Emory's 2023 Greenhouse Gas Emissions Inventory

EMORY

sustainability initiatives

Prepared for Emory's Office of Sustainability Initiatives by E Rowe Consulting

Executive Summary

On October 13, 2021, Emory joined Second Nature's Presidents' Climate Commitment and the UN Race to Zero Campaign, two coalitions of higher education institutions committed to achieving net-zero carbon emissions and building resilience to the impacts of climate change. Key components of Emory's climate commitments include publicly reporting greenhouse gas (GHG) emissions annually and reporting on all climate action planning efforts. Emory has reported its GHG emissions since 2010, and this inventory is the third to be reported through the Second Nature platform.

In 2019, Emory updated its greenhouse gas reduction goals to mirror the latest scientific evidence and recommendations of the United Nations Intergovernmental Panel on Climate Change (IPCC). In a 2018 IPCC report, scientific evidence showed that to stabilize global mean surface temperature to a 1.5-degree Celsius (°C) target or lower, net anthropogenic emissions of greenhouse gases must decrease by 45% by 2030 (from 2010 levels), and the worldwide economy must achieve decarbonization by 2050. Aligning with the international expertise of the UN IPCC, Emory leadership approved updating Emory's baseline inventory year to 2010 and matching its GHG emissions reduction goals to these global targets. In accordance with Emory's climate commitments, Emory's interim 2030 emissions reduction goal was updated in 2023 from reducing total emissions by 45% from a 2010 baseline by 2030 to reducing emissions by 50% in the same period.

Since 2010, Emory, which includes both Emory University and Emory Healthcare, has reduced its GHG emissions by 33.48%.

Emory emitted a net quantity of 224,047 MT CO_2e (metric tons of carbon dioxide equivalent) of GHGs in 2023 (Figure 1). Emory's GHG emissions by scope were:[1]

SCOPE 1 ..... **53,880.84 MT CO_2e representing a 24.28% reduction from 2010 and 8.07% increase from 2022**

SCOPE 2 ..... **97,121.44 MT CO_2e representing a 46.32% reduction from 2010 and 7.58% increase from 2022**

SCOPE 3 ..... **73,044.36 MT CO_2e representing a 13.98% reduction from 2010 and 31.52% increase from 2022**

GHG Emissions from 2010-2023

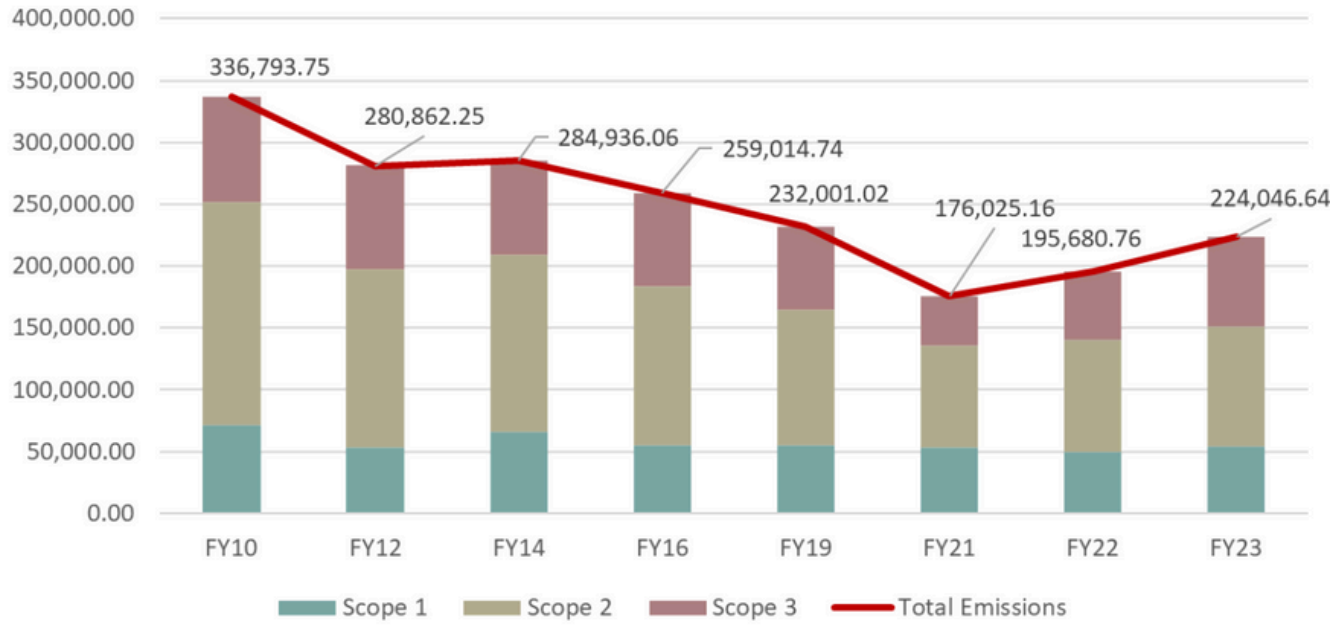

Figure 1. This stacked chart shows GHG emissions by scope from 2010-2023, and the trend line represents total GHG emissions. Emissions are shown in MT CO_2e.

1. Definitions of Emory's emissions scopes can be found in Appendix C: Methodology.

While an increase in emissions from 2022 to 2023 was anticipated given the decrease in emissions during the COVID-19 pandemic closures, this most recent inventory suggests Emory has returned to pre-COVID-19 business-as-usual emissions levels. The 2021 inventory results demonstrated the profound impact institutional policies can have on emissions reductions. From 2010 to 2021, Scope 3 emissions, which include activities such as commuting, air travel and study abroad, decreased by 31%, partially due to COVID-19 pandemic closures. Since 2021, Scope 3 emissions have increased by 80% (Figure 2). While Emory's emissions have decreased since 2010, the years since the onset of the COVID-19 pandemic in 2020 have demonstrated that institutional policies are driving changes in Emory's emissions. For Emory to achieve its 50% reduction by 2030, its annual emissions must be less than or equal to 168,027 MT CO_2e, meaning emissions must be reduced by 56,019 MT CO_2e by the end of the decade. For Emory to meet its 2030 emissions reduction goal, it is imperative that Emory begin evaluating the emissions categories that have seen the most growth and pursuing active policy changes and incentives to drive community behavior change.

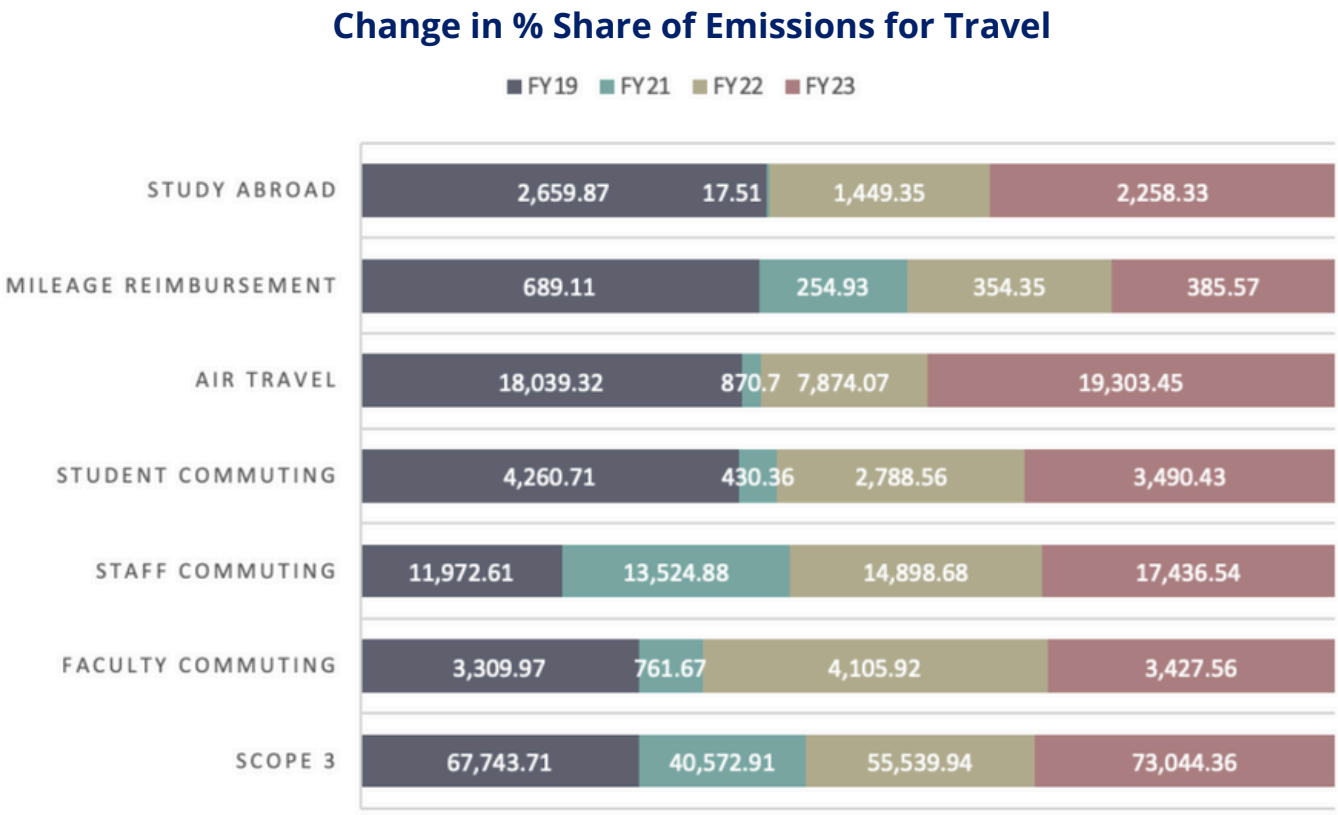

Figure 2. Travel is one of the principal drivers of changes to Emory's emissions from 2021 to 2023. This chart shows the percent share of emissions for travel for each travel type reported in the GHG inventory.

2. Pre-COVID business-as-usual emissions levels are represented in the 2019 inventory report. All references to 2019 emissions indicate historic business-as-usual emissions.

Introduction

Emory regularly measures its greenhouse gas (GHG) emissions, or carbon footprint, to monitor its efforts to reduce emissions to net zero by 2050 through strategies including energy efficiency, behavior change, clean and renewable energy sources, and new innovations. Emory began measuring and reporting its GHG emissions in 2010, with 2005 as the original baseline year, and subsequent inventories have been conducted in 2013, 2014, 2016, 2019, 2021, 2022, and 2023. The goal of these GHG inventories is to inform Emory's short- and long-term mitigation decisions, increase on-campus awareness of mitigation efforts, and provide accountability to these goals.

On October 13, 2021, Emory joined Second Nature's Presidents' Climate Commitment and the UN Race to Zero Campaign, two coalitions of higher education institutions committed to achieving net-zero carbon emissions and building resilience to the impacts of climate change. Key components of Emory's climate commitments include publicly reporting its annual GHG emissions and reporting on climate action planning efforts to the Second Nature platform. Prior to joining Second Nature, Emory had already reported its GHG emissions on the Office of Sustainability Initiatives (OSI) website and through its triennial Sustainability, Tracking, Assessment, and Rating System (STARS) report. In advance of the one-year anniversary of Emory's climate commitments, Emory published its historic GHG inventories and the 2021 inventory – the first to be completed since joining the commitments. This 2023 inventory is the third to be shared under the Second Nature commitment.

In 2019, Emory updated its GHG reduction goals to mirror the latest scientific evidence and recommendations of the United Nations Intergovernmental Panel on Climate Change (IPCC). At that time, scientific evidence showed that in order to stabilize global mean surface temperature to a 1.5-degree Celsius (°C) target or lower, net anthropogenic emissions of GHGs must decrease by 45% by 2030 (from 2010 levels) and the worldwide economy must achieve decarbonization (or reach net-zero emissions) by 2050.[3] Aligning with the international expertise of the UN IPCC, Emory leadership approved updating Emory's baseline inventory year to 2010 and matching its GHG emissions reduction goals to these global targets. In accordance with Emory's climate commitments, Emory's interim 2030 emissions reduction goal was updated in 2023 from reducing total emissions by 45% from a 2010 baseline by 2030 to reducing emissions by 50% in the same period. In addition to these goals, Emory completed its 2023 Climate Action Plan (CAP) in October 2023. The purpose of this plan is to prepare Emory to accelerate its emissions reductions, increase resiliency, embrace climate equity, and continue to lead on climate and sustainability among peer institutions. A progress update on Emory's CAP is provided later in this report.

3. Special Report: Global Warming of 1.5 °C (IPCC - 2018)

Inventory Results: Overall Emissions[4]

Historically, Emory has achieved annual GHG reductions despite significant growth. In 2021, Emory's emergency response to the COVID-19 pandemic caused an unusual reduction in GHG emissions. These reductions were primarily driven by Emory's temporary suspension of all University-sponsored travel and study abroad, and limitation of in-person activities, rather than any intentional, enduring changes in Emory's policies or operations.

It was therefore expected that Emory's emissions would rise in 2023 as Emory resumed pre-pandemic operations. While Emory's total emissions decreased from 2019 pre-pandemic levels, emissions did increase in several high impact areas, particularly air travel (Appendix A, Table 2).

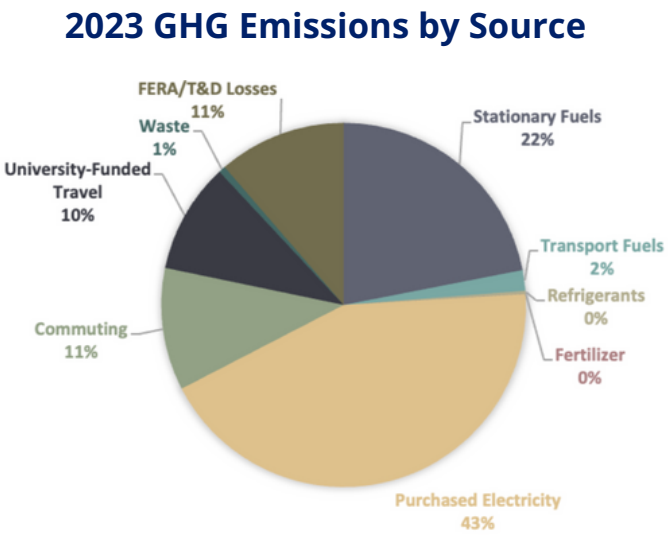

Figure 3. This chart shows the breakdown of Emory's GHG emissions with consolidated inputs to visualize how each of the overall emissions sources are impacting emissions.

As described above, Emory's COVID-19 policies demonstrated the profound impact Emory policy can have on Emory's emissions, both positively and negatively, and the increases in emissions for 2023 are primarily driven by policy decisions.

Since 2010, Emory has reduced its GHG emissions by 33.48% (Figure 3). Emory emitted a net quantity of 224,046.64 metric tons of carbon dioxide equivalent (MT CO_2e) in 2023 (see Appendix A, Table 1 for a breakdown of GHG emissions results). While it was not unexpected that emissions increased from 2022 to 2023, emissions increased by 13.53% and increased by 27% since 2021 (Figure 4).

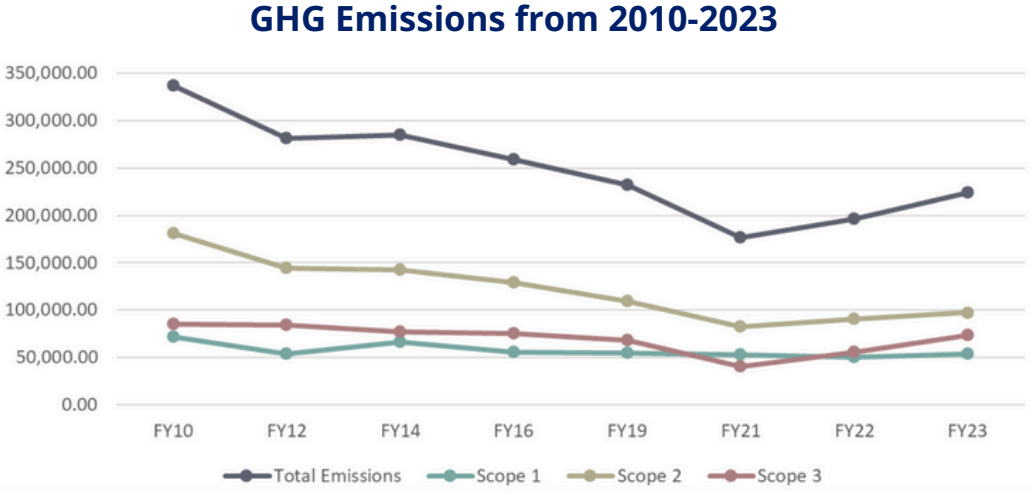

Figure 4. This chart shows changes in emissions from 2010 to 2023 for total emissions and each emissions scope.

4. In 2022, Emory's emissions reports began including FERA (fuel- and energy-related activity) emissions. These emissions are automatically calculated by SIMAP, and all previous inventories were re-run to include FERA emissions. For more information on this methodology change, as well as the inclusion of Transmission and Distribution (T&D) losses emissions, please reference Emory's 2022 GHG Inventory Report.

Changes in Emissions Factors for Purchased Electricity

Historically, Emory has utilized the emissions calculation settings built into the Sustainability Indicator Management and Analysis Platform (SIMAP) tool to complete its GHG inventories. To calculate the emissions for purchased electricity, SIMAP uses regional emissions factors provided by the Environmental Protection Agency (EPA) Emissions & Generation Resource Integrated Database (eGRID). An emissions factor is a coefficient that converts a quantity of an emissions-causing activity, in this case the amount of electricity consumed, to the corresponding quantity of GHG emissions released into the atmosphere. For purchased electricity, emissions factors measure the carbon intensity of the electricity grid for that region or state. The eGRID regional factors used by SIMAP do not capture all electricity generation changes occurring at the utility scale. Emory's regional utility mix includes Georgia, Alabama, northwest Florida and portions of Mississippi, many of which are areas included in the Southern Company's (Georgia Power's parent company) territory. Therefore, while each of these utilities have unique energy mixes, they are all comparable to each other, and therefore using this regional emissions factor has provided an acceptable estimate of Emory's purchased electricity emissions.

While using this regional emissions factor has historically been a best practice for Emory, changes in Georgia Power's utility mix prompted OSI to investigate if there is a more accurate emissions factor available. In July 2023, Georgia Power brought online Vogtle 3, an additional nuclear reactor at the Vogtle Plant, with Vogtle 4 under construction. Nuclear power does not produce carbon dioxide emissions, and therefore will reduce the carbon intensity of electricity in the state. At this point, the projected carbon intensity of Georgia Power's energy grid is unknown since, while the utility has plans to decommission most coal-fired power plants within the next decade, the utility has recently sought approval of increasing its supply of natural-gas fired power plants. The emissions associated with these new facilities have the capacity to out-pace the emissions reductions from Georgia Power's expanded nuclear capacity.

In addition to providing regional emissions factors, eGRID also provides emissions factors at the state-level. Georgia has historically had a less carbon-intensive grid mix than the region as a whole. This gap will likely widen as nuclear energy is added to Georgia's grid. Emory's OSI has made the decision to transition from using regional emissions factors for purchased electricity to using a Georgia-specific emissions factor. This change results in a reduction in reported Scope 2 emissions (Table 1), as well as a reduction in overall emissions. For example, in 2023, Scope 2 emissions are ~15% lower using a Georgia emissions factor as opposed to a regional emissions factor, and total emissions are ~7% lower.

OSI has updated all emissions reports back to the 2010 baseline to ensure consistent reporting, and all the emissions figures provided in this report are using the Georgia-specific emissions factors. It is also important to note that using a state-wide emissions factor is not a best practice for all universities since some states have multiple electric utility companies. However, Georgia Power provides electricity to 155 of the state's 159 counties, meaning that a state specific emissions factor is an accurate reflection of the carbon intensity of the Georgia Power grid.

	SSRO Region	Georgia-Specific	Change
2010 ($MTCO_2e$)	189,838.75	180,931.56	8,907.19
2019 ($MTCO_2e$)	123,797.65	109,593.90	14,203.75
2021 ($MTCO_2e$)	113,010.59	82,418.72	30,591.87
2022 ($MTCO_2e$)	104,358.86	90,282.27	14,076.59
2023 ($MTCO_2e$)	113,868.92	97,121.44	16,747.48

Table 1. Scope 2 emissions from SSRO regional emissions factor compared to the new Georgia emissions factor.

In both the region and the state, the carbon intensity of the electricity grid decreased in 2020, which resulted in a decrease in emissions. Despite purchased electricity increasing in 2023 compared to 2019, emissions from purchased electricity have decreased (Appendix A, Table C). However, Georgia experienced a larger reduction in carbon intensity during this time period than the region as a whole, which is reflected in the 30,591.87 MT CO_2e change in purchased electricity emissions for 2021 (Table 1). Carbon intensity increased again in 2022 for the state and region, and, in 2023, it stabilized for the region. In 2023, Georgia's carbon intensity once again decreased, and it is expected it will continue to decrease at a faster rate than the region given the influx of nuclear energy.

Changing the emissions factors used to calculate Emory's GHG inventory provides a more accurate picture of Emory's climate impact and gives insights into what factors are driving changes in emissions. Regardless of the change in Georgia Power's grid mix though, Emory's demand for purchased electricity is increasing even from the pre-COVID pandemic closures, and as a result, Emory's Scope 2 emissions are increasing as well.

Changes in Square Footage

For previous emissions inventories, OSI reported the gross square footage for buildings included in the campus boundary. In order to align with Emory-wide reporting standards, OSI has updated its reporting methodology to report gross floor area as defined by the National Center for Education Statistics' Facilities Inventory and Classification Manual (FICM). This definition excludes parking lots, patios, atriums, and unexcavated basements, and results in a roughly four million square foot decrease in reported square footage for Emory's Druid Hills campus than had previously been reported.

While this change in reporting methodology has no bearing on the overall results of the greenhouse gas emissions inventory, the change will appear on Emory's SIMAP profile and will also impact calculated energy use intensity in Emory's triannual Sustainability Tracking Assessment & Rating System (STARS) reports.

Scope 1 Emissions

Scope 1 emissions are GHG emissions from sources controlled and owned by Emory, including stationary fuels, transportation fuels, fertilizer, and refrigerants. In 2023, they represented 24% of Emory's GHG emissions, the same proportion as in 2019 (Figures 5 & 6). Scope 1 emissions were 53,880.84 MT CO_2e and have decreased by 24.28% from the 2010 baseline and 1.53% from 2019 pre-pandemic levels.

Changes in Scope 1 Emissions and Emission Sources

- Stationary Fuel emissions declined by 2.23% from 2019 levels. Natural gas usage decreased by 3.22% from 2019 levels; however, distillate fuel oil usage increased by 104.32% from 2019 levels (Appendix A, Table 3). In 2023, Emory's distillate fuel oil usage was the highest it has been in the last decade, and the fuel switching between fuel oil and natural gas is impacting the rate of emissions reductions for Scope 1 emissions.
- Transportation fuel emissions increased by 4.78% compared to 2022, and the quantity of transportation fuels used increased by 1.43% compared to 2022, meaning the carbon intensity of the fuels used is increasing and more fuels are being consumed (Appendix A, Table 3).
- Refrigerant emissions decreased by 72.58% compared to 2022, which reflects further refinement to the methodology to track Emory's refrigerant leaks. The 2022 inventory most likely overestimated Emory's refrigerant emissions, but the new reporting methodology will continue to provide insights into refrigerant emissions.
- Emissions from fertilizer use increased by 10.67% since 2022.

Emory's steam plant

Scope 2 Emissions

Scope 2 emissions are GHG emissions from purchased electricity, steam, and chilled water. Scope 2 emissions physically occur at the facility where electricity is generated but are attributed to Emory as the end user of the energy. For Emory, Scope 2 emissions are from electricity purchased from Georgia Power. In 2023, they represented 43% of Emory's GHG emissions, which is a lower share than in 2019 (Figures 5 & 6). In 2023, Scope 2 emissions were 97,121.44 MT CO_2e compared with 90,282.27 MT CO_2e in 2022. Scope 2 emissions have decreased by 46.11% from 2010 levels and increased by 7.58% compared to 2022 levels.

Solar panels on Emory's Fishburne parking deck

Changes in Scope 2 Emissions and Emission Sources

As noted above, Emory has changed the methodology for calculating Scope 2 emissions by using a Georgia-specific emissions factor as opposed to the regional factor historically used. Using the Georgia-specific emissions factor provides a more accurate estimate of Emory's GHG emissions from purchased electricity and additional insights into how the Georgia Power utility mix and Emory's consumption of purchased electricity are driving emissions. Since 2010, Scope 2 emissions have decreased by 46.32%, however the amount of electricity consumed has only decreased by 6.11%, meaning emissions reductions are primarily being driven by changes to the utility mix (Appendix A, Table 3). Since 2019, Scope 2 emissions have decreased by 11.38%, however the amount of electricity consumed has increased by 5.3% during that same time period (Appendix A, Table 3). The carbon intensity of Georgia Power's grid will continue to decrease as coal-fired plants are phased out and nuclear power plants come online. Consequently, Emory's scope 2 emissions will likely decrease over time. But for Emory to meet its 2030 reduction goal, Emory must continue investing in energy efficiency measures and renewable energy. Relying on the utility grid to drive emissions reductions is not a reliable strategy to reducing emissions, particularly if Emory continues to increase its rate of consumption of purchased electricity.

Scope 3 Emissions

Scope 3 emissions are attributable to Emory's operations, but do not occur on Emory's campus, meaning they are indirect emissions sources. This includes Emory-sponsored air travel, mileage reimbursement for ground travel, study abroad air travel, commuting, landfilled waste, FERA, T&D losses, and wastewater. In 2023, these sources represented 33% of Emory's GHG emissions compared with 29% in 2019 (Figures 5 & 6). Scope 3 emissions totaled 73,044.36 MT CO_2e. Scope 3 emissions were greatly reduced in 2021, and Scope 3 emissions have increased by 80% since 2021. While an increase in Scope 3 emissions was anticipated as Emory returned to business-as-usual operations, Emory's Scope 3 emissions have increased by 7.81% since 2019. While some of these emissions increases are attributable to changes in reporting methodologies for commuting, particularly staff commuting, Scope 3 emissions have increased from 2019 for air travel, waste, and wastewater.

Changes in Scope 3 Emissions and Emissions Sources

- For the 2023 inventory, OSI had access to additional data on commuting behavior and updated the methodology for calculating commuting emissions accordingly. As stated above, year over year comparisons of commuting emissions are difficult given this more accurate updated methodology. For example, Healthcare staff were not included in the 2019 inventory, and as a result commuting emissions have increased by 45.64% since 2019. There are also now 109% more commuters included in the calculation. Residential students have also been removed from the calculation since it is assumed they walk or take Emory transit. This means that the number of student commuters decreased by 23.85% since 2019. On the whole, fewer Emory community members are participating in telecommuting. Future inventories will provide additional insights into how commuting behavior is changing.
- The most dramatic change in the 2023 inventory was for University-sponsored air travel. Air travel emissions were 19,303.45 MT CO_2e, a 67.63% increase from 2010 and a 7.01% increase from 2019. Air travel accounts for 8.6% of Emory's total emissions, and 26.4% of Scope 3 emissions. At the same time, mileage reimbursement for ground miles and rail travel, have decreased by 14.53% since 2010 and 44.05% since 2019. Study abroad, which is calculated the same way as air travel, has also decreased since 2010 (36.84%) and 2019 (15.10%).
- Despite landfilled waste decreasing by 9.85% since 2019, waste emissions have increased by 196.2% over the same time period (Appendix A, Table 3). As described above, Emory's new waste hauler is taking Emory's waste to a landfill that practices methane flaring, as opposed to its previous hauler which used a landfill that practiced methane capture for energy. As indicated in the data, methane flaring has a much larger GHG intensity resulting in higher emissions.
- Wastewater emissions increased by 6.54% since 2022 and 8.36% since 2019, which is a reflection of an increase in potable water use.

A cyclist choosing a sustainable transportation option on campus

2023 Emissions by Scope

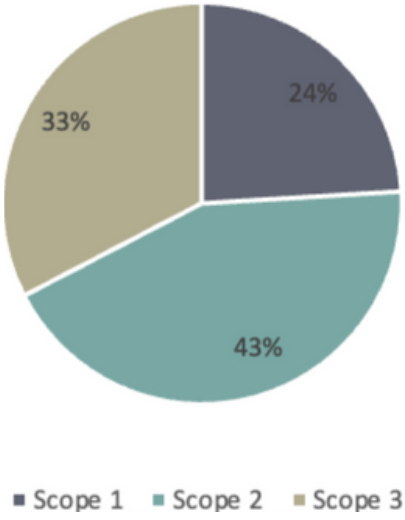

Figure 5. This chart shows the percentage of emissions by Scope for 2023.

2019 Emissions by Scope

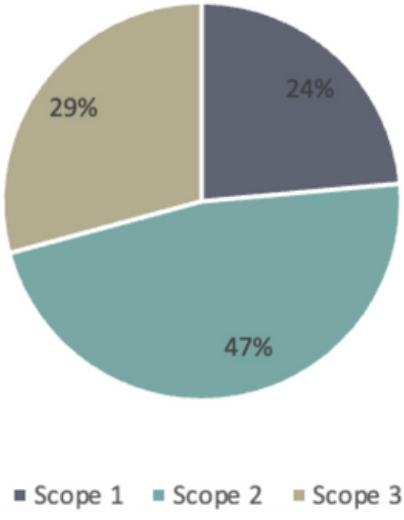

Figure 6. This chart shows the percentage of emissions by Scope for 2019.

Progress on Achieving Climate Action Plan Recommendations

Two years after signing Second Nature's Presidents' Climate Commitment, Emory's Office of Sustainability Initiatives published its 2023 Climate Action Plan. This plan is recognized as a dynamic, living document and intended to be responsive to changing technologies, policy conditions, and the integration of additional feedback from the Emory community. The 2023 GHG inventory is the first to be completed since the publication of Emory's CAP, and while the GHG inventory results cannot provide progress updates on all the CAP goals, the following is a progress report on the initiatives relevant to the GHG inventory.

Goal: Analyze the impacts of aligning Emory's decarbonization pathway with the practices of the UN IPCC by adopting a 2019 emissions baseline for all future emissions inventories.

Progress: By changing the baseline year for future emissions inventories and goal setting from 2010 to 2019, Emory would commit to make a more substantial emissions reduction this decade, which the IPCC has advised is critical to achieving net-zero emissions by 2050 and stabilizing global temperatures to 1.5 °C of warming by 2100. To reach a 50% reduction from a 2019 baseline, Emory's emissions must be less than or equal to 116,000.51 CO_2e, meaning emissions must be reduced by 108,046 CO_2e by the end of the decade.

Goal: To fulfill Emory's commitment to the UN Race to Zero pledge, it must adopt an interim goal of 50% emissions reductions by 2030.

Progress: As of 2023, Emory has achieved a 33.48% reduction in total GHG emissions from the 2010 baseline. For Emory to achieve its 50% reduction by 2030, its annual emissions must be less than or equal to 168,397 MT CO_2e, meaning emissions must be reduced by 55,650 MT CO_2e by the end of the decade.

Goal: Incorporate more elements of Emory's enterprise into annual emissions inventories and climate action planning.

Progress: At present, Emory's GHG inventory includes all University and Healthcare properties located on the Druid Hills campus, with the exception of the Wesley Woods campus. While an expansion of Emory's campus boundary would increase its current GHG emissions, these emissions are attributable to Emory's operations regardless of whether they are included in the inventory. Emory's OSI is exploring the feasibility of expanding the current GHG inventory to include all Healthcare properties and delineating University and Healthcare emissions to better understand how different elements of Emory's enterprise are driving changes in GHG emissions.

Goal: Prioritize energy efficiency in all campus buildings and operations.

Progress: Decreasing Emory's demand for energy through improved energy efficiency is a critical step in achieving carbon reductions. Emory currently has a goal to reduce Energy Use Intensity (EUI) by 50% by 2025 (from 2015 baseline), and as of 2023, EUI had decreased by 14.8%. In addition, Emory is also striving to achieve a 25% reduction in total energy consumption, and as of 2023, total energy consumption had decreased by 10.8%. The two primary programs Emory uses to increase campus energy efficiency are building recommissioning and Emory's Sustainable Performance Program (Appendix C). Through recommissioning, buildings achieve an average 29% reduction in energy use. This program not only reduces demand for purchased electricity, but also decreases the quantity of renewable energy required to offset the emissions from electricity use.

Goal: Investigate hot water rather than steam and using alternative fuel for Emory's steam plant.

Progress: Combined, the use of natural gas and fuel oil make up ~22% of Emory's emissions. These energy sources are primarily used to operate Emory's five 100,000 pound/hour steam boilers, which produce steam to heat Emory's buildings (Appendix C). At present, no significant emissions-reducing changes have been made in Emory's steam plant operation, but Emory has retained a consultant to investigate the feasibility and cost of such a conversion. Increases in energy efficiency and a change in operations in Emory's steam plant will be necessary to reduce Emory's Scope 1 emissions.

Goal: Continue installation of on-site renewable energy.

Progress: Since 2019, Emory's solar production has increased by 820%, and these solar arrays have a combined capacity of 3.6 MW (Figure 7). Emory is continuing installation of its Cherry Street solar project, which when complete will include 15,000 panels, and generate 5.5 MW representing 10% of Emory's peak energy demand. Combined, this will reduce Emory's annual GHG emissions by 4,200 MT. Despite the increase in solar production on campus, Emory's purchased electricity emissions have increased because Emory's consumption of electricity has been on the rise since 2021 and currently exceeds pre-pandemic levels.

Emory Solar Production

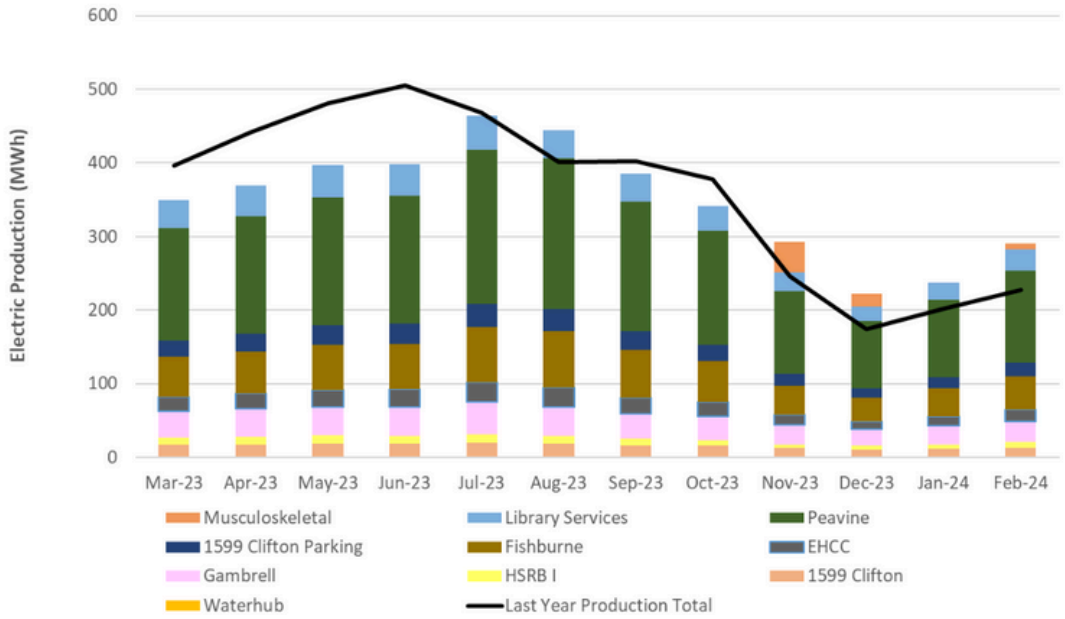

Figure 7. This chart shows Emory's solar production from March 2023 to February 2024.

Goal: Decrease the greenhouse gas emissions from Emory's fleet and shuttle systems, including conducting an analysis to understand the causes of Emory's increasing transportation emissions.

Progress: Both transportation fuel usage and emissions from transportation fuels are increasing. Emissions are increasing at a faster rate than fuel usage, which indicates that Emory is using emissions-intensive fuels in addition to using more transportation fuels. Even so, Emory's shuttle system is a critical resource in reducing commuting emissions. To maximize the benefits of Emory commuters using Emory's shuttle system, Emory should expand the use of less emissions-intensive fuels and transition to a hybrid/electric fleet.

Goal: Accelerate efforts to add electric vehicle charging stations to campus and maximize electrification of Emory's Cliff Shuttle System.

Progress: Emory currently has six electric vehicle charging stations and installed six chargers for six electric commuter buses in Fall 2023. While these data are outside of the date range for this inventory, increases in electric vehicle charging will increase the amount of electricity consumed on campus. However, this vehicle transition should also result in decreasing emissions from commuting and transportation fuels. This shift in fuels is especially important because purchased electricity is less carbon-intense than transportation fuels and will continue to become less carbon-intense as more carbon-free energy is introduced into the state's utility mix, and Emory increases its solar energy production.

Goal: Investigate opportunities to decrease emissions from staff, student, and faculty commuting.

Progress: At present, commuting emissions account for ~11% of Emory's GHG emissions. For the 2023 inventory, OSI updated the methodology for calculating Emory's commuting emissions, which makes a direct comparison to previous years difficult. However, one clear takeaway from the results is that fewer faculty, staff, and students are telecommuting than in 2022. From 2022 to 2023, telecommuting decreased by 95% among students, 28% among staff, and 95% among faculty. At the same time, the percentage of drive alone trips increased for all three stakeholder groups, and use of sustainable transportation options remained relatively stable. Moving forward using the new calculated methodology, it will be easier to compare commuting emissions year to year and understand what is driving changes in commuting emissions.

Goal: Consider options for minimizing or neutralizing carbon emissions from Emory-sponsored travel

Progress: While travel emissions obviously decreased during the COVID-19 pandemic, as referenced in the Executive Summary of this report, there was still a notable increase in 2023 even from 2019 levels. From 2021 to 2022, air travel increased by ~16 million miles, and from 2022 to 2023 air travel increased by ~26 million miles to reach ~44.5 million miles. Air travel emissions increased by ~145% from 2022 to 2023 and increased ~7% from the pre-pandemic emissions levels of 2019. Policy changes and incentives to minimize the number of Emory-sponsored miles flown, such as creating carbon budgets for air travel or adopting incentives for rail travel over air travel, are necessary for Emory to reach its 2030 emissions reduction goal.

Minimize Emory campus and healthcare waste sent to landfills.

Progress: Emory University reduced the quantity of waste it sent to landfills from 2022 to 2023 (and from pre-pandemic 2019 levels); however, emissions from landfilled waste have increased dramatically since Emory changed waste haulers in 2022. Emory's current waste haulers take waste to a landfill that practices methane flaring, which has a large emissions impact. Prior to changing waste haulers in 2022, Emory's landfilled waste was taken to a landfill that captured methane for energy production and had a much lower emissions profile.

Previous Inventory Corrections

While completing the 2023 inventory, there were several data errors discovered in the 2021 and 2022 inventories. Since the same team was completing the FY23 inventory, OSI made the decision to correct the data errors it could verify. These errors highlight why this is an iterative process, and inventories and methodologies should be evaluated annually.

Staff Commuting: Staff from Wesley Woods, a campus that is outside of the scope of this inventory, had been included in the number of Healthcare staff reported for staff commuting in 2021 and 2022. These individuals were removed (2021: 13; 2022: 173), and subsequently staff commuting emissions decreased for both 2021 and 2022.

Staff Commuting	Number of Commuters	Emissions ($MTCO_2e$)	Change ($MTCO_2e$)
FY21 - Original	6,238	13,554.87	
FY21 - Updated	6,225	13,524.88	-29.99
FY22 - Original	13,132	15,106.78	
FY22 - Updated	12,959	14,898.68	-208.1

Mileage Reimbursement: Rail mileage data was included in the 2021 inventory, but not the 2022 inventory. Since this data was available and included in 2021 and 2023, rail mileage (5,822 miles) was added into the inventory.

Mileage Reimbursement	Emissions ($MTCO_2e$)	Change ($MTCO_2e$)
FY 22 Original	353.62	
FY22 - Updated	354.35	0.73

Study Abroad: There was conflicting information in communications with the study abroad office about the number of miles traveled for 2022. After confirming the information, the study abroad miles were updated (38,282 miles).

Study Abroad	Miles	Emissions (MT CO_2e)	Change (MT CO_2e)
FY22 - Original	3,300,000	1,432.73	
FY22 - Updated	3,338,282	1,449.35	16.62

Waste: OSI is working on expanding emissions reporting to include waste produced from Healthcare operations. The complete report of healthcare waste data was not available at the time of the 2022 inventory's completion, but some was entered into SIMAP. This waste data (2,191.97 tons) was removed since it was incomplete, however the impact on emissions was minimal since this waste was taken to a facility that practices methane capture for energy production.

Waste	Waste (Tons)	Emissions (MT CO_2e)	Change (MT CO_2e)
FY22 - Original	4,773.76	1,085.79	
FY22 - Updated	2,581.79	1,086.96	0.90

Conclusion

Completing annual greenhouse gas inventories is an iterative process, and each GHG inventory represents just a snapshot in time. In a given year, there can be limitations in collecting data and discoveries of new data sources. This inventory and each previous inventory represent the best estimate of Emory's GHG emissions within its defined scope. As the urgency of the climate crisis continues to strengthen, there is a growing need for all sectors to continue to expand their reporting to include more emission types and divisions of their enterprises. This is even more important given the results of this inventory and Emory's increasing GHG emissions and 2030 emissions reduction deadline. Emory University is committed to annually benchmarking its GHG emissions, updating its reporting methodology to follow industry best practices, and analyzing its progress to achieving the goals of its Climate Action Plan.

Appendix A: GHG Emissions Tables

Table 1. Total GHG Emissions

Emission Type	Emissions ($MT CO_2e$)
Total	224,046.64
Scope 1	53,880.84
Scope 2	97,121.44
Scope 3	73,044.36
Stationary Fuels	49,128.42
Transport Fuels	4,093.79
Refrigerants	643.28
Fertilizers	15.35
Purchased Electricity	97,121.44
Faculty Commuting	3,427.56
Staff Commuting	17,436.54
Student Commuting	3,490.43
Air Travel	19,303.45
Mileage	385.57
Study Abroad	2,258.33
Waste	1,143.94
Wastewater	237.4
FERA	19,925.62
T&D Losses	5,435.52

Table 2. Percent Reductions

In the table on the right, green boxes indicate a reduction in emissions, and red boxes indicate an increase in emissions. The purpose of this table is to show the following emissions reductions:

FY23-FY10: compares FY23 to FY10 to show total reduction of emissions and reflects long-term progress made toward Emory's carbon neutrality goals.

FY23-FY22: compares FY23 to FY22 to show the percent reductions achieved between the two most recent inventories.

FY23-FY19: compares FY23 to FY19 to show percent reductions compared to a pre-COVID operating year.

Emission Type	FY23-FY10 (%)	FY23-FY22 (%)	FY23-FY19 (%)
Total	33.48	-14.50	3.43
Scope 1	24.28	-8.07	1.53
Scope 2	46.32	-7.58	11.38
Scope 3	13.94	-31.52	-7.81
Stationary Fuels	17.23	-12.7	2.23
Transport Fuels	-118.22	-4.78	-10.5
Refrigerants	93.5	72.58	15.55
Fertilizers	20.18	-10.67	-262.03
Purchased Electricity	46.32	-7.58	11.38
Faculty Commuting	-3.23	16.52	-3.55
Staff Commuting	38.30	-17.03	-45.64
Student Commuting	-16.99	-25.17	18.08
Air Travel	-67.63	-145.15	-7.01
Mileage	14.53	-8.81	44.05
Study Abroad	36.84	-55.82	15.1
Waste	Historic Errors	-5.27	-196.2
Wastewater	Historic Errors	-6.54	-8.36
FERA	16.31	-12.53	1.97
T&D Losses	51.39	-7.58	7.71

Table 3. Percent Reductions in Usage by Emissions Activity

This chart shows changes in the usage of data inputs for GHG emissions categories. Comparing usage of data inputs with GHG emissions can provide insights into what is driving emissions reductions/increases. For all categories, except solar, green cells represent a decrease in usage, which correlates for a decrease in emissions. For solar, an increase in solar production is marked in green since an increase in solar results in a decrease in Scope 2 emissions.

Emission Type	FY23-FY10 (%)	FY23-FY22 (%)	FY23-FY19 (%)
Natural Gas	14.98	-12.09	3.22
Distillate Oil	61.86	-56.07	-104.32
Solar	-	-3.4	820.61
Transportation Fuels	-98.35	-1.43	-3.98
Fertilizer	0	-7.35	-68.2
Refrigerant	84.13	77.44	21.33
Purchased Electricity	6.11	-10.63	-5.3
Faculty Commuters	-26.32	10.58	-27.25
Staff Commuters	31.25	-9.00	-105.99
Student Commuters	35.03	29.30	23.85
Mileage Reimbursement	6.42	-9.65	41.69
Rail Travel	-	-10.53	-
Air Travel	-103.26	-145.15	-7.01
Study Abroad Miles	23.41	-55.82	15.1
Waste	-	14	9.85
Wastewater	-	-6.54	-8.36

Appendix B: Understanding Greenhouse Gas Emissions

Greenhouse Gases

Greenhouse gases are gases that trap heat in the atmosphere.[5] While these gases, with the exception of hydrofluorocarbons, are naturally occurring in the atmosphere, human activities over the last ~150 years have increased the concentration of these gases in the atmosphere. This in turn leads to an increase in global temperatures, or anthropogenic climate change. The primary source of human-caused greenhouse gas emissions is the burning of fossil fuels (coal, oil, and gas), and the primary greenhouse gas emitted is carbon dioxide. Carbon dioxide, nitrous oxide, and methane account for 82% of present-day worldwide warming.[6]

Some greenhouse gases are more effective at trapping heat in the atmosphere than others. The most common anthropogenic emissions source is carbon dioxide, with carbon dioxide accounting for 79% of all U.S. GHG emissions.[7] In order to compare different GHGs and measure total GHG emissions (not just carbon dioxide), all greenhouse gases are converted into carbon dioxide equivalent. For example, methane is four times more potent than carbon dioxide, meaning it is four times more effective at trapping heat in the atmosphere than carbon dioxide. This means that one pound of methane emissions is equivalent to four pounds of carbon dioxide emissions. One pound of methane emissions can be denoted as 4 pounds CO_2e.

1.5 Degree Celsius Temperature Target

In order to mitigate the worst impacts of climate change and protect vulnerable populations, global warming must stabilize at 1.5°C this century. Therefore, an institution's commitment to achieving the mitigation pathways determined by the IPCC to reach this temperature target is a foundational step to grounding their climate action work in climate and environmental justice. This is not to say that there are no climate change impacts for warming below the 1.5°C threshold. To date, global temperatures have increased by 1.1°C, which has already caused widespread global impacts, including the three hottest months on record occurring from June-August in 2023.[8] Preventing every tenth of a degree of warming is critical for protecting human health and preserving the health of the planet.

5. Overview of Greenhouse Gases (US Environmental Protection Division - 2023)
6. Greenhouse Gas Emissions Information for Decision Making: A Framework Going Forward (National Academies - 2022)
7. Overview of Greenhouse Gases (US Environmental Protection Division - 2023)
8. The world just sweltered through its hottest August on record (National Oceanic and Atmospheric Administration – 2023)

Appendix C: Methodology

GHG inventories quantify GHG emissions and are used by a range of stakeholders to identify baseline emissions, track reductions, and inform future mitigation planning. All base figures for calculations, graphs, charts, and tables in this report were generated through SIMAP, and all figures were generated in Excel. SIMAP was chosen for this report because it is an emissions calculator specifically designed for higher education and the GHG reporting platform used by Second Nature for the Presidents' Climate Commitments reporting requirements. SIMAP utilizes an activity-based approach which calculates GHG emissions by multiplying the driver of a GHG producing activity, such as gallons of fuel used, by a conversion or emissions factor to calculate the corresponding GHG emissions.[9]

SIMAP updates its emissions factors and Global Warming Potential (GWP) factors annually, utilizing data from the IPCC, Climate Registry, and Greenhouse Gas Registry. Emory uses the emissions factors provided by SIMAP, and for 2023, updated factors to match SIMAP's latest recommendations, including:[10]

- Emissions Factors Version 2022: emissions factors vary by input type
- Global Warming Potential Version AR5 100-year: the effect greenhouse gases will have in the atmosphere over a 100-year time period. This GWP version does not account for the climate-carbon feedback. For several of the refrigerants used by Emory, SIMAP does not provide GWPs for those chemicals. These GWPs are pulled from the California Air Resources Board which provides a database of all GWPs for all refrigerants on the market.
- Radiative Forcing Factor of 2.7: emissions from air travel are multiplied by a radiative forcing factor (2.7) to account for the higher GWP from emissions released at higher altitudes, such as air travel.
- Scope 2 Market-Based: Emory updated its calculations for Scope 2 emissions from Location-Based to Market-Based in 2021 to reflect the reporting requirements for Second Nature. Both approaches account for regional fuel mixes, meaning that regions with less renewable energy in the grid mix will have higher GHG emissions for Scope 2. The market-based approach allows an institution to account for any renewable energy purchased or sold by an institution. Since Emory does not purchase or sell renewable energy, switching from the location-based to market-based scenario has not altered the calculations for Scope 2 emissions.

This inventory was completed by a third-party consultant with internal support from Emory's OSI staff.

9. Greenhouse Gas Emissions Information for Decision Making: A Framework Going Forward (National Academies - 2022)
10. More information on speicif emissions factors in publicly provided on SIMAP's website.

Emissions Sources and Scopes

Emory's emissions are largely from carbon dioxide (CO_2). Methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HFC) emissions represent only a small percentage of Emory's total inventory. These GHGs currently account for 82% of present-day, worldwide warming.[11] Below is a list of Emory's sources for each of these emission types.

- **CO_2 (carbon dioxide)**: On-Campus Stationary Sources, Transportation Fuel, Purchased Electricity, Commuting, and Air Travel (including Study Abroad)
- **CH_4 (methane)**: On-Campus Stationary Sources, Transportation Fuel, Purchased Electricity, Commuting, Air Travel (including Study Abroad), Solid Waste, and Wastewater
- **N_2O (nitrous oxide)**: On-Campus Stationary Sources, Transportation Fuels, Fertilizers, Purchased Electricity, Commuting, and Air Travel (including Study Abroad)
- **HFC (hydrofluorocarbon)**: Refrigerants

GHG calculations are delineated as either direct emissions sources (which are owned or operated by Emory) or indirect emissions sources (which are not owned or operated by Emory, but are a result of Emory's operations). Emissions sources are further categorized by means of three different scopes:

- **Scope 1** includes all direct GHG emissions from sources owned or maintained by Emory. For example, emissions from burning fuels in Emory's boilers and fleet vehicles are considered Scope 1 emissions. Scope 1 emissions occur on Emory's campus.
- **Scope 2** includes indirect GHG emissions from purchased electricity by the institution. Scope 2 emissions physically occur at the facility where electricity is generated, such as Georgia Power's power plant, but are attributable to Emory as the end user of the product.
- **Scope 3** includes all other indirect emissions. Scope 3 emissions are directly attributable to Emory's operations but are from sources outside the definitions of Scopes 1 and 2. At present, Emory reports Scope 3 emissions for Emory-funded travel; study abroad; student, faculty, and staff commuting to Emory; and wastewater and landfilled waste generated by Emory. SIMAP also automatically calculates the emissions for transmissions and distribution (T&D) losses and fuel- and energy-related activities (FERA).

Under its Second Nature commitment, Emory is only required to report Scope 3 emissions for Emory-funded travel and commuting. When comparing Emory's progress to peer institutions in the Second Nature reporting platform, note Emory is voluntarily reporting additional emissions sources which impacts its total emissions and Scope 3 emissions.

11. Greenhouse Gas Emissions Information for Decision Making: A Framework Going Forward (National Academies - 2022)

Inventory Boundary and Timeframe

GHG emissions for this inventory are collected for the main campus of Emory University and Emory Healthcare located in the Druid Hills neighborhood of Atlanta, Georgia. This inventory includes in its scope all Emory buildings located on and around Clifton Road, the Briarcliff campus, and Emory National Primate Research Center. Healthcare facilities included are Emory University Hospital and its adjacent buildings; Clinics A, B, and C; the 1525 Clinic; and the Emory Rehabilitation Hospital. Wesley Woods hospital campus and other Emory Healthcare hospitals and campuses are not included within the campus boundary at this time. A university and healthcare system have very different building requirements and energy demands, and it is rare for a university to include its healthcare system within its GHG inventory, as Emory does. OSI is exploring the possibility of differentiating University and Healthcare emissions to better understand how these two entities are driving Emory's total GHG emissions. More information about this will be provided in a future inventory report.

All data are reported for fiscal year 2023, which ran from September 1, 2022 to August 31, 2023.

Utilities

Roughly 70% of the emissions in this inventory come from Stationary Fuels and Purchased Electricity, which together provide the energy necessary to operate Emory's buildings.[12] Emory's campus receives utilities from external sources through several electric, natural gas, and domestic water systems. As of this 2023 inventory, 4,053,136 kWh of solar power was produced on campus – an 820% increase from 2019 and a 3.4% decrease from 2022. In 2020, Emory began installation of 15,000 panels totaling 5.5 MW which have the capacity to generate 10% of Emory's peak electricity demand and reduce emissions by 4,300 MT annually.[13]

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 to over 100 buildings.[14] Five large natural gas fired boilers in the central steam plant distribute steam throughout steam mains to buildings. The steam produces hot water and hot air for water heating and building comfort. The boilers recover energy from the exhaust steam and control the amount of unburned oxygen to maximize energy conservation efficiency. In 2016, a steam-turbine generator, which is part of a cogeneration/combined heat power (CHP) system utilizing the existing mechanical heat from the natural gas boiler, became operational. The heat is captured, generating a higher-pressure steam that turns a turbine that improves the efficiency of Emory's energy use. This system has the capacity to provide an additional 1 mega-watt (MW) of electricity for the same level of natural gas usage. This electrification of energy systems is a critical pathway to carbon neutrality, since electricity can be produced from carbon-free sources, whereas there are no carbon-free alternatives for natural gas and other heating oils. At the time of this inventory, the cogeneration facility was not operational and therefore not included within the inventory.

In 2019, a system of 400-foot-deep geothermal wells were dug in nearby McDonough Field to provide some 700 tons of heating and cooling capacity to the LEED Platinum-certified Student Center. This system is not directly reported in the GHG inventory since geothermal does not generate power. Instead, this system is indirectly reported through reductions in stationary fuel usage.
Three chilled water plants use electrical centrifugal water chillers to produce 42°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.

Steam and chill water loads have decreased as a result of a temperature control policy and weekend, evening, and holiday building shutdowns. A LEED (Leadership in Energy and Environmental Design) Silver minimum requirement for all new construction and complementary Emory Sustainable Performance Program are major drivers of EUI reductions for Emory, and result in energy efficiency and optimization.

12. For the purpose of this inventory, water usage is not included in the calculation because SIMAP only accounts for purchased chilled water, and Emory creates its own chilled water via electric water chillers.
13. Transformative solar power agreement will help Emory reduce greenhouse gas emissions (Emory University - 2020)
14. Plug and process loads are energy loads that are not related to general lighting, heating, ventilation, cooling, and water heating, and that typically do not provide comfort to the occupants.