

# **The Carbon Footprint of Transportation of the Edgewood College Community**

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## **Abstract:**

Since CO<sub>2</sub> emissions have become a great concern related to global warming, we investigated the amount of CO<sub>2</sub> that the Edgewood College Community contributes in the commute to and from Edgewood College. We collected data on the topic and arbitrarily surveyed members of the community to determine how many days per week people commute, the distance they commute roundtrip, and the average mileage that their vehicle gets. We also considered alternative forms of transportation such as the shuttle and the Madison Metro. From there we calculated individual, group, and average emissions. Our results support the hypothesis that the Edgewood College Community, on average, emits less CO<sub>2</sub> per person than other communities. We believe that this is because of the conscious effort that the Edgewood College Community is making to “go green,” and the proactive attitude often associated with Madison. In congruence with our findings, we suggest some ways that Edgewood can continue to offset its emissions, for example planting one tree for every 50 pounds of CO<sub>2</sub> emitted. While our study focuses on a new topic in Natural Science and our error bar seems to be quite high, we hope that this study is the beginning of further investigation and continued efforts to reduce CO<sub>2</sub> emissions at Edgewood College.

## **Introduction:**

Carbon dioxide (CO<sub>2</sub>) emissions have become a serious problem. Carbon dioxide (among other greenhouse gases) naturally warms the Earth’s surface by trapping solar heat from the sun in the atmosphere (Gore, 2006). The overuse of fossil fuels and inefficient energy sources contribute to the enormously increasing amounts of carbon dioxide found in the atmosphere. As the CO<sub>2</sub> levels increase, more heat is trapped in the atmosphere and the Earth’s temperature is affected (Gonick & Outwater, 1996).

A carbon footprint is a calculation of the amount of CO<sub>2</sub> emissions each person is responsible for (Gore, 2006). Transportation is one way in which people contribute to the rise of the CO<sub>2</sub> in the atmosphere. This study focuses on what the Edgewood College Community contributes to the carbon dioxide emissions in the atmosphere when commuting to and from

Edgewood College. By calculating what the Edgewood College Community contributes in vehicle emissions, we are then able to compare our own CO<sub>2</sub> emissions to the city of Madison, the state of Wisconsin, and other schools in the United States. Our hypothesis is that the Edgewood College Community, on average, will emit less carbon dioxide into the air per person than other communities. This is because Edgewood College and Madison as a whole have a reputation of being more conscious of carbon emissions. Madison is full of walkers, bikers, mopeds, and public transportation. In addition, Edgewood College provides alternatives to driving and encourages carpooling and the use of the Madison Public Transportation System. Edgewood College also offers free bus passes to encourage student use, as well as incentives for those who use the shuttle services.

This study is being performed to find out what the carbon emissions of the Edgewood College Community are. From there, we can enlighten the Edgewood College Community of the impact that their CO<sub>2</sub> emissions have on the environment with their transportation accommodations. We hope to find ways in which Edgewood can continue to reduce transportation emissions and lower the carbon footprint.

### **Methods:**

We surveyed students, faculty, and staff members to determine how many days per week they commute, the distance they commute roundtrip, and the average mileage that their vehicle gets. We arbitrarily surveyed twenty of each group by passing out surveys in classrooms and offices in Predolin and Regina on a Wednesday afternoon and Thursday morning. We also received data on the number of trips per day, average number of riders per day, and the mileage of the two Edgewood College Shuttles (Star Cinema on McKee Road in Fitchburg and Westwood Christian Church on Odana Road in Madison) (E. Bykowski, personal communication, November 12, 2008). With this data we took the number of carbon emissions given off by the shuttle each day (based on the number of rounds each shuttle takes) and divided it by the average number of people that ride per day. That number was then multiplied by two to get the emissions per person round-trip for one day. We took those numbers and added them to each person's (who commutes by the shuttle) emissions from their car when commuting to the shuttle location. We did this same process for both shuttle locations. We entered each person's data (type of vehicle and average miles per week when commuting) from the survey into The

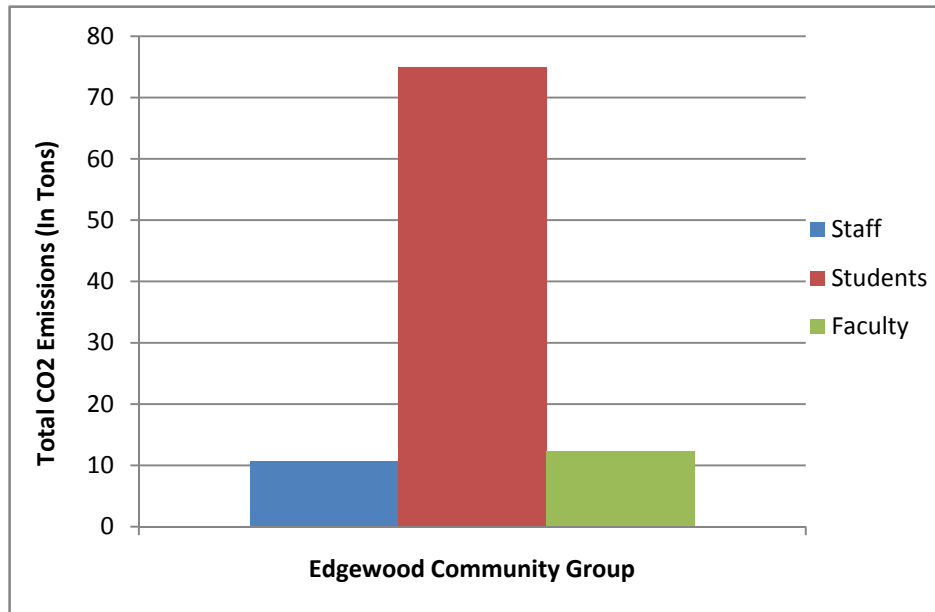
Nature Conservancy Carbon Calculator (The Nature Conservancy, 2009). We recorded the carbon emissions individually and then averaged each group (faculty, staff, and students). We also recorded the emissions of the two shuttles for those that indicated that they used that means of transportation on the survey.

We obtained statistics on the number of faculty and staff members and students enrolled at Edgewood College's Monroe Street Campus (Y. Zhang, personal communication, March 3, 2009). Then we took the average number of carbon emissions per person, multiplied it by the number of people in the specific category, and found the average amount of CO<sub>2</sub>, in tons, that each group emits per week during the school year. We also added those numbers together to get the average number of total carbon emissions for the Edgewood College Community. We took the number of people in a specific group and divided by the total number of people in the Edgewood College Community. We then compared this number to other communities, states, and schools.

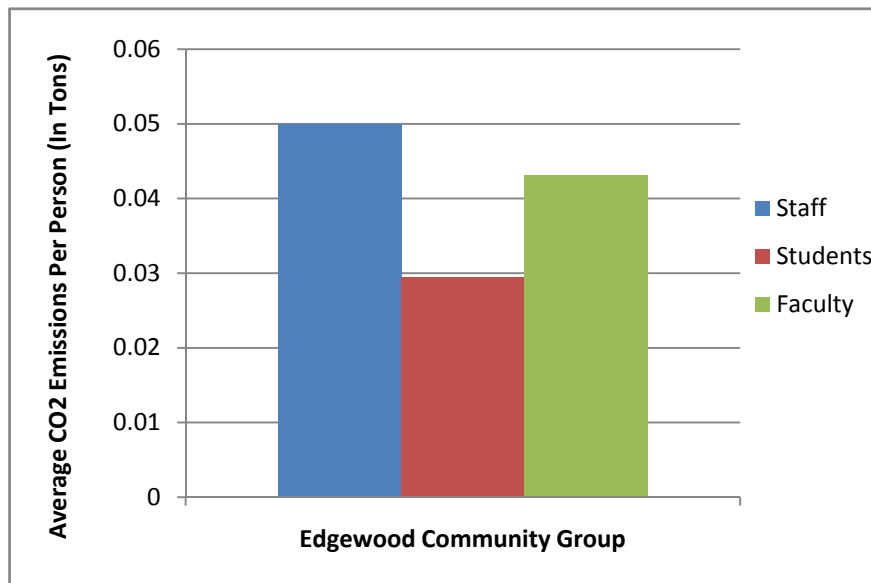
## **Results:**

Our results show that the Edgewood College Community emits a total of 98.1 tons of CO<sub>2</sub> during an average week of the academic school year (Figure 1). On average, each person is emitting 244.87 pounds (0.122 tons) of carbon in one week during the academic school year (Figure 2). From the data we found that, on average, students emit less carbon per week with an average total of 58.92 pounds (0.029 tons) of CO<sub>2</sub>. On the other hand, staff came in as the highest amount of carbon emitted per week during the school year with 99.84 pounds (0.049 tons). Faculty was not far behind with an average of 86.12 pounds (0.043 tons) of CO<sub>2</sub> emitted. The total emissions for each community group were: staff 10.7 tons, students 74.9 tons, and faculty 12.4 tons. We also found that the Star Shuttle emits 1,384.62 pounds (0.692 tons) of carbon per week, which is 6.92 pounds (0.003 tons) per person. The Westwood Shuttle emits 500 pounds (0.25 tons) of carbon per week, which is 4 pounds (0.002 tons) per person. The staff at Edgewood College emits 10.9% of the emissions, students account for 76.4%, and faculty 12.6% (Figure 3).

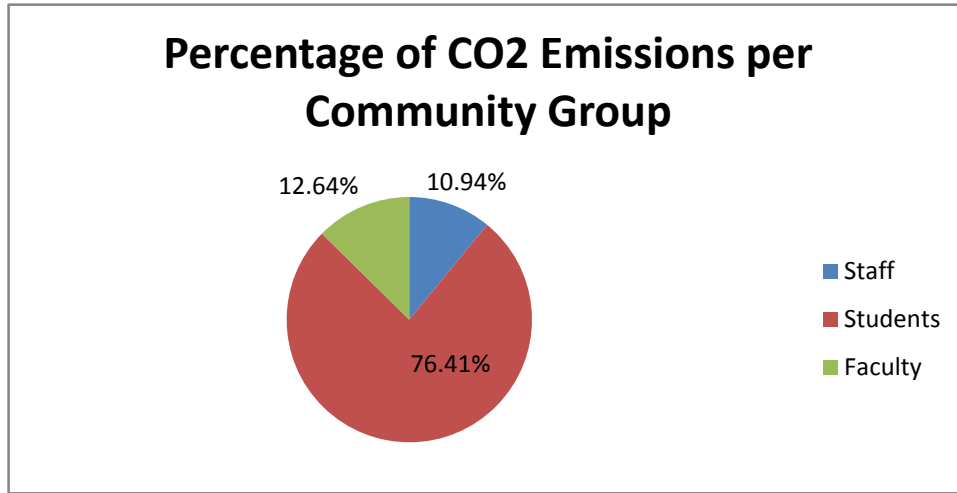
**Figure 1. Total Amount of CO2 in Tons Emitted by Staff, Students and Faculty During an Average Academic School Week**



**Figure 2. Average CO2 Emissions in Tons Emitted by Staff, Students and Faculty During an Average Academic School Week**



**Figure 3. Percentage of CO<sub>2</sub> Emissions Per Staff, Student and Faculty Group During an Average Academic School Week**



**Discussion:**

The information we collected and the results that we found generally supported our hypothesis that the Edgewood College Community would emit less CO<sub>2</sub> than other comparable communities. We believe this is because of the efforts that Edgewood College is making to reduce emissions by encouraging walking, biking, and moped use, as well as offering shuttle services and free Madison Metro transportation passes. In addition, Madison is known for its proactive attitude in reducing emissions and putting forth an impressive effort to be “green”. While the reason for Edgewood having fewer emissions on average is not totally clear, it’s possible that other communities may not share this eagerness to protect the environment. It may also be possible that Edgewood’s location and limited amount of parking encourage alternative ways of travel than coming by vehicle.

The Edgewood College Community’s contributions in vehicle emissions can be compared to other cities, communities and schools. According to our information, a member of the Edgewood College Community averages just over 1 ton of CO<sub>2</sub> emissions per year in their commute (Figure 1). A resident of the city of Madison’s annual average is 3.21 tons of CO<sub>2</sub> for transportation and residential use (Brookings Institution, 2009). Montgomery County Community College of Philadelphia, which is comprised of over twenty thousand students, conducted a similar study and reported a total of 12,372.2 tons of CO<sub>2</sub> per fiscal year (Montgomery County Community College, 2007), or an estimated 343.7 tons of CO<sub>2</sub> per week

(over 36 weeks). On a national level according to the Energy Information Administration, the Department of Energy, and the Environmental Protection Agency, the United States, in 2007, emitted 6,637.8 million tons of CO<sub>2</sub>. Of that amount, 30% is attributed to CO<sub>2</sub> from transportation; meaning in 2007 the United States contributed 1,991.3 million tons of CO<sub>2</sub> emissions from transportation (EIA: 2007 Annual Energy Review). Comparing the findings of transportation emissions from the Energy Information Administration to the total number of people in the population via the Census Bureau a United States citizen emits 6.5 tons of CO<sub>2</sub> per year on average.

An interesting finding was the amount of trees that would need to be planted to offset the carbon dioxide emissions from the data we collected. On average, a tree can absorb about 50lbs of CO<sub>2</sub> per year (Tree New Mexico, 2007 and Oakley, 2008). Considering the weekly amount of CO<sub>2</sub> that Edgewood College emits, we would need to plant 200,000 trees to offset the carbon dioxide emissions solely from commuting to and from school. This means that if we were to start planting trees and space them 3 feet apart in each direction, we would need roughly 41 acres of land to plant the 200,000 trees.

For every gallon of gasoline or fuel oil used, 22 pounds of CO<sub>2</sub> is emitted in to the air (Bloch, 2009). The United States is the largest contributor of carbon dioxide emissions in the world, and is double to the next largest polluter (Environmental Defense Fund, 2009). This means that the Edgewood College Community's efforts to reduce carbon emissions are very respectable and necessary. Studies like this are just one step that we can take to be proactive about reducing our carbon emissions and making our community, nation, and ultimately planet a better place to live. If students, faculty, and staff at Edgewood College would reduce the amount they drive their cars by carpooling, walking, or taking public transportation, the amount of fuel oil used would be reduced and would help in the CO<sub>2</sub> emissions.

There are a few possible sources of error in our testing methods and execution of collecting information. Since this is the first study done in the area of transportation and carbon emissions for Natural Science, we did not have anything to compare it to. While we put forth our best effort, at times we were unsure about how to collect data or make the most accurate conclusions. For instance, we did not calculate CO<sub>2</sub> emissions for summer; we only looked at an average week during the academic school year which could be a source of error in our results. Another possible source of error is in the survey information. It is possible that our survey was

not always an accurate representation of the information. For example, the individuals surveyed simply estimated the mileage that their vehicles get on average. The survey is also a representation of a sample of the Edgewood Community and therefore may not account for everyone. Since the survey was distributed within a 24 hour period, we may have sampled a different group than we would have gotten within a different period of time. In future studies, it may be helpful to distribute the study differently. For example, it could be given at different times throughout the year or on different days to see if results change. In addition, when we entered numbers into the carbon calculator, we weren't able to use exact numbers. The numbers were grouped. Therefore, vehicles such as the shuttle busses were computed in the same way that some vans were computed even though it is obvious that the busses go less miles per gallon than vans. Collecting information from more people and/or a different group of staff, students, and faculty could have returned different results. We noticed in the surveys that only staff members indicated riding the shuttle, when in fact we know that both students and faculty also ride the bus. There is also potential for error in the data collected from agencies and offices. Since Edgewood's effort to go green is somewhat recent, there is not an abundance of information on it. We needed to trust the statistics given to us on commuter students, shuttle riders, bus passes distributed, etc., even though it may not be absolutely accurate. Considering the shuttle data, since the numbers used were averages, it is possible for shuttle rides to have few (sometimes if any) passengers. This would mean that the shuttle may not always be reducing emissions as much as we would hope. Another possible source of error is that the information on the number of trees needed to offset our emissions is based on an average that depends on the location and species of tree; changes could affect the overall averages.

Our findings are important because carbon dioxide emissions continue to be a large factor in the deterioration of the atmosphere and the change in the Earth's temperature. It is important for the Edgewood College Community to be aware of the emissions that they are responsible for and the impact they are making on the environment. We can assume that Edgewood College is making advances in our attempt to be more conscious of our CO<sub>2</sub> emissions, especially in comparison to other communities. Continuing to offer alternate means of transportation and raising awareness of individual contributions will help Edgewood to continue to make a difference.

Overall, we do feel that there are areas for improvement in our study, but we are confident that our experiment begins to accurately express the important information about the CO<sub>2</sub> emissions in the commute to and from Edgewood College. This is just the beginning of what we hope will become a more common area of study. It's great to see some of the efforts that the Edgewood College Community is already making, and we hope that they will continue this effort in the future.

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