# Middlebury's EcoFoot


**An analysis of Middlebury College's Ecological Footprint: A movement towards Sustainability**

*The care of the Earth is our most ancient and most worthy, and after all our most pleasing responsibility. To cherish what remains of it and to foster its renewal is our only hope.*

*--Wendell Berry*

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**The movement towards Sustainability at Middlebury College**

Middlebury College's mission statement includes a clause that it strives to give students an opportunity to learn in "a splendid natural setting with well-maintained buildings and grounds that not only support our academic and co-curricular programs, but also impart a sense of permanence, stability, tradition, and stewardship." In light of this central goal Middlebury has maintained a tradition of environmental interaction and awareness. As educated, engaged, affluent and socially responsible students, our educations should incorporate a desire to be aware of the environmental repercussions of our daily lives.

Middlebury College sends more than seven hundred graduates each year out into the world. It is imperative that these graduates know the environmental effects of our community actions and the role that we ourselves play in global degradation. The world currently suffers from loss of biodiversity, dwindling natural resources, exponential population growth, increasing greenhouse gases in the atmosphere and a whole plethora of other impending environmental problems.

Middlebury is situated in a fantastic area for crop cultivation and sustainability, with farmland and forests surrounding the college in Addison County. But the rural location of the college also creates a dependency on fuel for transportation and imports to and from this remote paradise. The climate in Vermont also lends itself to a need for fuel in order to heat and cool during the extreme temperature fluctuations in summer and winter and in order to bring in a variety of foods that do not grow in the cold climate. Middlebury is merely a microcosm of a nation that is completely fuel-dependent. The

demands of the small population here in Middlebury, Vermont put certain strains on the Earth that make the college far from sustainable.

According to the Environmental Kuznet's Curve, the more prosperous a community or country, the more it can afford to preoccupy itself with the health of the environment. The affluent Middlebury community can and certainly does devote some its intellectual attention to a commitment to improving the environment and our own sustainability, however there is always room for improvement in this endeavor. We can use the resources of knowledge, wealth and dedication to stewardship to launch a conscious effort for further minimizing our ecological footprint.

Our footprint compiles the "human natural resource consumption and waste output within the context of nature's renewable and regenerative capacity." In this case a footprint analysis measures the biologically productive area needed to sustain the course of students' daily lives at the institution of Middlebury College. We limited our analysis to the main Middlebury campus land and calculated the use of resources consumed by the 2,350 students that study here. In the study we took into account the consequences of transportation, food consumption, heating, water, waste, electricity, and land use. Given the limitations of time and access to data it was difficult to obtain exact figures and calculations of Middlebury's emission use over the past decade, but this footprint should give the college knowledge of how demanding it is on the Earth, a jumping off point for further research and ideas for reduction methods in the college's future. This study can help the college move towards a more sustainable future.

## Ecological Footprint Analysis

Mathis Wackernagel patented the Ecological Footprint Analysis in the 1990s. His innovative work ventures to measure the "minimum land necessary to provide the basic energy and material flows required by the economy" (Wackernagel 18). We also follow a study done by Emily Pezzetta Wright at Colorado College who created an ecological footprint following Wackernagel's instruction. The general goal of the footprint is to convert the demands of an institution—in terms of goods and services—into hectares of land needed in order to sustain those demands.

Annually calculating the footprint can show progress and help to guide college in the areas where it can minimize its impact. The ingredients include energy use in heating, electricity, food and waste. We then compare the area of land Middlebury owns with the amount we would need in order to be sustainable as well as consider ways to reduce the overall impact on the Earth.

The initial footprint that we have created is somewhat rudimentary. Someone with more time and research resources could definitely expand upon the study in more depth, but this provides a place to start in order to see the distribution of our impact in the following categories.

## Methodology

Our advisor for this project, Jack Byrne, helped us to focus the direction of our research. Jack is the Middlebury College sustainability coordinator. He met with us weekly and helped us to seek out statistics in each of the footprint sectors. His guidance was crucial to our project. Without Jack we would have struggled to obtain information.

To obtain our information we contacted various departments within the college. The food data was gathered from Matthew Biette and Charles Sargent in the Receiving Department of the Dining Services. The transportation information came from Public Safety's records. For fuel use, electricity and heating we contacted Michael Moser from the facilities staff. The college land holdings, a means for carbon sequestration, were obtained from the sustainability office. Jack provided access to this information. The calculations computed involved formulas provided by Mathis Wackernagel and Emily Pezzetta Wright and can be followed step by step in the following sections.

**Heating & Energy**

Heating the many dorm rooms, class rooms, dining commons, and social spaces at Middlebury College is a very important task given the weather conditions of this region during most of the months school is in session. To accomplish this on the main campus, the school has installed a system that uses steam to heat the buildings. The steam is created through the burning of Oil #6, a non-carbon neutral source. In the fiscal year 2004-2005, the school imported 2,029,520 gallons of Oil # 6. The vast majority of this oil was burned in order to create the steam that heats the main campus, but a small percentage of the oil was used to create electricity that would supplement the amount that is bought from outside sources. In terms of Middlebury's footprint, burning all this oil created 22,734 metric tones of carbon dioxide. In order to sequester this much carbon dioxide, 12,630 hectares of forest land would be required; this amounts to about 1% of Middlebury's total footprint. In general, Middlebury's oil #6 consumption has risen steadily, almost linearly since 1995.

All of the houses located on college property employ the use of furnaces during the winter in order to stay warm. These furnaces run on Oil #2. This is very similar to Oil #6, but it is more useful in smaller spaces like the outer houses at the college. In the fiscal year 2004-2005 Middlebury used 175,000 gallons of oil #2. The impact was that 987 hectares would be required to sequester the 3,209 metric tones of carbon that was released into the atmosphere. This accounts for ____% of the total footprint. Interestingly, the 175,000 gallons used in 2004-2005 is less than half the amount used in the year 2000 (390,599 gallons). This could be associated with the construction Middlebury was undertaking around the year 2000.

**Electricity**

In general, Middlebury College purchases the vast majority of their electricity from outside sources. As stated above, some power is generated on campus, but it only accounts for 18.2% of the total power used. The rest of the power is imported and comes from various sources. Middlebury imports electricity from Vermont Yankee and HydroQuebec. These companies mainly utilize hydro-power and nuclear power, which are carbon neutral sources. Up until the year 2000, coal, a very dirty source, was used by these power companies, but this practice ended with the hope that more sustainable and environmentally friendly sources could be utilized.

It is impossible to come up with the exact amount of carbon that is released in order to create the electricity used by college because the power comes from different sources and the exact distribution is unknown. Thus, for the purposes of this project it is mostly important to note that Vermont Yankee and HydroQuebec attempt to promote

environmentally stable practices by utilizing nuclear and hydro-power and moving away from coal.

**The Challenges of Measuring the Food Footprint**

Past studies of Middlebury College's ecological footprint have not taken into account the College's food consumption. This project considered the food footprint to be an important component of Middlebury's environmental impact. The Colorado College environmental footprint assessment's calculation of food footprint was used as a model for Middlebury's food footprint. It is very important to consider the energy involved in production, transportation and preparation of food when establishing an estimate of Middlebury's overall environmental footprint.

Measuring the food footprint was one of the more challenging components of the footprint calculation. It was quickly discovered that documentation of food received by Middlebury College is only partial and formatted in a manner such that it is extremely difficult to break down into categories and quantify in a way that is helpful to our footprint calculation. It was physically impossible, given the amount of time for the study, to trace all of the food that Middlebury College consumes in a year, let alone over ten years!!

Given this, the most helpful food statistics that we found pertained to Middlebury's local food consumption and were provided to us by Matthew Biette, the Director of Dinning Services at Middlebury. Biette pointed out that while Middebury has always relied on some sources of local foods, primarily because of necessity it has only been in the last 8 to 10 years that there has been an increase in interest from students,

faculty and staff as to where their food is coming from. Rough estimates show that in 2003 Middlebury's consumption of local foods was 23% and has gone up to consumption of 30% local foods today. This information is useful in the footprint calculation because it indicates a per student decrease in the distance of food traveled.

Building upon this information, we used a study completed by a Colorado College student in 2002 that calculated their ecological footprint, as well as a general break down of energy involved in food production and transportation that was provided by Wackernagel. The Colorado College study estimated the average student's food footprint to be 571 hectares for the entire student body. (per school year). This number was calculated using formulas provided by Wackernagel and assumed no consumption of local foods. We chose to use this number as an example of the food footprint for a college that is not promoting consumption of local foods. For example, if Middlebury was not consuming local foods in 2005 its food footprint would be 705 hectares.

It was then necessary to investigate the amount of energy that Middlebury saves in purchasing local food products and adjust the college student food footprint for Middlebury students accordingly. A breakdown of energy involved in food footprint calculations provided us with the statistic that 17.5% of all energy involved in food services is devoted to production, and 11% is transportation. Given these figures, we were able to calculate a reduction in hectares of land used in the Middlebury College student food footprint through their purchases of local foods. Statistics used in these calculations were 15% local food consumption by Middlebury in 1995, 23% local food consumption in 2000 and 30% local food consumption in 2005. Calculations of Middlebury's food footprint only took into account students (excludes faculty, staff)

**Gas and Diesel for Student Travel and Team Buses**

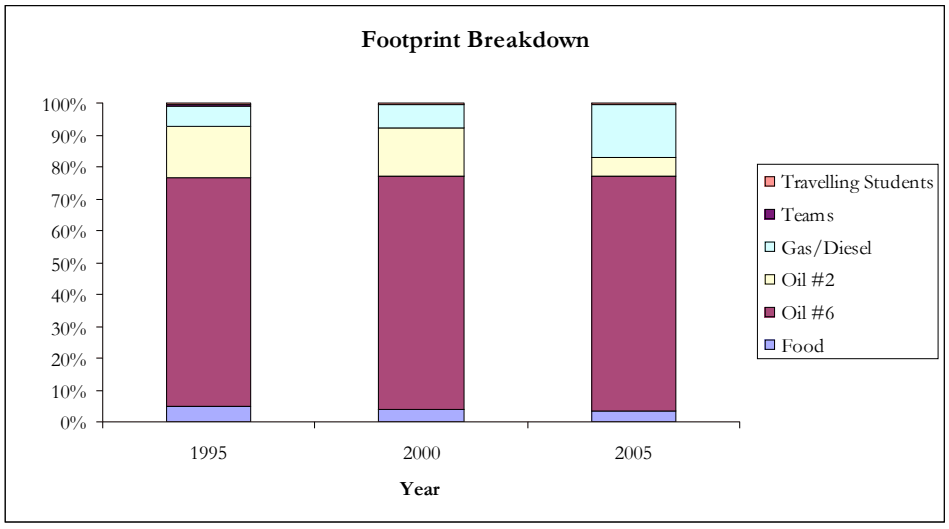
We decided that the Middlebury College ecological footprint should include environmental impacts generated by students and athletic teams traveling to and from campus. Tamara Jacobi talked with the athletic department and received information regarding the amount of fossil fuels that are emitted by the charter buses used by the teams. We converted pounds of CO2 emitted into an area footprint using Wackernagel's study as a guide. We found that for the past athletic season the Middlebury sports teams collectively emitted 75.082 tonnes of CO2, which would require 41.7 hectares of forest or peat bog to sequester the carbon.

Students also travel to and from campus, but in the case of traveling students we can only assume that they travel between campus and their homes at least once. In order to calculate this section of the footprint, Adam Lovell contacted Public Safety and received information about the interstate distribution of cars that have student parking permits. Using this information, we were able to calculate the distance traveled by each student to get to campus. We found that students traveled a minimum of 769,476 miles to get to campus and back home in the 2004-2005 academic year. At a standard gas mileage of 21 mpg (EPA), we calculated total carbon emissions to be 88.63 tonnes that require 49.24 hectares for sequestration. Therefore, we concluded that the fuel footprint of Middlebury College should include an extra 90.1 hectares in order to compensate for these College-oriented activities. Given the quantity of emissions released due to heating and cooling the college and other fuel uses as tabulated by the Campus Sustainability

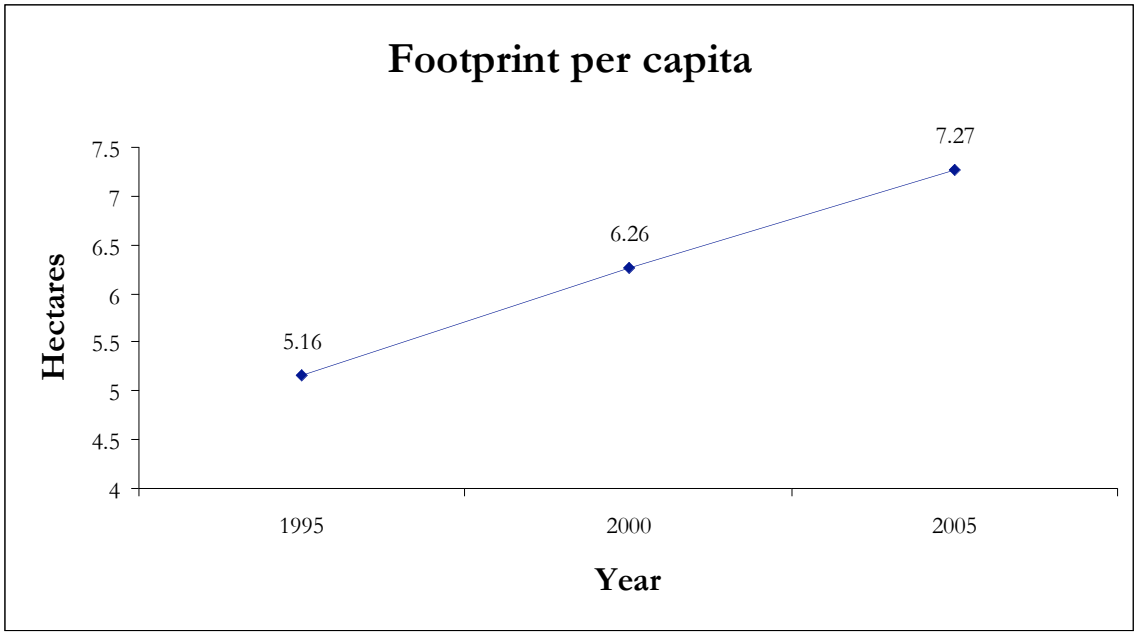
Office and Facilities Department, our additional transportation categories are not highly significant.

## Results

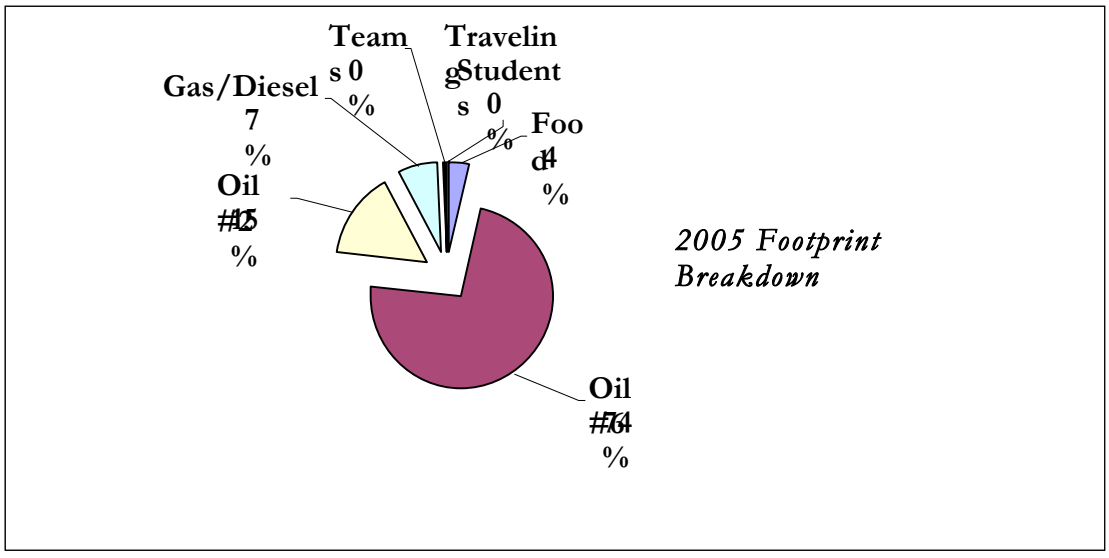
| Year | 1995 | 2000 | 2005 |
|---|---|---|---|
| ***Population*** | *2148* | *2307* | *2350* |
| **Food** | 633.7 | 674.59 | 681.735 |
| **Oil #6** | 7898.281 | 10543.6 | 12630.17 |
| **Oil #2** | 1783.058 | 2202.866 | 986.9489 |
| **Gas/Diesel** | 743.0287 | 1050.999 | 2811.305 |
| **Teams** | 41.712 | 41.712 | 41.712 |
| **Travelling Students** | 44.956 | 44.956 | 44.956 |
| **Total Footprint** | 11076 | 14449 | 17080 |
| **Per Capita Footprint** | 5.156441 | 6.263171 | 7.268124 |




This graph illustrates the relative changes in the various components that make up our footprint from 1995 to 2005. A significant decrease in the use of Oil #2 can be seen in the last decade while it seems that the college has increased its use of gas and diesel. Less apparent in this graph is Middlebury's (but better illustrated in the table) is Middlebury's decrease in food footprint.




This graph demonstrates a significant increase in Middlebury's per capita footprint since 1995. The number of hectares utilized per student has gone from roughly 5 to 7 in the past decade.



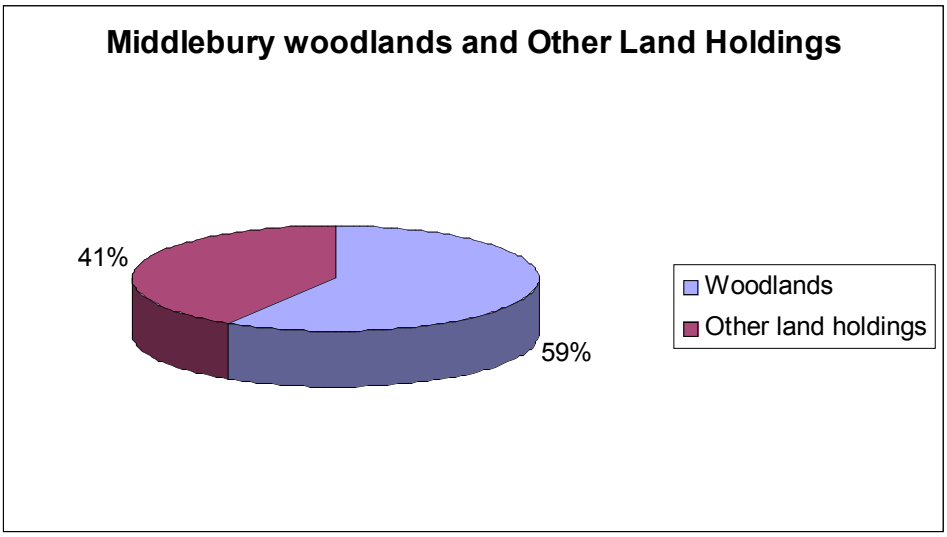
This pie graph helps to illustrate visually the breakdown of the footprint into its various components. It is clear that Oil #6 is the largest contributor to Middlebury's footprint while teams and traveling students' impacts are less than one percent each.

## Middlebury Land Holdings

According to Mathis Wackernagel, "forest ecosystems and peat bogs are among those natural systems that can be significant net assimilators of carbon dioxide". (Wackernagel, 1996) "Young to middle-aged forests can accumulate $CO_2$ at the highest rate over a 50 to 80 year time span." Therefore, though Middlebury owns quite a bit of land of various types; woodlands, farmlands, campus land, athletic fields, houses and other, only woodlands are useful in offsetting Middlebury's ecological footprint. Middlebury has a total of 4101.16 acres of woodlands that could be considered to be "carbon sinks".

| Town Name | Total Acres | Woodland |
|---|---|---|
| Albany | 160 | 160 |
| Bridport | 2.01 | 0 |
| Bristol | 56.68 | 0 |
| Cornwall | 463.86 | 49.97 |
| Fayston | 89.5 | 89.5 |
| Hancock | 763 | 672 |
| Leicester | 119 | 105 |
| Lincoln | 158 | 133 |
| Middlebury | 2653.11 | 684.11 |
| New Haven | 94 | 35 |
| Waitsfield | 31.39 | 31.39 |

| | | |
|---|---|---|
| Weybridge | 233.59 | 73.17 |
| Ripton | 2141.45 | 2006.42 |
| **Out of State** | | |
| Hawaii | 1 | 0 |
| Maryland | 9.44 | 0 |
| Montana | 318.88 | 0 |
| New Jersey | 82.09 | 6.96 |
| New Mexico | 2 | 0 |
| | | |
| **Totals** | **7370.03** | **4101.16** |




**How much more land do we need in order to be sustainable?**

17080 (total holdings of woodlands) - 4101.16 (total footprint of the college) = 12978.84 hectares, which would be 4.2 times the amount of land that Middlebury currently owns. In order for these lands to offset Middlebury's emissions they must be wooded hectares. It is important that Middlebury keep purchasing woodlands.

**Economic Incentives**

In order to draft policy changes regarding our ecological footprint, scale of effect must be taken into account. The heating oil consumed by the college is our main emissions source, and thus the 2 degrees campaign by the Sunday Night Group is the best step that could be taken in order to reduce our footprint. Any increase in efficiency or decrease in heating and cooling (and thus oil use) is important, especially given the expansion of the college in recent years. Green architecture could drastically reduce heating and cooling costs in buildings, but the campus has just muted its construction plans for the near future and renovations seem unlikely.

Food consumption is our next largest footprint sector after oil, and it can be dramatically reduced by increasing the amount of local foods that the college consumes. By increasing the proportion of local to non-local foods Middlebury College could reduce food miles, which is very important when multiplied across the entire student body for an entire academic year. The change of a few dozen hectares per student is magnified to a change of a few thousand hectares for the college's footprint.

It is important to consider the opportunity cost of Middlebury's efforts towards sustainability in one component of the footprint over another. For example, though a reduction of oil use would be costly to start up (the cost of use of alternative energies); it would be more effective in curbing Middlebury's contribution to global warming than focusing efforts on negligible team travel.

On a final note, electricity does not actually affect the ecological footprint of Middlebury College in a direct manner. Our electricity is derived from mainly

hydroelectric and nuclear sources, so we do not directly reduce our footprint or combat climate change by reducing electricity consumption.

**Uncalculated Impacts**

Though we attempted to create a footprint that was as comprehensive as possible, there were a few components that we could not convert into hectares because we could not get the data. These components are the amount of water consumed on campus and the amount of waste. The Electricity for Middlebury is provided mostly by nuclear energy which does not utilize much land use, however a small portion of it does use energy and so is included in our footprint—the amount is so trivial however that Adam calls the calculation the "baby toenail" of our overall footprint.

Another important aspect of our project is that we only included our impact based on the main campus' use of resources. This seemed more manageable and in our results we think we might be able to make the student body more aware of aspects it can change about our footprint if the study is limited to the area we live in. The impact at the Breadloaf campus and the Middlebury Snow Bowl are therefore not included in the study.

We realize that the impact of waste is large in terms of its land use in hectares. However due to a lack of information and the lack of a way to convert the waste into a footprint calculation (besides the amount of carbon dioxide emitted) made it impossible for the time being to include this information.

**Thoughts for Future Studies and Methods for Reduction**

Given the time frame for this project we found that there are areas of Middlebury College's ecological footprint that could have been calculated more accurately and more in-depth. Middlebury College's climate change awareness group SNG has recently adopted the goal of obtaining complete Carbon Neutrality for the Middlebury Campus over the next 5 years. If this is to happen, there must be much more investigation and calculation of Middlebury's total carbon emissions. Our project encountered several difficulties with exact numbers and incomplete records, double counting, problems with the science behind emissions of different types of oil (oil #2 vs. oil #6) and particularly problems with calculating the impacts of Middlebury's food footprint. We would like to suggest that future projects focus specifically on the individual elements of the ecological footprint. This would allow for more specific and careful calculations of the individual elements of Middlebury's ecological footprint.

We would also like to suggest that Middlebury Facilities keep more careful, organized record-keeping about its energy use. Particularly in the realm of water and food records we think it would be useful to have more easily accessible statistics available to the general Middlebury population.

There are many ways to reduce certain aspects of our college's footprint. These reductions may be manifested in expanding the size of the garden, eating in season foods, using energy-efficient technology, promote clean energy, paying attention to less travel and fewer cars on campus, using more fuel-efficient cars, sponsoring better public transportation, closing windows, etc.. The ecological footprint analysis makes it impossible for us to ignore the huge repercussions of our excessive consumption in daily

life. Exposing this footprint will help Middlebury reach its high expectations for promoting a more sustainable community.

## Conclusion

After examining the data from Middlebury's environmental impact, we feel that Middlebury should take further action if it indeed endeavors to be a community praised for sustainability. It is disturbing to us that though Middlebury claims to be moving towards sustainable practices, the student per capita footprint appears to be growing instead of shrinking. It is advisable for Middlebury to take immediate steps towards implementing more efficient energy and consumption habits. Furthermore, future studies could support our data and might help to convince Middlebury investors to purchase more woodland landholdings in order to offset our impact. But offsetting our emissions is not the only policy that Middlebury should pursue. It is also important that students become aware of their impact and that they reduce consumption at an individual level. If Middlebury has indeed chosen to pursue the Sustainability Standard in its economic practices, then reducing resource demands and emission reductions must be promoted if we want to make our tread on the Earth a little lighter.

**Bibliography**

Byrne, Jack. Group Advisor, Consultation Partner, Data Guru, Sustainability Coordinator at Middlebury College.

Dautremont-Smith, Julian. *Guidelines for College-Level Greenhouse Gas Emissions Inventories*. Lewis and Clark College. 2002.

Environmental Protection Agency. *Converting Between carbon dioxide and carbon units*. Available at http://www.epa.gov/nonco2/units.html. Accessed May 7, 2006.

Wackernagel, Mathis and William Rees. *Our Ecological Footprint: Reducing Human Impact on the Earth*. Gabriola Island, British Colombia: New Society Publishers, 1996.

Wright, Emily Pezzetta. *The Ecological Footprint of the Colorado College: An Examination of Sustainability.* An Independent Study May 2002. Advised by Professor Howard Drossman of Colorado College.