

Greenhouse Gas Reduction Plan  
Vassar College  
February 2011

The National Wildlife Federation has estimated that a 2-3% annual reduction in total greenhouse gas (GHG) emissions is enough to curb global warming. Vassar College has decreased GHG emissions by an average of 4% a year since 2004-2005. The College has adopted a goal of reducing GHG emissions by an annual average decrease of 3% of the 2004-2005 emission peak of 30,500 MTCDE (metric tons of carbon dioxide equivalent). This trajectory requires an average annual decrease of 915 MTCDE, and will bring the college GHG emission level to around 14,000 MTCDE by 2020, a 54% reduction from 2005 emission levels. If campus building space remains relatively constant, the GHG emissions per square foot will reduce from 0.097 MTCDE/sq. ft. in 2009 to 0.057 MTCDE/sq. ft. in 2020.

A new science facility will increase the college's total amount of building floor space by as much as 3% (depending on whether other buildings are removed). This may increase energy consumption and GHG emissions, but design and construction of a science facility in accordance with LEED Gold or higher standards will minimize the need for other extraordinary major emission decreases to offset the emissions associated with a new science facility.

Some strategies to decrease GHG emissions are listed below. They are ranked roughly in order of their potential effects on GHG emissions, and the likelihood that they will occur. CCS will work together with the college administration to prioritize these strategies, and to create a multi-year plan for their implementation. Furthermore, the college will evaluate its progress and, if necessary, make adjustments to the plan at the end of fiscal years 2013 and of 2017.

The values for energy consumption and GHG emissions referenced in the strategies below are taken from Table 1, which summarizes the college's GHG emissions for academic year 2008-09.

1. Continue to use natural gas as the primary fuel in the Central Heating Plant.

Natural gas emits three-quarters as much CO<sub>2</sub> per Btu as oil (0.06 MTCDE/mmbtu for natural gas vs 0.08 MTCDE/mmbtu for oil). Fuel burned in the Central Heating Plant accounts for 98% of our Scope 1 emissions, and nearly 48% of our total college emissions (Fig. 1). Costs per mmbtu for natural gas (\$14.40/mmbtu) are less than for heating oil (average \$15.73/mmbtu for the mix of #2 and residual oil used in 2009; both values from Vassar EMR June, 2009) so this action will save money as well as GHG emissions.

2. Improve heating/cooling efficiency

The college should continue to prioritize building envelope renovations and other infrastructure improvements that increase energy efficiency, such as steam line repair and replacement. It is hard to put exact numbers on the emission reductions associated with these actions because we do not monitor buildings individually for steam consumption, but experience shows that such improvements reduce fuel use,

which saves money and reduces greenhouse gas emissions. Buildings and Grounds Services intends to monitor the differences in steam flow between a building with a complete envelope renovation (Davison House) and an un-renovated, but very similar building (Lathrop House) so that an estimate could be made of the impact of envelope renovations on GHG reductions.

### 3. Install lighting controls and fixture/bulb retrofits

According to a Central Hudson consultant, we have the potential to save one million kWh in electricity using occupancy sensors and more efficient light fixtures and bulbs for selected indoor lighting applications, equivalent to 300 MTCDE. This represents 5% of our annual electrical use and 1.2% of our total GHG emissions (Figure 1). It is also about 30% of our target average annual decrease. A new program from Central Hudson pays for 70% of the work, and finances the remaining 30% at zero interest for two years. This is a one-time contribution to GHG emission reductions, and similar projects would need to be completed each year to achieve similar GHG reductions, however similar reductions are possible from other potential projects. For instance, comparable savings are possible with outdoor lighting as well, so although Central Hudson is not in a position to finance outdoor work yet, this may be an option in the future.

### 4. Purchase carbon credits for student and faculty travel

JYA air travel (nearly 3 million miles) accounts for 45% of our Scope 3 emissions or about 10% of our total GHG emissions (Figure 1). Faculty and Staff travel (about 1.5 million miles) accounts for 24% of our Scope 3 emissions or about 5% of our total emissions (Figure 1). Since we do not want to restrict this travel because of the very important pedagogical and professional benefits, our only option for reducing greenhouse gas emissions related to travel is to generate carbon offsets in other ways, either through carbon reducing projects, or through purchasing carbon offsets.

Purchasing offsets is a major annual financial commitment (see below), but the cost could be widely distributed, and the GHG reductions would be significant. Offsetting all college air travel would accomplish nearly 4 years of our target annual average GHG emission decrease (of 915 MTCDE per year), and would communicate our commitment to GHG reduction in a very public way.

The price of carbon credits varies widely as do methods of calculating their effects. EPA estimates of carbon emissions show little difference between different kinds of long-distance transportation:

long haul flight: 0.18 kg CO<sub>2</sub>/passenger mile = 0.18 MTCDE/1000 miles

long haul train: 0.19 kg CO<sub>2</sub>/passenger mile = 0.19 MTCDE/1000 miles

long haul bus: 0.18 kg CO<sub>2</sub>/passenger mile = 0.18 MTCDE/1000 miles

However, the effects of carbon released into the stratosphere are believed to be much greater per unit than those of carbon released at ground level because of the phenomenon of radiative forcing. The following table is taken (for convenience) from a carbon calculator on the JetBlue website. That it is used here is not an endorsement of JetBlue's program. The carbon calculator is simply a quick and easy way to determine carbon offsets based on mileage traveled, and to compare the effects of radiative forcing

(here assumed to contribute by a factor a 2.7). Actual college policy will need to be formulated on more rigorous testing of greenhouse gas emission calculations and carbon credit purchasing.

Carbon Offset Options (an example from JetBlue website)  
 (round trip flight from JFK. Radiative forcing factor = 2.7)

destination	number of miles	cost of offset	w/radiative forcing
Los Angeles	4968	\$8.94	\$24.14
London (Heathrow)	6,924	\$12.46	\$33.65
Moscow	9,352	\$16.83	\$45.45
Buenos Aires	10,636	\$19.14	\$51.69
Tokyo	13,594	\$24.47	\$66.07
Pretoria	15,998	\$28.80	\$77.75
Melbourne	20,866	\$37.56	\$101.43

To offset all 3,000,000 miles for JYA and study travel (annual expense)  
 \$5439  
 \$14,700 w/radiative forcing

To offset all 1,500,000 miles of faculty and staff professional travel (annual expense)  
 \$2700  
 \$7350 w/radiative forcing

Options for raising funds to offset student travel include taking it out of the tuition money the college charges a student while on JYA, or instituting a fee associated with JYA and other travel programs based on the number of miles traveled. For faculty and staff travel, the money could be covered by individual travel expense budgets. In any case, the "carbon costs" of travel will need to be budgeted for, and we should begin discussing our options and their ramifications.

This may be a strategy that, while critical to controlling our GHG emissions footprint, should be debated and implemented over several years. There are agencies that investigate and rate carbon credit vendors, and there may also be Vassar community members who could help us identify appropriate carbon credits to purchase.

5. Increase on-campus generation of energy

The college already produces energy on-campus using cogeneration, photovoltaic cells, and ground-source geothermal heating and cooling systems. Wherever appropriate the college should increase the capacity of these systems. Solar thermal (hot water) systems are a viable option in our region, and as a more "low-tech" alternative than the other three, solar water heating could make contributions to decreasing Scope 1 emissions. It is estimated that converting faculty apartments at the Watsons to solar thermal hot water systems would cost about between \$10,000 and \$12,000 per unit and would save approximately 6 MTCDE per unit per year. A conversion of the entire complex would result in a one-time savings of 108 MTCDE,

about 12% of our target average annual decrease. NYSERDA estimates that 30% of New York's power needs could be generated with wind power, and although the Hudson Valley is not considered to be conducive to major wind projects at this time, it is worth investigating the possibility of generating power with wind as an alternative.

#### 6. Encourage energy conservation

Since > ¾ of our GHG emissions are for heat, air conditioning, and electricity (Figure 1), significant savings could also be realized through changes in behavior. Cutting heating by 10% saves > 1 year's worth of GHG reduction. Cutting electricity by 10% saves 2/3 of the 1-year goal. Much of this can be done through actions highlighted in points 1 and 2 above, but the entire college community can participate in activities such as turning off lights and electronic equipment when not in use and turning up air conditioning thermostats.

Another way to encourage energy conservation is to increase the amount of alternative transportation used by community members. Estimates of commuting miles for faculty and staff are close to 3.5 million miles per year. GHG emissions from automobile commuting represent 27% of our Scope 3 emissions, and 6% of our total (Figure 1). The College Committee on Sustainability could develop strategies to encourage carpooling, car sharing, ride sharing, and bus riding. The Vassar shuttle has proven effective in providing transportation for community members during its 4-hours of daily operation. A consistent arrangement with the local municipal transit would increase ridership. Other alternative methods of transportation, especially bicycling, could be encouraged with infrastructural improvements. Since many of these activities also represent changes in behavior, this is a strategy for which behavior-modification programs could be effective.

#### 7. Increase fuel efficiency of college vehicle fleet

GHG emissions from the fleet are a small percentage of the total (about 200 MTCDE or 1%) but represent an opportunity for continuous GHG emission savings, and financial savings, at a slow but steady rate. Where appropriate, the college should continue to downsize gasoline-powered vehicles and equipment used by B&G and other departments. At the same time, the college should increase the number of electric and diesel vehicles in the fleet. Diesel fuel is more efficient than gasoline in terms of GHG emissions (by about 13%: 101 gal diesel/MTCDE vs. 88 gal gasoline/MTCDE), and diesel vehicles typically have better fuel economy. Some diesel vehicles can also run on biodiesel if appropriate. Switching to diesel vehicles should result in significant cost savings as well: Although diesel is 8% more expensive than gas at this time (diesel = \$3.36/gallon; gasoline = \$3.09/gallon (USEnergy Information Agency East Coast average)), diesel vehicles get approximately 25% better gas mileage (fueleconomy.gov), and the vehicles are not necessarily more expensive (the 2011 Volkswagen Jetta sells for around \$24,000 for a gasoline model that gets 25mpg, and \$25,500 for a diesel model that gets 34mpg). Hybrid vehicles can more than double the gas mileage of conventional cars, and could be used as Security vehicles and as part of the college's motor pool. Although their impact is apparently small, every little bit helps, and hybrid vehicles would be a very visible signal of the college's commitment to GHG reduction.

How quickly the fleet can change is dependent on the replacement rate of vehicles, and the cumulative effect over the decade of this plan would be significant.

8. Purchase green power

Paying a surcharge for green electrical power is a real offset because the money is used to directly support the development of alternative sources for the electricity that feeds the power grid that we use. As an example of the premiums paid, a local company (Community Energy) offers two options for purchasing green power: all wind (+\$0.025/kWh), or 60% windpower/40% small hydropower (+\$0.016/kWh). Purchasing 10% of our power from green sources would cost between \$32,000 and \$50,000 and would decrease GHG emissions by 670 MTCDE, which is over two-thirds of our target average annual decrease. This would be an annual expense.

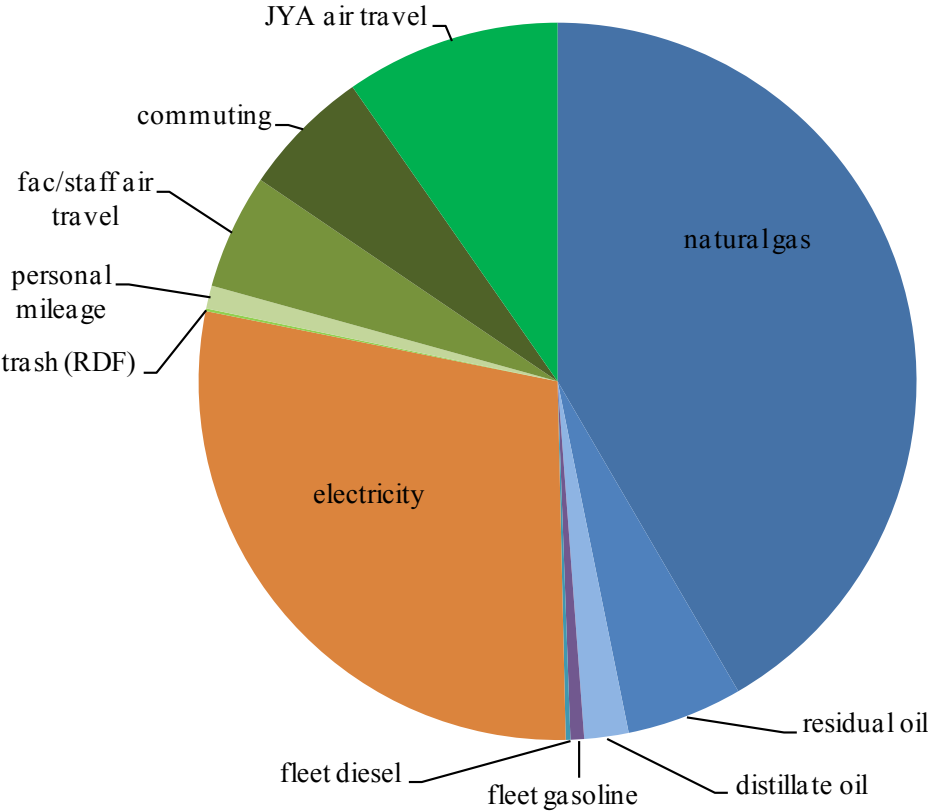


Figure 1. Proportion of GHG contributions (FY 2008-09; see table 1). Blue = scope 1 factors; orange = scope 2; green = scope 3.

Table 1. GHG inventory for 2008-2009, with conversions to metric tons of carbon dioxide equivalent (MTCDE).

<u>Item</u>	<u>Amount</u>	<u>Units</u>	<u>Tons CO2 (MTCDE)</u>	<u>Percentage of total CO2 equivalent</u>	<u>Conversion factor</u>	<u>Units</u>
<b>Scope 1</b>						
natural gas	123,740	mmbtu	9,801	42	13	mmbtu/MTCDE
residual oil	709,006	gallon	1,230	5	576	gal/MTCDE
distillate oil	10,853	gallon	470	2	23	gal/MTCDE
fleet gasoline	12,529	gallon	144	1	88	gal/MTCDE
fleet diesel	5,038	gallon	50	0	101	gal/MTCDE
<i>Total Scope 1</i>			<i>11,695</i>	<i>50%</i>		
<b>Scope 2</b>						
electricity	20,539,830	kWh	6,715	28	3,326	kWh/MTCDE
<i>Total Scope 2</i>			<i>6,715</i>	<i>28%</i>		
<b>Scope 3</b>						
JYA air travel	2,947,346	Miles	2,280	10	1,293	miles/MTCDE
commuting	3,488,640	Miles	1,374	6	2,539	miles/MTCDE
fac/staff air travel	1,580,713	Miles	1,223	5	1,292	miles/MTCDE
personal mileage	624,391	Miles	245	1	2,549	miles/MTCDE
trash (RDF) *	778	Sht. tons	-28	0	28	tons/MTCDE
compost	58	Sht. tons	negligible			
<i>Total Scope 3</i>			<i>5,094</i>	<i>22%</i>		
Total GHG emissions			23,504			
Campus building space (sq. ft)			2,444,810			
GHG emission intensity (MTCDE/sq.ft.)			0.097			

\* Refuse Derived Fuel