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# Virginia Institute of Marine Science 2011 Greenhouse Gas Inventory Report

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## I. Introduction

During the spring of 2011, members of the VIMS Green Team, with support from the College of William and Mary's Committee on Sustainability, collected data on resource use at the VIMS Gloucester Point campus in order to monitor our greenhouse gas emissions and develop methods for reducing our carbon footprint in the future. We processed these data using the Campus Carbon Calculator, a tool developed by Clean Air Cool Planet, a non-profit organization. This program, used by over 1,200 colleges and universities, calculates the total greenhouse gas emissions of a campus using emissions factors developed by the Intergovernmental Panel on Climate Change.

The areas of resource use we investigated are divided by the Campus Carbon Calculator into three categories or "scopes" based on the degree of control exercised by the institution. Scope 1 emissions are directly controlled and owned by the institution, and include on-campus stationary fuel use (propane), fuel use in fleet vehicles and vessels, chemicals used in refrigeration and air conditioning, and fertilizer use. Scope 2 emissions, such as electricity, are not operated by the institution but result from energy consumed on campus. Scope 3 emissions are other carbon sources that are off-campus, but financed or encouraged by the institution in some way. These include fuel used in commuting, off-campus travel financed by the institution, solid waste disposal, wastewater treatment, and paper production. Institutional data is also used by the Calculator to allow comparison to other colleges and universities.

The Calculator accepts the total amount of each resource consumed per fiscal year, and converts this into the amount of greenhouse gasses emitted, including not only carbon dioxide, but also nitrous oxide and methane, which have higher warming potential. The results in this report are expressed as CO2 equivalents (eCO2) which converts nitrous oxide and methane to the metric tons of CO2 that would have the equivalent warming potential. This value indicates the total warming effect of the use of each resource by all three greenhouse gases combined.

## II. Data and Results

### Overall Greenhouse Gas Emissions

Figure 1 and Table 1 show the breakdown of greenhouse gas emissions at the VIMS Gloucester Point campus in fiscal year 2010. Fertilizer, solid waste, and paper use were negligible in terms of their contribution to emissions.

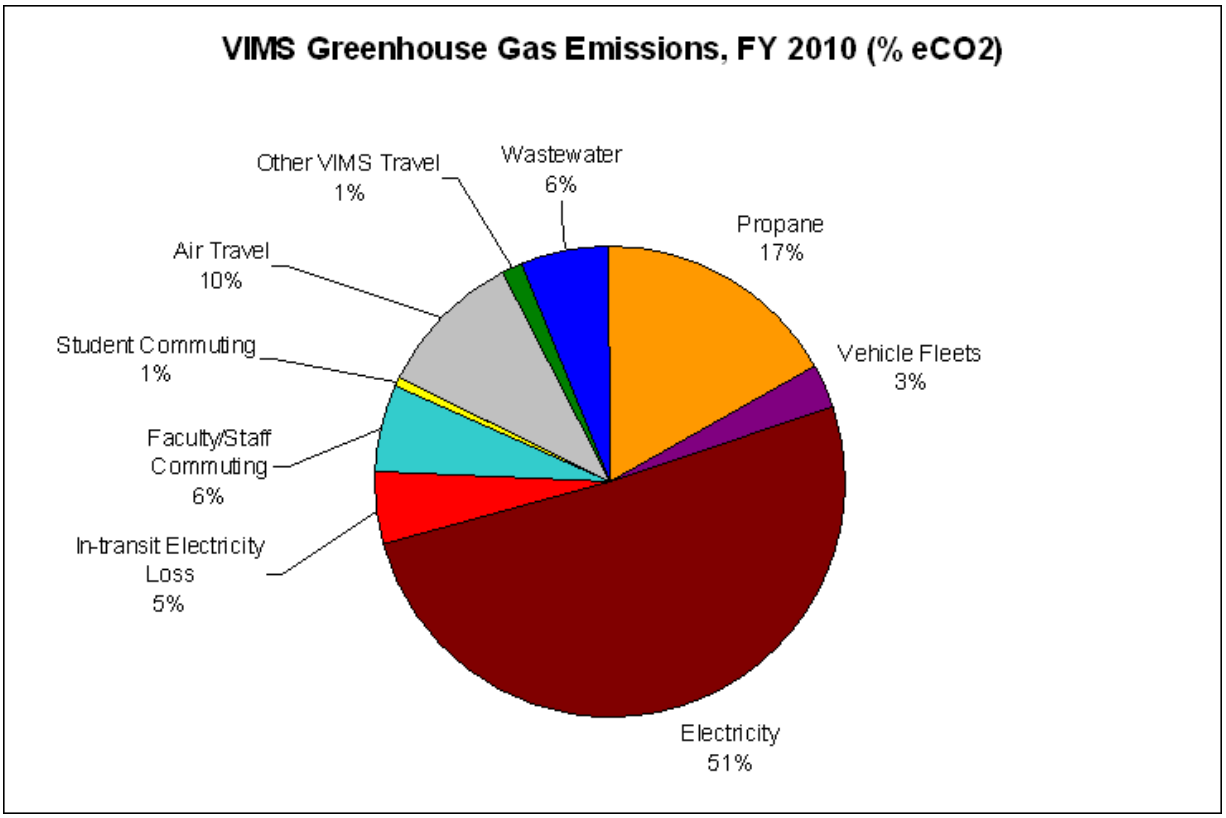


**Figure 1.** Total greenhouse gas emissions from VIMS Gloucester Point campus in fiscal year 2010. These include carbon dioxide, nitrous oxide, and methane and are expressed in percent carbon dioxide equivalents (eCO2).

**Table 1.** Emissions of specific greenhouse gasses from each source in 2010, and the metric tons of carbon dioxide equivalents.

| Emission | Carbon Dioxide (kg) | Nitrous Oxide (kg) | Methane (kg) | eCO2 (Metric Tonnes) |
|---|---|---|---|---|
| Electricity | 7,223,621.9 | 122.2 | 87.2 | **7,262.2** |
| Propane | 2,419,133.6 | 24.4 | 407.2 | **2,436.6** |
| Air Travel | 1,478,687.6 | 16.7 | 14.6 | **1,484.0** |
| Wastewater | 0 | 158.6 | 32,688.3 | **864.5** |
| Faculty/Staff Commuting | 829,097.5 | 57.1 | 165.8 | **850.3** |
| In-transit Electricity Loss | 714,424.1 | 12.1 | 8.6 | **718.2** |
| Vehicle Fleets | 443,397.1 | 23.9 | 66.7 | **452.2** |
| Other Travel | 203,840.9 | 14.0 | 40.5 | **209.0** |
| Student Commuting | 84,461.1 | 5.8 | 16.9 | **86.6** |
| Solid Waste | 0 | 0 | 684.4 | **17.1** |
| Paper | 0 | 0 | 0 | **9.9** |
| Fertilizer | 0 | 0.1 | 0 | **0.0** |

*Scope 1 Emissions:* Directly controlled emissions.

**Propane**

**FY 2010 Usage:** 447,841 gallons
**% of Emissions (eCO2):** 17%
**Source:** Chris Bata (cbata@vims.edu)

Propane use on campus shows a seasonal pattern, peaking in winter for the major buildings (Figure 3), although Andrews used a large amount in the summer of 2008.

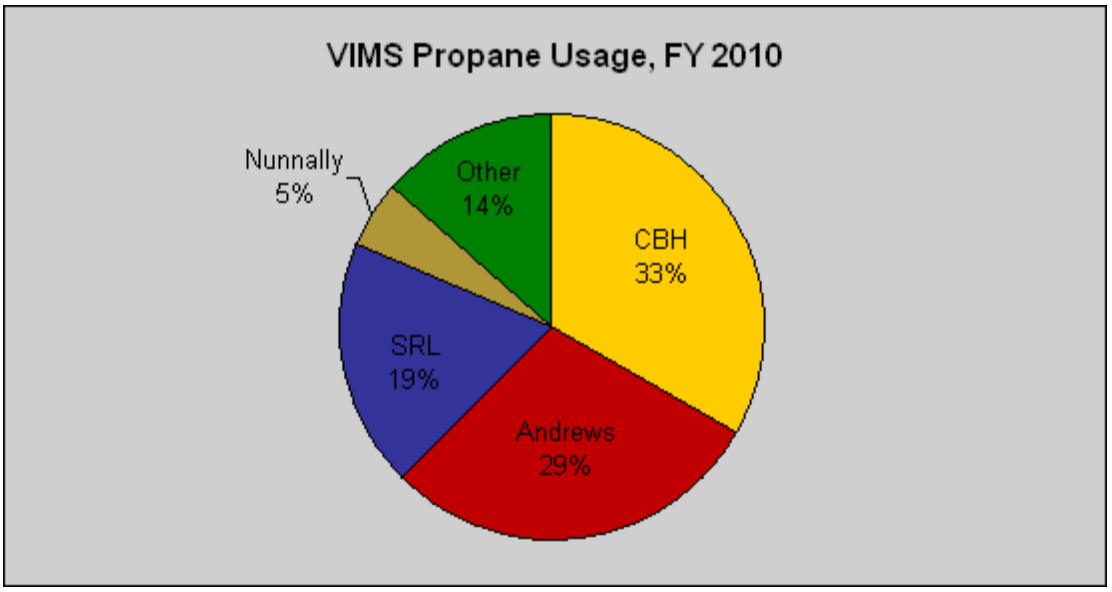


**Figure 2.** Total propane use at the VIMS Gloucester Point campus in fiscal year 2010.

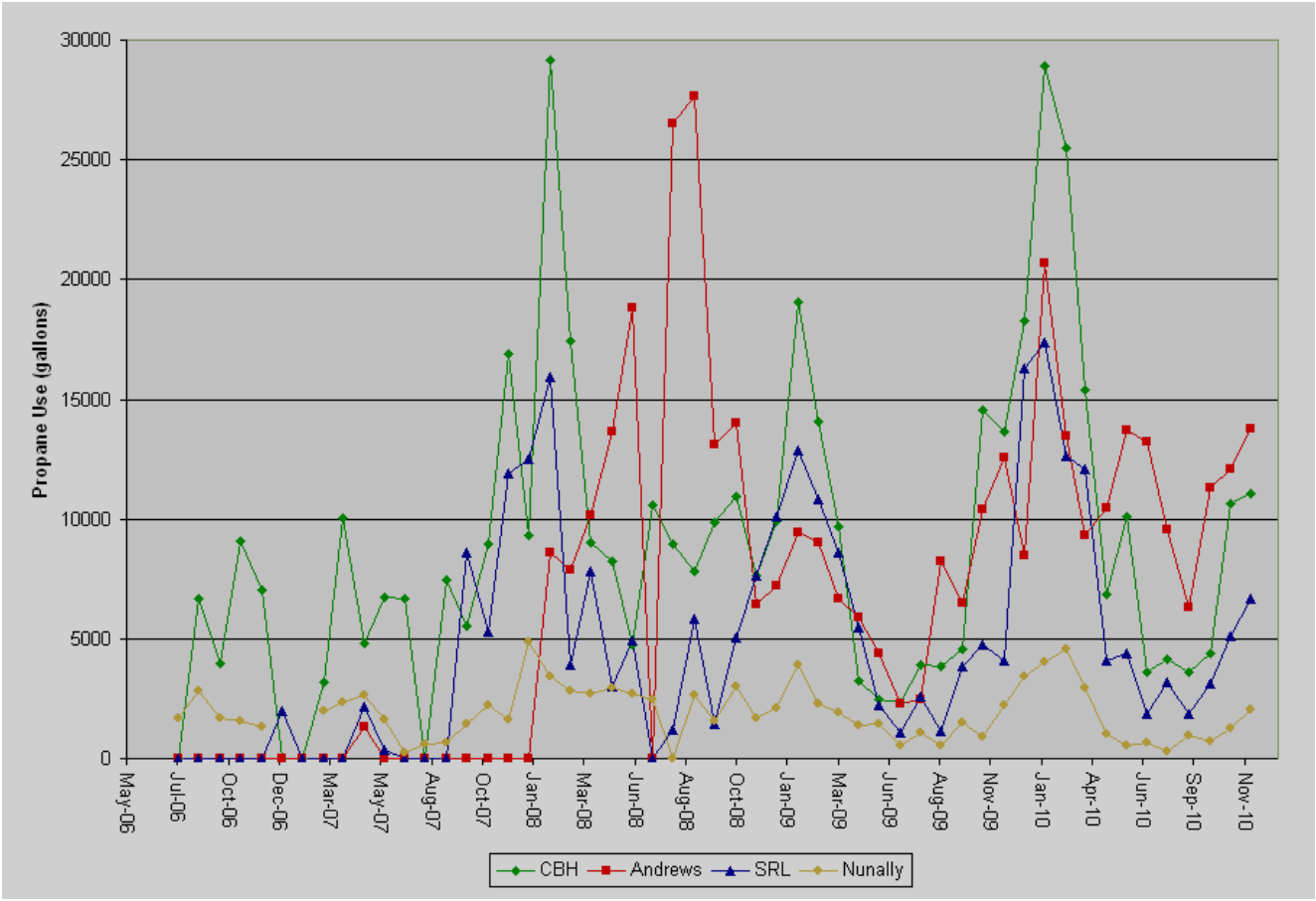


**Figure 3.** Propane usage of the top four buildings from July 2006 to November 2010.

## Vehicle Fleets

**FY 2010 Usage:** 33,330 gallons of gasoline, 15,340 gallons of diesel
**% of GHG Emissions:** 3%
**Source:** Automobile fleet: Chris Bata (cbata@vims.edu)
Boat fleet: Carol Tomlinson (carol@vims.edu)

All VIMS cars and trucks at the Gloucester Point campus are filled from a single gasoline tank on campus. Receipts from the filling of this tank were counted to determine annual usage.

The VIMS automobile and boat fleets use a similar amount of gasoline annually. However, the boat fleet also uses diesel fuel (almost all of the above amount).

Data collection of automobile gasoline use could be streamlined if the date and number of gallons from tank filling receipts were entered into a spreadsheet.

## Refrigerants and Air Conditioning Chemicals

Data on these parameters was not collected, although a refrigerator and freezer inventory is being conducted by Tom Grose.

## Fertilizer

**FY 2010 Usage:** 51 lbs N-10 fertilizer
**% of GHG Emissions:** 0%
**Source:** Kenneth Borkey, Grounds. (804) 684-7067

Fertilizer is not purchased every year, nor is it inventoried every year. Current estimates were calculated from records of fertilizer purchased in 2008, and a quick inventory of current stock. This suggested that since 2008, the VIMS grounds crew has used 130 lbs of N-10, and about 8 lbs of N-28. This totals to be about 51 lbs N-10 per year since 2008.

To streamline the process in the future, each year we should have an inventory of fertilizer to avoid averaging over multiple years. This can be done in concert with the GHG survey.

*Scope 2 Emissions:* Off-campus electricity generation.

## Electricity

**FY 2010 Usage:** 14,032,638 kWh
**% of Emissions (eCO2):** 56% (51% from energy consumed, 5% from energy lost in transmission lines)
**Source:** Chris Bata (cbata@vims.edu)

Electricity use on campus also shows a seasonal pattern in the major buildings (Figure 5), indicating a significant portion is used for cooling in the summer.

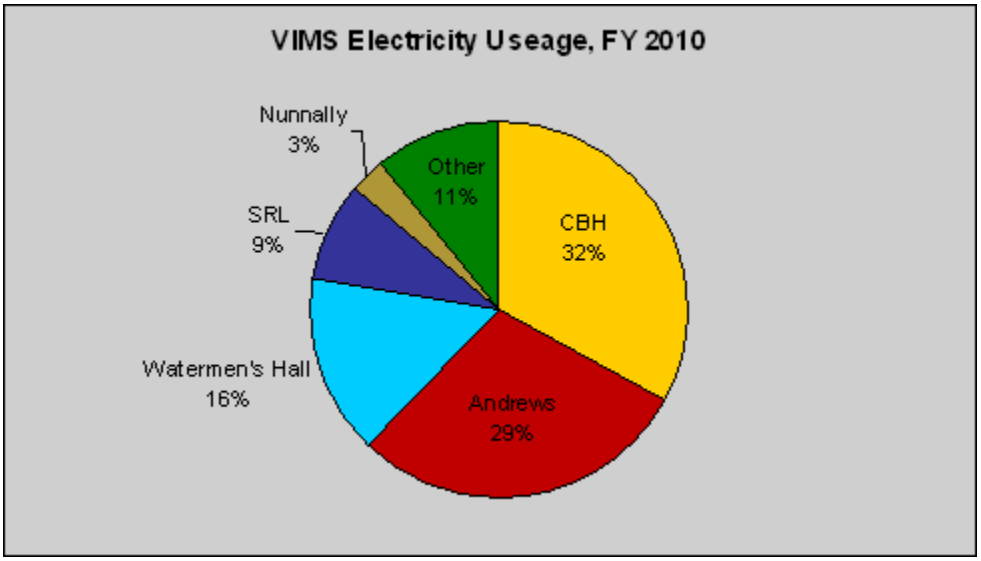


**Figure 4.** Total electricity use at the VIMS Gloucester Point campus in fiscal year 2010. This does not include energy lost in transmission lines en route to campus.

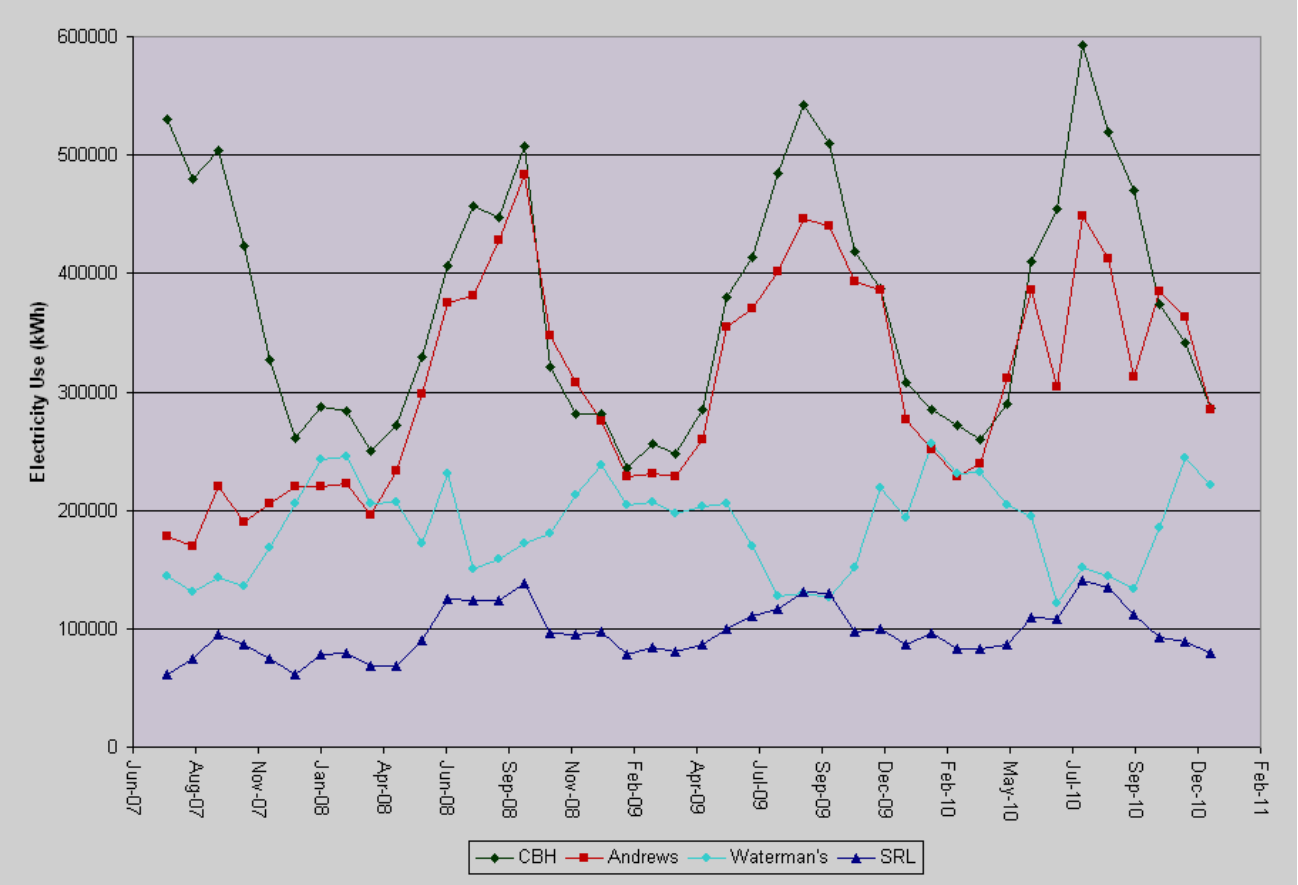


**Figure 5.** Electricity usage of the top four buildings from July 2007 to December 2010.

*Scope 3 Emissions:* Off-campus emissions.

## Commuting

**FY 2010 Usage:** Faculty/Staff: 2,402,257 miles
Students: 295,777 miles
**% of Emissions (eCO2):** 7% (6% faculty, 1% students)
**Source:** Survey of VIMS personnel

60% of students commuted alone in their personal vehicles, while 12% carpooled. The average distance a student commutes one way was 8 miles, and on average students commuted 5.25 days per week. The fuel efficiency of the average student owned car is 30.5 MPG.

92% of faculty commuted alone, while 6% carpooled. The average faculty one-way commute was 14 miles, and on average faculty commuted 5 days per week. Meanwhile, 91% of VIMS staff commuted alone, while 4% carpooled. On average, staff commuted 16 miles one-way, 5 days a week. Faculty and staff-owned vehicles get an average of 25 MPG.

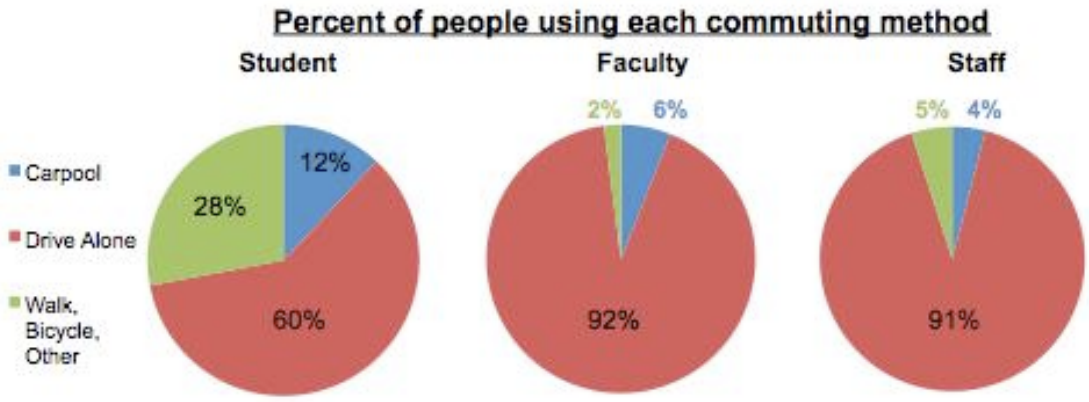


**Figure 6.** Survey results showing commuting methods of VIMS personnel for fiscal year 2010.

## Travel

**FY 2010 Usage:** Air, Faculty/Staff: 1,235,803 miles
Air, Students: 675,709 miles
Train: 9,715 miles
Taxi, Ferry, and non-VIMS Vessels: 708,234 miles
Bus: 49 miles

**% of Emissions (eCO2):** 11% (10% air, 1% other)
**Source:** Survey of VIMS personnel

In addition to the use of VIMS automobiles and the impact of personal commuting, we also collected data on other travel financed by VIMS. This data was collected using a survey, as records of mileages travelled for financed VIMS trips were not available. Future monitoring could be streamlined if mileages for each type of travel were reported on VIMS travel forms and recorded on spreadsheets.

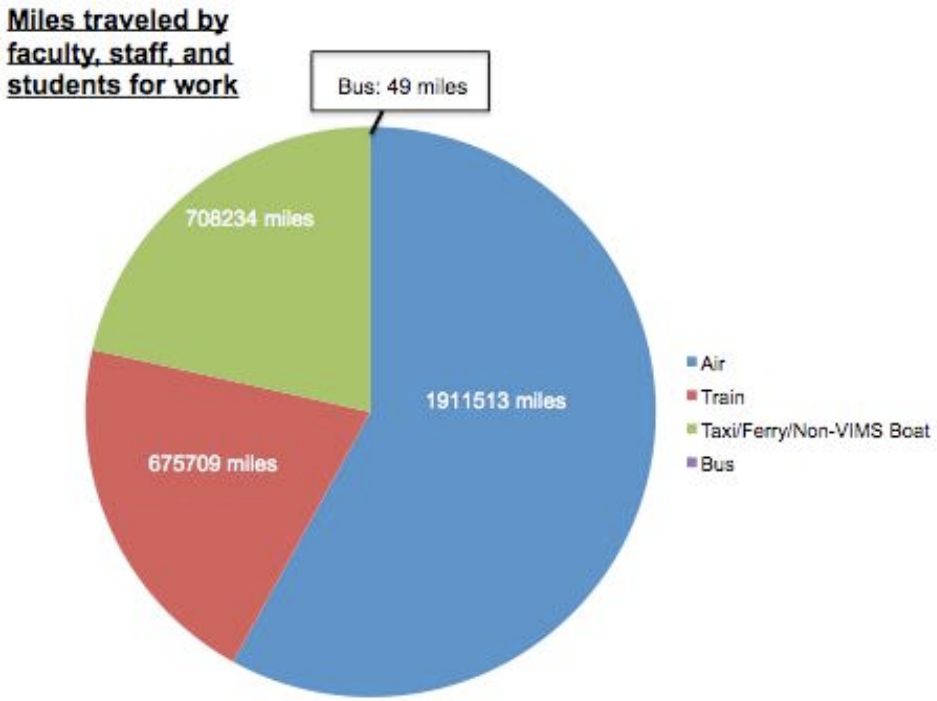


**Figure 7.** Survey results showing VIMS-financed travel in fiscal year 2010.

## Solid Waste

**FY 2010 Usage:** 98.29 short tons
**% of GHG Emissions:** 0%
**Source:** Debbie Galvez, Facilities. (804) 684-7090

Solid waste production cannot be measured directly due to the challenge of determining the composition and weight of trash produced. Current estimates were calculated based on the assumption that VIMS dumpsters are at least 50% full when emptied each week. There are seven dumpsters on campus, each with an 8 cubic yard capacity. Dumpsters were observed to be 75% full on average before emptying. Solid waste conversion factors from College & University Recycling Coalition were used for "campus waste (loose)," at approximately 90lbs / cubic yard and 22.22 cubic yars / short ton. The solid waste is taken to the Middle Peninsula Landfill, which utilizes a gas recovery and energy conversion facility on-site.

Recycling bins for paper, cardboard, co-mingled (plastic, aluminum, and glass) are located around campus, however the locations of these bins are not always well known and some areas are still in need of bins.

To streamline the process in the future, visual assessment should be made on a weekly basis as to the fullness of each dumpster and the overall composition of the waste. Recommendations include signage on recycling bin location (and what is recyclable), placement of additional recycling bins, and education on ways to reduce solid waste production at VIMS.

**Wastewater**

**FY 2010 Usage:** 97,286,520 gallons
**% of Emissions (eCO2):** 6%
**Source:** Chris Bata (cbata@vims.edu)

Wastewater is taken into account in the Calculator because of the greenhouse gas emissions of wastewater treatment plants. This data is taken from water bills and describes incoming water to the campus, which would overstimate the greenhouse gas impact of water use somewhat as not all of the incoming water is treated as wastewater (for example, those used to water lawns and trees).

Wastewater from the VIMS Gloucester Point campus is treated at the York River Treatment Plant, operated by the Hampton Roads Sanitation District. The plant uses a combination of aerobic and anaerobic processes for liquid treatment and anaerobic digesters for solid treatment (determined by calling the Hampton Roads Sanitation District at 757-460-2261 and directing to the engineering department). The calculator includes input fields for these three treatment types, but the documentation does not indicate how to handle a mixture of treatment methods. The data was entered into the anaerobic field, as the calculator uses this field to calculate methane emissions from treatment. This is accurate to the York River Treatment Plant, which does not have methane capture technology.

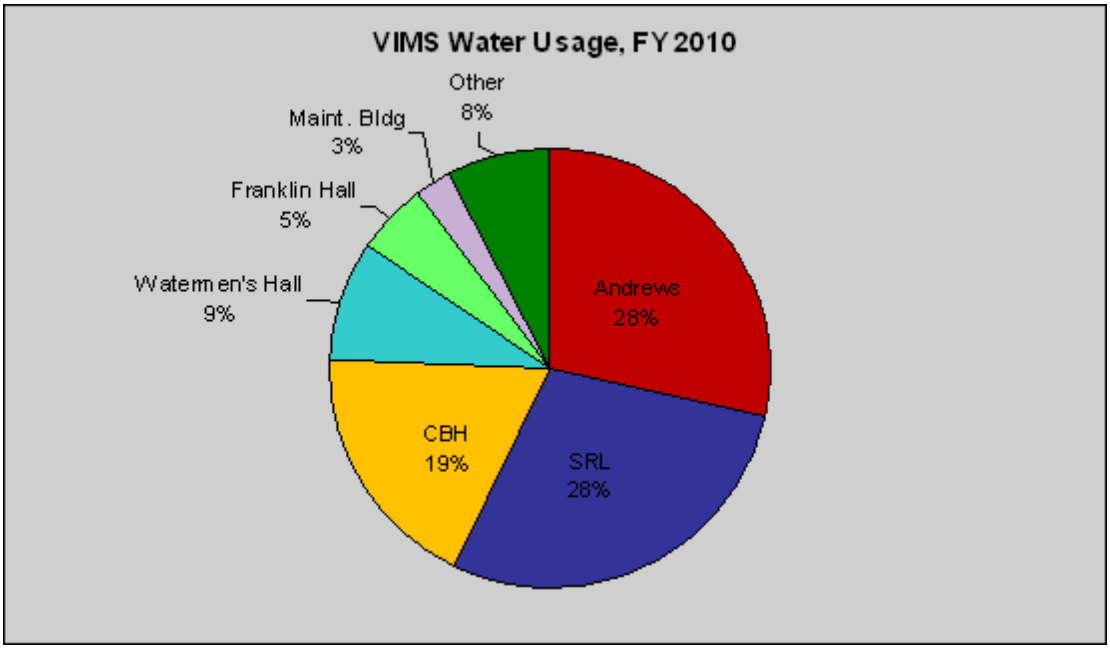


**Figure 8.** Total water use at the VIMS Gloucester Point campus in fiscal year 2010.

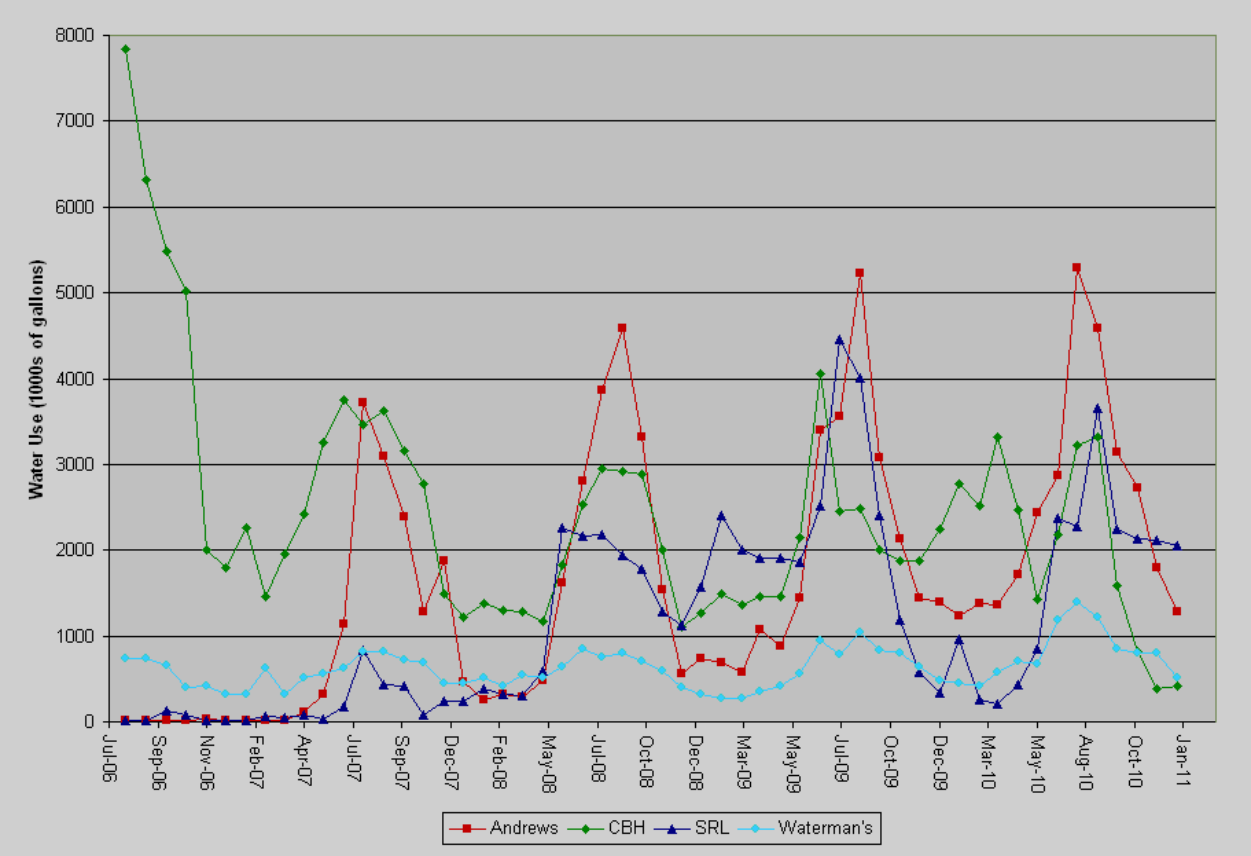


**Figure 9.** Water usage of the top four buildings from July 2006 to December 2010.

## Paper Use

**FY 2010 Usage:** 9,155 lbs (6315 lbs of 30% recycled paper and 2840 lbs of 75% recycled paper)
**% of Emissions (eCO2):** 0%
**Source:** See Table 2

**Table 2**. The following table gives information about which people were contacted, the department each person is responsible for purchasing paper, and each person's contact information.

| **Name** | **Department** | **Contact information** |
|---|---|---|
| Grace Walser | Fisheries Science | Gracie28@vims.edu |
| Debbie Galvez | Facilities Management | dagalv@vims.edu |
| Cynthia Harris | Physical Sciences | Harris@vims.edu |
| Maxine Butler | Biological Sciences | Maxine@vims.edu |
| Sylvia Motley | Print Shop | smotley@vims.edu |
| Carolyn Gardner | CBNERRS | gard@vims.edu |
| Dawn Fleming | CCRM | dawnf@vims.edu |
| Debbrah Pelata | ABC-hatchery/Kauffman Center | dpelata@vims.edu |
| Linda Ward | ESL | lward@vims.edu |
| Cheryl Teagle | Advisory Services | cteagle@vims.edu |
| Carol Birch | Waterman's copiers/printers | cjbirch@vims.edu |

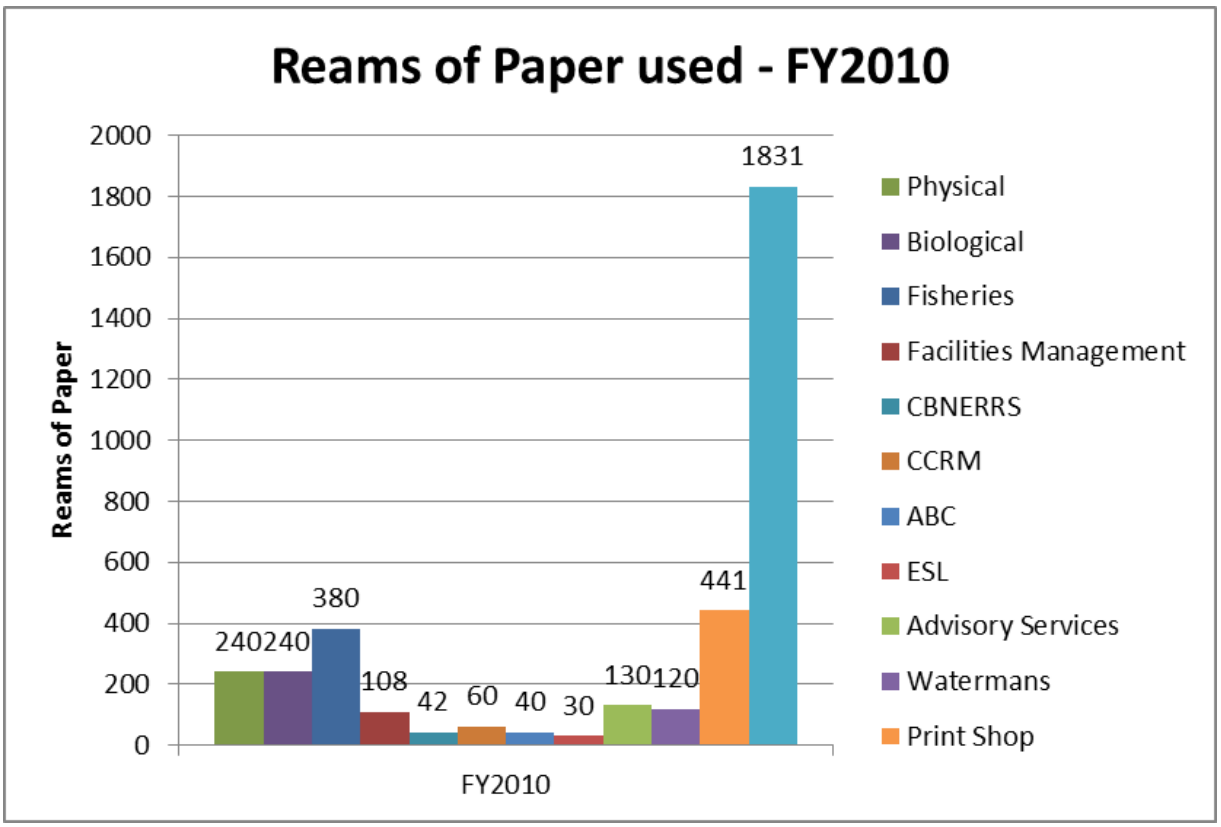


**Figure 10.** Reams of paper used in fiscal year 2010 split by department at VIMS. Also included is the total number of reams used for the entire campus.

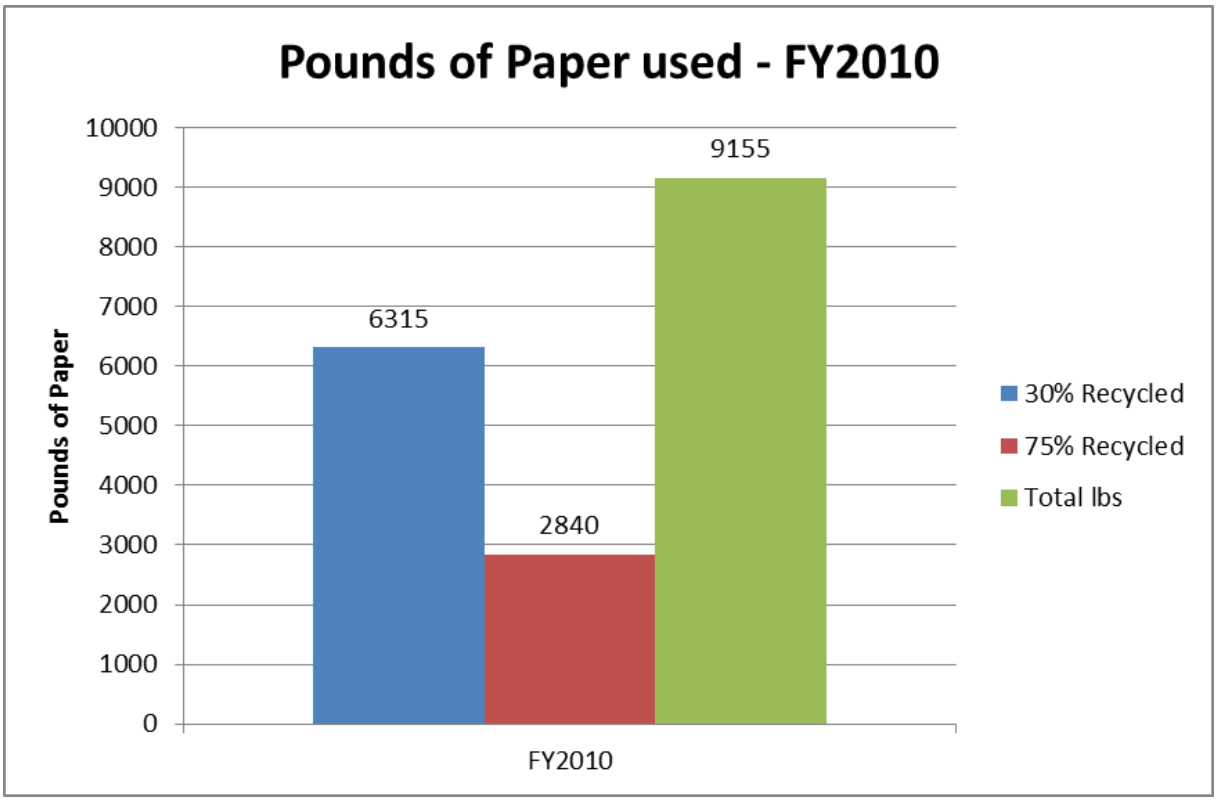


**Figure 11.** Pounds of paper used split by recycled content of paper used. The paper used at VIMS consisted of two different recycled contents, 30% and 75%. The total weight of all paper used is also given.

Data was only able to be collected for fiscal year 2010, and not any years previous, due to records not being kept longer than about a year. There were also some estimates given by those who were contacted, as some records on paper purchasing are not kept at all.

Each ream of paper was estimated at being 5 lbs in order to make calculations easy and free of decimals. The actual weight of each ream as computed using statistics from paper packaging is 4.987 lbs.

Each contact person listed above is responsible for purchasing paper for the department. It would be helpful in the future for each contact person to keep a simple spreadsheet of how much paper has been purchased, in order to see how the trend changes over time or how the recycled content of the paper has changed. This would be easy to maintain by each contact person, and when information is gathered in the future for the Greenhouse Gas Inventory, old purchase records, if kept, would not have to be scoured in order to find the necessary data.

## III. Conclusion

The results from the carbon calculator show that electricity and propane usage are by far the major sources of our greenhouse gas emissions. The seasonal pattern of use (Figures 3 and 5 - increased propane use in summer and electricity use in winter, particularly in Chesapeake Bay Hall and Andrews Hall) suggest that heating and cooling are major areas of use for these resources. Therefore, increasing heating and cooling efficiency on campus should be a top priority, including evaluating ways to increase efficiency, as well as the possibility of retrofiting systems in current buildings. Furthermore, the implementation of energy-efficient heating and cooling systems should be emphasized in planning future buildings.

In order to keep better records of travel by VIMS personnel, both for the purposes of future Greenhouse Gas Inventories and for standardized documentation of travel, either a mandatory quarterly survey of all travel should be implemented or exact mileage should be reported on travel forms and compiled into an inter-departmental spreadsheet. Emissions related to commuting to VIMS could be decreased by encouraging carpooling by setting up a carpool page on the VIMS website, where those interested in participating could find other individuals living near by. Additionally, special parking spaces could be established for those who carpool (with at least 3 individuals per vehicle). Additional bike racks could also encourage students, faculty, and staff to use a bicycle instead of a car.

Another way to potentially decrease energy use on campus would be the implementation of a competition between buildings to see if the individuals in that building can reduce their energy consumption the most. An award could be hung in the winning building until the next session of the competition.

Using biodiesel from local sources in on-campus machinery (i.e. lawnmowers) and some boats would further reduce emissions. Switching to B20 biodiesel fuel would cut greenhouse gas emissions from diesel use by 21%.

The on-campus production of solar and wind energy thought the installation of solar panels and wind turbines on top of the buildings on campus could also reduce our dependence on purchased electricity (reducing energy loss in transmission lines) and allow VIMS to play a leading role in the shift to clean energy production in the community.