FINAL REPORT

Fiscal Year 2019 Greenhouse Gas Inventory for the University of Pittsburgh, Pittsburgh Campus

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Acknowledgements

This report presents the greenhouse gas inventory results for University of Pittsburgh (Pitt) for FY 2019. The authors acknowledge the contribution of Laura Zullo from the Office of the SVC of Business & Operations, who both provided valuable information, data, and review that allowed us to complete the inventory. In addition, we sincerely thank all other Pitt staff members who provided us data and shared important information regarding their sustainable practices; these individuals are fully acknowledged in Appendix C.

Executive Summary

The objective of this report is to present and assess the Greenhouse Gas (GHG) Inventory for the Pittsburgh Campus of the University of Pittsburgh (Pitt) for fiscal year (FY) 2019, including direct and indirect activities of the university. Since the initiation of a GHG inventorying process in 2008, this is Pitt's fifth GHG inventory report, building on and comparing to the previous four inventories from FY 2008, 2011, 2014, and 2017 [1]–[4].

This report and its precursors serve as a guideline for the Chancellor's Advisory Council on Sustainability, its Carbon Commitment Committee, and any future committees, groups, or individuals working to reduce the GHG emissions of Pitt in the future. Especially given Pitt's February 2020 commitment to achieving carbon neutrality for its Pittsburgh campus by 2037, this report has new bearing and urgency [5]. Understanding current GHG emissions is a necessary step towards developing the strategies that will help achieve Pitt's carbon goals by lowering future GHG emissions. An annual GHG inventorying process is also a part of Pitt's new Carbon Commitment [6].

Beyond carbon, Pitt has set specific goals related to its sustainability. The *Pitt Sustainability Plan* was published in January 2018, detailing 61 goals over 15 impact categories that fall into three overarching themes: Exploration, Community & Culture, and Stewardship [7]. Some of these goals align with those of the Pittsburgh 2030 District, of which Pitt is a Founding Property Partner of the Oakland boundary [8]. The Pittsburgh 2030 District Goals are to reduce water consumption, energy consumption, and GHG emissions from transportation by 50% by 2030 [9]. Pitt intentionally aligned its *Pitt Sustainability Plan* GHG goal with those of the 2030 District, setting a 50% reduction in GHG emissions goal by 2030 (below 2008 levels); the Plan also includes many more goals across the full spectrum of sustainability.

For this analysis, Pitt's Fiscal Year 2019 was selected as the temporal boundary, July 1, 2018 through June 30, 2019; fiscal years have been chosen for all past GHG inventories, allowing for result comparisons across all GHG Inventory years, which previously include FY 2008, 2011, 2014, and 2017.

Overall, the University of Pittsburgh saw an increase in GHG emissions from 214,185 in FY17 to 215,522 in FY19 metric tons CO_2e, due to an increase from on-campus stationary sources, commuting, directly financed air travel, and study abroad. Increased use of Bellefield Boiler Plant due to FY19 maintenance on the Carrillo Street Steam Plant had an impact on raising the GHG emissions from steam usage, which also increased due to more heating degree days.

In line with widespread higher education GHG inventorying practices, Pitt uses the SIMAP (Sustainability Indicator Management and Analysis Platform) web software created by the University of New Hampshire's Sustainability Institute to manipulate all GHG Inventory data [10]. As the University previously used a SIMAP predecessor *called "Clean Air-Cool Planet," FY 2008, 2011, and 2014 GHG inventories were imported into the SIMAP tool,* causing slight changes in past-reported data. These differences can be primarily attributed to slight changes in emissions factors between the two tools; these specific instances are highlighted throughout the report as relevant.

From FY 2008 to present, there have been numerous changes in campus infrastructure, creating ongoing potential to change source distribution, and resulting GHG emissions. For FY 2019, the overall distribution of Pitt's GHG emissions by source activity shown in Figure 1 remained similar to the previous inventoried fiscal years, as shown in Table 1.

For FY19, purchased electricity was again the largest GHG emitting source for the university, accounting for 34% of all of the University's emissions. Overall, total campus-wide electricity usage remained relatively

similar to FY17 levels, with only a 0.83% (1,769 MWh) increase, despite building additions to the inventorying process resulting in a 14% increase in gross building area served (by 1350 kSF). Since FY08, marked changes in the regional electricity generation mix have significantly reduced the percentage of electricity produced by coal, while increasing nuclear, natural gas, and renewable electricity. Additionally, as a result of both grid shifts and Pitt's purchases of unbundled renewable energy certificates (RECs), the FY19 GHG Inventory shows a 30% reduction in GHG emissions (31,805 metric tons CO_2e) from purchased electricity compared to FY17 – and a 47% reduction since FY2008 (64,898 metric tons CO_2e). Due to the lowering of regional emissions factor since FY08, Scope 2 transmission and distribution losses related to electricity demand have also decreased every year including FY19.

Behind purchased electricity and combined on-site and purchased steam, the third largest contributor to Pitt's GHG emissions is "Directly Financed Air Travel," which saw a large increase between FY17 and FY19. Overall, fuel efficiencies for airlines continue to improve, but Pitt saw an 47% increase in faculty and staff air travel. Similarly, study abroad emissions increased by roughly a factor of two, due to a significant growth in air travel miles, an increase in the number of countries traveled to by students, and reporting corrections. Similar to many other universities, Pitt strongly encourages students to participate in international studies, which is beneficial to the students and the university for many reasons but has resulted in a substantial increase of GHG emissions from air travel.

The University of Pittsburgh, overall, saw a small increase in GHG emissions from 214,185 in FY17 to 215,522 in FY19 metric tons of CO_2e. In order to decrease their emissions, the university could participate in a number of reduction activities, specifically, those aimed at the largest contributing factors to the GHG inventory. Purchased electricity has always been the largest contributor to emissions; however, as seen in the FY19 inventory, a significant decrease was made due to the purchasing of more renewable sources for electricity. The university should continue to increase their purchasing and usage of renewable sources to decrease their emissions overall. The second largest contribution to emissions is from directly financed air travel which is a Scope 3 emission that has increased with every inventory. In order to reduce these emissions, the university could look more closely into where and how people are travelling and could re-direct some of the air travel to lesser GHG producing modes of transportation. Another large increase in FY19 was in study abroad travel by almost double. Though there has been a calculation error in previous years to account for some of this increase, it is still recommended the university look at how and where university members are travelling and see if there is a way to decrease these emissions by way of the mode of travel.

In FY20, there are a number of steps we want to take to have more accurate accounting of emissions as well as help to inform the university of how to further decrease their emissions. One of these essential steps is paying significant attention to all university-related transportation (including commuting, owned vehicles, and purchased ground and air travel) in both analysis and significant emissions reduction strategies. Another step that should be taken is accounting for all possible carbon offsets, both downstream and upstream, that the university has access to whether that be in directly financed car and air travel or in renewable energy purchased. A last step that should be completed in the next inventory is an improved accounting of the building stock and its utilities usage at the Pittsburgh campus and the inclusion of properties that are not owned by the university but fully leased. These changes in addition to Pitt's new goal to reduce energy and water usage by 50% by 2030 should expedite these efforts and expand them to include the regional campuses as well for an overview for the entire University system.

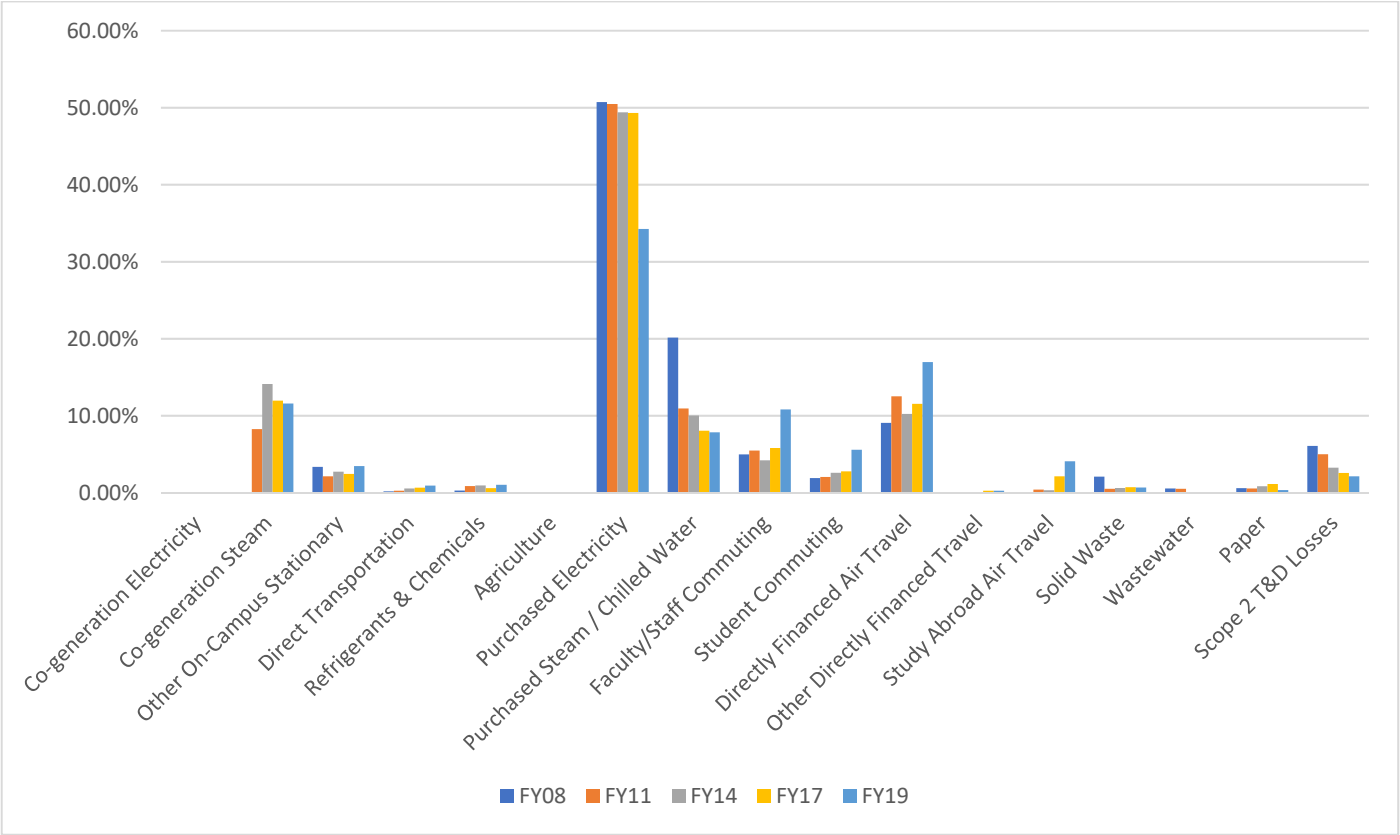


Figure 1 - Pitt GHG Emission Source Distributions for All GHG Inventory Years

Table 1 - Pitt GHG Emissions for All GHG Inventory Years

(All emissions in metric tons of carbon dioxide equivalent (MT CO_2e)

	Source Category	FY08	FY11	FY14	FY17	FY19
Scope 1	Co-generation Electricity	0	0	0	0	**0**
	Co-generation Steam	0	22,200	32,981	25,623	**24,978**
	Other On-Campus Stationary	9,200	5,700	6,386	5,245	**7,470**
	Direct Transportation	500	700	1,273	1,388	**1,992**
	Refrigerants & Chemicals	800	2,300	2,192	1,266	**2,240**
	Agriculture	0	1	2	1	**1**
Scope 2	Purchased Electricity	138,700	135,500	115,341	105,607	**73,802**
	Purchased Steam / Chilled Water	55,100	29,400	23,404	17,238	**16,892**
Scope 3	Faculty / Staff Commuting	13,600	14,700	9,845	12,433	**23,293**
	Student Commuting	5,200	5,500	6,064	5,962	**12,036**
	Directly Financed Air Travel	24,800	33,600	23,921	24,706	**36,560**
	Other Directly Financed Travel	100	50	211	548	**582**
	Study Abroad Air Travel	0	1,100	775	4,578	**8,816**
	Solid Waste	5,700	1,400	1,437	1,522	**1,454**
	Wastewater	1,500	1,400	136	104	**102**
	Paper	1,600	1,500	1,949	2,441	**729**
	Scope 2 T&D Losses	16,600	13,400	7,596	5,523	**4,575**
	Scope	**FY08**	**FY11**	**FY14**	**FY17**	**FY19**
Totals	Scope 1 (Direct Emissions)	10,500	30,901	42,834	33,523	36,681
	Scope 2 (Indirect Emissions)	193,800	164,900	138,744	122,845	90,694
	Scope 3 (All Other Emissions)	69,100	72,650	51,933	57,817	88,147
	Reporting Metric	**FY08**	**FY11**	**FY14**	**FY17**	**FY19**
Totals	Required (Scope 1 & 2)	204,300	195,801	181,578	156,368	153,928
	Scope 1 & 2, Air Travel, Solid Waste	234,800	231,901	207,711	187,174	200,758
	Scope 1 & 2, Transportation, Solid Waste	255,200	253,551	223,966	206,221	237,690
	All Accountable Emissions	**273,400**	**268,451**	**233,511**	**214,185**	**215,522**

1 INTRODUCTION

Universities have the knowledge necessary to create sustainable campuses at many levels. Increasing numbers of student sustainability groups and increased enrollment in sustainability-focused and related academic courses and majors illustrate the growing attention of this generation towards sustainability on-campus and as a profession. Higher education institutions also teaching about and conduct research on sustainability, including how issues like climate change are interwoven with racism, equity, and economic injustice. As a result, higher education institutions have a multitude of opportunities to lead society towards solutions of climate change, which is a shared human threat regardless of country and location.

This report stems from this understanding and aims to quantify and facilitate strategies that support reductions of GHG emissions from the University of Pittsburgh's activities. A GHG inventory is both a first and repeatable step towards creating effective GHG reduction strategies, especially since inventories help identify and quantify hotspots or critical areas to address among different GHG sources.

There are three stages to the GHG Inventory process: data collection, GHG emissions calculation, and data analysis for climate action planning [11].

Step 1: Data Collection – Many pieces of raw data are required to conduct a GHG inventory, including purchased electricity, transportation modes and distances, solid waste quantities, refrigerants utilized, carbon offsets purchased, etc.

Step 2: Emissions Calculations – Collected data is processed as inputs into a calculator tool. Pitt uses SIMAP (Sustainability Indicator Management & Analysis Platform). SIMAP is an online, comprehensive tool for college campuses to measure, calculate, and report carbon and nitrogen footprints in order to meet their sustainability goals effectively and efficiently.

Step 3: Data Analysis – In order to compare GHG sources and identify emissions reduction opportunities, SIMAP converts all emissions into CO_2 equivalents.

This report begins by introducing SIMAP, the study boundaries, and scope. Results are presented under each category together with assumptions made during calculations. Discussion of results and comparison to previous GHG Inventory results are provided, followed by recommendations for updating this report in the future. The last chapter of the report is conclusions.

2 SIMAP: SUSTAINABILITY INDICATOR MANAGEMENT AND ANALYSIS PLATFORM

The University of New Hampshire (UNH) and now defunct nonprofit Clean Air Cool Planet (CA-CP) collaborated to create a widely used Clean Air-Cool Planet Campus Carbon Calculator (CA-CP calculator) to calculate GHG emissions. Specifically designed for educational institutions, the CA-CP calculator was used by 90% of the thousands of U.S. colleges and universities that publicly report their GHG emissions and recommended by the American College and University Presidents' Climate Commitment (ACUPCC) [7]. ACUPCC became the President's Climate Leadership Commitments, which are managed by Second Nature [6]. As a result, all measurement processes now reference Second Nature's Carbon Commitments "Measurement Progress" Guidance [12], which leans on Greenhouse Gas Protocol, which "supplies the world's most widely used greenhouse gas accounting standards" [11].

An Excel-based spreadsheet, the CA-CP calculator was designed to facilitate data collection and analysis. Although the primary purpose of the tool was to conduct a greenhouse gas inventory, it could be used to facilitate other tasks also. If data regarding carbon reduction projects are available, such as the amount of reduction expected for a certain commodity, the tool can be used to estimate future GHG emissions taking into account common emissions and reductions from potential projects. SIMAP can also be used to predict total Nitrogen emissions should that be valuable to the university. The calculator used standard methodologies and emission factors provided by the GHG Protocol.

The University of New Hampshire's Sustainability Institute evolved the CA-CP calculator from a Excel tool to an online portal. As of January 2018, all university GHG inventories are fully recommended to use the new, online SIMAP (Sustainability Indicator Management and Analysis Platform). **Pitt began using SIMAP for its FY14 GHG Inventory and all successive inventories (including this FY19 GHG Inventory)**. This tool functions identically to the CA-CP Calculator and allows users to upload prior Calculator Excel results. All data from previous inventories were uploaded to SIMAP and all tables, analyses, and explanations reflect results from the updated SIMAP calculations.

3 BOUNDARIES OF THE INVENTORY

Three boundaries exist for calculating the campus GHG emissions: organizational, operational, and temporal. Each is described in the sections below.

3.1 ORGANIZATIONAL BOUNDARIES

Organizational boundaries are the highest of the three boundaries, and therefore the first boundaries drawn during the creation of the GHG Inventory. Organizational boundaries state whether GHG emissions are measured for one department, school, or an entire campus. Setting the organizational boundary helps determine which facilities and operations must be included in the GHG analysis. **For this study, the University of Pittsburgh's Pittsburgh Campus (primarily located in the Oakland neighborhood of Pittsburgh) was selected as the organizational boundary.** Student Housing facilities located on- and off-campus and managed by Pitt were included in the analysis. Buildings owned and managed by the separate nonprofit organization University of Pittsburgh Medical Center (UPMC) were excluded, as were facilities and operations of Pitt's four regional campuses in Bradford, Greensburg, Johnstown, and Titusville. A full list of buildings included in the FY19 inventory is provided in Appendix B.

Within this organizational boundary for FY19, buildings owned and managed by Pitt at the Pittsburgh Campus total 109 buildings with a gross building area of 11.6 million ft^2 -- **an increase of approximately 1,350,000 square feet from the FY17 inventory**. Table 2 summarizes all the changes in the campus building stock between FY17 and FY19, including the new Sports Dome, which opened in mid-2017; other additions include off-campus facilities managed by Facilities, but not previously included: Plum Borough Research Facility, Scaife Hall for the inclusion of Medical students and their facilities, Thomas Boulevard facility that houses Surplus and library assets, and Motor Pool.

As Table 2 also summarizes, between FY17 and FY19, six off-campus Housing facilities owned by Pitt (but located outside of the traditional Pittsburgh campus boundary) were added to the inventory for the first time. These facilities were not previously included because tenants were billed individually and/or directly by utility companies; all meters for these Housing buildings are now controlled by the University, so they have been added as of the FY19 inventory.

Table 2 - Pitt Building Stock Data Changes between FY17 and FY19 GHG Inventories

Building Name	Gross Square Footage
530 Melwood (Motor Pool)	8,200
College Gardens Apartments	297,510
Darragh Street Housing	102,217
Forbes Craig Apartments	43,554
Franklin Complex	50,753
Mayflower Apartments	14,940
Oakwood Apartments	14,886
Plum Borough Research Facility	41,139
Scaife Hall	474,881
Thomas Boulevard	192,000
Thomas Boulevard Parking	0
Trees Field - Sports Dome	105,608
Total	**1,345,688**

LEED (Leadership in Energy and Environmental Design) is the U.S. dominant green building rating system created by the US Green Building Council. LEED certification distinguishes buildings designed, constructed, operated, and maintained to offer occupants a host of sustainability benefits, including lower energy and water consumption, better indoor environmental quality, and a plethora of other sustainable features [13]. Pitt has LEED certified buildings dating back to 2005, with the Graduate School of Public Health (GSPH) Addition achieving LEED Gold in FY19. Pitt's cumulative LEED certified square footage totals 1.8 million square feet, or nearly 16% of the campus building stock. Table 3 summarizes all of Pitt's Pittsburgh campus buildings pursuing LEED certification post-FY19.

Table 3 - Pittsburgh Campus Buildings Recently Awarded & Pursuing LEED Certification

Building Name	Certification	Year
GSPH Addition	Gold	2018
Clapp Hall	Silver	2020
GSPH Renovations	Registered - Certified	Pending
Hillman Library	Registered - Silver	Pending
Salk Hall Renovations	Registered - Gold	In Construction
Scaife Hall Addition and Renovation	Registered - Gold	In Construction
Petersen Sports Complex	Registered - Silver	In Construction
Recreation and Wellness Center	Gold - Anticipated	In Design
Hillside Housing	In Design	In Design

In FY19, there were 28,673 full–time equivalent (FTE) students enrolled at Pitt. Part-time students, included in this total, were accounted for as a half of a full-time equivalent student (per SIMAP methodology). Additionally, in FY19, Pitt's Pittsburgh campus had 2,704 faculty and 5,769 staff. The staff total includes Pitt individuals listed as staff, research associates, and postdoctoral associates at the Pittsburgh campus. *These numbers include all schools including the School of Medicine (post-docs as staff and students), which is a new addition for FY19.* We have not included School of Medicine faculty due to the intractable links to UPMC. Although Pitt's School of Medicine is considered a UPMC affiliate, staff utilize Pitt-owned facilities and contribute to the University's GHG emissions profile. Pitt's FY19 inventory population numbers are compared to previous years in Table 4, showing a 7.6% increase from FY17 and a 14.5% increase from FY08.

Table 4 - University of Pittsburgh Population, All GHG Inventory Years

Community	FY08	FY11	FY14	FY17	FY19
Students (FTE)	24,755	26,740	25,917	26,240	28,673
Faculty	2,688	2,878	2,791	2,944	2,704
Staff	4,995	5,079	5,012	5,341	5,769
Total	**32,438**	**34,697**	**33,720**	**34,525**	**37,146**

3.2 OPERATIONAL BOUNDARIES

Operational boundaries identify GHG emitting sources to be included in the inventory. The GHG Protocol categorizes emissions into three scopes [14]. Scope 1 includes "direct emissions" from sources that are owned and controlled by Pitt, such as on-campus steam and electricity generation, on-campus natural gas usage, transportation by campus operations, refrigerants and chemical use, and agricultural activities. Scope 2 emissions include "indirect emissions" from sources that are neither owned nor operated by Pitt, but whose products are linked to campus energy consumption; Scope 2 includes purchased electricity, steam, and chilled water. Scope 3 emissions are "other sources" neither owned nor operated by Pitt, but that are either "directly financed" by the University (i.e., commercial air travel paid by Pitt, waste removal) or are otherwise linked to the campus via influence and/or encouragement (i.e., air travel for study abroad programs; daily faculty, staff, and student commuting). Scope 3 emissions also include paper consumption, solid waste disposal, wastewater treatment, and energy transmission and distribution losses.

Tracking Scope 1 and 2 emissions is mandatory under the GHG Protocol. Although Scope 3 emissions are deemed optional by the GHG Protocol, Pitt includes as many emission sources as possible and relevant to obtain a realistic inventory for the institution. The University's GHG reduction goals specified in and after the *Pitt Sustainability Plan* refer to Scope 1, 2, and 3 emissions. Pitt's carbon goals include 50% reductions in GHG emissions below 2008 levels by 2030 and carbon neutrality for the Pittsburgh campus by 2037 [5].

3.3 TEMPORAL BOUNDARIES

The final boundary is the temporal boundary. The calculator uses fiscal years instead of calendar years since most universities (including Pitt) financially function on a fiscal year basis. Fiscal years at Pitt begin on July 1 and end on June 30 of the following calendar year. This study focused on evaluating Fiscal Year 2019, which began July 1, 2018, and ended on June 30, 2019. Previous inventories included Fiscal Years 2008, 2011, 2014, and 2017. One aim of this compendium of GHG Inventory work is to understand the changes in Pitt's carbon footprint since 2008.

4 EMISSIONS

The context of each emission source, results obtained, and assumptions made during calculations are detailed under each section below. Table 22 summarizes all of the information. However, individual data points that are inputs into SIMAP are also provided at the end of each subsection.

4.1 SCOPE 1 EMISSIONS

Scope 1 emissions cover sources that are fully owned and managed by the University of Pittsburgh.

4.1.1 STATIONARY COMBUSTION

Scope 1 stationary combustion emissions include any activities where fuel is burned, or gases are directly released into the atmosphere. This includes any on-campus electricity generation, steam generation, and gas usage. During Pitt's first GHG Inventory in FY08, Scope 1 emissions had a smaller impact because the university purchased all of its steam from single "outside generator," the Bellefield Boiler Plant.

In November 2009, Pitt began operation of its own Carrillo Street Steam Plant (CSSP), a natural gas powered, high-efficiency, low NO_x emitting steam plant located on the upper Pittsburgh campus. The CSSP is jointly owned and operated by Pitt and the University of Pittsburgh Medical Center (UPMC), and serves Pitt, UPMC, and other Oakland buildings tied into this cooperative commercial district steam network.

The CSSP is not a co-generation heat and power (CHP) facility and thus does not create electricity along with steam. As a result, "Co-generated Electricity" for Pitt has always been zero.

The CSSP was first included in Pitt's FY11 inventory but was not in full operation at that time, only supplying Pitt with 49% of its total steam demand. FY14 was the first inventoried year where CSSP was in full operation, supplying Pitt with 64% of its annual steam demand. At that time, the other 36% was supplied by the Bellfield Boiler Plant (BBP), the other Oakland district steam plant to which CSSP is interconnected; the BBP is not directly owned or operated by Pitt, and is discussed in greater detail in Section 4.2.2 covering Scope 2 Purchased Steam Emissions.

Between each inventoried year, Pitt's total steam demand increased by roughly 150,000 klbs every three years between FY08 and FY14, from 533,000 klbs in FY08; to 699,000 klbs in FY11; to 841,000 klbs in FY14. In FY17, Pitt's total steam demand dropped to 642,000 klbs in FY17 and then increased slightly to 663,000 klbs in FY19. In FY19, this translated into **total steam-related emissions of 41,870 MT CO2e, which accounted for 19% of Pitt's total GHG emissions.** Because the CSSP is Pitt's only Scope 1 steam source and supplied 61.1% of the total Pitt steam demand in FY19, total Scope 1 "Co-Generation Steam Emissions" total to 24,978 MT CO_2e. A detailed breakdown and comparison of steam consumption and related emissions are shown in Figure 2 and detailed in Table 5. Steam plant efficiencies and emission factors vary between years, which is why consumption-to-emission ratios are not constant year-to-year. For FY17, an overall decrease in heating degree days explains a significant drop in steam demand; for FY19, continued steam use reduction is attributed to campus-wide operational efficiency efforts by Facilities Management. However, this reduction is small and that can be attributed to the increase of heating degree days in FY19.

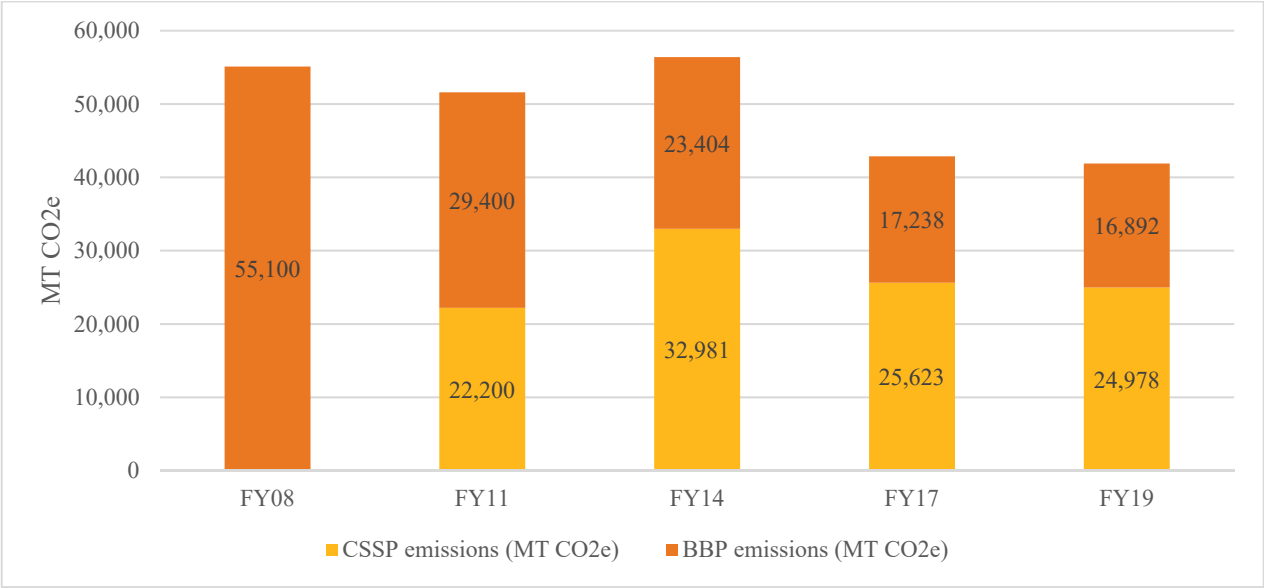


Figure 2 - GHG Emissions from Pitt's Steam Consumption for All GHG Inventory Years (CSSP = Carrillo Street Steam Plant, BBP = Bellefield Boiler Plant)

"Other On-campus Stationary Sources" at Pitt include natural gas used in individual buildings. This natural gas is typically used for air heating, water heating, backup generators, and/or for laboratory purposes. The total natural gas usage in FY19 accounted for 140,427 MCF, which translates to 7,470 MT CO_2e (3.5% of total Pitt GHG emissions). Emission factors associated with the combustion of natural gas were provided by SIMAP.

Table 5 - Pitt Stationary Combustion Data for All GHG Inventory Years (CSSP = Carrillo Street Steam Plant, BBP = Bellefield Boiler Plant)

	FY08	FY11	FY14	FY17	FY19
CSSP Steam (klbs)	n/a	342,405	535,812	409,236	405,180
BBP Steam (klbs)	532,693	356,381	304,889	148,299	227,913
Total Steam (klbs)	**532,693**	**698,786**	**840,701**	**641,819**	**663,093**
CSSP Emissions (MT CO_2e)	n/a	22,200	32,981	25,623	24,978
BBP Emissions (MT CO_2e)	55,100	29,400	23,404	17,238	16,892
Total Steam-Related Emissions (MT CO_2e)	**55,100**	**51,600**	**56,385**	**42,861**	**41,870**
Natural Gas[a] (MCF)	168,289	104,555	120,120	98,595	140,427
Total Emissions from Natural Gas Usage (MT CO_2e)	**9,200**	**5,700**	**6,386**	**5,245**	**7,470**

[a] On-campus natural gas usage for non-CSSP activities.

4.1.2 UNIVERSITY FLEET

Another source of Scope 1 emissions is fuel usage by the University Fleet. This category includes all fuel used and financed by the University for campus-wide transportation and select off-campus ground transportation. Fuel in this category is used by Facilities Management, Dining, Logistics, Real Estate, campus shuttles, Athletics, and other university-owned vehicles; it does not include chartered bus service.

Pitt uses three (3) tracking systems for its fleet fuel use:

1) Guttman Oil tracking is used for fuel purchased strictly on Pitt's Pittsburgh campus;
2) Voyager tracking includes additional University of Pittsburgh purchased fuel, including both the Pittsburgh campus and regional campuses; and
3) Fuelman tracking which includes fuel purchased by Pitt for shuttle buses.

In the Voyager system, it is difficult to accurately extract Pittsburgh campus-related fuel purchases because not all purchases have identification corresponding to a campus or a department. However, a combination of credit card numbers and "fill up" addresses was used to identify fuel purchases by Pittsburgh campus personnel, which were allocated to this inventory. This FY19 University Fleet process mirrors the records and analysis performed in FY14 and FY17, but varies from those of the FY08 and FY11 inventories.

Guttman Oil weekly fuel reports were available for all of FY19, with minor adjustments required as weekly reports did not align precisely with the Fiscal Year calendar. Voyager and Fuelman reports are generated monthly and were available for all FY19 months.

The Guttman, Voyager, and Fuelman reports identify the purchased fuel to be either regular gasoline or diesel, which is consistent across all inventories. For appropriate vehicles, Pitt uses blended biodiesel instead of pure, petroleum-based diesel. Biodiesel can be mixed with petroleum diesel to create different blends suitable for different vehicle engines and performance. Pure biodiesel is labeled as B100; a mix of 5% biodiesel and 95% petroleum diesel is labeled as a B5 mix. Although different grades of biodiesel are currently available in the market, only two biodiesel mixtures exist in Pittsburgh: B5 or B100. A B5 blend was assumed to be used by the University Fleet.

Based on data provided by Pitt's Office of Parking, Transportation, and Services, Pitt's FY19 vehicle fleet consisted of 281 vehicles total, of which 233 were Pittsburgh campus vehicles and 48 were regional campus vehicles, see Table 6. **The total estimated FY19 fuel use was 157,400 gallons of gasoline; 994 gallons of biodiesel; and 60,626 gallons of diesel, translating into total GHG emissions of 1,992 MT CO_2e (0.81% of total GHG emissions).** This included estimated fuel reported from:

- Fuelman of 35,481 gallons of gasoline;
- Guttman Oil of 48,706 gallons of gasoline and 994 gallons of biodiesel;
- Voyager of 121,919 gallons of gasoline and 11,920 gallons of diesel.

Between FY17 to FY19, total gasoline consumption increased approximately 28,000 gallons (1.6 times FY17), while combined bio/diesel usage increased by 38,570 gallons (nearly 22%). The FY19 fuel use increase is primarily attributed to the inclusion of shuttle fuel usage, which was not previously included. Additionally, more accurate records and a slight increase in the size of the fleet contributed to increases.

Table 6 - University Fleet Data for All GHG Inventory Years

	FY08	FY11	FY14	FY17	FY19
Number of Vehicles	203	193	218	228	233
Gasoline (gallons)	42,300	71,800	126,973	129,164	157,400
Diesel (gallons)	-	-	-	-	60,626
Biodiesel (gallons)	11,220	9,500	11,976	23,050	994
GHG Emissions (MT CO_2e)	**500**	**700**	**1,273**	**1,388**	**1,992**

4.1.3 REFRIGERANTS

Hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) are greenhouse gases often used for refrigeration -- and accounted for under Scope 1 emissions. Under ideal conditions, these gases are used as refrigerants in closed loop systems not contributing to fugitive GHG emissions. However, inevitable leaks in cooling systems result in refrigerants becoming fugitive emissions that must be included in Pitt's GHG Inventory because refrigerants often have high global warming potentials (GWP). The quantity of Pitt's fugitive GHG emissions from refrigerants is assumed to be equal to the amount of refrigerants needed to recharge on-campus mechanical systems during maintenance activities.

In FY19, Pitt used total of 1,707 pounds of refrigerants, which translates to 2,240 MT CO_2e (1.04% of total GHG emissions). This total is similar to FY11 and FY14 inventories, though nearly 77% higher than FY17. Due to the erratic nature of refrigerant leakage, disposal, and replenishment, Pitt's overall refrigerant use is part of required refrigerant maintenance and cannot be attributed to any change in facilities or campus policies. This makes it difficult to compare refrigerant emissions between GHG inventories, with the exception of reviewing general consumption trends of refrigerants by GWP.

Table 7 summarizes the type and amount of refrigerant used by Pitt across all inventoried fiscal years, along with the GWP of each refrigerant. It should be noted that SIMAP uses Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) values, which varies slightly from IPCC AR4, which was used in previous inventories [15]. Additionally, all past inventories input R-12 under refrigerant NF3, which has a GWP of 16,100, much higher than that of CFC-12, which has a GWP of 10,200 (and is now used as part of SIMAP's calculations).

Table 7 - Pitt Refrigerant Quantities for All GHG Inventory Years [15]

	Quantity Used (lbs)						
Type	**FY08**	**FY11**	**FY14**	**FY17**	**FY19**	**GWP100**	**Source**
R-134a	41	840	400	6	35	1,430	EPA
R-12	20	36	0	18	0	10,890	EPA
R-404a	1	1	0	171	172	3,943	SIMAP
R-22	637	754	453	897	718	1,810	EPA
R-123	400	200	200	400	100	77	EPA
R-11	0	400	0	0	600	4,600	SIMAP
R-407c	0	0	0	0	50	1,924	SIMAP
R-408a	0	4	0	0	2	2,430	SIMAP
R-410a	0	107	0	65	31	1,924	SIMAP
R-414	19	0	0	0	0	1,450	FY08
R-500	3	0	0	0	0	37	FY08
R-503	1	0	0	0	0	15,000	FY08
R-507	0	0	0	37	0	3,985	EPA
GHG Emissions (MT CO_2e)	**799**	**2,251**	**2,192**	**1,266**	**2,240**		

Note: GWP100 = global warming potential for a 100-year horizon

Although they make up a small percentage of overall GHG emissions, refrigerants pose significant threats to human health and should be minimized whenever possible. **In general, trends show Pitt shifting away from more potent GWP refrigerants in preference of lower GWP refrigerants.** The University should further use its now annual GHG Inventory process and this report to continue to shift away from high volume usage of high GWP products that have particularly high GWP (R-11, R-12, R-22) when used in high volumes, to decrease the impact of refrigerants campus-wide. In general, as older mechanical units reach the end of their lifecycles and are replaced, the University should also avoid further use of the more potent refrigerants. Though outside the temporal boundary of this inventory, Pitt replaced its last two (2) R-11 chillers in 2020 and is seeking to replace its remaining small R-22 split systems in the near-term.

4.1.4 AGRICULTURAL ACTIVITIES

Scope 1 agricultural sources of GHG emissions account for animal herding as well as fertilizer, pesticide, or herbicide use for crop growth and landscaping. Since Pitt does not herd animals on its Pittsburgh Campus, there are no herding-related emissions. However, Pitt does use herbicides for landscaping activities.

Synthetic herbicides are labeled with their chemical makeup using three (3) numbers that represent the percentages of nitrogen (N), phosphorus (P), and potassium (K). For example, Momentum (a pre-emergent crabgrass herbicide) is identified by the numbers 21-0-11, indicating that it consists of 21% nitrogen, 0% phosphorus, and 11% potassium. Fertilizers and herbicides contribute towards GHG emissions when a portion of their nitrogen content volatizes and forms the compound N_2O.

Because different commercial fertilizers have different nitrogen percentages, a weighted average of nitrogen content is typically calculated based on the amount of fertilizer used and its specific nitrogen content. Because Pitt only used one type of fertilizer in FY19, this calculation was not necessary.

In FY19, Pitt used 2,648 pounds of fertilizer with a nitrogen content of 11%. Overall, this was a 40% increase in fertilizer usage, see Table 8. However, because the % nitrogen was only a small increase from the 10.2% used in FY17, **only 0.73 MT CO_2e is associated with Pitt's FY19 GHG emissions from fertilizers** (using SIMAP emission factors).

Table 8 - Pitt Fertilizer Data for All GHG Inventory Years

	FY08	FY11	FY14	FY17	FY19
Total (pounds)	475	1,125	2,250	1,892	2,648
Nitrogen Content (%)	12.6%	18.1%	20.3%	10.2%	11.0%
GHG Emissions (MT CO_2e)	**0.26**	**0.85**	**1.89**	**0.72**	**0.73**

4.2 SCOPE 2 EMISSIONS

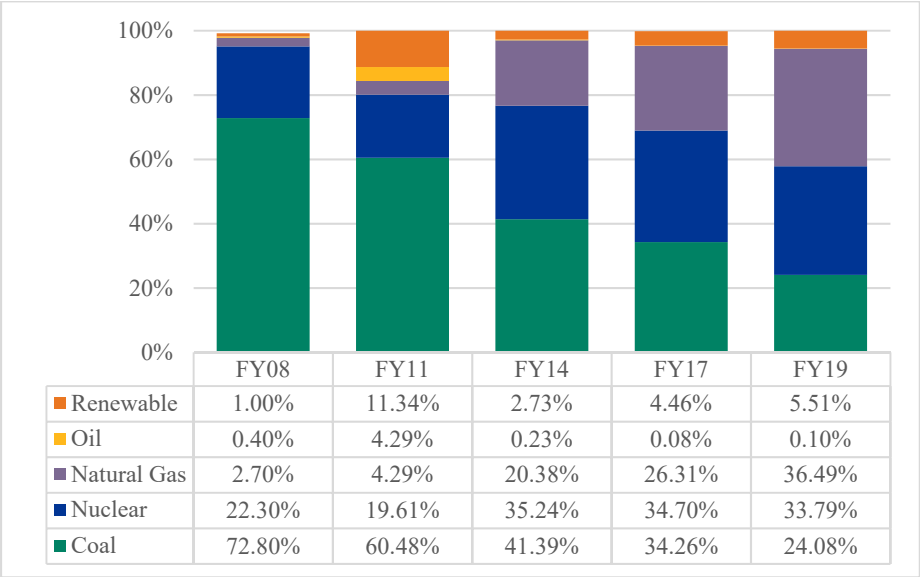
Scope 2 emission sources cover purchased electricity and steam, which are vital to support the activities of Pitt's urban campus, which primarily occur in buildings. Purchased electricity and steam make up the majority of emissions for many higher education institutions.

4.2.1 PURCHASED ELECTRICITY

The Scope 2 "Purchased Electricity" category includes all electricity not generated on Pitt's campus and purchased from outside suppliers. **Purchased electricity it is the largest contributor to Pitt's GHG emissions in all inventoried years.** Emissions from purchased electricity are calculated using reported electricity usage and the electricity generation fuel mix reported by suppliers – thus any changes in electricity consumption and mix have a large impact on the Pitt's total GHG emissions.

The SIMAP tool can use either regional fuel mix information from the U.S. EPA's eGRID program OR a customized, user-input fuel mix for its calculation [16]. Electricity generation fuels are organized into the following 10 categories: coal, natural gas, distillate oil, residual oil, nuclear, waste-to-energy, hydroelectric, biomass, renewable (wind, solar), and other.

A detailed comparison of electricity generation fuel mixes is shown in Figure 3 for all five Pitt GHG Inventory years. **From FY08 to FY19, coal has decreased from 72.8% to 24.1% of the grid mix, while natural gas has grown from 2.7% to 36.5%.** Renewables have increased from 1% to 5.5% of the grid, though the University's tracking of renewables goes beyond the grid, as described in Section 4.2.1.1.



	FY08	FY11	FY14	FY17	FY19
Renewable	1.00%	11.34%	2.73%	4.46%	5.51%
Oil	0.40%	4.29%	0.23%	0.08%	0.10%
Natural Gas	2.70%	4.29%	20.38%	26.31%	36.49%
Nuclear	22.30%	19.61%	35.24%	34.70%	33.79%
Coal	72.80%	60.48%	41.39%	34.26%	24.08%

Figure 3 - Regional Grid Electricity Generation Fuel Mix by GHG Inventory Year

Pitt's FY08 inventory used the default fuel mix for the RFC West region, which was dominated by 73% coal and 22% nuclear power. Starting in FY11, a custom fuel mix has been used, as summarized below:

- **FY11** = *Provided by First Energy.* Decreased to 60.5% coal and 19.6% nuclear. Significant increase in energy generation from oil and gas (8.6%) and renewables (11.3%).
- **FY14** - *Provided by PJM Interconnection.* 41.1% coal, 35.2% nuclear, 20.4% natural gas, 2.7% renewables, and 0.2% oil.
- **FY17** - *Provided by USource.* 34.3% coal, 35.2% nuclear, 26.3% natural gas, 3.5% renewables, and 0.1% oil.
- **FY19** - *Provided by EDF on PJM Interconnection.* 24.1% coal, 33.8% nuclear, 36.5% natural gas, 5.5% renewables, and 0.1% oil.

Because this inventory process uses a custom fuel mix in SIMAP, emissions factors are specific to campus. This means that the total emissions for the campus are site-specific and, therefore, more precisely reflect the impact of Pitt's electricity. As Table 9**Error! Reference source not found.** indicates, the emissions factors for the fuel mix of Pitt's campus are generally lower than the default eGrid regional emissions factors. These "Custom Fuel Mix Emissions Factors" are applied to Pitt's annual electricity consumption (covered subsequently) to calculate GHG emission resulting from Pitt's electricity usage.

Table 9 - eGrid and Custom Fuel Mix Emission Factors (kg CO2/kWh)

Fiscal Year	eGrid Emission Factor	Custom Fuel Mix Emissions Factor
2008	0.704	0.742
2011	0.682	0.652
2014	0.626	0.540
2017	0.568	0.488
2019	0,529	0.413

As shown in Table 10, Pitt's total electricity consumption in FY19 increased by 0.8% (1,769 MWh) from FY17. This small increase is likely due to the more inclusive building square footage included in this inventory, not an increase in electricity demand overall. Additionally, given the increase in cooling degree days from FY17, electricity consumption by building air conditioning systems was likely up, indicating that the more electricity retrofits occurring across campus are contributing to responsible electricity management campus-wide (Table 11). However, as a result of the electricity generation fuel mix changes discussed above, **Pitt's FY19 GHG emissions from purchased electricity decreased by 31,805 MT CO_2e, a 30% decrease compared to FY17 and a 47% decrease since FY08.**

Table 10 - Pitt Electricity Data All GHG Inventory Years

	FY08	FY11	FY14	FY17	FY19
Electricity Usage (MWh)	198,040	211,101	211,614	213,622	215,391
GHG Emissions (MT CO_2e)	138,700	135,500	115,341	105,607	73,802

Table 11 - Heating Degree Days for All GHG Inventory Years

Category	FY08	FY11	FY14	FY17	FY19
Heating Degree Days	4,194	4,525	4,605	3,508	4,236
Cooling Degree Days	1,594	1,741	1,559	1,902	1,735

4.2.1.1 Purchased Unbundled Renewable Energy

In addition to purchasing electricity directly from retail suppliers that provide it to the university via the local electrical grid, the University of Pittsburgh has procured renewable energy via a number of different mechanisms, which currently include bundled and unbundled renewable energy credits (RECs). RECs are "a market-based instrument that represents the property rights to the environmental, social and other non-power attributes of renewable electricity generation. RECs are issued when one megawatt-hour (MWh) of electricity is generated and delivered to the electricity grid from a renewable energy resource" [17].

While the University has long-purchased small numbers of RECs specifically for LEED building certifications, they have not been accounted for in past inventories. For FY19, Pitt had a total of 41,736 unbundled Green-e certified RECs (or 41,736 MWh), equating to 19.4% of Pitt's annual electricity consumption being attributed to renewables via RECs. Of the RECS, 371.5 were specific to a recently LEED certified building project; 4,364 RECs were included in a University electrical contract for its general small and medium (GS/GM) electrical meters; and 32,000 unbundled RECs were purchased under separate contract.

SIMAP records RECs only in its final results – and not in any of the Scopes, Sources, or Categories. As a result, RECs are only reflected in the net GHG emissions values. As a result, the impact of RECs on Pitt's GHG emissions is bundled together with consumption and reflected in the significant decrease in emissions shown in Table 9.

Future renewable energy will also be procured by Pitt via long-term power purchase agreements (PPA) that include both the electricity and bundled renewable energy attributes for local, renewable power from both a local, solar farm on the Allegheny / Beaver County line and a run-of-the-river hydro facility on the Allegheny River near the Highland Park Bridge

4.2.2 PURCHASED STEAM AND CHILLED WATER

Pitt does not purchase any chilled water, but it does purchase steam to offset the difference in demand not covered by the Pitt operated Carrillo Street Steam Plant (CSSP) mentioned in Scope 1. The purchased steam comes from the Bellefield Boiler Plant (BBP) which is operated by a third-party consortium of multiple owners and supplies steam to many other entities in Oakland (e.g., Carnegie Library). Since steam from the BBP is purchased, and the BBP is a non-Pitt plant, this steam generation falls under Scope 2 emissions.

Until 2009, Bellefield Boiler Plant was the only steam plant in Oakland; at that time, it was joined by the CSSP, which was not fully operational until FY 2014. The BBP was powered by coal and natural gas until 2009 and was nicknamed the "The Cloud Factory." This nickname came from the plume of air emissions resulting from coal burning at the plant, which accounted for higher GHG emissions from purchased steam in FY08. In 2009, BBP switched to 100% natural gas fuel, which helped to increase its efficiency and lower GHG emissions associated with steam produced there. This fuel switch had an observable impact on the FY11 and FY14 emissions and continues to result in improvements of campus emissions.

As mentioned in Section 4.1.1 for Scope 1 Stationary Combustion, Pitt consumed a total of 663,093 klbs of steam in FY19, resulting in total emissions of 41,870 MT CO_2e. The Pitt CSSP plant supplied 64% (405,180 klbs) of this demand and BBP supplied the remaining 36% (227,913 klbs). With all-natural gas fuel and estimated efficiency of 85%, the emissions associated with the BBP came to 16,892 MT CO_2e. This is a reduction of about 991 MT CO_2e from FY17 (Table 12).

Table 12 - Pitt Purchased Steam and GHG Emissions for All GHG Inventory Years

(CSSP = Carrillo Street Steam Plant, BBP = Bellefield Boiler Plant)

	FY08	FY11	FY14	FY17	FY19
CSSP steam (klbs)	n/a	342,405	535,812	409,236	405,180
BBP steam (klbs)	532,693	356,381	304,889	148,299	227,913
Total steam (klbs)	**532,693**	**698,786**	**840,701**	**641,819**	**663,093**
CSSP emissions (MT CO_2e)	n/a	22,200	32,981	25,623	24,978
BBP emissions (MT CO_2e)	55,100	29,400	23,404	17,238	16,892
Total emissions (MT CO_2e)	**55,100**	**51,600**	**56,385**	**42,861**	**41,870**

4.3 SCOPE 3 EMISSIONS

Sources that emit greenhouse gasses. but are indirectly related to Pitt are accounted for under Scope 3. This includes any financially sponsored or outsourced activities such as travel, waste management, paper purchasing, etc.

4.3.1 DIRECTLY FINANCED OUTSOURCED TRAVEL

Pitt pays for faculty and staff to use various transportation modes for business travel, including via airline, rental car, bus, train, and personal mileage reimbursement. Detailed information on travel paid for by the University is provided by Purchasing Services, but include a variety of internal sources, including Financial

Services, travel tracking software, and others. In FY17, separately funded Athletics travel was included; it was not provided nor included in FY19.

Pitt Purchasing has records of both travel reimbursements and travel card purchases, the latter of which is directly billed to the University. In FY08, the various modes of financed travel were recorded as a single entry into the reimbursement statement, which also included items such as hotels, per diem, and meals. In FY11, university departments began switching to a new network-based system for recording reimbursements and travel card purchases, which provided more comprehensive travel expense data. This system continues to be used, so travel data for FY14, FY17, and FY19 includes descriptions of the nature of the expenses, allowing for more accurate disaggregation between air and land travel expenses. It is estimated that in 30% of all reimbursements were filed using the new system in FY11, which was used for up to 70% of travel purchases in FY14, and 90% in both FY17 and FY19. Increasing data inclusion and accuracy makes it difficult to directly compare the emissions between FY08, FY11, FY14, FY17, and FY19 for this category.

It was previously common for faculty and staff to book travel through a Pitt travel agent, which meant a third source of travel expense had to be tracked. However, Pitt has integrated its travel system so that all travel card and reimbursement charges are now tracked internally via Concur.

Once all travel expense data was aggregated, it was separated into the following three modes: air travel, bus travel, and rail travel. To avoid the need of another conversion factor outside of SIMAP, the aggregate monetary values for each travel mode were input directly into SIMAP, which performs calculations using its own factors.

In FY19, Pitt faculty and staff purchased $11,769,526 worth of *air travel*, and traveled an estimated 303,572 *land* miles, resulting in total emissions of 37,142 MT CO_2e. From FY17 to FY19, land miles increased by about 8% from FY17 to FY19, a total of 21,899 miles. In all of the previous inventories, the air mileage was estimated from the travel expense data and showed an increase in miles traveled with each inventory. However, SIMAP allows for direct input of dollars so this estimation only added uncertainty to our calculations. Starting in FY19, and for inventories moving forward, the air travel GHG emissions will be calculated by inputting the travel expense data as dollars and reporting the GHG emissions from SIMAP which can be seen in Table 13.

Over past inventories, GHG emissions increases due to Air Travel from FY08 to FY14 is attributed to improved documentation. The drop between FY14 and 17 is not explained, but the resurgence of emissions in FY19 indicates that university-related **air travel rebounded in FY19.**

Due to varying levels of detail in reported data and changing conversion factors used to translate dollar values to miles prior to this inventory, land mile estimates have fluctuated rapidly from inventory to inventory. **Increasing data tracking and conversion to emissions for both land and air travel is needed in future inventories.**

Table 13 - Pitt's Directly Financed Outsourced Travel for All GHG Inventory Years

	FY08	FY11	FY14	FY17	FY19
Air Travel ($)	$4,193,961	$5,912,251	$8,461,970	$7,256,322	$11,769,526
Land travel (miles)	440,001	514,306	731,728	281,673	303,572
GHG Emissions (MT CO_2e)	**24,900**	**33,650**	**24,132**	**25,254**	**37,142**

4.3.2 STUDY ABROAD AIR TRAVEL

Like many universities, Pitt offers students the chance to complete one or two terms of academic studies in other countries under a "Study Abroad" program. Due to the nature of higher education decision-making and practice, the SIMAP calculator separates these miles from "Directly Financed Outsourced Travel". However, GHG emissions resulting from them carry the same weights and are calculated using the same emission factors.

Due to lack of data, Pitt's Study Abroad Air Travel was not included in the FY08 inventory but has been included in every Pitt GHG Inventory since. Starting in FY11, the travel costs for Pitt's study abroad travel has been obtained from Pitt's Study Abroad team. For FY19, Pitt's total air miles traveled and total related GHG emissions from study abroad were 20,035,978 miles and 8,816 MT CO_2e – a nearly 2.75-fold increase in miles traveled, resulting in **a 93% increase in GHG Emissions from Study Abroad alone in FY19** (compared to FY17) (Table 14). This drastic increase is due in part to increased data accuracy for FY19, accounting for all legs of study abroad air travel trips. Additionally, increasing popularity of and number of countries possible to visit via study abroad continues to contribute to increases in GHG emissions from the practices. Pitt's current Study Abroad programs spans 75 countries via 350 programs, with utilization as high as 55% in the School of Business, which boasted the highest University-wide participation rate of 55% [18].

While this report is entirely focused on the GHG emissions of the University (which study abroad travel has an increasing contribution to), studying abroad has obvious benefits for Pitt students as well as the University. Regardless, as part of the future *Pitt Climate Action Plan*, the University needs to create strategies for choosing carbon neutral airlines for international travel and/or offsetting study abroad travel overall.

Table 14 - Pitt Study Abroad Travel for All GHG Inventory Years

	FY08	FY11	FY14	FY17	FY19
Distance (miles)	n/a	1,417,847	1,524,920	5,378,016	20,035,978
GHG Emissions (MT CO_2e)	n/a	1,100	775	4,578	8,816

4.3.3 COMMUTER TRAVEL

As indicated by prior Pitt GHG inventories and other studies, commuting can be a significant contributor to GHG emissions; however, it has been difficult to assess without regular, organizationally specific and representative commuter survey data which was not available until the FY19 inventory. Pitt offers access to a suite of transportation and mobility solutions that can help reduce GHG emissions resulting from single occupancy vehicle commutes; those options include public transportation, biking infrastructure, on- and off-campus student housing, parking capacity, carpool and vanpool programs, and more. However, because commuter habits are influenced by a wide variety of factors, broad-based assumptions and solutions are not always accurate, with individuals making daily commute decisions based on distance between and number of destinations, road infrastructure, traffic patterns, public transportation access and reliability, parking availability, and more.

In FY19, Pitt provided on-campus residence hall capacity was for 7,891 students, which generally encourages walking. The number of bike amenities did not change between FY17 and FY19, holding steady at 182 bike racks offering 1,136 lockable bike spaces (Table 15).

Pitt offered 4,766 total parking spaces on its Pittsburgh campus, including 4,669 parking spaces in garages or lots and 97 metered parking spaces for public use. Pitt issued 2,887 parking permits and had a combined 371 registered carpoolers and vanpoolers in FY19.

A major bus transportation corridor runs through Pitt's Pittsburgh campus, and Pitt has a partnership with the local transit agency (Port Authority of Allegheny County) that allows all active Pitt students, faculty, and staff ride for free with their Pitt ID.

Table 15 - Pitt Commuting Data for All GHG Inventory Years

		FY08	FY11	FY14	FY17	FY19
Population	Faculty	2,154	2,487	2,791	2,944	2,704
	Staff	4,662	4,734	5,012	5,341	5,769
	Students	24,755	26,740	25,917	26,240	28,673
	Total	**31,571**	**33,961**	**33,720**	**34,525**	**37,146**
Student Housing	On-campus	7,000	7,000	7,825	7,928	7,891
	Off-campus (close)[a]	2,475	2,674	2,592	2,624	2,867
	Off-campus (far)	15,279	17,066	15,500	15,688	17,915
	Total	**24,755**	**26,740**	**25,917**	**26,240**	**28,673**
Carpool	Passengers	382	188	164	159	322
	Avg. Mileage	11.87	11.27	11.73	11.00	12.55
Vanpool	Vans	10	9	9	7	7
	Passengers	65	57	67	53	49
	Avg. Mileage	23.1	23.9	22.9	29.0	29.70
Permit	Number	3,058	3,153	2,756	2,797	2,887
	Avg. Mileage	12.95	12.95	12.74	12.82	12.44
Total Driving	**Avg. Mileage**	**12.86**	**12.88**	**12.72**	**12.77**	**11.97**
Parking	Garage	4,437[b]	2,563	2,299	2,597	2,802
	Lot	0	1,833	1,733	1,784	1,867
	Metered	165	147	119	118	97
Bike	Racks	0	181	178	182	182
	Spaces	1,000	1,670	1,600	1,136	1,136

a - Based on an assumption that 10% of off-campus living students live within a walking distance to Pitt.

b - Garage and lot spaces were reported together in FY08.

In order to calculate commuting-related emissions, SIMAP inputs include data related to faculty, staff, and student travel distributions by mode; the average distance traveled by each mode; number of one way trips each week; and the number of weeks in the fiscal year. Subsequently, the data documented in Table 15 had to be supplemented with some general assumptions listed below:

1) There are 47 working weeks in a fiscal year for faculty and staff, and 30 regular school weeks for students (Fall and Spring semester).
2) All students living on-campus walk to school.

3) 10% of students living off-campus live in close enough proximity to Pitt they walk to school.
4) All bike spaces fill up completely once a day, proportionately by faculty, staff, and student ratios.
5) The same percentage of faculty and staff walks and bikes to campus based on a calculation and assumption from FY08.
6) Students hold 5% of all parking permits and fill up 4 times all metered parking spaces in a day.
7) Faculty hold 50% of all permits, and staff holds 45% of all parking permits.
8) Only staff carpools and vanpools.
9) The remaining portion of each population takes transit to campus, which in Pittsburgh is primarily the bus.

Although some of these assumptions may grossly generalize the different Pitt populations' commuting behaviors, they provide a relationship between some of the known data in Table 15 and estimated modal distributions in Table 16. Of all categories in the GHG Inventory, calculating impacts from Pitt's commuting continues to be one of the most challenging.

Table 16 - Pitt Commute Mode Distributions for All GHG Inventory Years

		FY08	FY11	FY14	FY17	FY19
Students	Bike	3.2%	4.9%	4.7%	3.3%	3.1%
	Walk	38.3%	36.2%	40.2%	40.2%	48.7%
	Drive Alone	3.3%	2.8%	2.4%	2.3%	1.9%
	Carpool	0.0%	0.0%	0.0%	0.0%	0.0%
	Bus	55.3%	56.1%	52.7%	54.2%	46.4%
Faculty	Bike	3.2%	4.9%	4.7%	3.3%	3.1%
	Walk	3.2%	4.9%	4.7%	3.3%	3.1%
	Drive Alone	71.0%	63.4%	49.4%	47.5%	53.4%
	Carpool	0.0%	0.0%	0.0%	0.0%	0.0%
	Bus	22.7%	26.8%	41.1%	45.9%	40.5%
Staff	Bike	3.2%	4.9%	4.7%	3.3%	3.1%
	Walk	3.2%	4.9%	4.7%	3.3%	3.1%
	Drive Alone	29.5%	30.0%	24.7%	23.6%	22.5%
	Carpool	9.6%	5.2%	4.6%	4.0%	3.6%
	Bus	54.6%	55.0%	61.2%	65.9%	67.7%

For FY19, attempts were made to holding the same assumptions as in the previous inventories; however, known population and mobility amenity data shown in Table 15 has shifted assumptions over subsequent inventories. Estimation of commuting impacts in the FY08 and FY11 GHG Inventories were based primarily on assumptions and incorporated only a portion of the Pitt provided data shown in Table 16. The adapted approach used in FY14, FY17, and FY19 provides a more comprehensive evaluation of the different factors influencing Pitt's commuters' choices, providing explainable, quantitative framework for the assessment.

4.3.4 SOLID WASTE

Pitt's Solid Waste is picked up and managed by Republic Waste Services. Landfilled waste is taking to a landfill with a methane recovery system in place, which means that methane is trapped and stored before it is emitted to the atmosphere. The trapped methane is then traditionally processed for future use in electricity generation; the Republic Waste Services landfill utilized by Pitt captures methane but does not process it for electricity generation on site. The same system has been used in all inventoried fiscal years except for FY08.

Pitt's solid waste stream data was provided by Facilities Management and is inclusive of campus-wide materials and waste management, including from Housing and Dining. In FY19, Pitt's total solid waste stream totaled 6,701 tons, with a small decrease of 89 short tons between FY17 and FY19. **Following past trends, Pitt yet again increased the percentage of waste recycled campus-wide -- to 2,512 tons or 37.5% of the solid waste stream.** This was a net 2.1% increase over FY17, reflecting a net increase in recyclables diverted of 14.8% between FY08 and FY19, over which the overall volume of solid waste has remained relatively steady, thus decreasing landfill volume while increasing recyclables. As shown in Table 17, **Pitt's total GHG emissions due to methane release from landfilling 4,189 tons of material accounted for 1,454 MT CO_2e.**

Table 17 - Pitt Solid Waste for All GHG Inventory Years

	FY08	FY11	FY14	FY17	FY19
Landfilled (tons)	5,246	4,596	4,634	4,384	4,189
Recycled (tons)	1,543	1,572	1,764	2,406	2,512
% of Waste Recycled	22.7%	25.5%	27.6%	35.4%	37.5%
GHG Emissions (MT CO_2e)	**5,700**	**1,400**	**1,437**	**1,522**	**1,454**

4.3.5 WASTEWATER

Based on water consumption data provided from Pitt Facilities Management, wastewater was assumed to be equal to the amount of water consumed in almost all campus buildings. It is very difficult to measure the actual contribution of Pitt to Allegheny County's central wastewater treatment plant, which was assumed to use aerobic treatment of wastewater. As shown in Table 18, this marginal contribution problem has been identified by other researchers; however, even if the assumptions made for this report are an overestimation Pitt's GHG emissions resulting from treatment of its wastewater, the impact on Pitt's total GHG emissions is low **(0.4% of total emissions), only 102 MT CO_2e.**

Table 18 - Pitt Wastewater Data for All GHG Inventory Years

	FY08	FY11	FY14	FY17	FY19
Wastewater (million gallons)	278,350	246,450	280,055	240,165	236,027
GHG Emissions (MT CO_2e)	**1,500**	**1,400**	**136**	**104**	**102**

4.3.6 PAPER

Paper is vital for most businesses, but seemingly essential for large educational facilities where printed material is consumed and produced daily in great quantities. While tracking GHG emissions from paper is not mandatory under the GHG Protocol, Pitt's GHG Inventory has always included it, as it is a potentially significant emission source. Pit Purchasing provides information regarding the quantity of purchased paper in regular, recycled, and carbon neutral varieties.

Since FY08, Pitt has made great strides in using larger quantities and increasing percentages of recycled paper content paper. While percentages of overall recycled content have varied over the years, its overall trend has been upward, though total paper used has varied quite widely. This is due in part to more comprehensive accounting in FY17. Despite better than ever before, in FY19, the paper purchased totaled 682,820 pounds, with recycled content totaling 34.0%; this is both the lowest total amount of paper Pitt has purchased since FY08 and the highest recycled content of that paper. This decrease is also due in part to Pitt's purchase of TreeZero paper which is a carbon neutral paper product and is accounted for as 100% recycled content [19]. As shown in Table 19, due to both consumption decreases and recycled content increases, **the total GHG emissions from paper was 729 MT CO_2e in FY19 (and only 0.30% of total emissions, the lowest it has ever been).**

Table 19 - Pitt Paper Data for All GHG Inventory Years

	FY08	FY11	FY14	FY17	FY19
Total Paper (lbs)	1,113,740	730,725	1,488,165	1,787,020	682,820
Overall Recycled Content	4.2%	20.7%	9.4%	18.6%	34.0%
GHG Emissions (MT CO_2e)	**1,600**	**1,500**	**1,949**	**2,441**	**729**

5 SINKS

SIMAP has a section titled 'Sinks' in which the university is able to enter data for compost, offsets, and non-additional sequestration such as carbon storage that comes from campus property (e.g. forests, soils). The compost section includes the total amount of composting from both dining and agricultural waste which will reduce the total footprint when included in the inventory. The offsets section includes projects that a university completes that are above and beyond business as usual that will reduce the carbon and/or nitrogen footprint (e.g. reforestation and biogas projects). These projects can be on or off-campus and do not require certification in order to be included in this section [20–22].

As part of this section (which is new in the FY19 Inventory), it is also worth reemphasizing part of Section 4.2.1.1 on "Purchased Unbundled Renewable Energy" of Pitt's first sizable purchase of renewably-sourced energy for use on campus. The inclusion of these RECs allowed for a significant reduction in the overall net emissions for FY19. Also, in the FY19 inventory, composting was included for the first time. The total amount of compost from dining waste totaled to 12,778 pounds and the remaining compost from the rest of campus, including housing and other campus buildings, totaled to 94.46 short tons. The inclusion of this compost data also allowed for a reduction in the overall net emissions. However, a total amount of diverted emissions is not reported in SIMAP and is only subtracted from the final net emissions total.

To-date, the University of Pittsburgh has not strategically approached carbon offsets – or even accounted for incidental offsets that may already be in its upstream emissions (resulting from other companies' commitments to carbon neutrality). The FY20 GHG Inventory should highlight and include these upstream emissions and plan to include the downstream emissions included this year. It is also highly recommended that Pitt develop a carbon offset strategy as part of its in-development *Pitt Climate Action Plan*.

6 RESULTS DISCUSSION

Pitt's GHG emissions Fiscal Year 2019 totaled 215,522 MT CO_2e and the distribution of these emissions by source is presented in Figure 4. For comparison, Appendix B includes all past GHG Inventory results, including for Fiscal Years 2008, 2011, 2014, 2017, and 2019.

To contextualize these results, Table 20 compares Pitt's emissions for all inventories normalized by number of students, total number of community members, and gross building square footage. Pitt's total Scope 1, 2, and 3 emissions metrics tons of CO_2e was used as the numerator for each calculation. Until FY17, every Pitt GHG Inventory saw a decrease in every normalized category, which supported continuous monitoring and evaluation of campus emissions.

FY19 saw a small decrease in normalized emissions across the board (~3.5 to 6.5% decreases), indicating that Pitt's GHG emissions increase was generally attributable to student, community, and/or building space counts.

Table 20 - All Pitt Accountable Emissions per Student, Community Member, and Building Square Footage

All Accountable Emissions	FY08	FY11	FY14	FY17	FY19
Students (MT CO_2e / FTE students)	11.0	10.0	9.0	8.2	7.5
Pitt Community Members **(MT CO_2e / Person)**	8.4	7.7	6.9	6.2	5.8
Building Space (MT CO_2e / 1,000 ft^2)	29.1	27.8	22.9	21.0	18.6

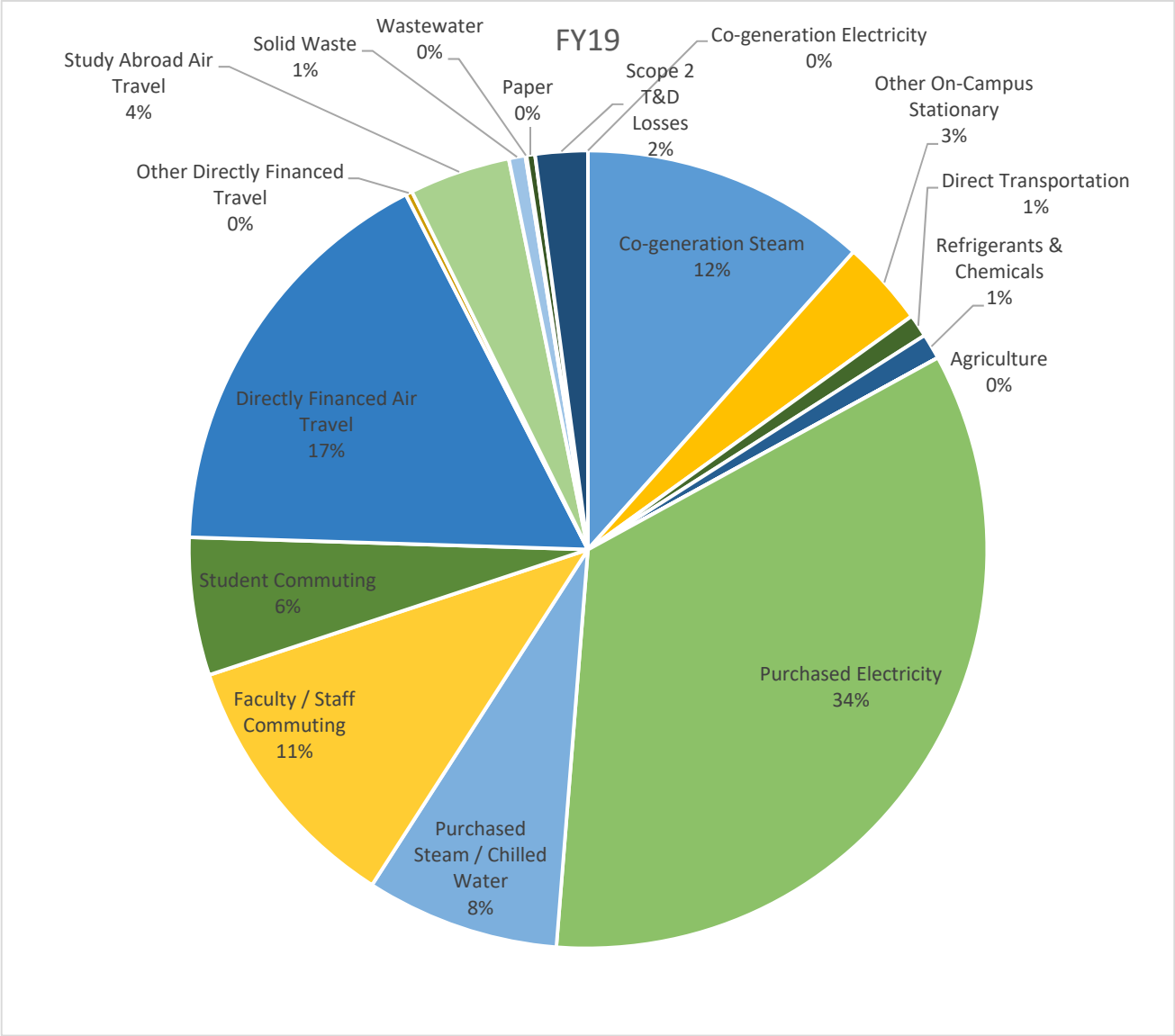


Figure 4 - Pitt FY19 GHG Emissions Distributed by Source

Table 21 - GHG Emissions by Category for FY19

		CO2	CH4	N2O	CO_2e
		kg	kg	kg	Metric Tonnes
Scope 1	**Co-gen Electricity**	0	0	0	-
	Co-gen Steam	24,895,329	2,477	50	24,978
	Other On-Campus Stationary	7,445,440	741	15	7,470
	Direct Transportation	1,977,215	75	49	1,992
	Refrigerants & Chemicals	-	-	-	2,241
	Agriculture	-	-	3	0.7
Scope 2	**Purchased Electricity**	72,930,417	7,655	2,480	73,802
	Purchased Steam / Chilled Water	16,835,799	1,675	34	16,892
Scope 3	**Faculty / Staff Commuting**	23,201,248	932	246	23,293
	Student Commuting	12,018,918	71	59	12,037
	Directly Financed Air Travel	36,441,399	396	407	36,560
	Other Directly Financed Travel	490,196	620	281	582
	Study Abroad Air Travel	8,786,941	95	98	8,816
	Solid Waste	-	-	-	-
	Wastewater	-	51,939	-	1,454
	Paper	-	-	385	102
	Scope 2 T&D Losses	4,521,086	475	154	4,575
Offsets	Additional				0
	Non-Additional				0
Totals	Scope 1	34,317,984	3,293	117	36,682
	Scope 2	89,766,216	9,330	2,514	90,694
	Scope 3	85,459,788	54,528	1,630	88,148
	All Scopes	**209,543,988**	**67,151**	**4,261**	**215,522**
	All Offsets				

Net Emissions: 215,522 MT CO_2e

6.1 RESULTS COMPARISON

As defined previously, the scoped approach categorizes emission sources based on level of organizational responsibility and control but does not dictate the boundaries to be used for emissions reporting. The final decision on what to report is left to the discretion of the institution; however, guidelines by the GHG Protocol Initiative and the (former) ACUPCC exist to ensure that reported results are compatible with each other. Boundaries to consider are as follows:

- **All Scope 1 and Scope 2 Emission Sources:** Scope 1 and 2 are minimum levels for reporting emissions. The Greenhouse Gas Protocol requires reporting of all Scope 1 and Scope 2 emissions, but consider Scope 3 emissions optional [23].
- **All Directly Financed Emissions:** This boundary includes Scope 1 and Scope 2 emissions along with directly financed Scope 3 emissions, such as air travel and solid waste management. Second Nature requires Scope 3 emissions for commuting and directly financed air travel, on top of Scope 1 and Scope 2 emissions [12].
- **All Directly Financed Emissions and Select Directly Encouraged Emissions:** In addition to the previous boundary, this boundary includes Scope 3 emissions that are encouraged, but not necessarily financed. For instance, a university policy that requires students to study abroad for a certain period of time would indirectly require them to use air transportation, although they might not be reimbursed for the trip. Another category to consider would be the daily commuting of students, faculty and staff, especially in locations with few public transportation options.
- **"All Accountable Emissions" - All Directly Financed or Significantly Encouraged Emissions AND Selected Upstream Emissions:** This would be the largest boundary for reporting campus GHG emissions. In addition to the previous boundary, certain Scope 3 emissions are also included, mainly for allocating reductions to these sources. For example, if a policy to decrease paper consumption is in effect, then the paper category could be included in the inventory to observe the impact of paper reduction policy. Second Nature strongly encourage reporting additional Scope 3 emissions, especially from large and meaningful sources influenced by the institution.

Selection of a study boundary is vital for any GHG Inventory study. Selection of a limited boundary would exclude important emission sources and result in an underestimation of the actual emissions resulting from the institution. On the other hand, developing an inventory for all actual emissions requires significant time and resources; further, data is often not available in all desired categories.

Using FY19 results, Pitt's GHG emissions increase by 41% between the most limited reportable boundary (Scope 1 and 2 only) to the most extended reportable boundary (Scopes 1, 2, and 3). Reporting emissions by any one of these defined boundaries is allowed – and should be recognized during comparison of results with respect to other institutions, since different studies use different boundaries, which directly affect end results. The comparison of results from each inventoried year is shown in Table 22.

Table 22 - Comparison of GHG Emissions across All Inventory Years

	Category	FY08	FY11	FY14	FY17	FY19
Scope 1	**Co-generation Electricity**	0	0	0	0	0
	Co-generation Steam	0	22,200	32,981	25,623	24,978
	Other On-Campus Stationary	9,200	5,700	6,386	5,245	7,470
	Direct Transportation	500	700	1,273	1,388	1,992
	Refrigerants & Chemicals	800	2,300	2,192	1,266	2,240
	Agriculture	0	1	2	1	1
Scope 2	**Purchased Electricity**	138,700	135,500	115,341	105,607	73,802
	Purchased Steam / Chilled Water	55,100	29,400	23,404	17,238	16,892
Scope 3	**Faculty/Staff Commuting**	13,600	14,700	9,845	12,433	23,293
	Student Commuting	5,200	5,500	6,064	5,962	12,036
	Directly Financed Air Travel	24,800	33,600	23,921	24,706	36,560
	Other Directly Financed Travel	100	50	211	548	582
	Study Abroad Air Travel	0	1,100	775	4,578	8,816
	Solid Waste	5,700	1,400	1,437	1,522	1,454
	Wastewater	1,500	1,400	136	104	102
	Paper	1,600	1,500	1,949	2,441	729
	Scope 2 T&D Losses	16,600	13,400	7,596	5,523	4,575
	Scope	**FY08**	**FY11**	**FY14**	**FY17**	**FY19**
Totals	Scope 1 (Direct Emissions)	10,500	30,901	42,834	33,523	36,681
	Scope 2 (Indirect Emissions)	193,800	164,900	138,744	122,845	90,694
	Scope 3 (All Other Emissions)	69,100	72,650	51,933	57,817	88,147
	All Accountable Emissions	**273,400**	**268,451**	**233,511**	**214,185**	**215,522**

6.1.1 COMPARISON OF RESULTS WITH PEER INSTITUTIONS

For comparing results with other institutions of higher education, metrics were defined such as using Scope 1 and 2 sources only, including air travel and solid waste management in addition to Scopes 1 and 2, including all transportation activities and solid waste management in addition to Scopes 1 and 2, and finally all accountable emission sources. Comparing schools based on net emissions only can result in misleading conclusions as every school has different student enrollments, number of buildings, and educational and research activities. For a logical comparison, emission results are usually converted into one of the normalized metrics given below. If institutional data such as student numbers and gross building area are input into the SIMAP tool, such conversions are done automatically and presented together with overall results.

Numerous sources and GHG Inventory reports published by other higher education institutions were reviewed in order to determine Pitt's performance when ranked according to greenhouse gas emissions. Table 23 shows Pitt's performance among a group of peer institutions commonly used for benchmarking purposes. As discussed previously, selection of an extended operational boundary for Pitt of Scope 1, 2,

and 3 emissions increases emissions by 41% when compared to reporting only mandatory (Scope 1 and 2) emission sources. Both results are provided in Table 22.

Table 23 - Higher Education Institution Peer Group Benchmarking for GHG Emissions, Sorted by Net Emissions [17-19]

INSTITUTION	STUDY YEAR	NET EMISSIONS (MT CO_2E)	MT CO_2E/ FTE STUDENT	MT CO_2E/ 1,000 FT^2
Chatham University	2018	8,031	3.88	7.30
Carnegie Mellon	2019	40,485	2.06	6.56
Villanova	2019	67,037	7.00	14.1
Case Western Reserve	2017	116,133	10.70	19.5
Pitt - Required (Scope 1&2)	2019	127,375	5.90	13.9
University of Maryland - College Park	2019	133,221	3.56	7.77
Cornell University	2019	203,000	8.60	12.7
Pitt - All Sources	2019	215,522	8.21	22.1
University of Pennsylvania	2019	244,748	9.20	15.4
Duke	2018	257,031	16.90	15.7
University of Florida	2018	389,917	7.90	23.4
Penn State - University Park	2017	435,465	4.40	13.6
Ohio State	2020	568,984	10.20	22.6

7 RECOMMENDATIONS FOR FUTURE PITT GHG INVENTORIES

As with all GHG inventories, general assumptions were required to complete analysis for some categories studied in this FY19 GHG Inventory; as a result, some categories may lack accuracy, precision, and/or may have under or over estimation of their associated emissions. These assumptions were made using the SIMAP tool, external sources and references, and the best judgement of the authors; they are expected to roughly represent the true emission levels of Pitt's Pittsburgh campus. This FY19 study has a good foundation of assumption basis from the previous four inventories -- and attempted to improve or solidify assumptions where possible.

Future inventories should continue this effort, and both try to eliminate the need for assumptions, such as other studies, reports, and surveys. As Pitt is now committed to doing annual GHG Inventories, process improvements should be easier to integrate; to help ensure that happens, Table 24 briefly summarizes process recommendation improvements for FY20, based on comparisons to FY17. Detailed descriptions of some of these recommendations follow the table.

Table 24 - Pitt GHG Inventory Reasons for Differences & FY20 Process Recommendations

				Reason(s) for Changes			
		% Change in Category Between FY17 and FY19		More Complete Data	Change in Emissions Factors / Calculation	Activity Change	FY20 Recommendation
Scope 1	**Co-gen Electricity**	**n/a**				Slight Increase	-
	Co-gen Steam	**3%**	▼			Steam consumption up slightly	Continue to hone building stock list
	Other On-Campus Stationary	**42%**	▲			Natural gas consumption up.	
	Direct Transportation	**44%**	▲			Shuttles included & fuel consumption up	Focus on more fuel shifting & vehicle electrification
	Refrigerants & Chemicals	**77%**	▲			High required year	Develop high GWP phase out plan
	Agriculture	**27%**	▼				Keep as low % nitrogen as possible
Scope 2	**Purchased Electricity**	**30%**	▼				Continue to buy renewables directly
	Purchased Steam / Chilled Water	**2%**	▼			Steam consumption up slightly	Continue to hone building stock list
Scope 3	**Faculty / Staff Commuting**	**87%**	▲	Included School of Medicine staff			Review all assumptions & reference national & regional commuter surveys
	Student Commuting	**102%**	▲	Included School of Medicine students			
	Directly Financed Air Travel	**48%**	▲				Ensure Athletics accounted for
	Other Directly Financed Travel	**6%**	▲				
	Study Abroad Air Travel	**93%**	▲	Round trips		Increased	
	Solid Waste	**5%**	▼			% Recycled increased	
	Wastewater	**2%**	▼			Water consumption decreased	
	Paper	**70%**	▼			Lower overall & carbon neutral paper	
	Scope 2 T&D Losses	**17%**	▼		Linked to Electricity Factors		

				Reason(s) for Changes			
		% Change in Category Between FY17 and FY19		More Complete Data	Change in Emissions Factors / Calculation	Activity Change	FY20 Recommendation
Offsets	Additional	n/a		n/a	n/a	n/a	• Continue to purchase renewables directly & via RECs • Investigate offsets in existing supply chains. • Create strategy for future in/offsets

Fleet: The vehicles registered in the University Fleet and the fuel consumed is tracked under three separate programs. Obtaining data from the Guttman Oil and Fuelman system is simple, as it only includes Pitt's Pittsburgh campus fuel use. Obtaining Pittsburgh campus data from the Voyager system is more challenging because it includes regional and other Pitt fuel use as well -- and each transaction is not clearly identified with a particular campus. This year's study replicated the strategy used in FY14 and FY17 to associate individual card numbers to a particular campus based on the location of majority of purchases with that card. This same approach can be used in future inventories to maintain consistency and shorten the time needed for investigating the fuel reports.

Steam: In 2008, the Carrillo Street Steam Plant was planned to become operational in the very near future, supporting the decision to create a benchmark study to analyze the impacts of switching to CSSP from the Bellefield Boiler Plant. As expected, steam-related emissions decreased by ~6% between FY08 and FY11, despite total steam consumption increasing due to the addition of new facilities. In FY14, the CSSP was in full operation, but steam-related emissions continued to increase. In FY17, overall steam demand decreased due to a reduction in heating degree days; **FY19 showed a 2% decrease in GHG emissions from steam primarily, even though there was summer maintenance on the CSSP,** which required usage to be shifted to BBP. Though this decrease was small, the total emissions from steam usage per square foot still decreased due to the addition of 12 buildings to the Pitt GHG Inventory building stock, in which only one of them is tied into the district steam system.

Electricity: Over the 12-year period Pitt's five GHG inventories cover, **Purchased Electricity remains the largest source of emissions for Pitt, contributing 34% of the Pittsburgh campus's total GHG emissions for FY19**. Varying fuel mixes across the five inventories exemplify regional changes in energy sources across variety of fuel sources. Previously a coal-dominated electricity fuel mix region, federal emissions regulations have forced both a national and regional shift away from coal-fired electricity generation, helping grow natural gas and nuclear power's contribution to the grid. More importantly, via both direct procurement and renewable energy credits, **Pitt began purchasing larger amounts of renewable energy for its electricity consumption, which contributed to a 47% decrease in GHG emissions from Purchased Electricity since FY08,** despite a 0.8% increase in electricity consumed between FY17 and FY19 – and a 9% increase between FY08 and FY19. To continue to reduce GHG emission from Purchased Electricity and overall, it is recommended that the University continue to purchase more renewably-sourced energy for electricity, in line with its goal to produce or procure 50% renewables by 2030 – and become carbon neutral by 2037. Additionally, the University should continue to work towards aggressive building energy efficiency strategies and implementation.

Air Travel: With the upgrading of purchasing and network systems that simplify the travel reimbursement process for Pitt faculty and staff, recording of Pitt Air Travel has improved since FY08. The FY11 inventory first benefited from an updated system, though by FY14, participation was still not at 100%. FY17 and FY19 saw the new system used across the board, but a completeness should be ensured moving forward.

In FY17, data was provided by the Athletics department detailing their travel expenditures. Athletics was not included in FY19, but it should be included in all future inventories. Increasing data tracking and conversion to emissions for both land and air travel is needed in future inventories.

Commuting: Because up-to-date, representative data on commuting preferences of Pitt faculty, staff, and students was not available, assumptions were required to calculate GHG emissions resulting from commuting. The use of campus-wide commuting survey that generates a representative response is ideal; however, due to the size of the Pitt population, this approach is not temporally or fiscally feasible. Subsequent inventories should revisit all commuting data sources and assumptions in an effort to include estimates from this category. Additionally, commuter survey data from the national American Community Survey or the triennial regional Make My Trip Count survey should be explored more deeply in future inventories [24]; after generating over 2,000 responses from Pitt in 2015 and 2018, Make My Trip Count is anticipated to occur again in 2021.

Future inventories should consider including emissions contributions and reductions from the following sources, which have not been collected in any prior inventory, but should be explored, as they could have substantial emissions contributions and reductions that should be accounted for:

1) Backup building generators throughout campus.
2) On-site renewable installation, including on Benedum Hall.
3) Carbon offsets in Pitt's Scope 3 supply chains, specifically for Directly Financed Car and Air Travel.
4) Properties not owned by, but fully leased by the University.

Although water consumption is not a focus of this inventory, it should be noted that Pitt began more widely installing more water meters across the Pittsburgh campus in 2018. Due to the connection between water and energy, future inventories should take advantage of the increase in more accurate campus water data. As local water and sewage costs increase, this inventory process could positively contribute to campus wide cost-benefit analyses related to implementing more sustainable stormwater management practices on campus that simultaneously help mitigate city-wide combined sewer overflow issues, while reducing water consumption on via reuse of rainwater.

The total number of study abroad miles increased significantly from the last inventory. This is a result of an increase in popularity of spending time abroad during undergraduate years. This is also a result of data interpretation and transfer of data. In prior years, data was presented as total miles, but were in fact only in a one-way format. This year, the information was round trip, leading to a significant increase. This change should be noted and asked for as inventories continue to occur in the future. Similar to Pitt, universities across the country are encouraging students to take advantage of these learning opportunities. Therefore, this is less of a hotspot for this inventory and more a reflection of the study abroad department's growth. However, it should still be noted how this impacts the overall emissions for the university.

Finally, Facilities Management continues its decades of efficiency and conservation projects and practices by performing in-depth energy and water audits of campus buildings. Over the years, this process has to identified (and continues to adapt the list of) which buildings are the largest consumers of energy and water. As a large campus, Pitt still has many "low hanging fruit" opportunities for both energy and water retrofits that continue to be implemented (e.g., lighting retrofits). As more low hanging fruit is accomplished, these detailed building audits are crucial to identifying ongoing opportunities areas to help bring campus energy usage, while reducing the overall campus carbon footprint. **Given Pitt's goals to reduce energy and water usage 50% below baselines by 2030, the University should expedite these energy and water conservation projects -- and expand efforts to include the regional campuses.**

8 CONCLUSIONS

Pitt's calculated GHG emissions in FY19 total 215,522 MT CO_2e from all accountable sources (127,375 MT CO_2e from Scope 1 & 2 alone); this is an overall reduction of 21.2% compared to FY08, but a small increase of 0.6% over FY17.

The largest decreases between FY17 and FY19 were in Scope 1 and 2 emissions, which saw combined 18.5% decrease; these included a decrease in overall steam demand and a 30% decrease in emissions from Purchased Electricity. Since FY08, Pitt's Scope 1 and 2 emissions decreased 37.7%, which also account for changes in the regional electricity generation mix and the shift of steam production share from BBP to CSSP. Energy use reduction strategies in Pitt's buildings also continue to be successful, with electricity use only increasing 0.8% over FY17, despite adding nearly 1,350,000 square feet to its inventory; campus-wide Facilities efficiency projects have consistently decreased GHG emissions every inventory with a 47% decrease since FY08, despite a 23% increase in square footage. Steam demand should also continue to be monitored and considered for efficiency efforts, as a small increase is attributed to an increase in heating degree days but could be changed in the future due to other factors.

FY19 also saw a nearly 77% increase in GHG emissions from refrigerants over FY17. While refrigerant replacement does only occur when necessary, the University should develop and follow a considered equipment replacement and retrofit process to eliminate use of extremely high GWP refrigerants like R-11 and R-404a, while phasing out R-22 wherever possible.

However, Pitt's Scope 3 emissions went up 52% between FY17 and FY19, primarily due to transportation of all types, including commuting, directly financed ground and air travel, and study abroad. Though in Scope 1, Direct Transportation emissions also increased 43.5% over FY17. While data collection and calculation for all University-related travel and transportation activities did improve significantly in this FY19 inventory, all University-related travel and transportation (including commuting, owned vehicles, and purchased ground and air travel) needs some significant attention related to both in analysis and significant emissions reduction strategies.

In general, this overall increase in GHG emissions indicates that the University cannot rely on building efficiency and conservation alone to reach its carbon reduction goals -- and must continue to elevate its carbon strategy in both the short- and long-term. The University's early 2020 commitment to carbon neutrality and planned *Pitt Climate Action Plan* promise to help focus the institution on its carbon responsibilities across departments and in global context.

Acronyms

AASHE – Association for the Advancement of Sustainability in Higher Education

ACUPCC – American College and University Presidents Climate Commitment

AA – Airlines for America

BBP – Bellefield Boiler Plant

CA-CP calculator – Clean Air-Cool Planet Campus Carbon Calculator

CH_4 – Methane

CO_2 – Carbon dioxide

N_2O – Nitrous oxide

CSSP – Carrillo Street Steam Plant

FTE – Full Time Equivalent

GHG – Greenhouse Gas

GWP – Global Warming Potential

IPCC – Intergovernmental Panel on Climate Change

LEED – Leadership in Energy and Environmental Design

MMBtu – Million British thermal unit

MT CO_2e – Metric tonnes of carbon dioxide equivalents

Pitt – University of Pittsburgh, Pittsburgh Campus

PPA – Power Purchase Agreement

REC – Renewable Energy Certificate

SIMAP – Sustainability Indicator Management & Analysis Platform

WRI – World Resources Institute

Appendix A: Pitt FY19 GHG Inventory Contacts & Data

Meetings and communication with University of Pittsburgh staff from several departments were required in order to gather the data required for the inventorying process and SIMAP tool. Table 23 shows the list of individuals providing data and information for specific GHG Inventory categories.

Table 25 - Pitt Contacts Providing Data & Information for FY19 GHG Inventory

Contact Name	Contact Title	Pitt Department	GHG Category Information
Andy Moran	Senior Manager	Grounds, Facilities Management	Fertilizer
Aurora Sharrard	Director of Sustainability	Office of Sustainability	Renewable Energy, RECs
Brice Lynn	Assistant Director	Study Abroad Office	Study Abroad Air Travel
Cyndee Pelt & Hari Sastry	Chief of Staff & Senior Vice Chancellor/Chief Financial Officer	Office of Chief Financial Officer	Budget and Financials
Emily Duchene	Travel Program Manager	Purchasing Services	Airfare and Bus/Rail Travel
Jennifer Barnes	Supplier Diversity & Sustainability Coordinator	Purchasing Services	Paper
Jonathan Pearson & Jeff Yeaman	Director of Parking and Transportation & Senior Manager of Parking, Transportation, Services	Parking, Transportation, & Services	Parking, Carpool, Vanpool, University Fleet
Keith Duval	Environmental Manager	Environmental Health and Safety	Natural Gas and Generator Use
Lela Loving		Facilities Management	Building List with Utilities & Physical Measurements, Steam Production, Electricity Fuel Mix, Natural Gas, Wastewater, RECs
Mary Rugh & Will Mitchell	Director of Engineering & Director of Facility Services	Facilities Management	LEED Projects List, Refrigerants & Chemicals, Landfill & Recycling Weights

Appendix B: Pitt Buildings, FY19

Group	Building Name	Gross sq. ft.	Group	Building Name	Gross sq. ft.
Auxiliary - Housing				Chevron Science Center	236,768
	Amos Hall	68,000		Chevron Science Center - Food Services	
	Bouquet Gardens A-H			Chevron Science Center Addition	32,367
	Bouquet Gardens A-J			Child Development Center	24,517
	Bouquet Gardens A	19,708		Clapp Hall	85,893
	Bouquet Gardens B	19,708		Computer Center (RIDC)	19,355
	Bouquet Gardens C	19,708		Charles L. Cost Sports Center	82,977
	Bouquet Gardens D	19,708		Craig Hall	55,115
	Bouquet Gardens E	19,708		Crawford Hall	87,637
	Bouquet Gardens F	14,781		David Lawrence Hall	57,956
	Bouquet Gardens G	19,708		Eberly Hall	56,051
	Bouquet Gardens H	19,708		Eberly Solvent Storage	380
	Bouquet Gardens J	64,800		Engineering Hall	67,859
	Brackenridge Hall	55,569		Eureka Building	36,607
	Bruce Hall (Housing)	63,006		Falk School	28,213
	Centre Plaza Apartments	138,600		Falk School Addition	38,000
	College Gardens Apartments	297,510		Fitzgerald Field House	105,045
	Darragh Street Housing	102,217		Fitzgerald Field House - Concession Stand	
	Forbes Craig Apartments	43,554		Frick Fine Arts	73,088
	Forbes Pavilion	87,114		Gardner Steel Conf. Ctr.	26,714
	Forbes Pavilion (Added Offices+Graphics)			GSPH - Parran and Crabtree	227,908

	Franklin Complex	50,753		GSPH Annex	57,000
	Fraternity Housing Complex	73,600		Heinz Chapel	18,717
	Holland Hall	136,958		Hillman Library	252,778
	Edward H. Litchfield Towers	465,393		Hillman Library - Food Services	
	Lothrop Hall	241,770		Iroquois (SHRS)	60,000
	Mark A. Nordenberg Hall	200,471		Langley Hall	90,592
	Mark A. Nordenberg Hall - Wellness Ctr			Langley Hall - Food Services	
	Mark A. Nordenberg Hall - PNC Bank			Barco Law Building	139,611
	Mayflower Apartments	14,940		Barco Law Building - Food Services	
	McCormick Hall	43,686		Life Sciences Annex	50,000
	Oakwood Apartments	14,886		Log Cabin	400
	Panther Hall	161,542		LRDC	99,734
	Pennsylvania Hall	127,835		Mervis Hall	86,570
	Ruskin Hall	120,000		Mervis Hall - Food Services	
	Sutherland Hall	223,903		Music Building	21,275
	University Club	85,000		Van de Graaff (Nuclear Physics)	36,691
				O'Hara Student Center	40,000
Auxiliary - Parking				Petersen Events Center	430,000
	Craig Hall Garage	10,409		Plum Borough Research Facility	41,139
	Wesley W. Posvar Hall Garage	203,746		Upper Campus Chilled Water Plant	
	GSPH Garage	56,941		Petersen Sports Complex	23,200
	Halket/Iroquois Lot			Wesley W. Posvar Hall	513,893
	Joncaire/Boundary Lot			Wesley W. Posvar Hall - Einstein Bagels	
	Langley Hall Garage	6,904		Wesley W. Posvar Hall - Food Prep	

	Information Sciences Garage	38,499		Lower Campus Chilled Water Plant	
	O'Hara Garage	140,000		University Public Safety Building	23,200
	OC Garage	106,629		Salk Hall Annex	128,767
	Soldiers & Sailors Garage	344,626		Salk Hall Main	205,228
	Sennott Square Garage	See Sennott Sq		Salk Hall Addition	81,000
	Thomas Boulevard Parking			Sennott Square (Includes garage and vendors)	248,000
				Information Sciences Building	76,130
Educational and General & Health Sciences Facilities Managed by Facilities Management				Space Research Coordination Center	41,849
	3343 Forbes	25,122		Stephen Foster Memorial	27,182
	480 Melwood St.	44,562		Thackeray Hall	99,147
	530 Melwood (Motor Pool)	8,200		Thaw Hall	51,379
	Allegheny Observatory	30,017		Thomas Boulevard	192,000
	Allen Hall	58,026			
	Alumni Hall	162,970		Trees Field - Sports Dome	105,608
	Athletic Fields Building	1,312		Trees Hall	244,412
	Bellefield Hall	107,545		Victoria Hall	128,759
	Benedum Aud.	19,586		Victoria Hall - Food Services	
	Benedum Hall	433,326		William Pitt Union	178,726
	Benedum Hall - Food Services			William Pitt Union - Food Services	
	Benedum Hall - MCSI Addition	20,480			

	Center for Bioengineering	91,123	**School of Medicine Division/Health Sciences Buildings**		
	Cathedral of Learning	599,637		Biomedical Science Tower 3	326,000
	Cathedral of Learning - Chick Fil A			McGowan Inst for Regen Medicine	45,000
	Cathedral of Learning - Food Services			Scaife Hall	474,881
	Carrillo Street Steam Plant	23,500			
	718 Devonshire Ave.	16,000	**Total**		**11,564,322**

Appendix C: Pre-FY19 Pitt GHG Emissions Inventory Data

Table 26 - Pitt's GHG Emissions for Fiscal Year 2017

		CO2	CH4	N2O	CO2e
		kg	kg	kg	Metric Tonnes
Scope 1	Co-gen Electricity	0	0	0	-
	Co-gen Steam	25,538,568	2,283	46	25,623
	Other On-Campus Stationary	5,227,507	467	9	5,245
	Direct Transportation	1,331,518	254	86	1,388
	Refrigerants & Chemicals	-	-	-	1,266
	Agriculture	-	-	3	1
Scope 2	Purchased Electricity	119,411,279	1,655	2,332	105,604
	Purchased Steam / Chilled Water	20,167,615	2,252	104	17,238
Scope 3	Faculty / Staff Commuting	12,073,458	1,152	446	12,433
	Student Commuting	5,844,545	392	167	5,962
	Directly Financed Air Travel	19,452,692	193	222	24,706
	Other Directly Financed Travel	65,927	3	2	548
	Study Abroad Air Travel	2,585,030	26	29	4,578
	Solid Waste	-	-	-	-
	Wastewater	-	81,183	-	1,522
	Paper	-	-	391	104
	Scope 2 T&D Losses	-	-	-	2,441
Offsets	Additional				0
	Non-Additional				0
Totals	Scope 1	32,097,593	3,004	144	33,523
	Scope 2	139,578,895	3,906	2,437	122,842
	Scope 3	51,937,639	83,218	1,475	57,817
	All Scopes	223,614,127	90,128	4,055	214,181
	All Offsets				

Net Emissions: 214,181

Table 27 - Pitt's GHG Emissions for Fiscal Year 2014

		CO2	CH4	N2O	CO2e
		kg	kg	kg	Metric Tonnes
Scope 1	Co-gen Electricity	32,890,427	3,272	65	32,999
	Co-gen Steam	6,368,762	634	13	6,390
	Other On-Campus Stationary	1,201,002	244	82	1,230
	Direct Transportation	0	0	0	615
	Refrigerants & Chemicals	0	0	6	1.68
	Agriculture	114,262,060	14,386	3,828	115,679
Scope 2	Purchased Electricity	22,521,931	2,241	45	22,597
	Purchased Steam / Chilled Water	2,943,193	400	144	2,992
Scope 3	Faculty / Staff Commuting	6,563,554	595	233	6,642
	Student Commuting	5,700,006	376	161	5,753
	Directly Financed Air Travel	28,146,410	279	321	28,239
	Other Directly Financed Travel	1,833,537	2,380	1,079	2,186
	Study Abroad Air Travel	911,986	9	10	915
	Solid Waste	0	57,462	0	1,609
	Wastewater	0	0	456	121
	Paper	0	0	0	2,033
	Scope 2 T&D Losses	5,975,823	752	200	6,050
Offsets	Additional				0
	Non-Additional				0
Totals	Scope 1	40,460,192	4,150	167	41,235
	Scope 2	136,783,991	16,627	3,873	138,276
	Scope 3	52,074,508	62,252	2,604	56,541
	All Scopes	229,318,691	83,029	6,644	236,052
	All Offsets				

Net Emissions: 236,052

Table 28 - Pitt's GHG Emissions for Fiscal Year 2011

		CO2	CH4	N2O	CO2e
		kg	kg	kg	Metric Tonnes
Scope 1	Co-gen Electricity	22,231,127	2,212	44	22,305
	Co-gen Steam	5,704,263	568	11	5,723
	Other On-Campus Stationary	705,096	139	47	722
	Direct Transportation	0	0	0	2,117
	Refrigerants & Chemicals	0	0	3	0.76
	Agriculture	137,555,193	15,358	2,170	138,560
Scope 2	Purchased Electricity	31,121,306	3,243	236	31,275
	Purchased Steam / Chilled Water	2,935,411	434	153	2,988
Scope 3	Faculty / Staff Commuting	6,512,906	628	242	6,595
	Student Commuting	6,272,156	439	184	6,333
	Directly Financed Air Travel	20,111,362	199	229	20,178
	Other Directly Financed Travel	1,598,834	2,100	952	1,910
	Study Abroad Air Travel	790,008	8	9	793
	Solid Waste	0	56,990	0	1,596
	Wastewater	0	0	402	107
	Paper	0	0	0	1,640
	Scope 2 T&D Losses	8,501,989	949	134	8,564
Offsets	Additional				0
	Non-Additional				0
Totals	Scope 1	28,640,485	28,640,485	106	30,867
	Scope 2	168,676,500	168,676,500	2,406	169,835
	Scope 3	46,722,664	46,722,664	2,305	50,703
	All Scopes	**244,039,649**	**83,266**	**4,817**	**251,404**
	All Offsets				0

Net Emissions: 251,404

Table 29 - Pitt's GHG Emissions for Fiscal Year 2008

		CO2	CH4	N2O	CO2e
		kg	kg	kg	Metric Tonnes
Scope 1	Co-gen Electricity	0	0	0	0
	Co-gen Steam	0	0	0	0
	Other On-Campus Stationary	9,181,420	913	18	9,212
	Direct Transportation	471,071	85	29	481
	Refrigerants & Chemicals	0	0	0	681
	Agriculture	0	0	1	0.23
Scope 2	Purchased Electricity	146,965,686	18,938	2,435	148,141
	Purchased Steam / Chilled Water	52,874,682	5,673	597	53,192
Scope 3	Faculty / Staff Commuting	2,567,191	405	141	2,616
	Student Commuting	6,430,133	633	243	6,512
	Directly Financed Air Travel	5,744,764	401	169	5,801
	Other Directly Financed Travel	17,009,837	169	194	17,066
	Study Abroad Air Travel	1,369,756	1,799	815	1,636
	Solid Waste	0	650,504	0	18,214
	Wastewater	0	0	454	120
	Paper	0	0	0	1,745
	Scope 2 T&D Losses	14,535,068	1,873	241	14,651
Offsets	Additional				0
	Non-Additional				0
Totals	Scope 1	9,652,491	999	48	10,374
	Scope 2	199,840,368	24,611	3,031	201,333
	Scope 3	47,656,748	655,783	2,256	68,362
	All Scopes	**257,149,606**	**681,392**	**5,336**	**280,069**
	All Offsets				0

Net Emissions: 280,069

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