# Emory Greenhouse Gas Emissions Inventory
# FY 2019 Update

## Summary Analysis

## I. Goals

Emory regularly evaluates its greenhouse gas (GHG) emissions, or "carbon footprint," in order to monitor its efforts to reduce emissions year over year through strategies that entail targeted mitigation, behavior change, clean and renewable energy sources, and new innovations. GHG emissions reporting began in the year FY2010, with 2005 as the original baseline year, and subsequent inventories were conducted in 2012, 2014, 2016, and 2019.

In 2019, Emory's Sustainability Vision Committee proposed an update to Emory's greenhouse gas emissions reduction goals to mirror the latest scientific evidence and recommendations of the United Nations Intergovernmental Panel on Climate Change. The scientific evidence shows that in order to mitigate global warming to a 1.5 degree Celsius increase or below, net anthropogenic emissions of carbon dioxide and other greenhouse gases must decrease 45% from 2010 levels by 2030, and reach net zero emissions by 2050.[1] In light of this evidence, Emory leadership approved an update to Emory's baseline inventory year to 2010 and its GHG reduction targets to match. In addition to these updated goals, Emory aims to:

- Invest in a portfolio of innovative projects that provide resilience, research, teaching and national leadership benefits to Emory by 2025.
- Achieve carbon neutral construction for all new buildings by 2025.
- Establish a Carbon Neutral Degree within an academic unit to create the opportunity to offset the environmental impacts of a degree.
- Develop a carbon offset program to allow students, faculty, and staff to offset university travel, commuting, and other activities that produce greenhouse gas emissions.
- Enhance purchasing incentives and restrictions to increase sustainable refrigerant use and disposal. [2]

This summary analyzes an inventory for the Fiscal Year 2019. Calculations for the inventory data are completed using regional fuel mix emissions factors rather than the national factors. The following results refer to data collected from the baseline FY2010, FY2012, FY2014, FY2016, and

[1] IPCC, 2018: Summary for Policymakers. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. *World Meteorological Organization, Geneva, Switzerland, 32 pp*.

[2] Emory Sustainability Vision 2015-2025

the most recent FY2019 inventory. Data were not collected in FY2017 or FY2018 due to the reorganization of responsible departments at Emory. However, the University intends to conduct annual inventories in the future starting with FY2019 (this inventory).

## II. Methodology

***SIMAP***

All base figures for calculations, graphs, charts, and tables in this report come from SIMAP (Sustainability Indicator Management and Analysis Platform). SIMAP was chosen for the purposes of this report because it is an emissions calculator specifically purposed for higher education, and because it is excellent at producing detailed graphs and tables that show trends in emissions over time. OSI uses SIMAP to benchmark each fiscal year's CO2 and N2O emissions data and compare its emissions year by year. Again, this report draws on the University's $CO_2$ data in SIMAP, since $N_2O$ (the other emission SIMAP analyzes) represents a much smaller percentage of Emory's total emissions.

SIMAP estimates the greenhouse gas emissions specified by the Kyoto Protocol, a global compact negotiated by the United Nations in 1997 that was not ratified by the United States. The monitored emissions include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride ($SF_6$). The calculator then converts emitted gases into units (in this case, metric tons) of carbon dioxide equivalents ($MtCO_2e$). This conversion depends on the global warming potential (GWP) of each gas. Emory's emissions are largely from $CO_2$ because there are no PFC or $SF_6$ gases emitted on Emory's campus, and emissions of $CH_4$, $N_2O$, and HFCs represent only a very small percentage of Emory's total emissions.

***Emissions Scopes***

Greenhouse gas calculations are delineated as direct and indirect emissions sources by means of three different scopes:

1) Scope 1 includes all direct GHG emissions from sources owned or maintained by Emory. For example, emissions from burning fuel in Emory's boilers or fleet vehicles.
2) Scope 2 includes indirect GHG emissions from purchased energy consumed by the institution, or otherwise imported into Emory's organizational boundary. Scope 2 emissions physically occur at the facility where electricity is generated (such as Georgia Power's production plants) but are attributable to Emory as the end user of the product.
3) Scope 3 (mostly composed of transportation emissions) allows for the inclusion of all other indirect emissions. Transportation is believed to be the largest and fastest growing source of GHG emissions globally.[3] Scope 3 emissions are directly attributable to Emory's activities, but are from sources that do not fit into the Scope 1 or 2 definitions.

[3] Wang, Shiying and Ge, Mengpin. 2019, October 16. Everything You Need to Know About the Fastest-Growing Source of Global Emissions: Transport [Blog Post]. Retrieved from https://www.wri.org/blog/2019/10/everything-you-need-know-about-fastest-growing-source-global-emissions-transport.

Some examples of scope 3 activities are business travel; commute transportation emissions 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 for FY2019 refers only to the carbon sequestration from the small amount of landscape material Emory composts on-site.

***Operational Boundary***

The Druid Hills campus of Emory University and Emory Healthcare is included in the GHG emissions inventory boundary, which is consistent with the scope of Emory's STARS (Sustainability Tracking, Assessment, and Rating System) report that is developed by AASHE (Association for the Advancement of Sustainability in Higher Education). This boundary includes all university buildings located on and around Clifton Road, the Briarcliff campus, the Clairmont campus, and Yerkes National Primate Research Institute. Healthcare facilities included are Emory University Hospital, Clinics A and B, Emory Rehabilitation Hospital, 1525 Clifton Rd. Clinic, and Winship Cancer Institute.

Other Emory facilities that are not contiguous to the main campus are not included in the calculation. Facilities not included are EUH at Wesley Woods, Emory University Hospital Midtown, Emory University Orthopedics and Spine Hospital, Emory St. Joseph's Hospital, Emory Johns Creek Hospital, Emory Decatur Hospital, Emory Hillandale Hospital, EUH Smyrna, Yerkes Field Station, Oxford College campus, and all other outlying Emory-owned facilities.

***Institutional Information***

In FY2010, there were 12,724 full time equivalent (FTE) Emory students included in the inventory. This number includes undergraduates, graduates, and professional school students. In FY2019, there were 10,737 FTE students included in the inventory, a 15.6% decrease compared to the FY2010 level. In FY2019, the Emory employee FTE within the GHG emissions inventory scope was 9,991 a 40.0% decrease from 16,664 in 2010. [4]

***Utilities***

To understand Emory's energy system, below follows an overview of how electrical power and on-campus energy generation from stationary sources work together to provide energy to Emory's buildings, the largest users. For purposes of this study, water usage is not included in the calculator because the model accounts for only purchased chilled water, and Emory creates its own chilled water via electric water chillers.

Emory's Druid Hills campus receives utilities from external sources through several electric, natural gas, and domestic water accounts to serve its buildings. As of this 2019 inventory, 440,263kwh of solar power are produced on campus, which are fed directly into the electrical

[4] Employee counts for Emory University and Emory Healthcare include only those employees within the GHG inventory boundary. Employee counts exclude student employees. Faculty counts include non-compensated faculty.

grid and counted as renewable energy credits (RECs) that Emory has not yet retired. Emory operates a 500,000 pound/hour steam plant and three central chilled water plants to provide cooling, heating, and plug and process load energy[5] to over 100 buildings.

Five large natural gas fired boilers in the central steam plant distribute steam through buried steam mains to buildings. The steam produces 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. A new steam-turbine generator began operation in 2016. The generator is part of a cogeneration/combined heat and power (CHP) system utilizing the existing mechanical heat from the natural gas boiler. The heat is captured, generating a higher-pressure steam that runs a turbine that improves the efficiency of Emory's energy use. The new system is expected to provide an additional 1MW of electricity from the same level of natural gas usage.

Three chilled water plants use electric centrifugal water chillers to produce 42$^{o}$ F chilled water. The chilled water is distributed to buildings through buried chilled water mains where it is used to dehumidify and cool the air. Some cooling is required year-round to dehumidify outside air before it is circulated to the interior area of buildings, which is then re-heated for occupant comfort. Heat absorbed from buildings is dissipated using evaporative water cooling towers located outside the chiller plants.

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 Emory buildings.

## III. **Principal Findings**

***Overview***

Since the new baseline year of FY2010, Emory has reduced its GHG emissions by 31%. Emory emitted a net quantity of 234,974 MT (metric tons) $eCO_2$ in FY2019. This figure represents a 6.8 percent reduction in emissions since FY2016 (252,263 MT eCO2) and is a continuation of the downward trend of Emory's emissions over the past decade. In FY2010, the University emitted a net quantity of 342,624 MT $eCO_2$, so the percent change in emissions reduction has been

[5] Plug and process loads are energy loads that not related to general lighting, heating, ventilation, cooling, and water heating, and that typically do not provide comfort to the occupants.

fairly consistent over the past decade at an average of 3.4% per year. The average annual percent reduction from FY2016 to FY2019 at 2.3% was notably slightly less than the decade average annual percent reduction. However, Emory's size has grown considerably since FY2016, and by then net $eCO_2$ emissions were only 62% of their original figure in FY2005 (409,980), the original baseline year of emissions analysis. When comparing the FY2019 $eCO_2$ emissions figure to the FY2005 figure, it appears that Emory has already doubled its "20% reduction of carbon emissions by 2020" goal set in 2005, at a 42.6% overall reduction.

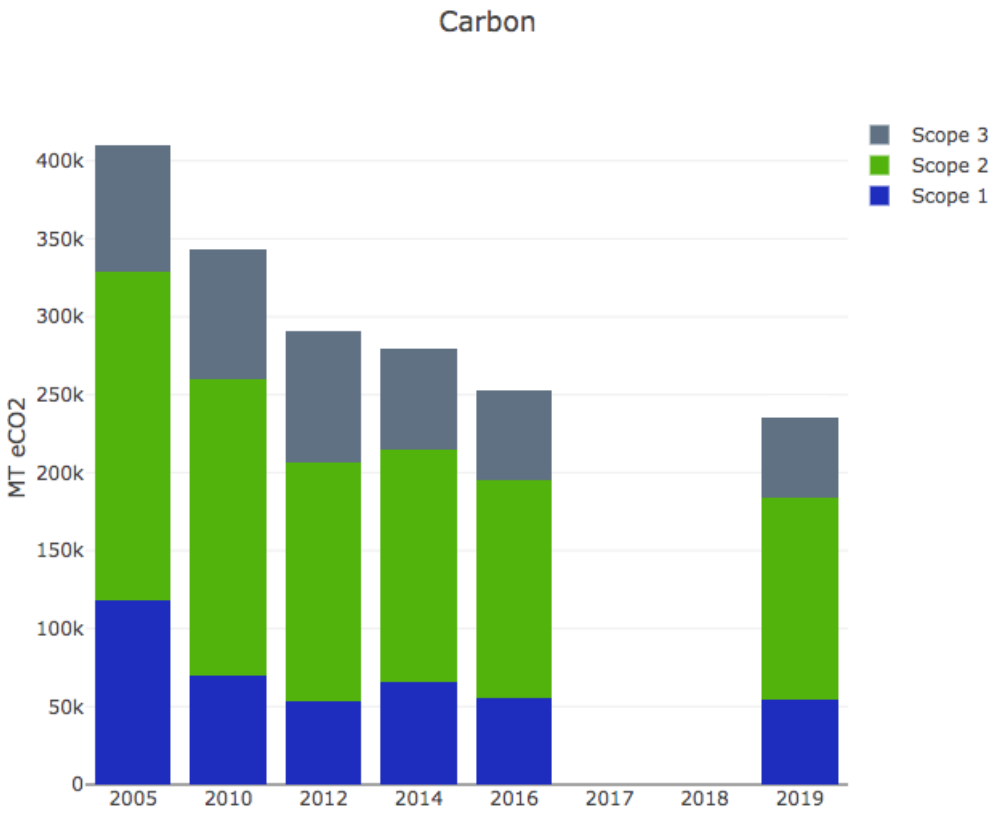


**Fig. 1** Emory's net $eCO_2$ emissions have decreased every monitored fiscal year, with Scope 2 consistently representing the largest proportion of emissions.

***Energy Results***

Emory University and Emory Healthcare continue to grow; however, Emory proudly recorded a 26.5% per square foot (EUI) decrease in energy consumption from FY2005 to FY2015, and has decreased EUI by 10.2% from 2015-2019. These reductions are the result of careful monitoring, strategic operations, innovative technology in constructed buildings, and behavior change. Emory continues to work toward its new energy goals of 50% reduction in EUI and 25% reduction in total energy consumption between 2015 and 2025.

A temperature control policy and weekend, evening, and holiday building shutdowns have decreased the steam and chilled water (stationary sources) loads required to heat and cool

university buildings. A general decrease in energy consumption of around 20% is attributed to occupant behavior modifications. A LEED (Leadership in Energy and Environmental Design) Silver minimum requirement for all new construction and the complimentary Emory Sustainable Performance Program ensure that buildings – the largest energy consumers – are built and operate efficiently. Most recently, the addition of 440,263kwh of solar power on campus adds clean and renewable energy to the campus electricity distribution, and the years 2020-2021 will see that solar power grow tremendously by more than 5.5MW. In 2019, a system of 400-foot deep geothermal wells were dug into nearby McDonough Field to provide some 700 tons of heating/cooling capacity to the LEED Platinum Emory Student Center. In addition to aligning with the IPCC carbon neutrality recommendations, Emory supports the City of Atlanta's plan to transition to 100% Clean Energy by 2035.

***Scope 1 (stationary items on campus)***

Refrigerants and chemicals, direct campus transportation, and other on-campus stationary sources, such as emissions from burning purchased fuel in Emory's boilers and fleet vehicles, are included in scope 1. Together, they represent about 23.3% of Emory's $eCO_2$ emissions, at about 54,880 MT total (see Figs. 2 and 3). In FY2010, total Scope 1 emissions were higher, at about 70,180 MT. Other on-campus stationary items represent most of the FY2019 figure, at 91.8% of this scope's emissions (21.4%/23.3%). Emory's geothermal and co- generation figures from 2019 were not incorporated into this calculation because sufficient data were not available.

***Change in Scope 1 emissions, 2010-2019***

- There was a sharp drop in emissions from refrigerants and chemicals between FY2010 and FY2016. These emissions were lowered from about 9,030 MT $eCO_2$ in 2010 to only about 820 MT in 2016. The FY2019 report kept this figure very close to the 2016 figure at about 815 MT. This decrease was due to lack of data collection for Emory Healthcare in this category.
- Direct transportation emissions initially increased from FY2010 to FY2016, going from about 1,880 MT to about 4,850 MT. This figure decreased slightly in the FY2019 report, though, going down to about 3,720 MT.
- Other on-campus stationary items decreased their emissions from 59,270 MT in FY2010 to 49,700 MT in 2016. In FY2019 this figure rose slightly to 50,340 MT.

***Scope 2 (purchased electricity)***

Emory's purchased electricity (all of scope 2) accounts for just over half of its $eCO_2$ emissions, at about 128,810 MT (54.8%; see Figs. 2 and 3). These emissions can be reduced over time through energy efficiency measures, onsite electricity generation by clean and renewable sources, behavior change for energy use reduction, and changes in Georgia's energy grid to include more clean and renewable energy.

***Change in Scope 2 emissions, 2010-2019***

- Purchased electricity accounted for 189,930 MT of $eCO_2$ emissions in FY2010. This figure fell to 139,860 MT in FY2016, and further to 128,810 in FY2019. Since purchased electricity

accounts for over half of the University's $eCO_2$ emissions, it is great to see that emissions in this category have reduced by about 32.2% since the beginning of the decade.

***Scope 1 and 2 Total Emissions Reduction, 2010-2019***

Taken together, there was a 76,420 MT overall $eCO_2$ emissions reduction within Scopes 1 and 2 from FY2010 to FY2019, or a percent reduction of 29.3%. This value includes a 15,300 MT reduction for Scope 1 emissions (21.8 % reduction) and a 61,120 MT reduction for Scope 2 emissions (32.2 % reduction). This represents the overall reduction in $eCO_2$ emissions for all non-transportation (non-Scope 3) emission sources on campus.

***Scope 3 (transportation: air travel and commuting; transmission and distribution loss of electricity)***

University-sponsored air travel, including directly financed air travel and study abroad air travel, accounts for 8.93% of Emory's FY2019 $eCO_2$ emissions, or about 20,980 MT. Student commuting, staff commuting, and faculty commuting respectively account for 2.24%, 6.02%, and 1.56% of the FY2019 $eCO_2$ emissions, for a total of about 23,070 MT (9.82%; see Fig. 2). Transmission and distribution loss of electricity (generated electricity that does not reach consumers) is also included in Scope 3 and accounts for another 6,600 MT of emissions (2.81% of the total; see Fig. 2).

***Change in Scope 3 emissions, 2010-2019***

- Directly financed air travel and study abroad air travel together accounted for 15,100 MT $eCO_2$ in FY2010. In FY2016, this figure rose to 27,070 MT, and fell back to 20,980 MT in FY2019.
- Student commuting accounted for 4,690 MT of emissions in FY2010, 5,800 MT in FY2016, and 5,260 MT in FY2019.
- Staff commuting accounted for 45,540 MT of emissions in FY2010, then sharply dropped to 13,660 MT in FY2016, and rose slightly to 14,160 MT in FY2019. This sharp decline is mostly due to a change in reporting in 2016, and more accurate representation will occur over time.
- Faculty commuting accounted for 5,350 MT of emissions in FY2010, 4,090 MT in FY2016, and 3,670 MT in FY2019.

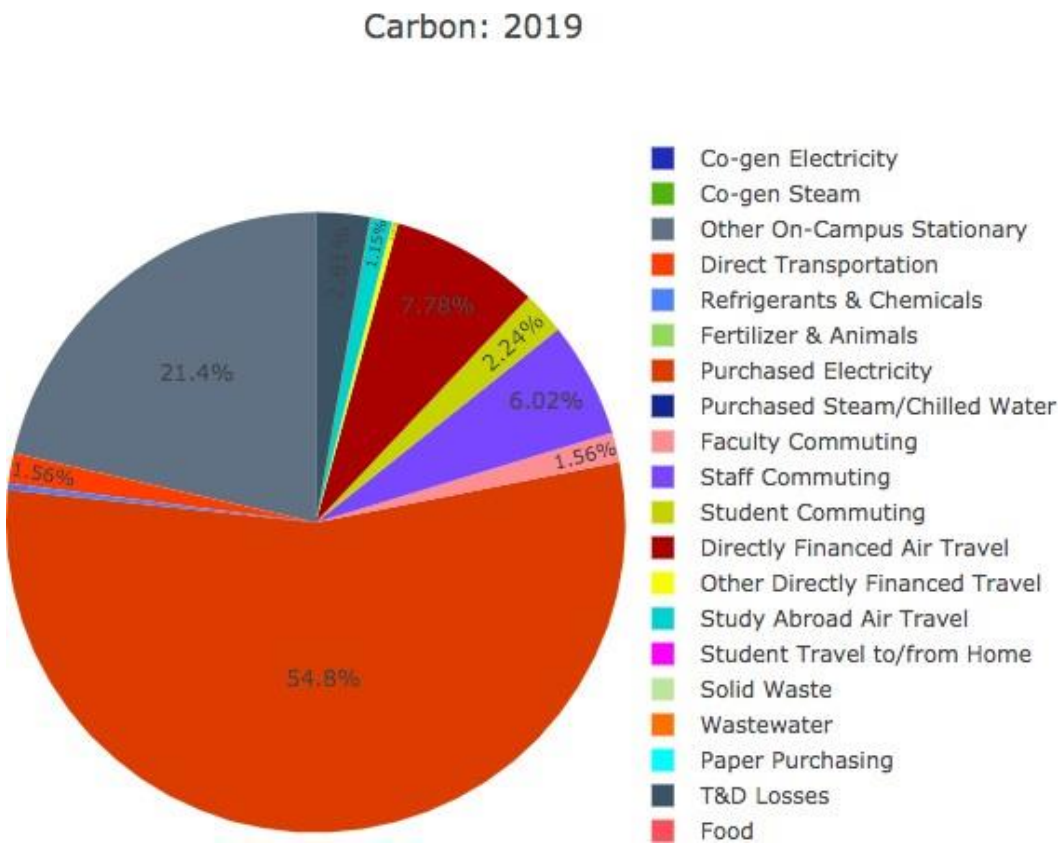


**Fig. 2.** Emory's $eCO_2$ emissions distribution for FY2019. The University's purchased electricity (scope 2) accounts for just over half of its emissions (54.8%). Scope 1 includes refrigerants and chemicals, direct transportation, and other on-campus stationary items, which together account for 23.3% of the University's emissions. Scope 3 includes directly financed air travel, study abroad air travel, student commuting, staff commuting, and faculty commuting, which together account for the remaining 21.9% of the University's emissions.

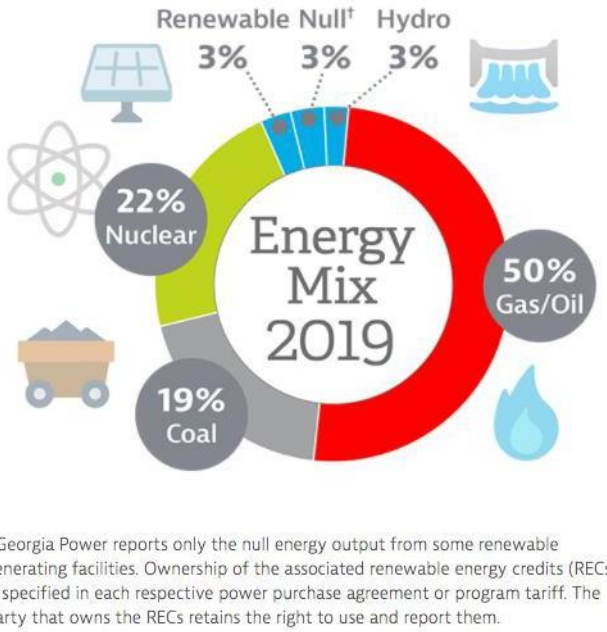


**Fig 3.** Scope 2 (purchased electricity) expanded. Most of Emory's purchased electricity comes from Georgia Power, and this is the company's energy source chart for 2019 (source: https://www.georgiapower.com/company/about-us/facts-and-financials.html). This chart is therefore a close representation of Emory's energy mix, though Emory's renewable energy proportion is rapidly growing through the continued installation of solar and geothermal energy sources on campus. The increased use of renewables at both Georgia Power and Emory itself are reflected in the 31.5% reduction of total GHG emissions between FY2010 and FY2019.

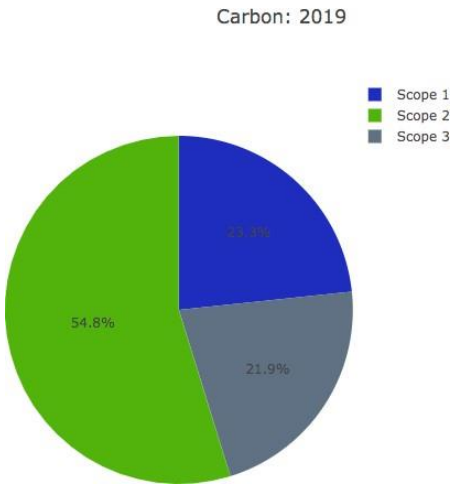


**Fig. 4.** This chart summarizes the contribution percentage of each scope toward the University's total FY2019 $eCO_2$ emissions.

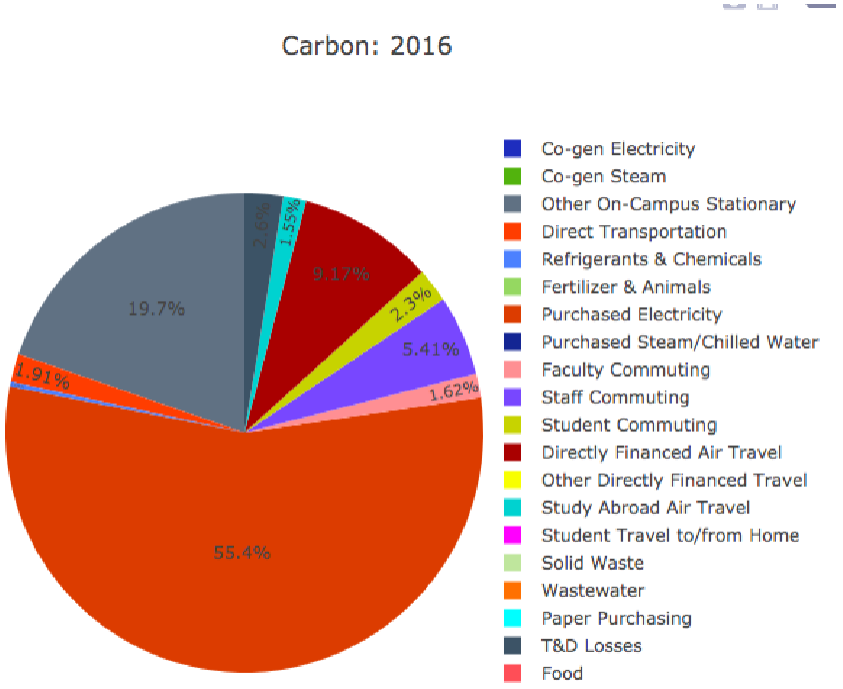


**Fig. 5.** Emory's $eCO_2$ emissions distribution for FY2016.

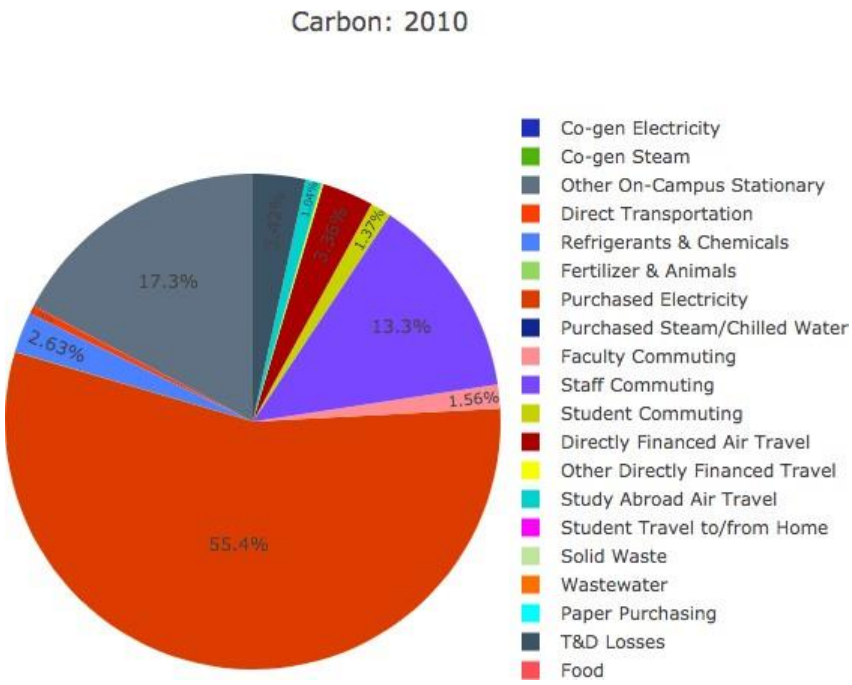


**Fig. 6.** Emory's $eCO_2$ emissions distribution for FY2010.