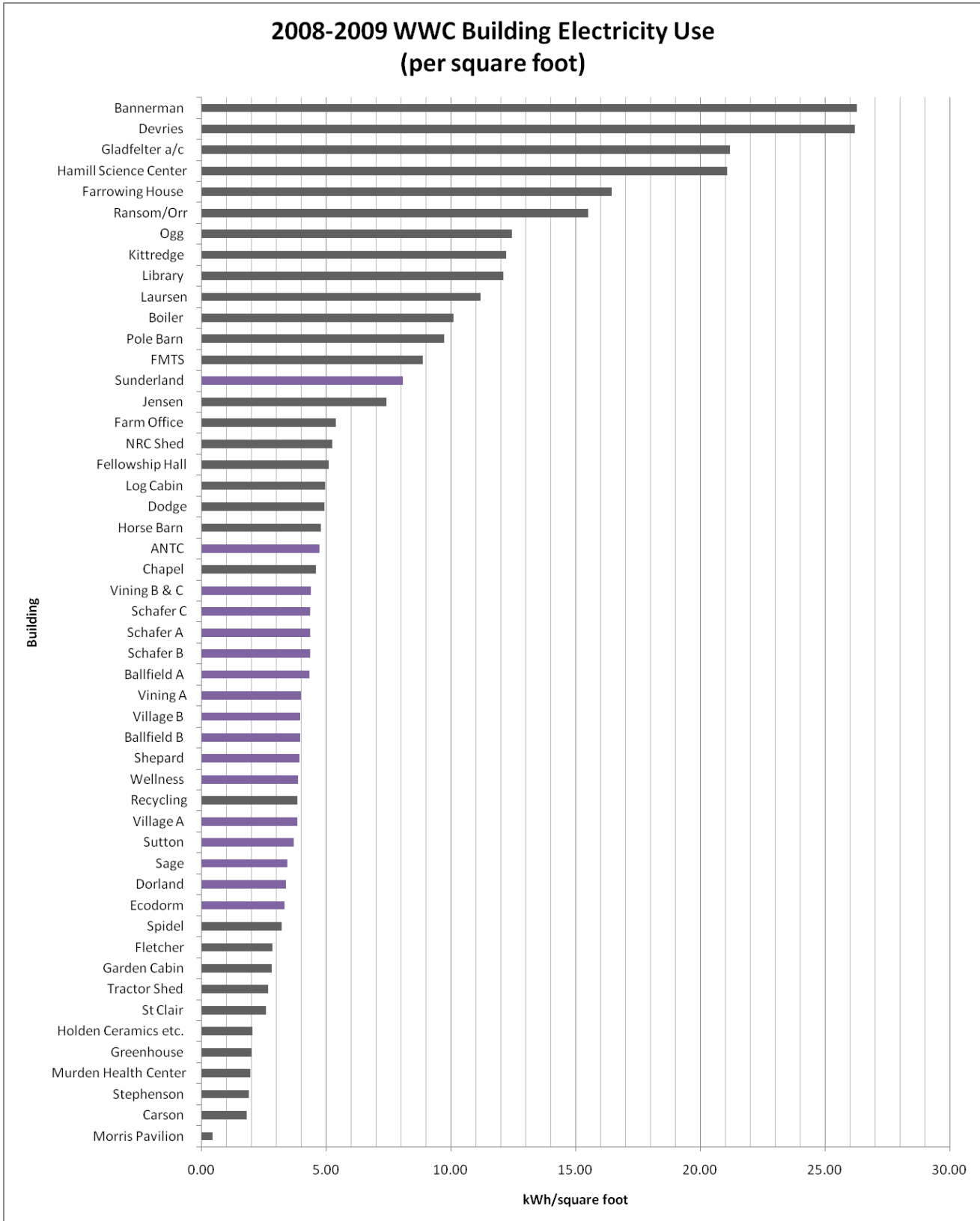


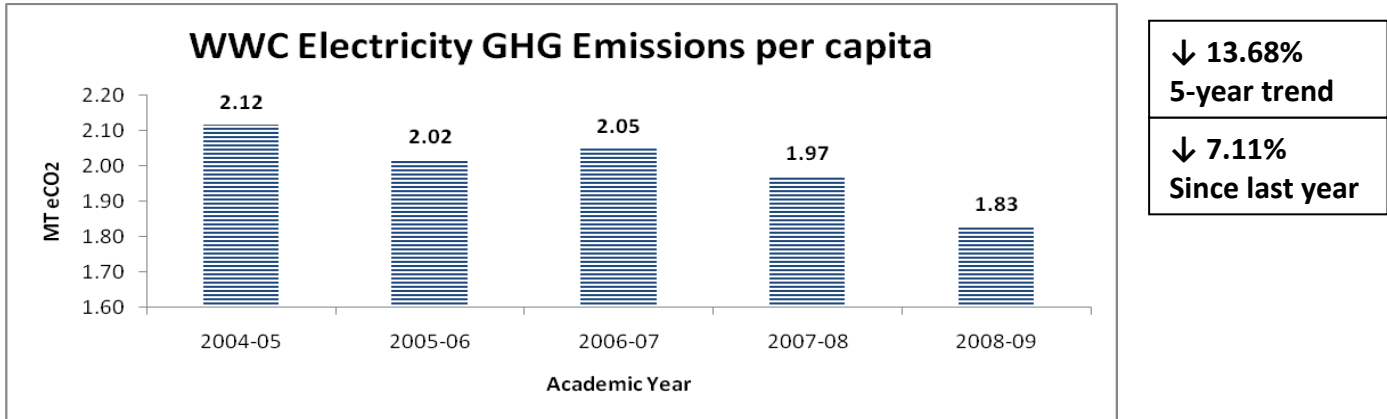
Figure 2.5, below, depicts building electricity use per building square foot.

Figure 2.5



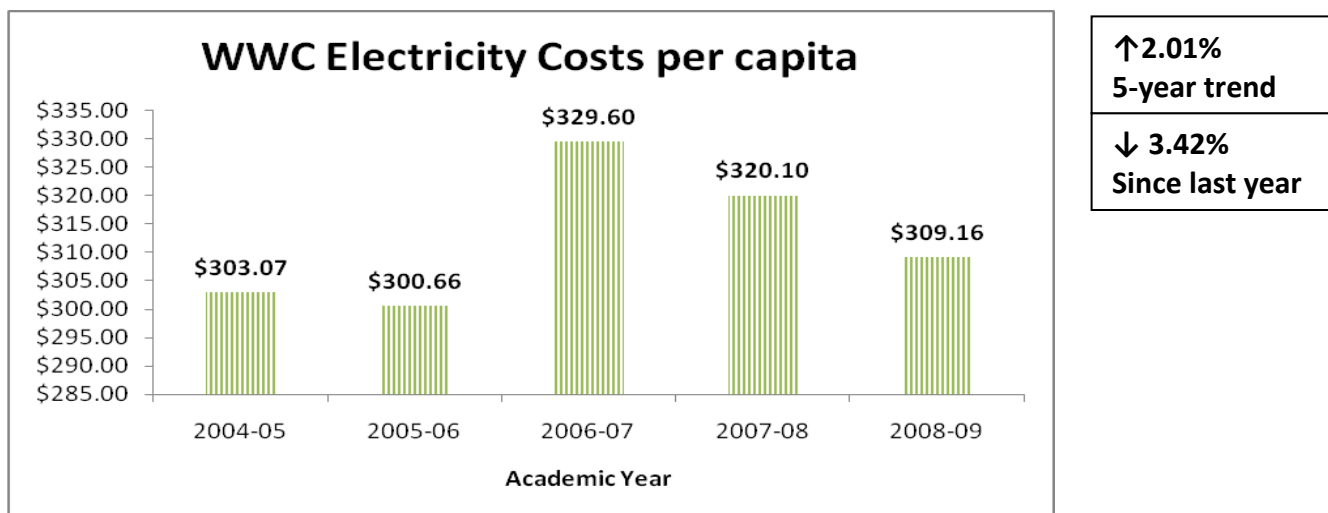
From 2004-2005 to 2008-2009, Warren Wilson College's electricity usage decreased by 25,265 kWh, or about 0.6%. This reduction is notable, given that the total campus population increased by 14.7% during the same period of time. On a per capita basis, and without considering RECs, the college's electricity-related GHG emissions decreased by 13.7% between 2004-2005 and 2008-2009. The five year trend of electricity emissions per capita is depicted below, in figure 2.6.

Figure 2.6



From 2004-2005 to 2008-2009, the total cost of electricity rose by \$50,901. However, during the same period, electricity costs per capita dropped by \$10.94. Figure 2.7, below, depicts the five year trend of electricity costs per capita for the college.

Figure 2.7



1. Renewable / Alternative Energy

Warren Wilson College produces some solar energy on location. According to an agreement made with the donor of the college's 13 kW photovoltaic array, the electricity is sold to the electric grid at a premium rate, through the NC GreenPower program. In the 2008-2009 academic year, the array produced 17,864 kWh. Revenue generated from selling this electricity to the grid is used to fund energy efficiency efforts in the community surrounding Warren Wilson College. These efforts help educate about and reduce total GHG emissions in the community.

Warren Wilson's Ecodorm includes a 2 KW solar array that provides electricity to the residence hall, and a solar water heating system, that provides domestic hot water and fuels the residence hall's radiant in-floor heating system. In addition, the college operates three geothermal heat pump systems that provide heating and cooling to the Jensen, Laursen, and Orr Cottage buildings. Many other buildings on campus utilize passive solar heating and day-lighting, which helps decrease the buildings' energy consumption.

B. Natural Gas

Climate Action Plan Goal: ↓20% of 2007 GHG emissions by 2014

Emissions from Natural Gas constitute 27% of the college's total GHG emissions. Natural Gas is used to heat campus buildings and also, to a much smaller extent, to heat water and cook food.

Table 3.1, below, depicts Warren Wilson College's natural gas usage, costs, and GHG emissions for the past five years.

Table 3.1

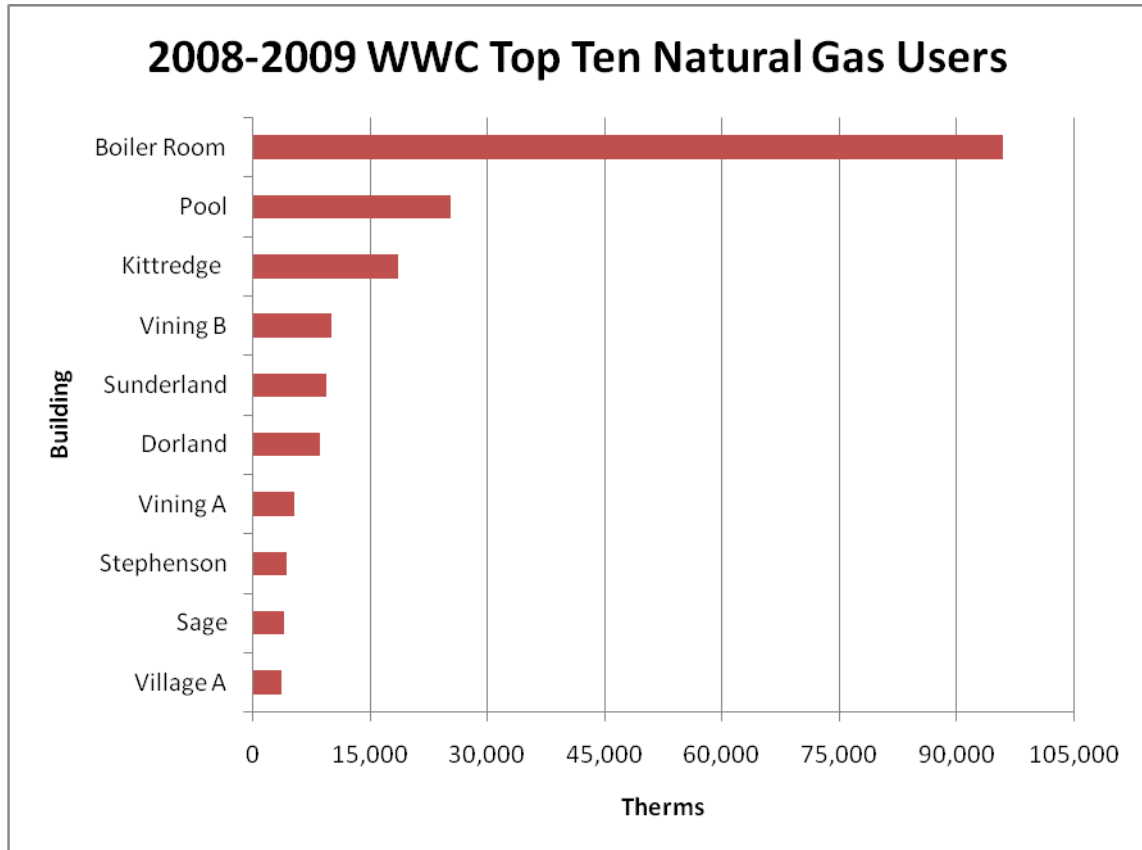
Natural Gas Use by WWC						
	Total Use (therms)	Total Use per capita (therms)	Costs	Costs per capita	Natural Gas GHG Emissions (MT eCO₂)	Natural Gas GHG Emissions per capita (MT eCO₂)
2004-2005	227,913	231	\$153,946	\$156	1,206	1.2
2005-2006	227,933	220	\$233,443	\$226	1,206	1.2
2006-2007	249,029	240	\$209,162	\$202	1,318	1.3
2007-2008	227,828	212	\$185,873	\$173	1,205	1.1
2008-2009	240,465	213	\$223,539	\$198	1,272	1.1

Note: A therm is equal to 100 cubic feet of natural gas.

Since 2004-2005, natural gas usage has increased by 12,552 therms, or 5.5%. This has resulted in an increase of 66.5 metric tons of eCO₂ emissions. On a per square foot basis, the increase in GHG emissions was even greater, rising 7.2% during this period. However, on a per capita basis, GHG emissions actually decreased by 8.0% from 2004-2005 to 2008-2009.

Figure 3.1, below, depicts the total natural gas consumption of the college's top-consuming buildings.

Figure 3.1



The Boiler Room is high in usage because it directly heats or dispenses natural gas to multiple buildings on campus: Bannerman, Carson, Spidel, Dodge, Gladfelter, the Library, the Work Program Office, Morse, Witherspoon, Ogg, Fletcher, Ransom, the Blacksmith Shop, the Greenhouses, the Paint Shed, the Recycling Complex, the Piggery (Farrowing House), the Garden Cabin, FMTS, and the Farm Office. Since all of these buildings are metered together, we do not know the precise natural gas usage of each included building. However, we can estimate the individual usages by assuming that each building uses natural gas in proportion to its size. Since we know the area of each building, as well as the combined area of all the buildings on the meter, we can correlate a single building's percentage of total area to its percentage of total natural gas consumption, thereby deriving an estimate of therms per square foot for each building heated by or provided natural gas through the Boiler Room.

Figure 3.2, below, depicts the breakdown of natural gas consumption per square foot of the college's residence halls.

Figure 3.2

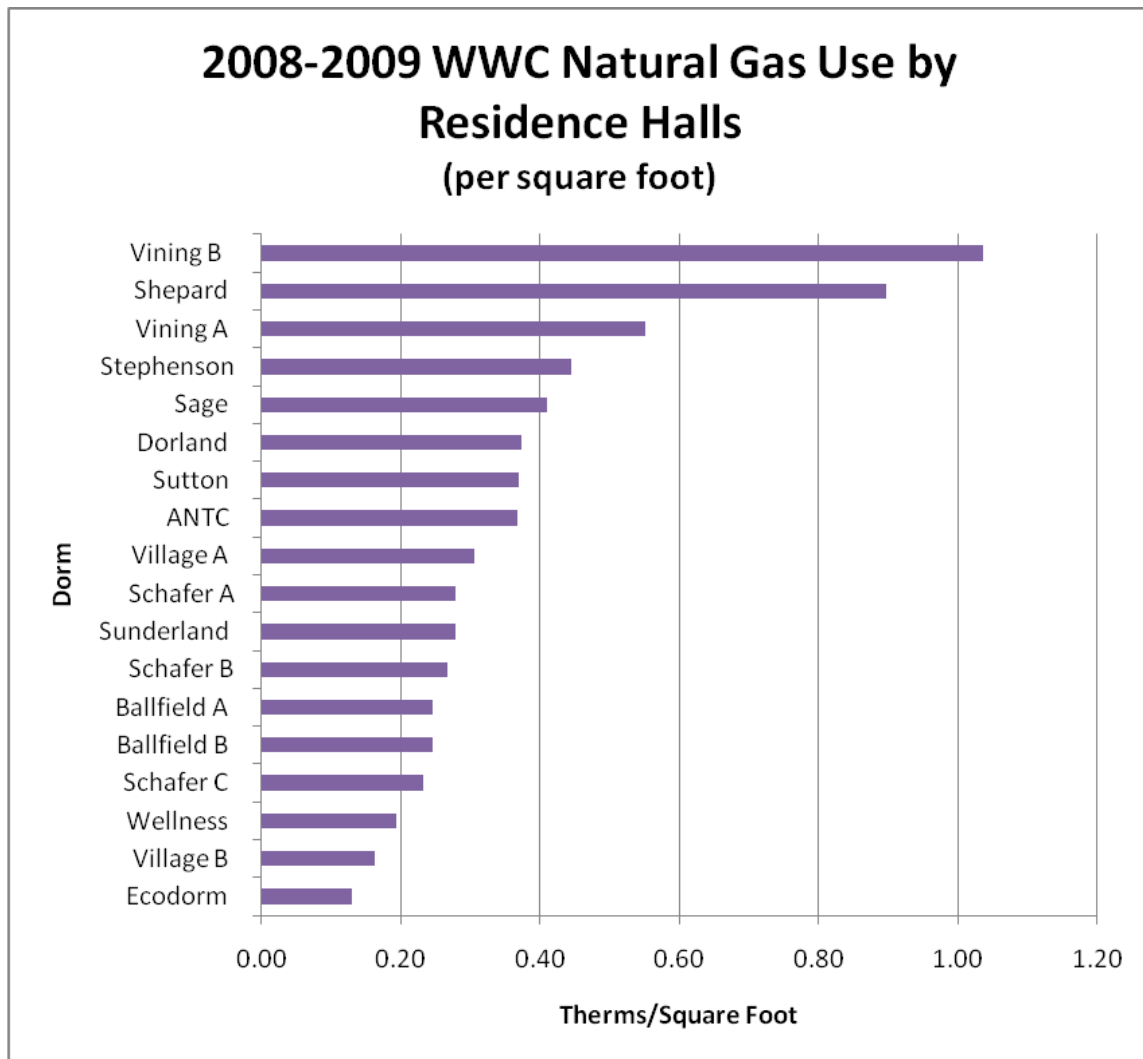


Figure 3.3, below, depicts the breakdown of natural gas consumption per square foot of the college's non-residential buildings (the usage of buildings connected to the boiler room has been approximated).

Figure 3.3

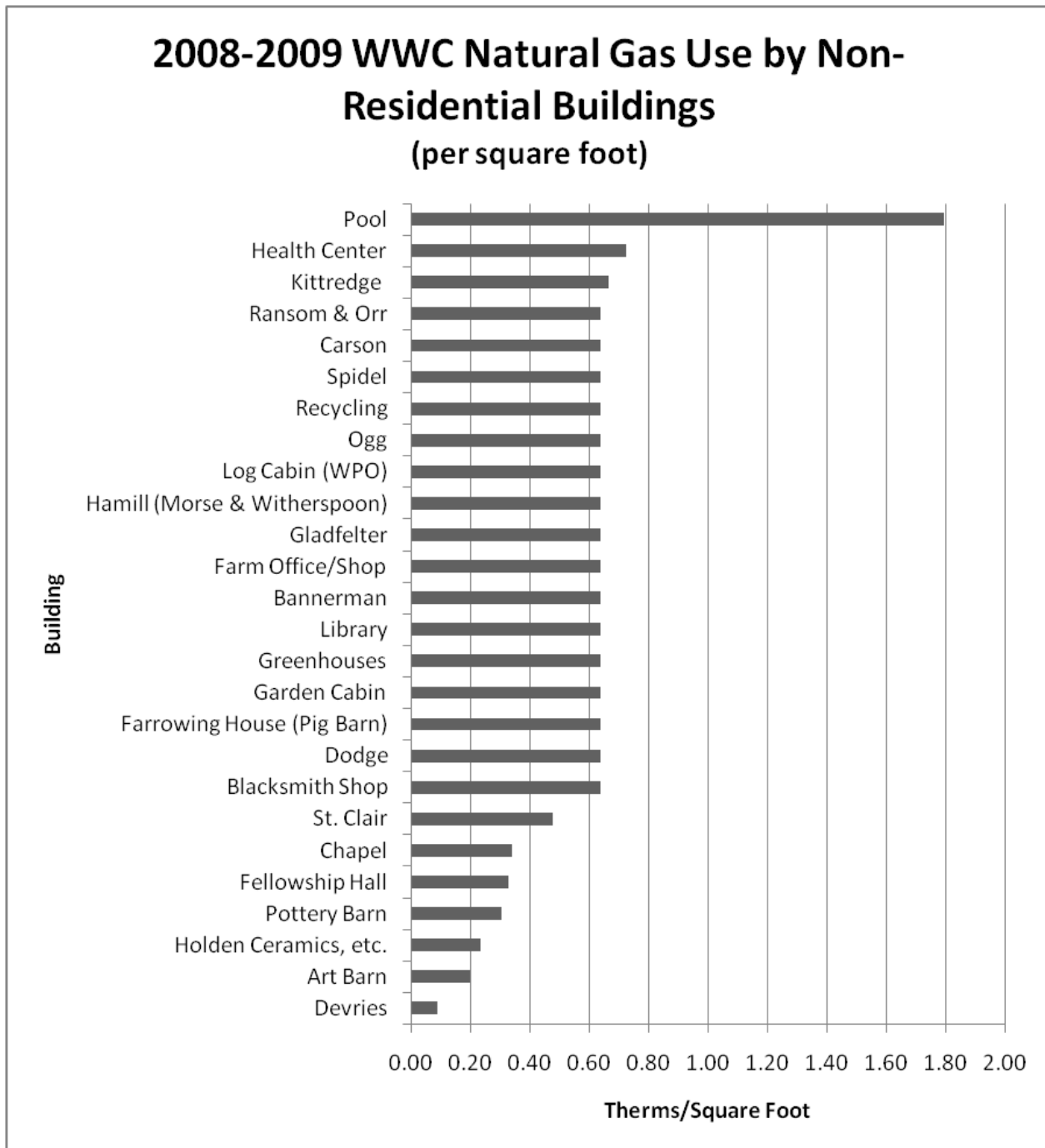


Figure 3.4, below, depicts which buildings consume the most natural gas per capita (the usage of buildings connected to the boiler room has been approximated).

Figure 3.4

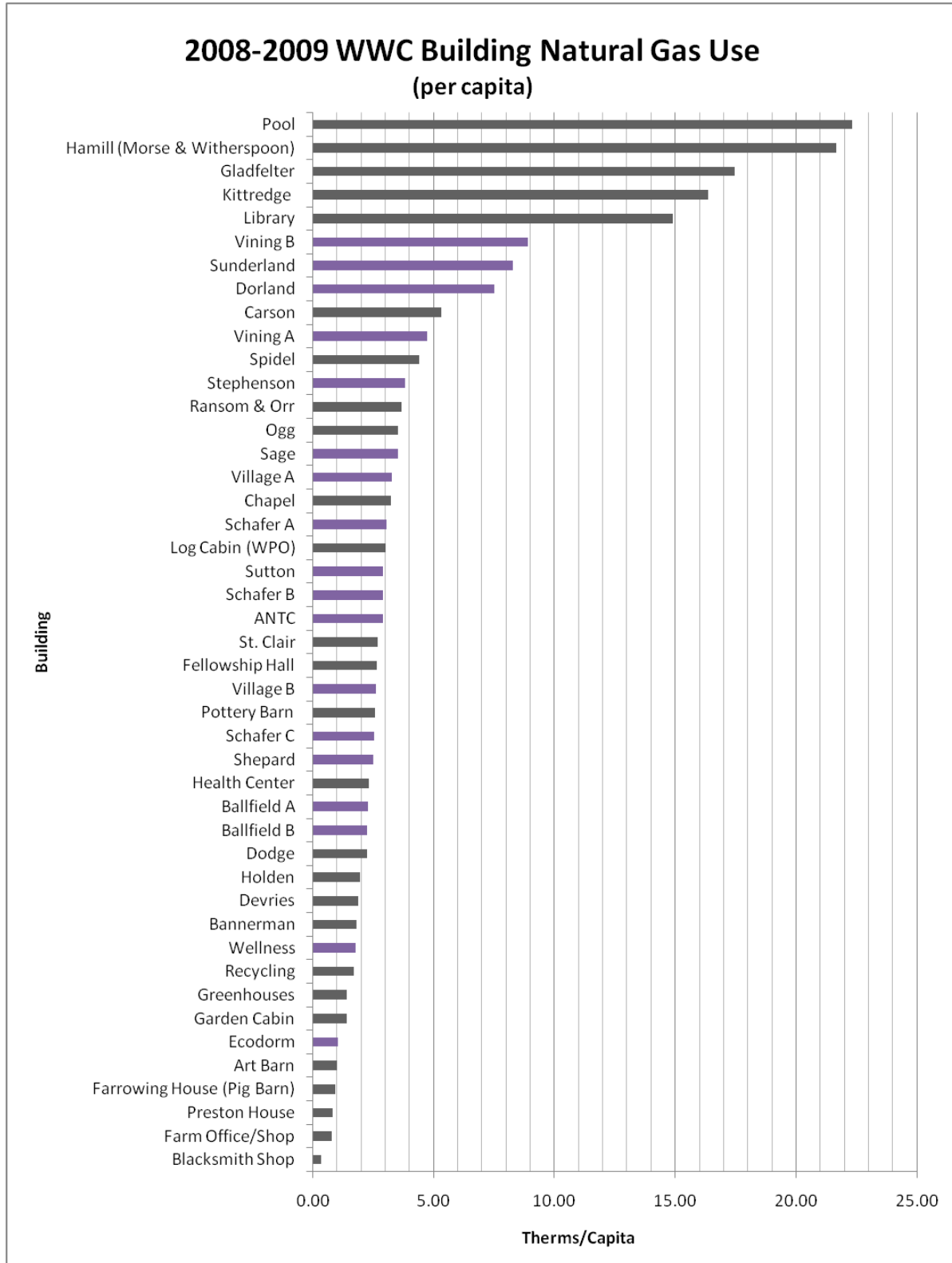
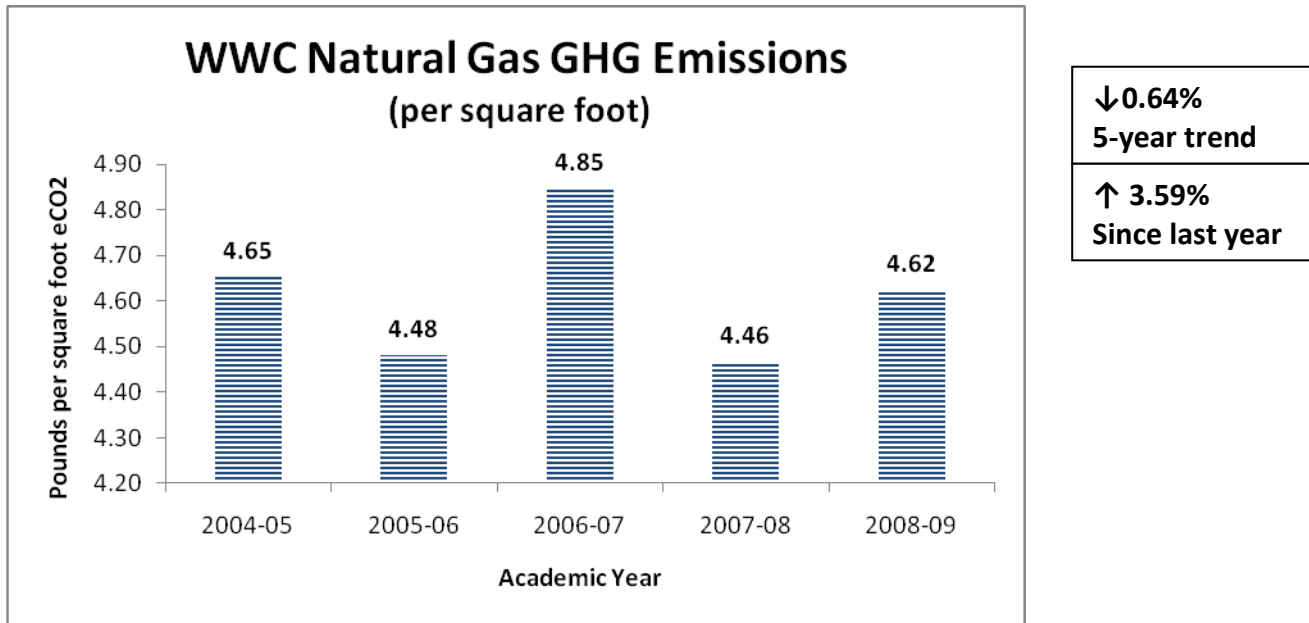


Figure 3.5, below, depicts the five year trend of natural gas GHG emissions per square foot.

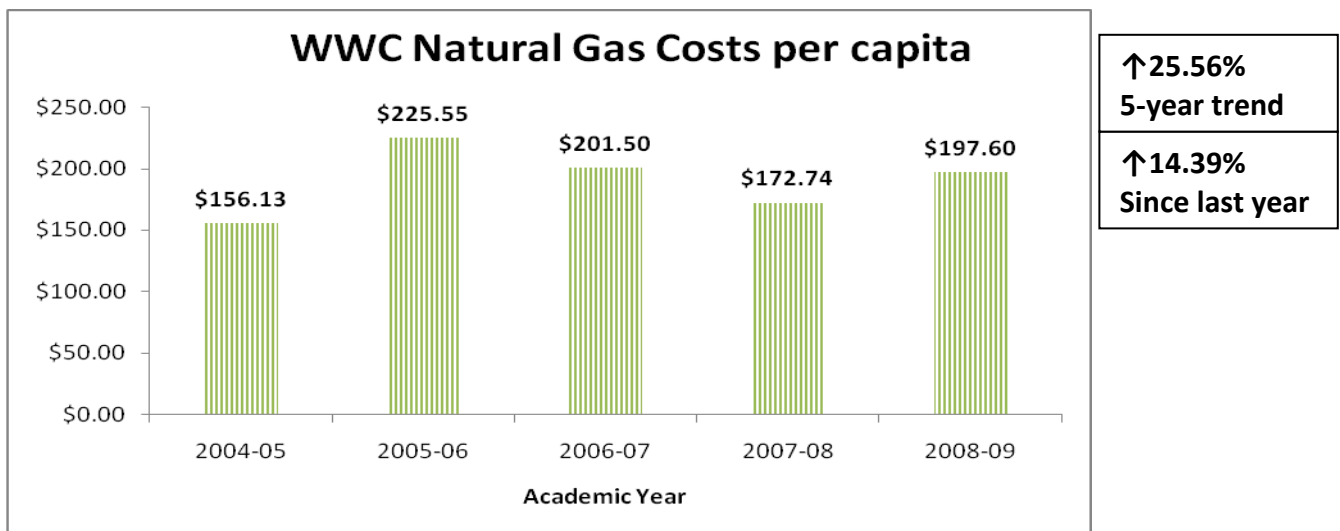
Figure 3.5



From 2004-2005, the total annual cost of natural gas for the college rose by \$69,593, or 45.2%.

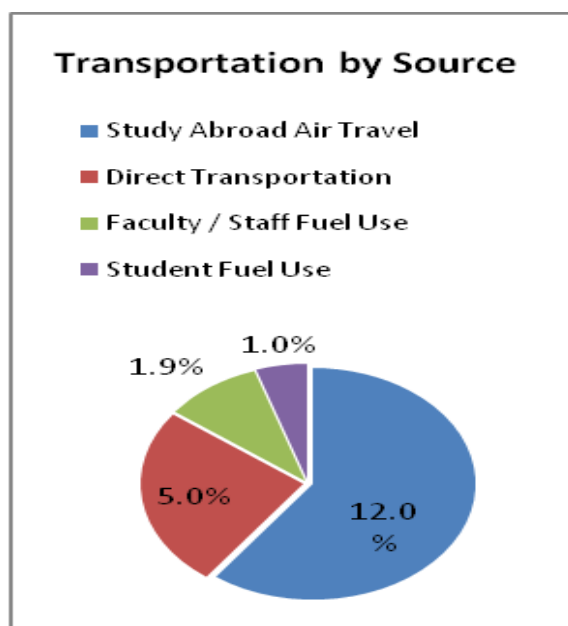
Figure 3.6, below, depicts the five year trend of natural gas costs.

Figure 3.6



C. Transportation

Climate Action Plan Goal: ↓50% of 2007 GHG emissions by 2014



1. International Flights

The college-sponsored study abroad air travel portion of transportation is the third largest greenhouse gas emissions sector, at 12% of the total GHG emissions. The study abroad trips are a crucial component of Warren Wilson College's educational offerings. They provide students with enriching global learning experiences. Dozens of students participate in the study abroad programs each year and some of the program costs are covered by tuition.

For inclusion within the inventory, annual round trip air travel mileage has been multiplied by the number of study abroad passengers to yield a figure for passenger miles. Passenger miles were imported into the Clean Air-Cool Planet Campus Carbon Calculator to determine the total emissions for the college-sponsored study abroad flights.

Each year the college selects different program destinations, which means that round trip mileage varies considerably from year to year. The number of participants also varies, so passenger mileage is affected. Thus, increases or decreases in total GHG emissions among years are not indicative of any particular trend. Table 4.1, below, depicts the total passenger miles per year and the resulting GHG emissions (in pounds).

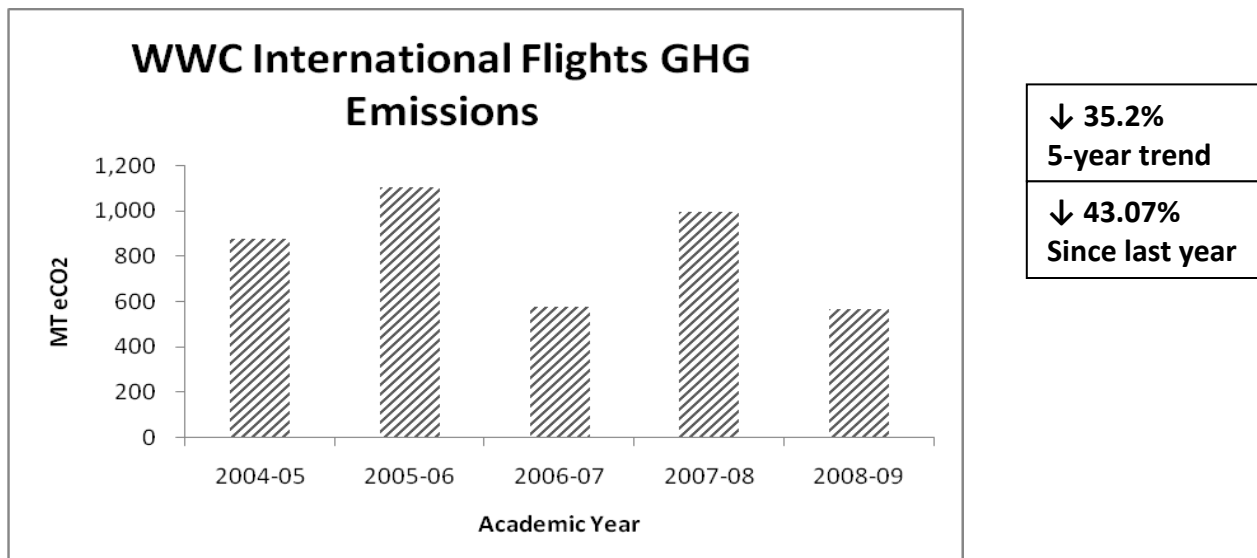
Table 4.1

Warren Wilson College International Flights			
	Passenger Miles	International Flights GHG Emissions (MT eCO ₂)	GHG Emissions per participant (MT eCO ₂)
2004-2005	1,126,931	875	10.2
2005-2006	1,416,440	1,100	12.8
2006-2007	738,668	573	6.7
2007-2008	1,282,706	996	11.6
2008-2009	729,957	567	6.6

From 2004-2005 to 2008-2009, study abroad passenger miles decreased by 35%; so did total GHG Emissions. At least three student participants chose to purchase carbon offsets for their travel; the college always encourages this option.

Figure 4.1, below, depicts the five year trend of study-abroad air travel GHG Emissions.

Figure 4.1



2. Student, Staff, and Faculty Fuel Use (from commuting)

The Warren Wilson College community has chosen to track and include fuel usage from commuting in its annual GHG inventory. Automotive fuel usage by members of the campus population is estimated each year by surveying students, staff, and faculty during the academic year of the relevant inventory. For this inventory, the campus population was surveyed during the Spring semester of 2008-2009, while in previous inventories the survey was issued in the fall semesters.

Table 5.1, below, depicts annual fuel usage by the various sectors of the population, and the resulting GHG emissions.

Table 5.1

2008-2009 WWC Faculty, Staff and Student Commuting				
	Total Gas & Diesel Usage (gallons)	Total Gas & Diesel Usage per capita (gallons)	Commuting GHG Emissions (MT eCO ₂)	Commuting GHG Emissions per capita (MT eCO ₂)
Faculty	2,970	39	27	0.35
Staff	7,288	54	65	0.49
Resident Students	2,022	2	18	0.02
Day Students	3,359	33	30	0.30

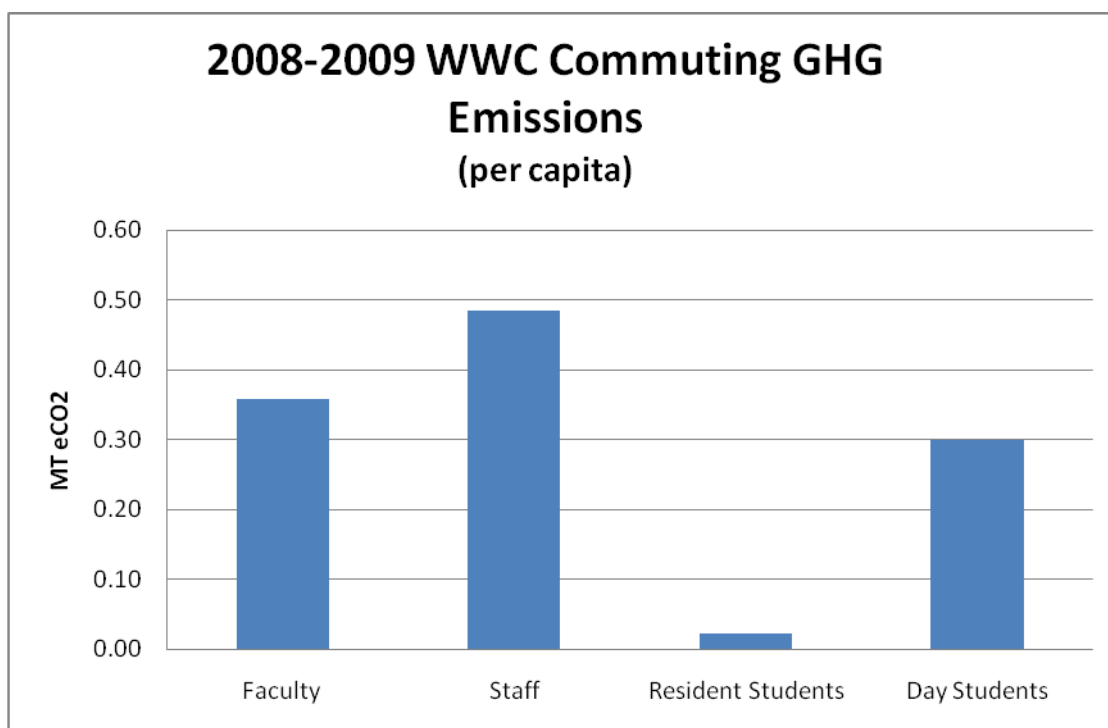
Gas and Diesel consumption per capita is the most accurate representation of the primary users of fuel at the college. The survey revealed that staff members consume the most fuel per capita, at 54 gallons per person. Faculty consumption follows at 39 gallons per capita, while day students consume 33 gallons per capita. Resident students consume much less fuel: only 2 gallons per person for the year. The fuel use for each group reflects the gallons of fuel that are consumed in the

commute to and from Warren Wilson College. About 90% of the college's enrolled students live on campus, and freshman are not permitted to have cars. In addition, the college mandate of 15 hours per week of on-campus work for each student discourages most resident students from obtaining outside employment. Thus, it is not surprising that fuel consumption due to commuting is so low for resident students. However, since about 1/3 of staff and faculty live on campus, it is interesting that the fuel use for these groups outweighs the fuel use of day students.

It is not accurate to construct a five-year trend for student, staff, and faculty fuel use because the total gallons consumed were calculated by the Clean Air–Cool Planet Campus Carbon Calculator for this inventory, but not for previous inventories. Instead, previous inventories relied upon student-created templates, which yielded much higher estimates of fuel use than the Calculator produces. It was hoped that the raw numbers which were used to calculate gallons in previous years could be imported into the Calculator, but this was not an option because previous inventories asked survey questions which are incompatible with the Calculator.

Figure 5.1, below, depicts a comparison of the fuel use by the four sectors of commuters, for the 2008-2009 year.

Figure 5.1



3. Campus Vehicle Fleet Fuel Use

The Campus Vehicle Fleet is composed of all the vehicles Warren Wilson College maintains for use in work crews, service trips, academics, athletics, and the Motorpool (which provides cars to community members for school-related purposes). “Direct Transportation,” when used in this inventory, refers to the Campus Vehicle Fleet in combination with the propane (1019 gallons) used in the landscaping crew’s lawnmowers and the off-road diesel fuel (1203 gallons) purchased by Warren Wilson College in 2008-09. “Direct Transportation” thus represents a sum total of all fuel consumption by on-campus college-owned vehicles. At 5% of the total GHG Emissions, Direct Transportation is the fourth largest emitter at the college.

Table 6.1, below, summarizes fuel use of the Campus Vehicle Fleet over the past five years (excluding propane and off-road diesel use).

Table 6.1

WWC Campus Vehicle Fleet Fuel Summary					
Academic Year	Total Fuel Usage (gallons*)	Total Fuel Usage per capita (gallons)	Costs	Average Cost per gallon fuel**	Fleet Fuel GHG Emissions (MT eCO ₂)
2004-2005	23,041	23.4	\$46,817	\$1.92	209.6
2005-2006	27,831	26.9	\$66,999	\$2.58	241.6
2006-2007	27,550	26.5	\$76,868	\$2.60	238.2
2007-2008	29,857	27.7	\$88,239	\$2.96	264.5
2008-2009	26,613	23.5	\$60,337	\$2.27	235.9

* This is combined gallons gas and diesel fuel.

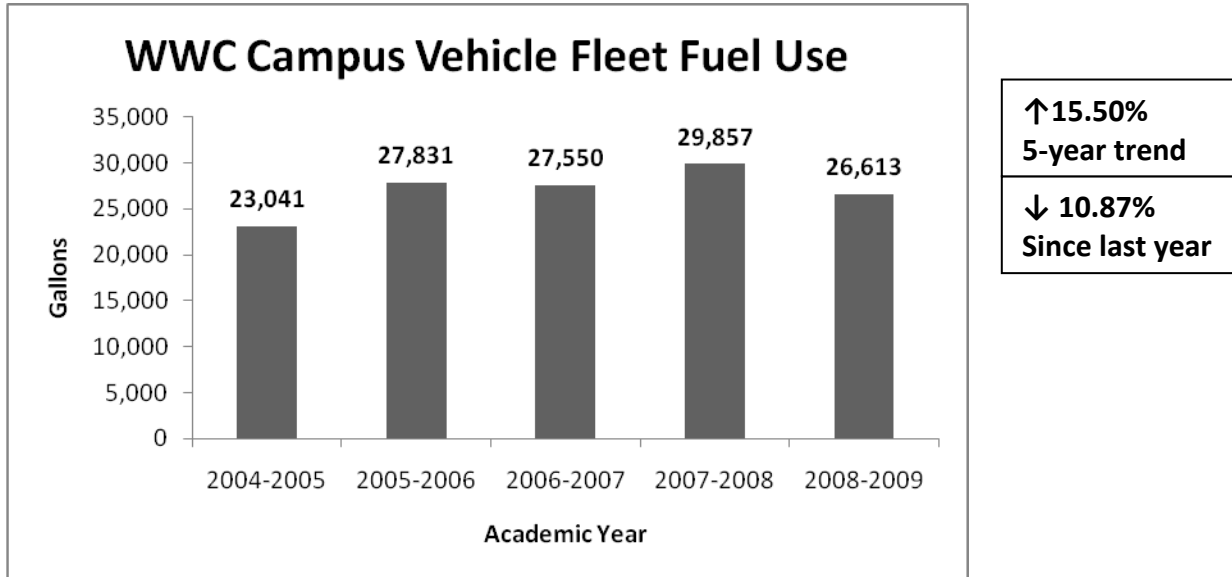
** Before 2007-08, national average fuel prices were used. In 2007-08 and 2008-09, calculations of total cost and average fuel prices were provided by John Verba, Office Manager/Motorpool Supervisor.

***In contrast to previous inventory years, total GHG Emissions were computed by the Clean Air–Cool Planet Campus Carbon Calculator, instead of by self-generated templates (previous years’ data was imported into the Calculator to generate new totals).

According to the recomputed totals, annual fuel usage by the Campus Vehicle Fleet has increased by 3,572 gallons, or 15.5%, since 2004-2005. Subsequent emissions have risen by 12.5%.

Figure 6.1, below, depicts the five year trend of Campus Vehicle Fleet Fuel Use.

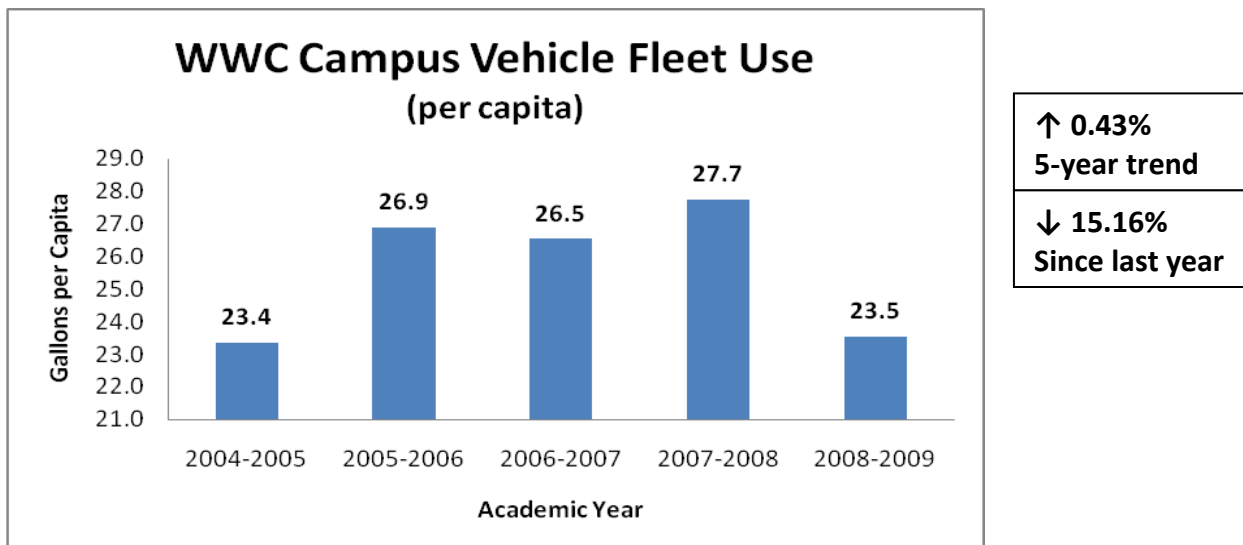
Figure 6.1



The five-year increase in fuel use is significant, given that the average cost per gallon of fuel rose by 18.22% from 2004-05 to 2008-09. The total cost of fuel to the college has risen by 28.88%, or \$13,520, during the five year period. Interestingly, usage dropped when average fuel prices dropped; from 2007-08 to 2008-09, fuel consumption by the campus vehicle fleet dropped by 10.87%, alongside a 23.31% drop in the price per gallon.

Figure 6.2, below, depicts campus vehicle fleet fuel usage on a per capita basis, for the five year trend.

Figure 6.2



The above representation is only partly accurate, as it is flawed by the fact that previous inventory authors have gathered campus vehicle fleet fuel usage in different ways. In 2004-05 and 2005-06, “fuel purchases from the Autoshop were used to extrapolate usage, and only work crews, service-learning trips, and athletic game trips were estimated.”² The author of the 2006-07 inventory instead examined and summed data from the individual gas logs. In 2007-08 and 2008-09, compiled fuel usage was provided directly to the inventory author by the WWC Motor Pool. The different methods of data collection certainly affect the estimates of campus vehicle fleet fuel use and associated emissions. As of last year, “Crew- and department-specific fuel use information is available in quarterly energy reports produced by the Environmental Leadership Center of WWC.”¹

IV. The Remaining Sources

A. Solid Waste

The disposal and burial of solid waste into landfills results in decomposition which releases methane into the atmosphere. Warren Wilson College operates a composting program which serves to reduce methane production from our waste stream, since the process of aerobic composting does not produce methane. In 2006-2007 and 2008-2009, the Buncombe County Landfill conducted partial flaring of the accumulated waste, which acts to reduce total GHG emissions (in prior inventory years, no flaring was done).

Table 7.1, below, depicts Warren Wilson’s waste stream for the past five years.

Table 7.1

WWC Solid Waste GHG Emissions Summary						
	Material	2004-05 (short tons)	2005-06 (short tons)	2006-07 (short tons)	2007-08 (short tons)	2008-09 (short tons)
to landfill:	Trash	326.4	279.5	255.2	257.4	259.1
diverted from landfill:	Recycling	137.1	134.9	163.6	181.2	142.8
	Reusables	3.0	2.1	3.0	4.9	3.4
	Compost	0.0	32.5	21.3	31.7	24.9
	TOTAL	466.5	449.0	443.0	475.1	430.2

Landfilled solid waste produces the most methane of all sources at Warren Wilson College. When it is weighted in terms of its global warming potential, in carbon dioxide equivalents, the methane produced by decomposing solid waste accounts for 1% of the college's total GHG Emissions. Due to a reconstruction of the program, no composting occurred in 2004-05, but it has occurred in all following years.

If the college did not participate in composting, its waste-related GHG emissions still would have decreased by 20.6% from 2004-05 to 2008-09. However, thanks to composting, actual solid waste GHG emissions have been reduced by 31.0% during this period.

Figure 7.1, below, depicts the comparison of what our GHG emissions would have been without composting to what they actually were, in a five year trend.

Figure 7.1

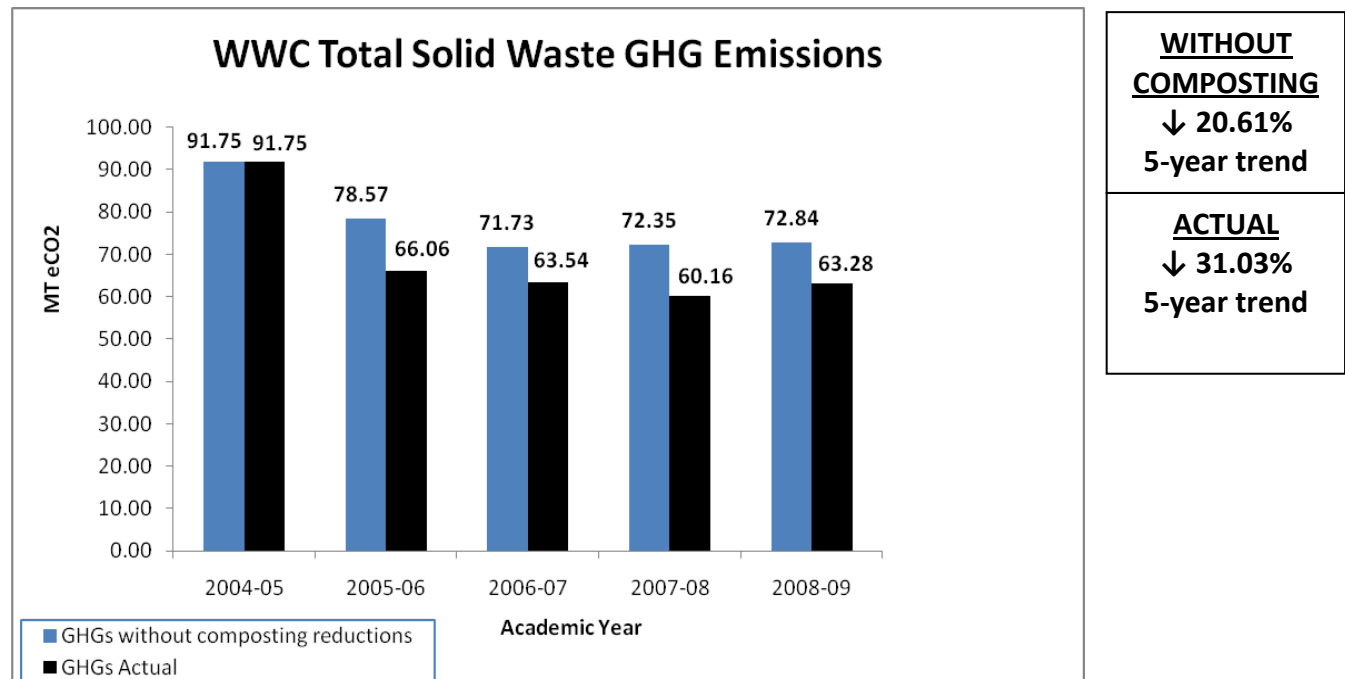
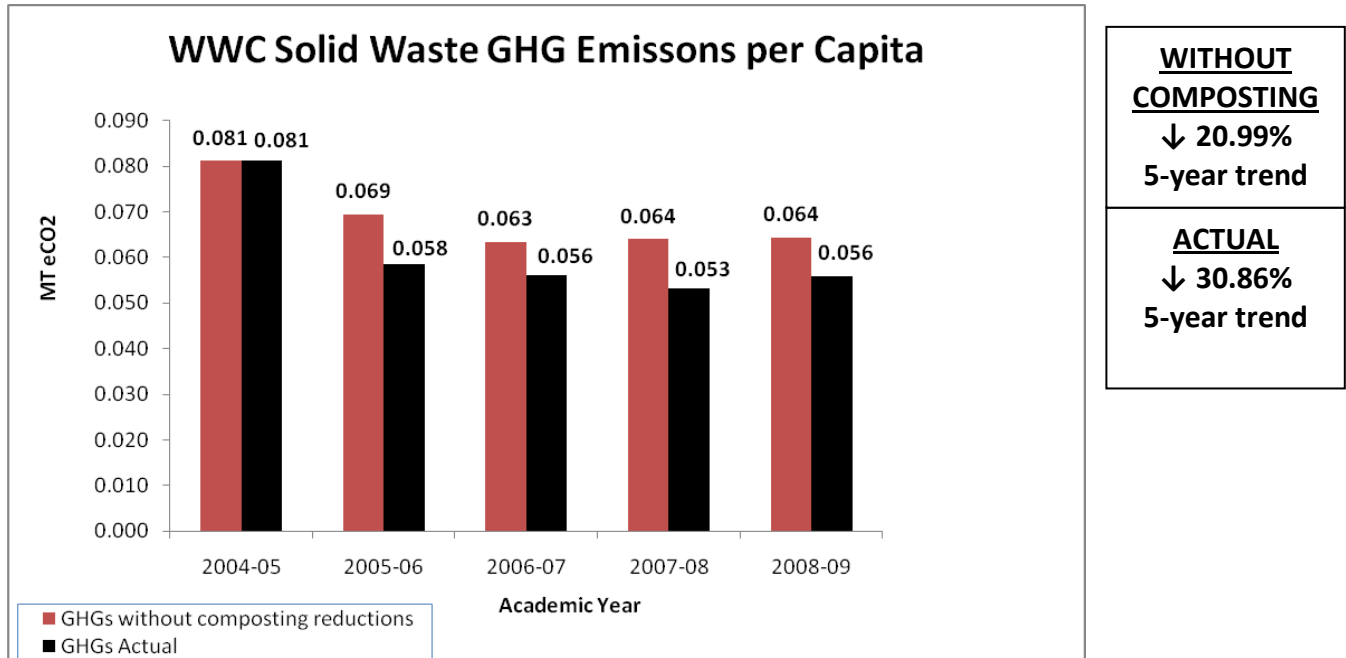


Figure 7.2, below, depicts the same comparison, but in GHG emissions per capita.

Figure 7.2

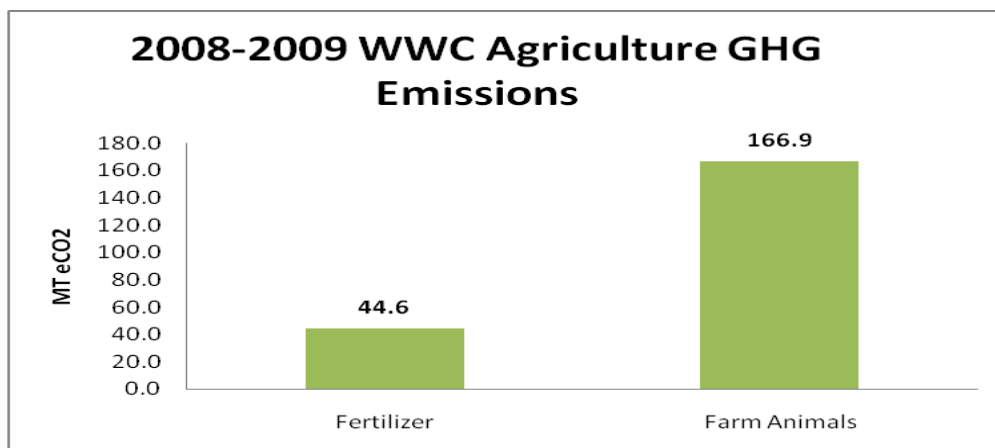


B. Agriculture

Warren Wilson College operates a farm, which produces agricultural emissions of methane (from animals and their waste) and nitrous oxide (from fertilizers). Methane and nitrous oxide are greenhouse gases with higher global warming potential than carbon dioxide. The Clean Air–Cool Planet Campus Carbon Calculator allowed input of amounts of fertilizer (both organic and synthetic) used and also numbers of animals (horses, pigs, cattle, chickens, and goats) maintained on the farm. Previous inventories (before 2007-08) did not differentiate between organic fertilizer and synthetic fertilizer.

The resulting 2008-09 agricultural GHG emissions, as computed by the Calculator, are depicted in Figure 8.1, below.

Figure 8.1

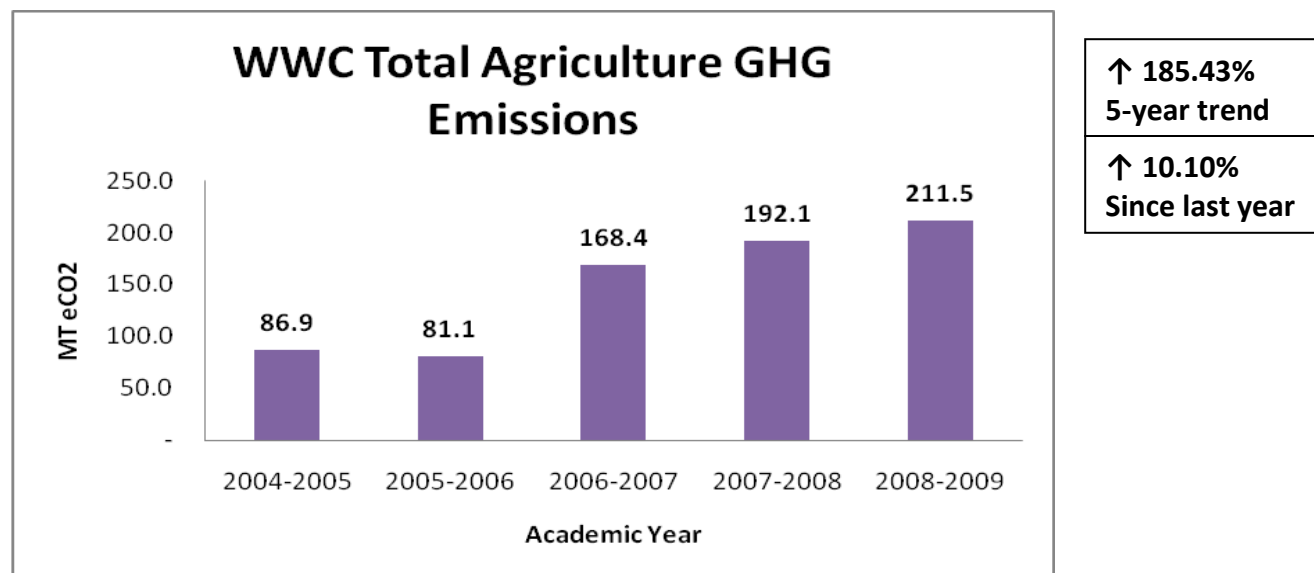


Note: Emissions from vehicles associated with agriculture have been included within the Direct Transportation category.

In 2008-2009, the nitrous oxide released from fertilizer application accounted for 0.94% of the college's total GHG Emissions, while the methane produced by livestock accounted for 3.52% of the total. From 2004-05 to 2008-09, methane production increased by 118%, while nitrous oxide production increased by 263%, due to an augmentation in fertilizer application and numbers of animals. Total GHG Emissions increased by 185%, or 124.6 MT.

Figure 8.2, below, depicts the five year trend of GHG Emissions from agriculture.

Figure 8.2



C. Miscellaneous

The Miscellaneous sector, as referred to in this inventory, consists of GHG emissions from 1) the used motor oil burned (in previous years) at the Autoshop; 2) escaped refrigerants; 3) paper consumption; and 4) coke used by the blacksmithing crew. Before the 2007-08 inventory, propane was also included in Miscellaneous; it is now categorized under “Direct Transportation.” The 2007-08 and 2008-09 inventories are the only ones which have tabulated paper consumption and lost refrigerants, because the Clean Air–Cool Planet Campus Carbon Calculator specifically asks for these values. However, for the purpose of accurate comparison, an attempt was made to collect previous years’ values for used motor oil, lost refrigerants, and blacksmithing coke; these, when available, were imported into the Calculator. Unfortunately there was no way to compute paper consumption for the previous years, since it is not tracked by the college.

In 2008-09, the Autoshop ceased burning used motor oil, but it was left in the category of Miscellaneous for comparison purposes with last year.

Table 9.1, below, depicts the total use and resulting GHG Emissions for Miscellaneous sources in 2008-09.

Table 9.1

2008-2009 WWC Miscellaneous GHG Emissions		
Source	Total Use	Total GHG Emissions (MT eCO₂)
Used Motor Oil (Furnace)	0 gal.	0 MT
Paper Purchasing	22,000 lbs.	22.6 MT
Coke (Blacksmith)	2.5 short tons	4.8 MT
Refrigerants (escaped/lost)	188 lbs.	144.4 MT

These sources comprise 4% of the college's total GHG Emissions. Since previous inventories tracked different items as part of the "Miscellaneous" category, it would not be accurate to sum the miscellaneous category for a five-year trend comparison. However, since the individual values are mostly available, comparisons are possible. Since 2005-06 (the first year for which all values, except paper, are known), 1) used motor oil consumption has decreased by 2,000 gallons (100%); 2) coke usage has increased by 1 short ton (67%); 3) refrigerants lost have decreased by 46 pounds (20%).

1. Future Initiative: Food Policy & GHG Emissions

Warren Wilson College also produces emissions through the food consumed in the campus dining locations. Gladfelter Cafeteria and Cowpie Café are contracted with Sodexo, Inc., but they also serve some food from the college's farm and garden. In addition, the farm and garden host garden markets and meat sales, supplying food directly to the college community. There has never been a study on emissions quantities from food consumption, but the college had always aimed to make this a sustainable sector. It is "currently working through its Sustainable Foods Policy Task Force to design and implement a local foods policy to guide purchases through Sodexo and develop a formula to prioritize purchase of foods with fewer miles traveled,"¹ thereby reducing GHG emissions.

V. Conclusion

Compiling an annual Greenhouse Gas Emissions Inventory enables Warren Wilson College to critically assess its environmental impact both in the present and over time. Table 10.1, below, depicts the five year sum changes in GHG Emissions for the various sectors discussed in this inventory.

Table 10.1

WWC Percent Change in GHG emissions from 2004-05 to 2008-09			
<i>Sector</i>	<i>Per Capita</i>	<i>Per Square Foot</i>	<i>Total</i>
Overall Total	↓ 9.69%	↑ 5.23%	↑ 3.53%
Electricity*	↓ 13.68	↓ 6.32%	↓ 0.81%
Natural Gas	↓ 8.01%	↓ 0.64%	↑ 5.51%
Transportation**	n/a	n/a	↓ 33.45%
Study Abroad International Flights	↓ 43.51%	n/a	n/a
Staff / Faculty Commuting**	↓ 55.16%	n/a	n/a
Student Commuting**	↓ 50.56%	n/a	n/a
Campus Vehicle Fleet	↓ 1.88%	n/a	n/a
Solid Waste (landfill only)	↓ 30.80%	n/a	↓ 20.62
Solid Waste (total)	↓ 30.86%	n/a	↓ 31.03%
Miscellaneous***	↓ 33.88%	n/a	↓ 27.75%

*This is not including RECs.

** This is for a two year trend; 2007-08 to 2008-09, because these two years are the only ones for which raw commuting data was available for input in the Clean Air—Cool Planet Campus Carbon Calculator for emissions calculations. However, survey questions varied between years, causing some of the percent change.

***This is for a three-year trend; 2005-06 to 2008-2009. Individual values for the items in what is now known as the Miscellaneous category were tallied up for 2005-06 as for 2008-09, for comparison. Paper was not included, since the figure is not known for 2005-06.

The above trends and those cited throughout this inventory are not just summaries of data; they are crucial indicators of Warren Wilson College's progress towards sustainability and carbon neutrality. These are figures that will be relied upon as the college continues to structure policies and decide upon long-term plans. For instance, "the presidentially-appointed Greenhouse Gas

Emissions Reduction Task Force and its Behavior Change Committee will [utilize] this information to help generate institutional goals and campaign plans for energy and emissions reductions as it guides the College toward a more sustainable future.”³ The inventory is thus crucial to the support of the American College and University Presidents Climate Commitment and WWC’s Climate Action Plan. In addition, it is hoped that future inventories will be able to examine more sectors in order to draw a more complete vision of the college’s current impact on the environment.

VI. Areas for Improving the Inventory

In line with the observation of last year’s inventory author, “The most impactful way to improve this inventory would be to improve College record- keeping. More organized, accessible, and formatted data would reduce time investment required and increase accuracy.”¹

Data collection could be improved through the following actions:

- *Sub-meter the buildings which are heated by or receive their natural gas from the Boiler Room. Doing so would allow WWC to understand the actual energy consumption of each building, rather than relying on informed estimates when making sustainability decisions.*
- *Track miles logged and fuel consumed for business travel by all departments.*
- *Track water usage by building.*
- *Track all building energy efficiency improvements by date and amount invested so as to be able to calculate return on investment if a drop in energy usage occurs.*
- *Track paper purchasing more accurately (currently, this figure is a best estimate).*

VII. Appendix I: In Detail Methods and Data by Source

Electricity

Electricity data was gathered from the Progress Energy website (<http://www.progress-energy.com/>), which provides access to monthly bills for all on-campus electricity meters. The data was tabulated in Microsoft Excel and individual building electricity consumption was computed. The sum annual electricity usage for the college was then input into the Clean Air–Cool Planet Campus Carbon Calculator to generate total GHG emissions from electricity. Costs were also computed.

Natural Gas

Natural gas data was collected from the PSNC website, located at <http://www.psnenergy.com>. The data was tabulated in Microsoft Excel and individual building natural gas consumption was computed. The sum annual usage for the college was then input into the Clean Air–Cool Planet Campus Carbon Calculator to generate total GHG emissions from natural gas. Costs were also computed.

International Travel

The college International Programs office supplied itineraries and total passengers for each of the college-sponsored study abroad trips that occurred in this year. The distance traveled from location to location on the itineraries was then calculated by using the Geobytes City Distance Tool.² The total mileage was multiplied by the number of WWC student passengers to get passenger miles, the sum of which was entered into the Campus Carbon Calculator for GHG emissions calculations.

Staff, Faculty, and Student Commuting

Fuel Use surveys were issued to the WWC community in the Spring semester of 2008-2009. The raw numbers generated from the responses were tabulated and entered into the Campus Carbon Calculator for GHG emissions calculations.

Campus Vehicle Fleet

Methods were as stated in the 2007-2008 Greenhouse Gas Emissions Inventory:

“This inventory included all gasoline and diesel purchased for use in campus fleet vehicles. Record keeping was inadequate to calculate the total exact miles driven, and no records exist for gasoline purchases made on long-distance trips - such as those often made by sectors like athletics and service-learning; also, the Autoshop loans vehicles to departments on campus, and the amount of miles traveled for those vehicle is logged in separate data sheets. However, the sum of all vehicle fuel sold through the campus pumps is available since it is recorded by accounting, and this was entered into the Campus Carbon Calculator.

The information that was available on fuel usage and corresponding cost were provided in Excel spreadsheets by the Office Manager / Motor Pool Supervisor. While the Calculator only calls for the combined total gallons of vehicle fuel (gasoline and diesel) consumed, the College does have more specific data on the breakdown by crew or department on record should this be needed in the future.”¹

Solid Waste

The Recycling and Solid Waste Manager provided a spreadsheet with all current and historical solid waste data tabulated. The historical data was updated for this inventory, as an error in past calculations was discovered. Raw data was input into the Campus Carbon Calculator, which considers composting an “offset with additionality,” meaning that “the methane production avoided by diverting composted material from the landfill is now counted in the total College’s GHG emissions but discounted in its net emissions.”¹

Agriculture

Agricultural data was supplied by the WWC Farm Manager. The data, including the number of farm animals, pounds of synthetics fertilizer, pounds of organic fertilizer, and percent of nitrogen in the fertilizers, was input into the Clean Air—Cool Planet Campus Carbon Calculator to generate total GHG emissions from agriculture.

Miscellaneous Sources

Used Motor Oil

The Autoshop supervisor reported that no used motor oil was burned in the Autoshop for heating this year, as a departure from previous years.

Propane

The Purchasing Department director provided a spreadsheet of the total gallons of propane purchased by the landscaping crew each month for use in the riding lawnmowers. This information was then input in the Clean Air—Cool Planet Campus Carbon Calculator.

Refrigerants

*Refrigerants were first included in the 2007-2008 inventory, and the same methods of collecting the data were used for this year's inventory: "Data on refrigerant usage and loss were provided by the HVAC crew in Excel spreadsheets, and the poundage of escaped (non-recovered) refrigerants from July 200[8] to June 200[9] was entered into the Campus Carbon Calculator."*¹

Paper Purchasing

Paper purchasing was first included in the 2007-2008 inventory, and the same methods of collecting the data were used for this year's inventory: "The College Press Manager was interviewed and gave an estimate for the amount of paper products purchased by the College in the 0[8]-0[9] academic year."

Coke

*The Blacksmithing crew supervisor provided via email the figure for total tons of coke burned this year. As with last year's inventory, "It was assumed that emissions are similar to the burning of conventional coal, and this information was entered into the Calculator as "Coal (Steam Coal)" under the On Campus Stationary category."*¹

VIII. Appendix II: Data

More information about the GHG emissions of Warren Wilson College is available through the ACUPCC Reporting System at <http://acupcc.aashe.org>. For more detailed data regarding specific sources mentioned in this inventory, or for other comments or questions, contact Stan Cross, Environmental Leadership Center Education Director and Campus Greening Crew Supervisor, scross@warren-wilson.edu.

IX. References & Footnotes

Clean Air-Cool Planet Campus Carbon Calculator. Available at <http://www.cleanair-coolplanet.org>

¹ Mark Begley, 2007-2008 WWC Emissions Inventory