# *GREENHOUSE GAS EMISSIONS INVENTORY AND CALCULATION, FY2012 UPDATE*

## 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. Lead by the Office of Sustainable Initiatives, Emory University decided in 2007 to participate in the Association of Sustainability in Higher Education's (AASHE) Sustainable Tracking, Assessment and Rating System (STARS). STARS provides a framework for colleges and Universities to voluntarily self-report their sustainability efforts. As a component for the STARS rating system, the University has been updating its GHG inventory biennially starting in 2010.

The baseline year for this calculation was originally Fiscal Year 2006 (FY2006; September 1, 2005 – August 31, 2006). Later, the baseline year was changed to 2005 to better align with Emory's quantified sustainability goals. Since then, all years up to FY2010 have been evaluated. The Fiscal Year 2012 inventory was completed in February 2014 and is the subject of this updated report. **Only FY2005 (baseline year) and FY2012 (current) results are discussed hereafter.**

## 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 understanding, quantifying and managing 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.

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 many schools across North America and is consistent with GHG Protocol standards.

***Emissions Calculator***

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 from sources that are owned or maintained 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 creation 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 can be directly attributable to Emory's activities, but are from sources that do not fit into the Scope 1 or 2 definitions. 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 from Emory's composting.

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) - The monitored emissions include the gases; carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF6). The calculator then converts emitted gases into units (in this case, metric tonnes[1]) of carbon dioxide equivalents (eCO2). This conversion depends on each of the gas' global warming potential (GWP).This study will mainly focus on CO2 due the fact that there are no PFC or SF6 emitted on Emory's camps 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 in the detailed backup housed in Emory's Department of Campus Services. 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 the process of 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[2] , it was decided that it was important for these facilities to be included in the GHG calculation due to the facilities' large energy consumption and the quality of the data that is available for these locations.

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

### *Institutional Data*

There were 10,943 full time students attending Emory during FY2005. This includes undergraduates, graduates and first professionals. There were also 838 part time students and 4,191summer school students. These numbers increased to 13,286 (equaling an increase of 21percent in full time students); 884 part time students; and 3,919 summer school students for FY2012.

[1] A metric tonne is a measurement of a mass equal to 1,000 kilograms, or 2,204.6 pounds. This is differentiated from a short ton, which is the typical unit used in the United States that equal 2,000 pounds.
[2] Consists of Emory University Hospital, Clinics A and B, the Rehabilitation Center, 1525 Clifton, Winship Cancer Institute and the EUH Education Annex

Emory had 2,936 faculty and 17,520 staff in FY2005. In FY2012 there were 4,020 and 21,908 faculty and staff, respectively.

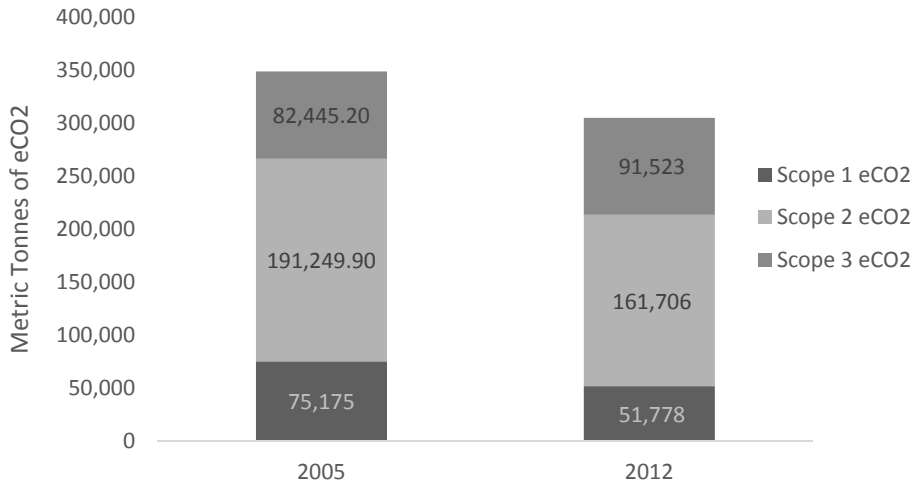
## PRINCIPAL FINDINGS

In the baseline year, FY2005, Emory emitted 348,870 net metric tonnes of carbon dioxide equivalents (eCO2), compared to 304,754 net metric tonnes eCO2 in FY2012. This represents a 12.6% reduction.

Significant decreases can be seen in stationary source fuel combustion, electricity consumption and faculty/staff commuting. A substantial increase is observed in emissions from all air travel. These trends are analyzed further in the *Utilities* and *Transportation* sections, respectively.

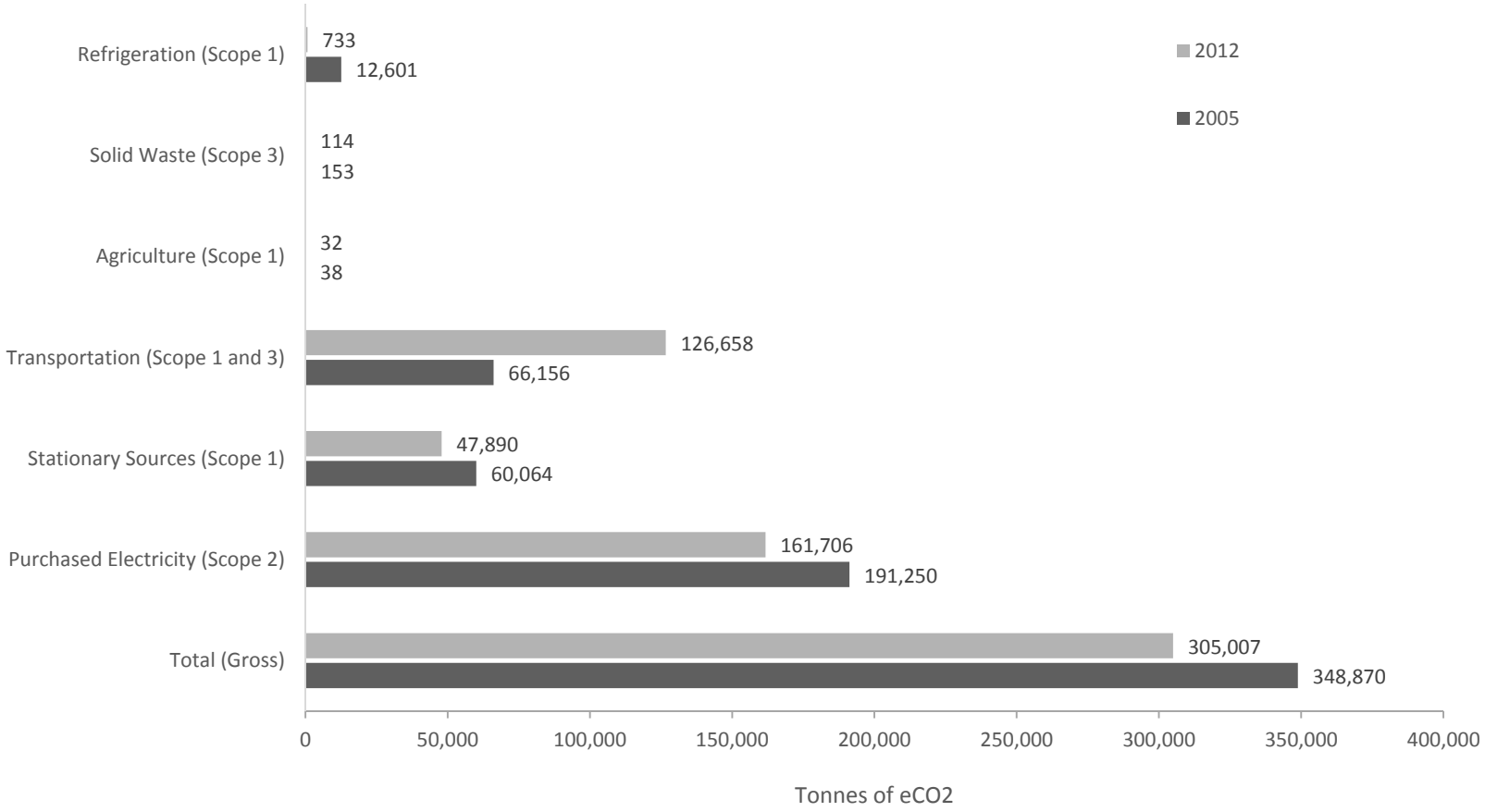
The graph below represents net eCO2 emissions per scope for FY2005 and FY2012.

**Net Scope Emissions of eCO2 in 2005 and 2012**




A graph showing total emissions by source, as defined by the calculator, is presented below.

## Emissions by Source 2005 and 2012



## *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 True Natural Gas.

Emory University's Clifton Road campus receives utilities from external sources through several electric, natural gas, and domestic water accounts to serve our buildings. 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 over 100 central campus buildings.

The central steam plant uses five large natural gas fired boilers to distribute steam through buried steam mains to several buildings where it is used to produce hot water and hot air for space and water heating. The boilers recover energy from the exhaust stream and control the amount of unburned oxygen to maximize energy conversion efficiency.

The chilled water plants use electric centrifugal water chillers to produce 42$^{o}$F chilled water. The chilled water is distributed to serviced 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.

Emory employs a "private" electric distribution loop to supply most 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.

Emory uses 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. Other private domestic water meters support billing water to buildings not directly served by the Dekalb County water system. In all, it takes hundreds of private and external utility accounts to allocate the energy consumed by main campus buildings.

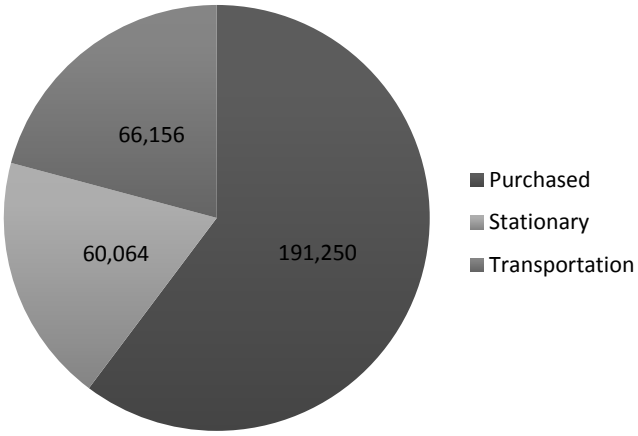
Discussion

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 to similarly increase. However, through careful monitoring and strategic operations, our emissions from power usage has actually decreased by over 15 percent .

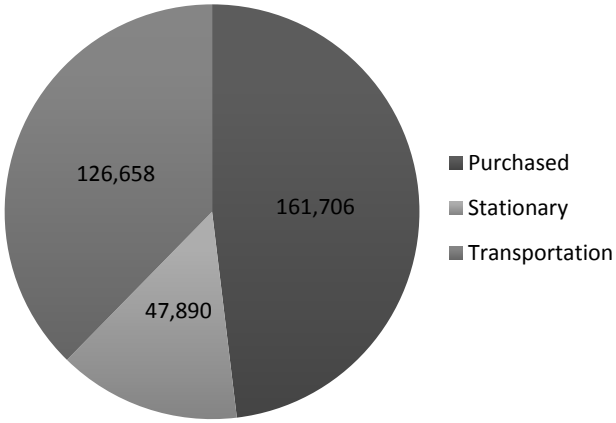
There are several reasons for this downward trend, including implementation of a temperature control policy in many buildings which has decreased the steam and chilled water (stationary sources) loads required to heat and cool the buildings; a general decrease in electrical consumption that can be at least partially contributed to occupant behavior modifications; and an increasingly bigger percentage of our building portfolio being Leadership in Energy and Environmental Design (LEED) certified which integrates several energy conserving practices into our buildings. Also, a robust recommissioning and SPP (sustainable performance program) has helped our older buildings become much more energy efficient since 2005. While electricity and natural gas are the main sources of Emory's energy consumption, emissions associated with the energy to fuel 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 how the percentages that each sub-category source, transportation included, contributes to Emory's overall energy consumption.

**Energy Consumption by year 2005 (MMBtu)**




**Energy Consumption by year 20012 (MMBtu)**




## *Transportation*

Faculty/staff commuting and University-related air travel are consistently large 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

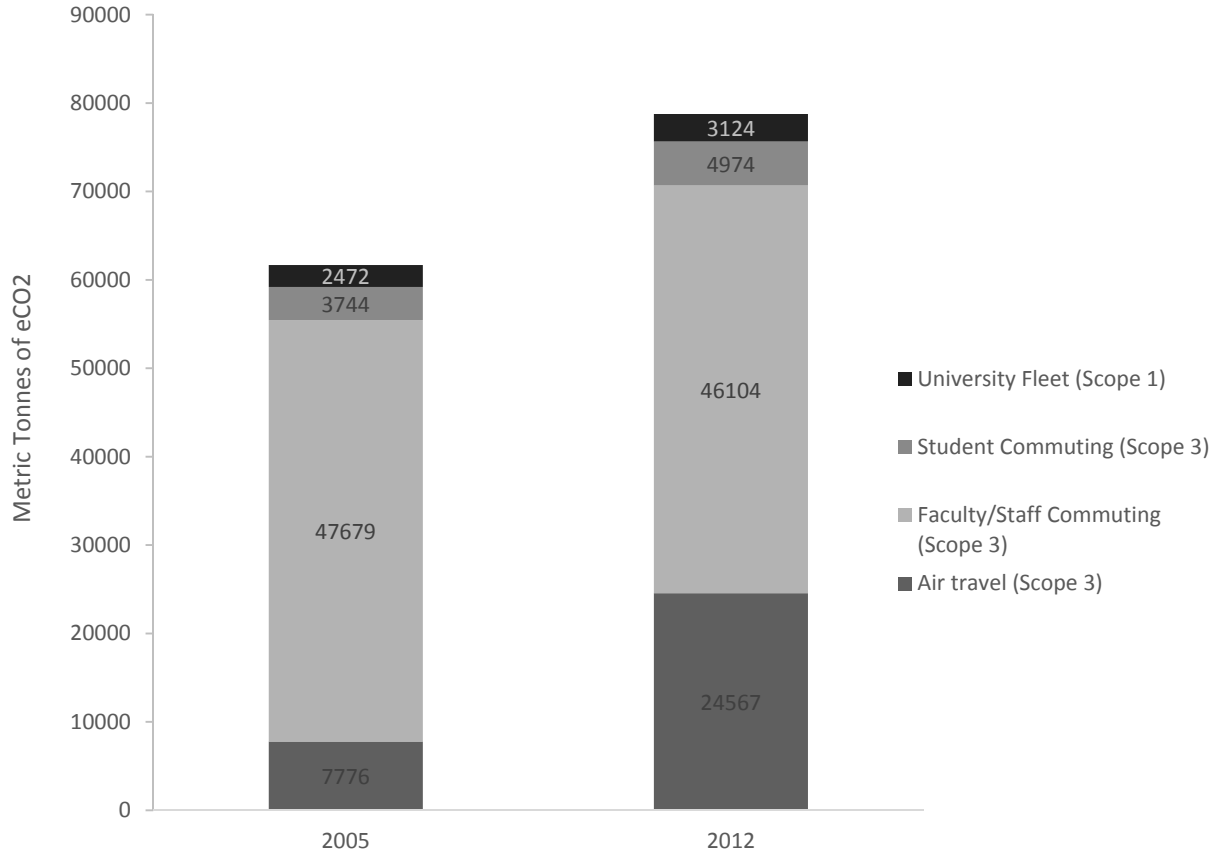
The University's fleet system and alternative commute options are expansive, and recent data suggests that increasing amounts of faculty/staff are taking advantage of these opportunities. Although some data gaps exist, it is suggested from the data available that in FY2012 only 19 percent of faculty/staff drive alone to campus while the remainder alternatively commute (carpooling, vanpooling, biking, walking, Cliff transit, etc.). This is based off of the number of people who register as alternative commuters and the number of issued parking permits on campus. For comparison purposes, in the FY2005 baseline year, 44 percent of faculty/staff drove alone to campus while 56 percent alternatively commuted.

Air travel is another significant contributor of emissions that is extremely difficult to reduce due to the increasing number of students, faculty, and staff on campus. Also, with such an active research community at Emory, it is not a surprise that our air miles increase significantly year to year with the large number of conferences

and research trips occurring. University related air travel during FY2012 was 46,640,942 miles; this equates to a 200 percent increase in emissions.

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 commutes to and from campus remained relatively constant from the baseline year (despite a large increase in population), but the percentage of emissions from University Fleet fuel consumption (a Scope 1 source) increased, likely due to the larger availability and options of shuttle services.

**Transportation Emissions by Source 2005 and 2012**



## 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 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 the University chooses to utilize.

However, Emory is already 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 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. 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. Many have already been completed. Upon further 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 continues to be 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.

The journey is far from over, however. Going forward the University has a long-term roadmap, including exploring more options for on-site renewable energy. Major solar panel installs may be in the works, and a geothermal system is currently being evaluated.

Other university departments have likewise been engaged in the commitment. With the adoption of Emory's Climate Action Plan in 2011, several other pledges were made by the Emory academic and operational units including lessening air travel to conferences and meeting attendance, instead opting for remote attendance when possible. More information about and a copy of the plan can be found here: http://sustainability.emory.edu/page/1014/Other-Programs