GREENHOUSE GAS EMISSIONS INVENTORY AND CALCULATION

EXECUTIVE SUMMARY

EMORY GREENHOUSE GAS EMISSIONS GOALS

The calculation of Emory University’s greenhouse gas (GHG) emissions, or carbon footprint, has been an on-going process undertaken by Emory students, faculty and staff over the last several years. A comprehensive study was undertaken this year when, in 2007, it was determined by Emory’s Office of Sustainability Initiatives that the University would participate in the Association for the Advancement of Sustainability in Higher Education’s (AASHE) Sustainability Tracking, Assessment & Rating System (STARS) pilot program, thus elevating the importance of determining Emory’s carbon footprint. STARS is a voluntary, self-reporting framework for gauging relative progress toward sustainability for colleges and universities and will ultimately provide a sustainability score similar to the rating provided by the Princeton Review for environmental friendliness. As part of the pilot program, a GHG emissions inventory and calculation must be conducted.

The baseline year for this calculation is Fiscal Year 2006, or September 1, 2005 – August 31, 2006. Fiscal Year 2007 was also evaluated to get an understanding of emerging trends within Emory’s boundaries.

METHODOLOGY

Greenhouse Gas Protocol

The Greenhouse Gas Protocol, developed by the World Resources Institute and the World Business Council for Sustainable Development, is the most widely-used international accounting tool for quantifying GHG emissions. It provides the accounting framework for nearly every GHG program and standard in the world, including the Chicago Climate Exchange and the California Climate Action Registry.
**Emissions Calculator**

The Clean Air Cool Planet *Campus Carbon Calculator* is a Microsoft Excel-based spreadsheet tool that provides procedural protocols and a framework for investigation of the emissions of greenhouse gases attributable to the existence and operations of an institution. The calculator is a tool used at over 200 schools across North America and is consistent with GHG Protocol standards.

To help delineate direct and indirect emission sources, three emission “scopes” (Scope 1, Scope 2 and Scope 3) are defined for GHG accounting and reporting purposes. The scope emission categories are described as follows:

1) Scope 1 includes all direct GHG emissions occurring from sources that are owned or controlled by Emory; for example, emissions from burning purchased fuel in our boilers or fleet vehicles, etc.
2) Scope 2 includes indirect GHG emissions from the generation of purchased fuels consumed by the institution. For example, purchased electricity is defined as electricity that is purchased or otherwise imported into Emory’s organizational boundary. Scope 2 emissions physically occur at the facility where electricity is generated (in our case, Georgia Power’s production plant) but are attributable to Emory as the end users of the product.
3) Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of Emory’s activities but occur from sources not owned or controlled by us. Some examples of scope 3 activities are business travel, the commuting habits of students, staff and faculty, and emissions from waste generated by the institution when the GHG emissions occur at a facility controlled by another company, e.g. methane emissions from landfilled waste. Credits included in Scope 3 may also include carbon “offsets,” which in Emory’s case would refer to the carbon sequestration provided by our preserved woodlands.

Although all three scopes were considered in developing Emory’s carbon footprint, Scope 1 and 2 sources are the main focus of this Executive Summary since they are the most monitored, we have the most control over their use and they are the largest contributors of emissions at Emory.

There are three steps to the greenhouse gas emission inventory process:

1) Data collection
2) Calculating greenhouse gas emissions
3) Analyzing and summarizing the results
The calculator estimates the greenhouse gas emissions specified by the Kyoto Protocol (a metric established by the United Nations in 1997 that was never adopted in the United States) - that is, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF6) - and converts them into units (in this case, metric tonnes\(^1\)) of carbon dioxide equivalents (eCO2) on the basis of each gas' global warming potential (GWP). The focus of this study is on CO2 since emissions of PFCs or SF6 do not exist on campus, and emissions of CH4, N2O, and HFCs represent only a very small percentage (about one one-hundredth of one percent) of Emory’s total emissions.

All documentation gathered, interpreted and input into the calculator is presented in Appendix A. The backup includes statements to explain how applicable data was qualified due to inconsistencies and/or missing information and the resulting assumptions that were made to fill in these data gaps.

**Operating Boundaries**

The first step in calculating Emory’s carbon footprint was to determine the limits of the institutional enterprise. While other credits in AASHE’s STARS pilot program do not include the Healthcare facilities on the Druid Hills campus (which consist of Emory University Hospital, Clinics A and B, the Rehabilitation Center, 1525 Clifton, Winship Cancer Institute and the EUH Education Annex), it was decided those facilities should be included in the GHG calculation because Healthcare is a large energy consumer and quality data is available for these locations.

Other Emory facilities/locations that are not directly contiguous to the main campus, with the exception of Briarcliff campus, are not considered in the calculation. These other facilities include Crawford Long Hospital, Grady Hospital, the Orthopaedics and Spine Hospital, Yerkes Field Station, Oxford campus and all other outlying Emory owned facilities.

As a result, 123 buildings with a total square footage of approximately 9,000,000 square feet (baseline year) have been considered in this calculation. A complete list of the buildings per year and their square footage is included in the documentation in Appendix A.

---

\(^1\) A metric tonne is a measurement of mass equal to 1,000 kilograms, or 2,204.6226 pounds. This is differentiated from a short ton, which is the typical unit used in the United States and equals 2,000 pounds.
In future carbon footprint calculations Emory may want to consider including all University controlled real estate, however the effort that would be required to assemble all necessary information for these other locations may be considered too formidable.

**Institutional Data**

There were 11,287 full time students attending Emory during FY2006. This includes undergraduates, graduates and first professionals. There were also 847 part time students and 4,292 summer school students. These numbers increased to 11,415 (equaling an increase of 1.1 percent in full time students); 923; and 4,154 students, respectively, for FY2007.

Emory had 3,456 faculty and 16,746 staff in FY2006. In FY2007 there were 3,534 and 17,032 faculty and staff, respectively. This represents a total increase of 1.8 percent.

Emory’s total budget information was also input into the calculator as well as research and energy dollars.

**PRINCIPAL FINDINGS**

In the baseline year, FY2006, Emory emitted 417,095 total metric tonnes of carbon dioxide equivalents (eCO2), compared to 419,231 total metric tonnes eCO2 in FY2007. With the calculated offset due to the natural forest preservation of our 181 acres of preserved woodlands, the net eCO2s are 376,376 and 378,512 metric tonnes in FY2006 and FY2007, respectively. Of these amounts, 314,476 and 311,898 metric tonnes, respectively, are attributed to Scope 1 and 2 sources.

As can be seen, there is a modest increase of 2,136 net metric tonnes total eCO2 (equal to 1 percent) between the baseline year and FY2007. This increase may be partially attributed to the additional square footage of building space (net 202,653 square feet) resulting in a demand for more heating, cooling and power resources but also to a shift in our transit habits that are related to University operations (to be discussed more in the *Transportation* section). It is important to note, however, that while total emissions went up, there was a slight decline in Source 1 and 2 emissions, of which energy consumption is the biggest sector. This trend is explained more in the *Utilities* section.
The graphs below represent total eCO2 emissions and the emissions per scope between FY2006 and FY2007. These numbers represent Emory’s total emissions for the purposes of this study.

**Total Emissions in Metric Tonnes eCO2**

![Graph showing total emissions comparison between FY2006 and FY2007.](attachment:total_emissions_graph.png)

**Net Scope Emissions in Metric Tonnes eCO2**

![Graph showing net scope emissions comparison between FY2006 and FY2007.](attachment:net_scope_emissions_graph.png)

Of the sources of emissions inventoried and measured by the calculator, the creation of the electricity we purchase and import from Georgia Power is the
largest energy consumer and therefore produces the most emissions. While it is
not surprising that more physical space on campus means additional electrical
usage, it is interesting to note that there was a 1 percent decrease in emissions
between the baseline year and FY2007 from our energy consumption. This could
be the result of a warmer winter/cooler summer, less consumer demand or better
equipment, but is likely due to more efficient building monitoring and operation.

Also, there was a slight increase in emissions from our transportation energy
consumption, again not surprising since our student body and faculty/staff
populations both increased from the baseline year.

Agriculture, represented by our use of pesticides in landscaping activities, solid
waste and refrigerant use are all expected yet insignificant emissions sources. Of
interest regarding our trash is the slight decline from the baseline year to FY2007.
This decrease is likely due to our concerted recycling efforts and the University’s
goal to increase waste diversion to 65 percent by 2015. The solid waste
contributions are also offset slightly by the fact that the landfill our waste is
disposed in collects and reuses its methane (CH4) to power a nearby chicken plant.
This reuse of the byproduct of our decomposing waste is accounted for in the
model calculator.

A graph showing total emissions by source, as defined by the calculator, is
presented below.
Emissions by Source (Metric Tonnes eCO2)

NOTE: Total emissions shown do not include offset for forest preservation.
Utilities

An overview of Emory’s energy utility is found below. It is important to understand the system so a clear picture is provided of how electrical power and on-campus energy generation from stationary sources work together to provide energy to our campus buildings, the largest users. For purposes of this study, water usage is not included in the calculator because only purchased chill water is accounted for by the model, and Emory creates our own chill water via electric water chillers.

Utility Overview

Emory purchases and consumes two main energy sources for the heating, cooling and electrical usage of its structures. Electricity is obtained from Georgia Power Company, while natural gas is provided by Coweta-Fayette Natural Gas.

Emory University’s Clifton Road campus receives utilities from external sources through 270 electric, natural gas, and domestic water accounts to serve 180 buildings. Annual utility consumption includes 300,000,000 kilowatt-hours (kWh) of electricity, 910,000 Deka-therms of natural gas, and 480,000,000 gallons of water. The University operates a 500,000 pound/hour steam plant and three central chilled water plants to provide cooling, heating and process load energy to 100 central campus buildings.

The central steam plant uses five large natural gas fired boilers to distribute steam to 51 buildings through buried steam mains where it is used to produce hot water and hot air for space and water heating. Peak day natural gas consumption for the steam plant runs around 4,300,000 cubic feet. The boilers recover energy from the exhaust stream and control the amount of unburned oxygen to maximize energy conversion efficiency. The boilers produce about 750,000,000 pounds of steam a year.

The chilled water plants use electric centrifugal water chillers to produce 42°F chilled water. The chilled water is distributed to 47 buildings through buried chilled water mains where it is used to dehumidify and cool the air in the buildings. Heat absorbed in the buildings is dissipated using evaporative water cooling towers located outside the chiller plants. Some cooling is required year around to remove heat from the interior area of the buildings. The chilled water plants produce about 50,000,000 ton-hours of cooling each year.
Emory employs a “private” electric distribution loop to supply 100 buildings in the central campus. Transmission lines rated above 100 kilo-volts (kV) feed two substations on campus. The substations step down the voltage to 20 kV and feed the underground distribution system. At each building on the 20 kV loop, electric transformers step down the voltage to less than 500 volts before it enters the building’s electrical system. About 260,000,000 kWh are billed on the 20 kV loop each year.

Emory uses about 260 private meters to measure and bill the electricity, steam and chilled water for individual buildings served by the 20kV loop, steam plant and chiller plants. Another 80 private domestic water meters support billing water to buildings not directly served by the Dekalb County water system. In all, it takes about 550 private and external utility accounts to allocate the energy consumed by 180 buildings.

Discussion

It is logical to assume that a consistent increase in University square footage to be heated, cooled and powered will only cause our energy consumption, and therefore the associated GHG emissions, to also increase. However, through careful monitoring and strategic operations, our power usage has actually decreased by almost 2 percent (as measured in MMBtu’s, a standard energy unit) resulting in a savings of 3,523 metric tonnes eCO2 being emitted into the atmosphere. Furthermore, if we were to achieve our sustainability goal of a 25 percent reduction in energy use per gross square foot by 2015, at FY2007 consumption rates our emissions would decrease by 44,038 metric tonnes eCO2 over the baseline year.

Other offsetting measures will likely be required, however, to help us reach this goal. Targeting large energy reductions through the Leadership in Energy and Environmental Design (LEED) process is one strategy that will help, however our University Master Plan calls for the addition of energy-intensive healthcare and research facilities that will likely lessen the total energy saving benefits that LEED could provide.

While electricity and natural gas are the main sources of Emory’s energy consumption, emissions associated with our transportation methods are also significant. Although most of the emissions attributed to the Transportation category are considered to be from Scope 3 sources, it is still nonetheless important to understand how both University-controlled and individually controlled activities
lend themselves to Emory’s overall carbon footprint. Transportation sub-categories are discussed more in the *Transportation* section.

The graphs presented below show the percentages that each sub-category source contributes to Emory’s overall energy consumption.
Energy Consumption by year (MMBtu)

2006

- Purchased Electricity: 1,315,674 (25%)
- Stationary Sources: 1,114,502 (22%)
- Transportation: 2,783,436 (53%)

2007

- Purchased Electricity: 1,372,399 (26%)
- Stationary Sources: 1,088,990 (21%)
- Transportation: 3,123,821 (53%)
Transportation

The sub-categories under Transportation are University Fleet, Commuters (Faculty/Staff and Students) and Air Travel.

Faculty/staff commuting and University-related air travel are consistently the largest GHG emitters. Both sub-categories, considered Scope 3 sources because Emory does not directly control the emissions that result from these activities, increased from the baseline year, and this is to be expected given the University’s continued growth.

Discussion

While the University’s fleet system and alternative commute options are expansive, the data suggests that most faculty/staff are not taking advantage of these opportunities. Although some data gaps exist, it is suggested from the data available that approximately 68 percent of faculty/staff drive alone to campus while 32 percent alternatively commute (carpooling, vanpooling, biking, walking, Cliff transit, etc.). Reversing this trend would go a long way in helping to promote carbon neutrality, and it is important to note that the data suggests we have attained our Sustainability Initiative goal of getting one in four cars off the road. Campus experts generally agree, however, that the percentage of alternative commuters is not this high, and since data gaps exist, more research is required to verify this assertion.

Air travel is another significant contributor of emissions, although until a more comprehensive tracking system is established, it is unknown exactly how many University-related air miles are being flown. It is thought that about only half of our actual miles are being tracked which, if correct, could mean an additional 15,000 metric tonnes eCO2 to our total carbon footprint.

The graph below represents the overall percentage that each transportation sub-category contributes to our total transportation related emissions for each year. It should be noted that emissions from our commute to and from campus remained relatively constant from the baseline year, but the percentage of emissions from University Fleet fuel consumption (a Scope 1 source) increased. This increase was expected due to expansion of our diesel-powered fleet in 2007 (although the diesel was comprised of 20 percent recycled vegetable oil). The nominal increase in percentage of air travel cannot be fully understood until all miles being flown are documented.
Transportation Emissions by Source (Metric Tonnes eCO2)

- **Air Travel (Scope 3)**: FY06 - 12.7%, FY07 - 14.4%
- **Faculty/Staff Commuters (Scope 3)**: FY06 - 82.1%, FY07 - 79.8%
- **Student Commuters (Scope 3)**: FY06 - 3.9%, FY07 - 3.7%
- **University Fleet (Scope 1)**: FY06 - 1.3%, FY07 - 2.1%
RECOMMENDATIONS

As can be seen from this calculation, the need for electricity is the biggest cause of Emory’s GHG emissions. Whether it is from direct usage to power our structures or to run equipment that heat and cool our structures, purchased and imported electricity from off-site sources accounts for more than half of our emissions. Although we are observing slight operational decreases in usage, our facility square footage that demands power and conditioning is on the rise. The upward trend of greenhouse gas emissions, therefore, is not likely to reverse itself without purchasing carbon offsets, and this is not a practice that will be utilized by the University. Accordingly, Emory has decided that participation in the President’s Climate Commitment is not in its best interest at this time.

However, Emory is employing several effective strategies to help lessen our energy impact and move us towards carbon neutrality, including:

1. LEED protocol and other green building principles are a standard at Emory, and more energy efficient buildings are being designed, constructed and operated every year. This strategy will help us minimize the proportional increases in energy demand. However with several high-energy healthcare and research spaces coming on-line in the next several years, it is unlikely that a reduction in overall consumption per square foot is achievable through green building alone. Targeting large energy reduction technologies is good in theory but would probably dictate a payback beyond what is considered acceptable.

2. Emory contracted with Siemens to conduct an in-depth energy and utility study for the purpose of identifying the most effective course of action to achieve our energy reduction goals. Siemens’ recommendations included 65 facility improvement measures, including lighting retrofits, automated building upgrades, water conservation retrofits, building envelope repairs, exterior slab insulation, heat wheel recommissioning and steam system improvements, to name a few. Upon implementation that is contingent on funding, the sustainability benefits could be as much as 20,000,000 pounds of saved carbon dioxide emissions annually.

3. The Office of Sustainability has several other great programs happening now, including strategies aimed at energy awareness, recycling and waste minimization, water conservation, sustainable food, commute options and educational outreach. Collectively, these will all help reduce our emissions but, more importantly, will change our behavior and thinking to ensure
sustainability becomes an Emory way of life. It is unknown, however, if the results of these programs can be effectively measured to demonstrate a GHG reduction using the Clean Air Cool Planet Campus Carbon Calculator or any other industry standard methodology.

Another possible driver in the push for carbon neutrality is U.S. EPA’s proposed mandatory GHG reporting requirement. Under the proposed regulation, reporting of greenhouse gas emissions from all sectors of the economy would be mandated. The rule would apply to fossil fuel suppliers and industrial gas suppliers, as well as to direct greenhouse gas emitters (i.e., Emory). EPA estimates that 85-90 percent of total national U.S. GHG emissions, from approximately 13,000 facilities, would be covered by the proposed rule.

The rule does not require control of greenhouse gases; rather it requires only that sources above certain threshold levels monitor and report emissions. The goal of the regulation will be to accomplish these objectives:

- Obtain data that is of sufficient quality that it can be used to support a range of future climate change policies and regulations.
- Balance the rule coverage to maximize the amount of emissions reported while excluding small emitters.
- Create reporting requirements that are consistent with existing GHG reporting programs by using existing GHG emission estimation and reporting methodologies to reduce reporting burden, where feasible.

Facilities and suppliers would begin collecting data on January 1, 2010. The first emissions report would be due on March 31, 2011, for emissions having occurred during 2010.

The proposed regulation is currently in a public review period, to end on June 9, 2009. It will likely be revised from its current version after that time.