University of Pittsburgh

Department of Civil and Environmental Engineering

FINAL REPORT

Greenhouse Gas Inventory of University of Pittsburgh for FY 2014

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By

Melissa M. Bilec, PhD, LEED AP
Associate Professor

Vaclav Hasik
Graduate Student Researcher

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Preface

This report presents the greenhouse gas inventory results for University of Pittsburgh (UPitt) for FY 2014.

The authors acknowledge the contribution of Laura Zullo from Facilities Management Department of UPitt, who provided valuable data that allowed us to complete the inventory. In addition, we sincerely thank all other UPitt staff members who provided us data and shared important information regarding their sustainable practices.

Executive Summary

The objective of this report is to assess the Greenhouse Gas (GHG) Inventory for the Pittsburgh Campus of the University of Pittsburgh (UPitt). The report presents a fiscal year (FY) 2014 GHG emissions inventory from direct and indirect activities of UPitt. This is UPitt's third GHG inventory document since its initiation in 2008, and it builds on and compares the previous two inventories [1, 2]. We anticipate that the report will serve as a guideline for any committee or group aiming to reduce the emissions of UPitt in the future. Understanding current GHG emissions is a necessary step towards developing strategies to lower future GHG emissions.

For this study, fiscal year 2014 was selected as the temporal boundary with the goal of comparing results to FY 2008 and 2011 GHG inventories. There have been numerous changes in campus infrastructure over the years, with a potential to change source distribution and total amount of GHG emissions. One of the most significant projects have been the construction of the state of the art Carrillo Street Steam Plant (CSSP). The CSSP is an ultra-low NOx control plant, considered one of the cleanest heating plants of any higher educational institutions in the United States [3]. FY 2014 was the first studied year with the CSSP being in full operation over the course of the entire fiscal year. Currently, the CSSP services UPitt and the University of Pittsburgh Medical Center (UPMC), meeting 64% of UPitt's steam demand.

The overall distribution of GHG emissions by source remained similar to previous years as shown in Figure 1. Table 1 shows greenhouse gas emissions totals for the three inventoried fiscal years with sources corresponding to source distributions shown in Figure 1. The most significant shift happened due to UPitt's switch to consuming primarily CSSP's steam for heating. Due to this switch, the distribution in GHG emissions for heating has shifted from 20% purchased steam and 0% on-site generated steam in 2008, to 11% and 8.3% in 2011, to the latest 10% and 14% in 2014. The overall emissions from steam consumption have risen since 2011, which can be attributed to increases in building area served, heating degree days observed, decrease in heat dissipation from lighting fixtures, and other factors.

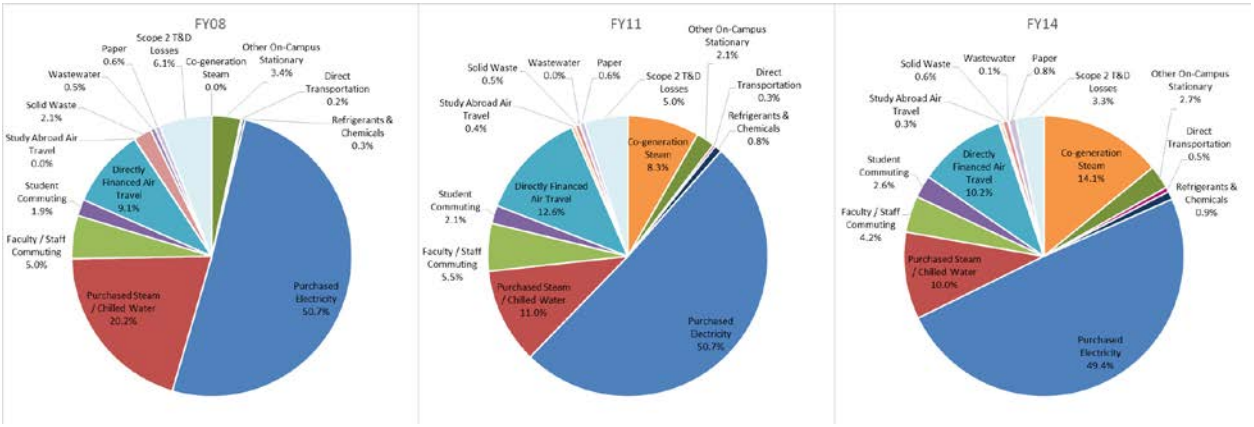


Figure 1 – GHG emission source distributions for fiscal years 08, 11, and 14.

The biggest greenhouse gas emitting source for UPitt is again electricity generation which accounts for about half of all of the university's emissions. **The total campus-wide electricity demand has remained relatively similar to FY11 level with only a 0.2% (513 MWh) increase, even though building additions resulted in**

a 6% (560 kSF) increase in gross building area served. A change in electricity generation mix, significantly reducing the ratio of coal while increasing nuclear powered electricity, resulted in a 15% (15,000 metric tons CO2e) reduction in greenhouse gas emissions from electricity. Scope 2 transmission and distribution losses related to electricity demand also decreased over the years due to lowering of the regional emission factor and higher contribution from other sources.

Table 1 – Summary and comparison of University of Pittsburgh GHG emissions for fiscal years 08, 11, and 14. All emissions are reported in metric tons of carbon dioxide equivalent (MT CO_2e).

	Category	FY08	FY11	FY14
Scope 1	Co-generation Electricity	**0**	**0**	**0**
	Co-generation Steam	**0**	**22,189**	**32,981**
	Other On-Campus Stationary	**9,162**	**5,693**	**6,386**
	Direct Transportation	**484**	**732**	**1,273**
	Refrigerants & Chemicals	**799**	**2,251**	**2,192**
	Agriculture	**0**	**1**	**2**
Scope 2	Purchased Electricity	**138,704**	**135,526**	**115,341**
	Purchased Steam / Chilled Water	**55,093**	**29,432**	**23,404**
Scope 3	Faculty / Staff Commuting	**13,622**	**14,682**	**9,845**
	Student Commuting	**5,180**	**5,543**	**6,064**
	Directly Financed Air Travel	**24,817**	**33,593**	**23,921**
	Other Directly Financed Travel	**112**	**47**	**211**
	Study Abroad Air Travel	**0**	**1,101**	**775**
	Solid Waste	**5,688**	**1,404**	**1,437**
	Wastewater	**1,466**	**120**	**136**
	Paper	**1,626**	**1,477**	**1,949**
	Scope 2 T&D Losses	**16,618**	**13,404**	**7,596**

	Reporting Metric	FY08	FY11	FY14
Totals	Required (Scope 1 & 2)	**204,243**	**195,823**	**181,578**
	All Accountable Emissions	**273,372**	**267,194**	**233,511**

The third largest contributor to GHG emissions, directly financed air travel, saw a slight decrease between FY11 and FY14. The same network-based recording of reimbursements and P-card purchases was used, but the data was more complete, accounting for even larger share of all travel reimbursements than in previous years. This increase in data collection effectiveness resulted in higher recorded number of miles traveled; however, changes in fuel technologies and reduction in the estimated emissions per mile traveled resulted in an overall emission decrease in this category.

Overall the University of Pittsburgh saw a reduction in GHG emissions from previous years, particularly due to electricity usage reductions and regional electricity fuel mix shift away from coal. The use of Carrillo Street Steam Plant and improvements to Bellefield Boiler Plant had significant impact on lowering emissions due to steam usage; however, steam demand itself has increased rapidly between inventories.

1 INTRODUCTION

Universities have the knowledge that is necessary to create a sustainable environment at their campuses. Increasing numbers of student communities and increased enrollment in the sustainability field illustrate the increasing attention directed towards sustainability. Higher education institutions are often responsible for teaching and conducting research on environmental issues such as climate change. Educational institutions have the opportunity to lead society towards the solution of this global problem, which is a common threat for humans regardless of country and location.

This report stems from this understanding and aims to quantify and therefore facilitate strategies that will eventually reduce campus emissions. A GHG inventory is a first step towards effective reduction strategies since one main purpose of the inventory is to identify hotspots among different sources.

There are three stages to the GHG inventory process: data collection; GHG emissions calculation; and data analysis for climate action planning[4].

Step one: Data Collection – many items of raw data are required to conduct a GHG inventory, such as purchased electricity, transportation, solid waste, refrigerants, offsets, etc.

Step two: Emissions Calculations – collected data is then processed as input into a calculator tool. The American College and University Presidents' Climate Commitment (ACUPCC) recommends the use of Clean Air-Cool Planet Campus Carbon Calculator (CA-CP calculator). The CA-CP calculator is an Excel-based spreadsheet that uses national inventories and methodologies of the Intergovernmental Panel on Climate Change (IPCC) and calculators of the Greenhouse Gas Protocol, and has been adapted for use with higher education institutions. The CA-CP calculator covers all emission sources with the defined scopes of the ACUPCC.

Step three: Data Analysis – the calculator converts all emissions into CO2 equivalent in order to compare GHG sources and identify 'hotspots' within the institution. These areas then form the greatest opportunities for emission reductions.

The report begins by introducing the CA-CP calculator, the study boundaries, and scope. Results are presented under each category together with the various assumptions made during calculations. Discussion of results and comparison to previous GHG inventory results are presented, followed by recommendations for updating this report in the future. The last chapter of the report is the conclusions section.

2 CLEAN AIR-COOL PLANET (CA-CP) CAMPUS CARBON CALCULATOR

The CA-CP calculator is a widely used tool to calculate GHG emissions, and is specifically designed for educational institutions. Currently, it is used by over 500 schools in North America [5].

The tool is an Excel-based spreadsheet designed to facilitate data collection and analysis. This first step forms the basis for institutional action on reducing greenhouse gas emissions. Although the primary purpose of the tool is to conduct a greenhouse gas inventory, the tool can 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.

The calculator uses standard methodologies and emission factors given by the GHG Protocol Initiative, and is a preferred tool by the ACUPCC [5]. CA-CP calculator version 7.0 tool was used in this project.

3 BOUNDARIES OF THE INVENTORY

Three boundaries exist for calculating the campus GHG emissions: organizational, operational, and temporal.

3.1 ORGANIZATIONAL BOUNDARIES

Organizational boundaries are generally the highest-level of the three boundaries, and therefore the first boundaries that are drawn during the creation of the GHG inventory. Organizational boundaries state whether GHG emissions are measured for one department, school, or for the entire campus. Depending on this boundary, the facilities and operations that are to be included into the analysis are determined. For this study, UPitt's Oakland Campus was selected as the organizational boundary. Buildings managed and used by University of Pittsburgh Medical Center (UPMC) were excluded, as well as other regional campuses that belong to UPitt. Student housing facilities located on campus and managed by UPitt were included in the analysis; however, housing owned by UPitt but located outside of the campus boundary was not, since each tenant is billed individually and directly by utility companies.

Table 2 – List of changes in building stock between FY11 and FY14.

Building Name		Gross SF
Bouquet Gardens	Acquired	217,537
Nordenberg Hall	Constructed	200,540
3343 Forbes	Acquired	25,122
GSPH Annex	Constructed	57,000
Salk Hall Addition	Constructed	81,000
University Place	Demolished	21,838
	Total added:	**581,199**
	Total removed:	**21,838**

Within this organizational boundary, buildings owned and managed by UPitt at the Oakland Campus consisted of 97 buildings and had a gross building area of 10.2 million ft^2, over 550 thousand ft^2 increase from 2011. Table 2 shows all the changes in the campus building stock since 2011, with the acquisition of 9 residential buildings in the Bouquet Garden complex, and the construction of the Mark A. Nordenberg Hall being the largest.

During the study period, there were 25,917 full–time equivalent (FTE) students enrolled at UPitt. Part-time students are accounted for as a half of a full-time equivalent student, per CA-CP methodology, and are included in the FTE number above. Additionally, there were 2,791 faculty and post-doctoral associates and 5,012 staff. These numbers include all schools except for the school of medicine, which is considered a UPMC affiliate, and are compared to previous years in Table 3.

Table 3 – Population numbers between FY08 and FY14.

Community	FY08	FY11	FY14
Students (FTE)	24,755	26,740	25,917
Faculty	2,688	2,878	2,791
Staff	4,995	5,079	5,012
Total	**32,438**	**34,697**	**33,720**

3.2 OPERATIONAL BOUNDARIES

Operational boundaries identify GHG emitting sources to be included in the inventory. The GHG protocol uses a structure in which all emissions are categorized into three scopes [5]. Scope 1 includes direct emissions from sources that are owned and controlled by UPitt, such as on-campus electricity and steam generation, on-campus natural gas usage, transportation for campus operations, use of refrigerants and chemicals, and agricultural activities. Scope 2 emissions include indirect emissions from sources that are neither owned nor operated by UPitt, but whose products are linked to campus energy consumption, such as purchased electricity, steam, and chilled water. Scope 3 emissions are other sources that are neither owned nor operated by UPitt but are either directly financed (i.e. commercial air travel paid by UPitt, waste removal) or are otherwise linked to the campus via influence or encouragement (i.e. air travel for study abroad programs, daily faculty, staff, and student commuting). Emissions associated with paper consumption, solid waste disposal, wastewater treatment, and energy transmission and distribution losses are also included in Scope 3.

Emissions that fall under Scopes 1 and 2 are mandatory and must be included in the inventory by the GHG protocol. Although Scope 3 emissions are deemed optional by the GHG protocol, researchers are encouraged to include as many emission sources as possible to obtain a realistic inventory for the institution.

3.3 TEMPORAL BOUNDARIES

The final boundary is the temporal boundary. The calculator uses fiscal years instead of calendar years since most schools function on a fiscal year basis. Fiscal years at UPitt begin on July 1st and end on June 30th of the following calendar year. This study focused on evaluating fiscal year 2014, beginning on July 1st 2013 and ending on June 30th 2014. Previous UPitt inventories included fiscal years 2008 and 2011. One aim of this work was to understand the change in UPitt'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 4 summarizes all of the information. However, individual data points input into the CA-CP calculator 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 were fuel is burned or gasses are directly released into the atmosphere. This includes any on-campus electricity generation, steam generation, and gas usage. During UPitt's first GHG inventory in FY08 this area had a small impact because the University purchased all of its electricity and steam from outside vendors; however, in November 2009 UPitt began operation of its own Carrillo Street Steam Plant (CSSP), a natural gas powered, high-efficiency, low NOx emitting steam plant located on the upper campus of the University of Pittsburgh. It is jointly owned and operated by UPitt and the University of Pittsburgh Medical Center (UPMC), and is serving UPitt, UPMC, and some Carnegie Mellon University (CMU) buildings. It was first included in the FY11 inventory, but was not yet in full operation, supplying UPitt with 49% of its total steam demand. FY14 was the first inventoried year where CSSP was in full operation, and supplied UPitt with 64% of its steam demand. The remaining 36% was supplied by the Bellfield Boiler Plant (BBP) which is a steam plant not operated by UPitt and will therefore be covered in more detail in Scope 2.

UPitt's total steam demand has increased roughly 150,000 klbs between each inventoried year, from 533,000 klbs in FY08, to 699,000 klbs in FY11, to 841,000 klbs in FY14. In FY14, this translated into total steam related emissions being 56,385 MT CO2e, which accounted for 23.8% of the total GHG emissions. Since CSSP is the only Scope 1 steam source and supply's 64% of the total UPitt steam demand, the total Scope 1 co-generation emissions are 32,981 MT CO_2e. A detailed breakdown and comparison of steam consumption and related emissions is shown in Figure 2 and Table 4. It is important to note that the plant efficiencies and emission factors vary between years, which is why the consumption to emission ratios are not constant year-to-year.

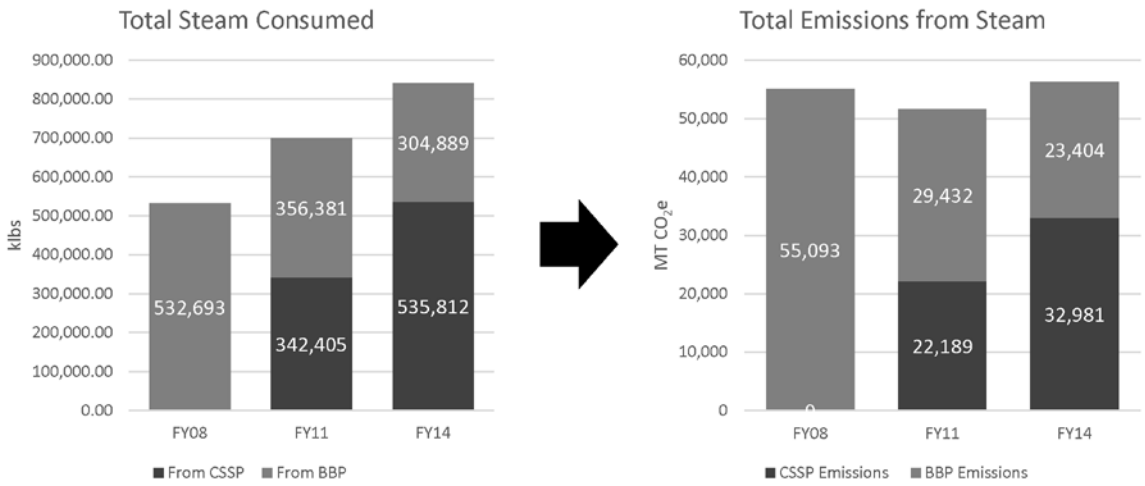


Figure 2 – Steam consumption and related emissions for FY 08, 11, and 14.

On-campus stationary sources at UPitt also include natural gas used in individual buildings. This natural gas is typically used for air heating, water heating, backup generators, and laboratory purposes. The total natural gas usage in FY14 accounted for 120,120 MCF, and translated into 6,386 MT CO_2e (2.7% of total emissions).

Conversion factors required to convert the amount of natural gas into energy units were obtained from EPA's Energystar website [6]. Emission factors associated with combustion of natural gas were provided by the CACP calculator.

Table 4 – Summary of stationary combustion data.
(CSSP = Carrillo Street Steam Plant, BBP = Bellefield Boiler Plant)

	FY08	FY11	FY14
CSSP steam (klbs)	n/a	342,405	535,812
BBP steam (klbs)	532,693	356,381	304,889
Total steam (klbs)	532,693	698,786	840,701
CSSP emissions (MT CO_2e)	n/a	22,189	32,981
BBP emissions (MT CO_2e)	55,093	29,432	23,404
Total emissions (MT CO_2e)	55,093	51,620	56,385
Natural gas[a] (MCF)	168,289	104,555	120,120
Total emissions (MT CO_2e)	9,162	5,693	6,386

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

4.1.2 UNIVERSITY FLEET

Another source of scope 1 emissions is the university fleet fuel use. This includes all of the fuel used and financed by the University for campus-wide transportation and select off-campus land transportation. This includes fuel used by the facilities management, food services, moving/receiving, property management, campus bus, chancellor and others, but does not include chartered bus service.

UPitt currently uses two tracking systems for its fleet fuel use. Guttman Oil tracking system is used for fuel purchased strictly on UPitt's Oakland campus, while Voyager tracking system includes all the rest of the University of Pittsburgh used fuel, including Oakland campus, regional and national campuses, and other uses. *It is difficult to accurately extract Oakland related fuel purchases from the Voyager system, because not all purchases have identification corresponding to a campus or a department.* A combination of card numbers and fill up addresses was used to identify fuel purchases by Oakland campus personnel. The same records were available in FY11, but the information was extracted in a different manner and some fuel was not accounted for. In FY08, UPitt was transitioning from a different tracking system, and not all fuel was account for either.

Guttman Oil weekly fuel reports were available for the entire 2014 fiscal year, with the exception of 2 missing weeks. Weekly average was calculated and added for the two missing weeks to account for the total of 52 weeks in a fiscal year. Voyager reports are generated on a monthly basis and were available for all months except for June. Monthly average was calculated and one month was added to the reported total to account for all 12 months in a fiscal year.

Both Guttman and Voyager reported the purchased fuel to be either regular gasoline or diesel, which has been consistent between all inventories. UPitt uses blended biodiesel instead of pure petroleum-based diesel for appropriate vehicles. CO_2 emitted during biodiesel combustion is theoretically offset by the carbon sequestered during the life of the fuel source, such as soybean or vegetable matter from which the biodiesel was derived. Biodiesel can be mixed with petroleum diesel to create different blends suitable for different vehicle engines and performance. A mix of 5% biodiesel and 95% petroleum diesel is labeled as a B5 mix, whereas pure biodiesel is labeled as B100. Although different grades of biodiesel are currently available in the market, only two biodiesel mixtures exist in Pittsburgh, B5 or B100. B5 type of blend was assumed to be used for the University Fleet since higher grades of biodiesel might cause performance problems especially during winter months.

Based on data obtained from UPitt's Transportation Services, in FY14 UPitt's vehicle fleet consisted of 270 vehicles total, of which 218 were Oakland campus vehicles, and 52 were regional campus vehicles. Only Oakland campus vehicles were accounted for in this inventory. The estimated gallons of fuel reported from the Guttman Oil system were 12,300 and 2,831 of gasoline and biodiesel respectively. The estimate from Voyager system was 114,672 and 9,144 gallons of gasoline and biodiesel respectively. The total estimated fuel use was therefore 126,973 and 11,976 gallons of gasoline and biodiesel respectively, translating into total GHG emissions of 1,273 MT CO_2e (0.6% of total emissions). The difference from FY11 to FY14 for gasoline consumption was an increase of about 55,000 gallons, while biodiesel increased by about 2,500 gallons. The reason for the increase in fuel use can likely be attributed to the upgraded tracking system and more accurate records, and not necessarily a large increase in miles traveled.

Table 5 – Summary of university fleet data.

	FY08	FY11	FY14
Number of Vehicles	203	193	218
Gasoline (gal)	42,300	71,800	126,973
Biodiesel (gal)	11,220	9,500	11,976
GHG Emissions (MT CO_2e)	484	732	1,273

4.1.3 REFRIGERANTS

Hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) are greenhouse gases that are often used for refrigeration and are accounted under Scope 1 emissions. Under ideal conditions, these gases are used in a closed loop system and do not contribute to GHG emissions once they are input into the system. However, leaks in the system result in fugitive emissions and are included in the GHG inventory since some of these refrigerants have high global warming potentials (GWP). The amount of fugitive emissions was assumed to be equal to the amount of refrigerants needed to recharge the systems during maintenance activities.

UPitt used total of 1,053 lbs of refrigerants in FY14, translating to GHG emissions of 2,192 MT CO_2e (0.9% of total emissions). This was similar to 2,251 MT CO_2e in FY11; however, it is difficult to compare refrigerant use between GHG inventories due to the nature of refrigerant leakage, disposal, and replenishment. Most of the refrigerant use are associated with annual fluctuations in demand for refrigerant maintenance and cannot be attributed to any change in facilities or campus policies. Table 3 presents the type and amount of refrigerant used at UPitt together with the GWP of each refrigerant and the comparison between previous inventories.

Table 6 – Summary of refrigerant data. (GWP100 = global warming potential for a 100 year horizon) [7, 8]

	Quantity Used (lbs)				
Type	**FY2008**	**FY2011**	**FY2014**	**GWP100**	**Source**
R-134a	41	840	400	1,300	EPA
R-12	20	36	0	10,890	EPA
R-404a	1	1	0	3,260	Calm et al
R-22	637	754	453	1,700	EPA
R-123	400	200	200	77	IPCC
R-11	0	400	0	4,750	EPA
R-408a	0	4	0	5,780	Calm et al
R-410a	0	107	0	1,980	Calm et al
R-414	19	0	0	1,450	EPA
R-500	3	0	0	37	EPA
R-503	1	0	0	15,000	EPA
GHG Emissions (MT CO_2e)	799	2,251	2,192		

4.1.4 AGRICULTURAL ACTIVITIES

Scope 1 agricultural sources of GHG emissions account for animal herding or fertilizer, pesticide, or herbicide use for crop growth and landscaping. Since there are no herding animals on the Pittsburgh Campus, there are no emissions associated with this source; however, UPitt does use herbicides for landscaping activities. Synthetic herbicides are labeled with their chemical makeup using three numbers to represent the percentages of nitrogen (N), phosphorus (P), and potassium (K). For example, Momentum, a pre-emergent crabgrass herbicide used on campus, is identified by the numbers 21-0-11 and 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.

Different commercial fertilizers have different nitrogen percentages. A weighted average was calculated based on the amount of fertilizer used and its specific nitrogen content. The resulting average was approximately 1,125 lbs of fertilizer having an average nitrogen content of 18%. By using the emission factors present in the CA-CP calculator, 0.9 MT CO_2-equivalents was obtained for GHG emissions from fertilizers.

Table 7 – Summary of agricultural data.

	FY08	FY11	FY14
Total (lbs)	475	1,125	2,250
Nitrogen Content (%)	12.6%	18.1%	20.3%
GHG Emissions (MT CO_2e)	0.26	0.85	1.89

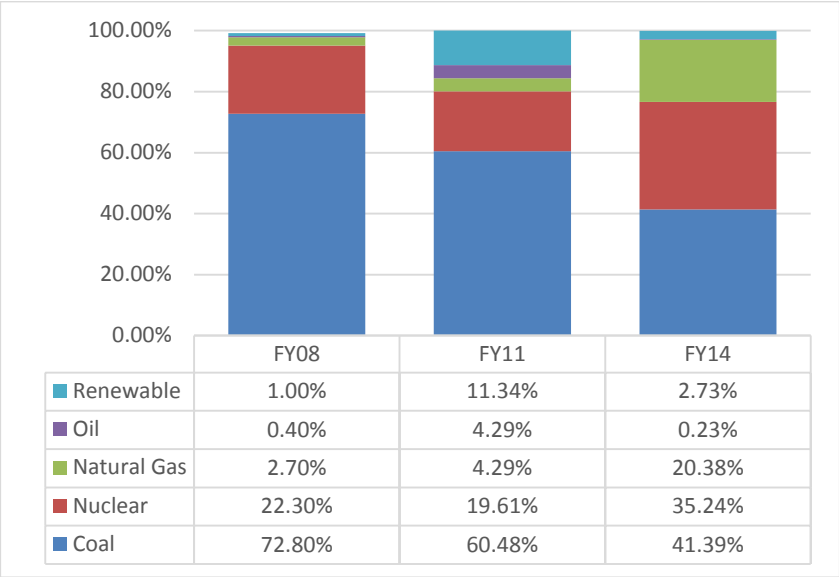
4.2 SCOPE 2 EMISSIONS

Scope 2 emission sources cover purchased electricity and steam that are vital for the activities of UPitt. These two items usually make up the majority of emissions for many institutions.

4.2.1 PURCHASED ELECTRICITY

Scope 2 purchased electricity category includes all electricity not generated on UPitt's campus and purchased from outside suppliers. This category has the most impact on the total GHG emissions, as it has accounted for about a half of all UPitt emissions in all inventoried years. These emissions are calculated based on the reported electricity usage, and the electricity generation fuel mix reported by suppliers. The CA-CP calculator uses either a regional fuel mix information from the EPA's e-GRID program or a customized user input fuel mix for its calculation. The CA-CP calculator categorizes electricity generation fuels into the following ten categories: coal, natural gas, distillate oil, residual oil, nuclear, waste-to-energy, hydroelectric, biomass, renewable (wind, solar), and other.

The FY08 inventory used the default fuel mix for the RFC West region, which was dominated by coal and nuclear power, 73% and 22% respectively. *A custom fuel mix was used for the first time in the FY11 inventory.* The fuel mix for that year was provided by First Energy, and showed a significant increase in energy from oil and gas (8.6%) and renewables (11.3%). Coal and nuclear decreased that year to 60.5% and 19.6%. Custom fuel mix was used again for the FY14 inventory, this time provided by PJM Interconnection. This mix consisted of 41.1% coal, 35.2% nuclear, 20.4% natural gas, 2.7% renewables, and 0.2% oil. A detailed comparison of fuel mixes is shown in Figure 3.



	FY08	FY11	FY14
Renewable	1.00%	11.34%	2.73%
Oil	0.40%	4.29%	0.23%
Natural Gas	2.70%	4.29%	20.38%
Nuclear	22.30%	19.61%	35.24%
Coal	72.80%	60.48%	41.39%

Figure 3 – Fuel mix summary and comparison.

The total UPitt electricity consumption in FY14 has remained almost identical to FY11 level with only a 0.2% (513 MWh) increase. This is a significant reduction of energy use on a per area basis, considering that building additions resulted in a 6% (560 kSF) increase in gross building area served. Combined with the fuel mix with much lower percentage of coal generated electricity, FY14 saw an overall decrease in GHG emissions from purchased electricity by about 20,000 MT CO_2e.

Table 8 – Summary of electricity data.

	FY08	FY11	FY14
Electricity Usage (MWh)	198,040	211,101	211,614
GHG Emissions (MT CO_2e)	138,704	135,526	115,341

4.2.2 PURCHASED STEAM AND CHILLED WATER

UPitt does not purchase any chilled water, but it does purchase steam to offset the difference in demand not covered by the UPitt 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. Since steam from the BBP is purchased, and the BBP is a non-UPitt plant, this steam generation falls under Scope 2 emissions.

Bellefield Boiler Plant was the only steam plant in Oakland until 2009 when UPitt built its Carrillo plant. The BBP was powered by coal and natural gas until 2009, and was nicknamed the "The cloud factory". This nickname came from the coal burning related pollution that the plant released into the air, and also explains the higher greenhouse gas emissions from purchased steam in FY08. In 2009 this plant switched to 100% natural gas fuel, and helped increase its efficiency and lower its emissions. This switch had an observable impact on the FY11 and FY14 emissions accounting for UPitt.

As mentioned in section 4.1.1 for Scope 1 stationary combustion, UPitt consumed a total of 840,701 klbs of steam in FY14, resulting in total emissions of 56,385 MT CO_2e. The UPitt CSSP plant supplied 64% (535,812 klbs) of this demand and BBP supplied the remaining 36% (384,889 klbs). With all natural gas fuel and estimated efficiency of 82%, the emissions associated with the BBP came to 23,404 MT CO_2e. This is a reduction of 6,000 MT CO_2e from FY11.

Table 9 – Summary of purchased steam.
(CSSP = Carrillo Street Steam Plant, BBP = Bellefield Boiler Plant)

	FY08	FY11	FY14
CSSP steam (klbs)	n/a	342,405	535,812
BBP steam (klbs)	532,693	356,381	304,889
Total steam (klbs)	532,693	698,786	840,701
CSSP emissions (MT CO_2e)	n/a	22,189	32,981
BBP emissions (MT CO_2e)	55,093	29,432	23,404
Total emissions (MT CO_2e)	55,093	51,620	56,385

4.3 SCOPE 3 EMISSIONS

Sources that emit greenhouse gasses but are indirectly related to UPitt are account 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

UPitt finances different modes of transportation for its faculty and staff, which include air travel, rental car, bus, train, and personal mileage reimbursement. Detailed information for such travel financing comes from different sources within the university, those being the business office, an air travel agent, and the athletics department.

The business office has records of travel reimbursements and P-card purchases. In FY08, the different modes of financed travel were recorded as a single entry into the reimbursement statement that also included items such as hotels, per diem, and meals. In FY11, departments within the University started switching to a new network-based system for recording reimbursements and P-card purchases, a system which provided more comprehensive expense data. In FY14 this system also included descriptions of the nature of the expenses, allowing for more accurate disaggregation between air, bus, and train expenses. Since this was not a one-time university-wide switch, some departments still report their reimbursements in a paper form, in which case they are not accounted for in this system, or in the inventory. *It is estimated that in FY11 about 30% of all reimbursements were filed using the new system, and in FY14 it was about 70%.* These inconsistencies make it difficult to directly compare the emissions between FY08, FY11, and FY14.

Faculty, staff, and the athletics department may also book flights directly through a UPitt travel agent, in which case the expenses do not show in the reimbursement and P-card system. The travel agent provides a total dollar amount spent on airfares, which is then added to the expenses reported by the business office. The athletics department also books chartered busses for UPitt athletic teams and reports the total expenses separately.

Once all travel expense data was aggregated it was separated into the following three modes: air travel, bus travel, and rail travel. Monetary values were converted into miles traveled using industry estimates. For air travel the revenue passenger mile (RPM) for FY14 obtained from Airlines for America (AA) was 14.98 cents per mile [9]. The Association for the Advancement of Sustainability in Higher Education (AASHE) recommends adding 20% to this value to account for taxes and fees associated with airfare, which brought the RPM to 17.98 cents per mile [10]. Bus and rail estimates were obtained from the American Public Transportation Association and were 90 cents per mile and 51.5 cents per mile respectively [11].

Using the monetary data and the industry conversion suggestions, it was estimated that in FY14 UPitt financed about 47 million air miles, and 731 thousand land miles, resulting in total emissions of 24,132 MT CO_2e. Air mile estimates have increased each inventoried year by about 11 million miles, which is most likely due to more accurate and comprehensive accounting. Land mile estimates have fluctuated rapidly from inventory to inventory mostly due to varying levels of detail in reported data, and varying conversion factors used to translate dollar values to miles. The decrease in FY14 emissions despite the rapid increase in both air and land miles traveled is due to a change in fuel emission factors in the CA-CP calculator. The CA-CP obtains its emission factors from the US Department of Transportation and the US Department of Energy and updates them each year.

Table 10 – Summary of directly financed outsourced travel.

	FY08	FY11	FY14
Air travel (miles)	25,417,945	36,094,326	47,063,237
Land travel (miles)	440,000	188,467	731,728
GHG Emissions (MT CO_2e)	24,929	33,639	24,132

4.3.2 STUDY ABROAD AIR TRAVEL

Like many universities, UPitt offers students the chance to complete one or two terms of academic studies in other countries, called the Study Abroad program. The CA-CP calculator separates these miles from the Directly Financed Outsourced Travel section, but they carry the same weights, and are calculated the same way, using the same monetary value to miles conversion, and using the same emission factors.

This category was not included in the FY08 inventory due to lack of data, but was introduced in FY11. Just like in FY11, in FY14 the travel cost data was obtained from the Study Abroad Office. The total expenses for study abroad in FY14 were $274,181 which translated to 1,524,920 air miles traveled, and total emissions of 775 MT CO_2e. The estimated distance was similar in FY11 and FY14, differing by only 100 thousand miles, but the emissions estimates have lowered in FY14 due to the lower jet fuel emission factors.

Table 11 – Summary of study abroad travel.

	FY08	FY11	FY14
Expenses ($)	n/a	232,243	274,181
Conversion (cent/mi)	16.50	16.38	17.98
Distance (miles)	n/a	1,417,847	1,524,920
GHG Emissions (MT CO_2e)	n/a	1,101	775

4.3.3 COMMUTER TRAVEL

Commuting can be a significant contributor to greenhouse gas emissions as shown in previous inventories and other studies; however, it is difficult to assess without either a traffic data or a commuter survey data, none of which were available for this inventory. Generally, several important factors influence commuter habits, such as distance between destinations, road infrastructure, traffic patterns, public transportation access and reliability, parking availability, and others. At UPitt it is access to public transportation, biking infrastructure, student housing, parking capacity, carpool and vanpool programs, and others.

In FY14 there were 4,032 parking spaces within UPitt parking lots and 119 metered parking spaces allocated for public use, totaling 4,151 parking spaces at UPitt Oakland campus. UPitt issued 2,756 parking permits to individuals, and had 231 registered carpoolers and vanpoolers in FY14. There were also 178 bike racks with approximately 1,600 bike spaces. On-campus residence hall capacity in Oakland was approximately 7,825 students. In terms of public transportation, there is major bus transportation corridor through the campus, and all UPitt faculty, staff, and students can ride for free with their Pitt ID.

Table 12 – Summary of commuting facts.

		FY08	FY11	FY14
Population	Faculty	2,154	2,487	2,791
	Staff	4,662	4,734	5,012
	Students	24,755	26,740	25,917
	Total	31,571	33,961	33,720
Student Housing	On-campus	7000	7000	7,825
	Off-campus (close)[a]	2,475	2,674	2,592
	Off-campus (far)	15,279	17,066	15,500
	Total	24,755	26,740	25,917
Carpool	Passengers	382	188	164
	Avg. mileage	11.87	11.27	11.73
Vanpool	Vans	10	9	9
	Passengers	65	57	67
	Avg. mileage	23.1	23.9	22.9
Permit	Number	3,058	3,153	2,756
	Avg. mileage	12.95	12.95	12.74
Total	Avg. mileage	12.86	12.88	12.72
Parking	Garage	4437[b]	2,563	2,299
	Lot	0	1,833	1,733
	Metered	165	147	119
Bike	Racks	0	181	178
	Spaces	1,000	1,670	1,600

a - This is based on an assumption that 10% of off-campus living students live within a walking distance to UPitt.

b - Garage and lot spaces were reported as a sum in FY08.

In order to calculate commuting related emissions, the CA-CP calculator asks for 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 a fiscal year. The documented data from Table 12 therefore 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 (fall and spring semester) school weeks for students.
2) 10% of off-campus living students live in close proximity to UPitt and walk to school.
3) All students living on-campus 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.
6) Students hold 5% of all permits, and fill up 4 times all metered spaces in a day.
7) Faculty holds 50% of all permits, and staff holds 45% of all permits.
8) Only staff carpools and vanpools.
9) The remaining portion of each population rides a bus to campus.

Although some of these assumptions may grossly generalize the different UPitt populations' commuting behaviors, they provide a firm relationship between some of the known numbers from Table 12 and estimated modal distributions in Table 13.

Table 13 – Summary of calculated commuting distributions.

		FY08	FY11	FY14
Students	Bike	3.2%	4.9%	4.7%
	Walk	38.3%	36.2%	40.2%
	Drive Alone	3.3%	2.8%	2.4%
	Carpool	0.0%	0.0%	0.0%
	Bus	55.3%	56.1%	52.7%
Faculty	Bike	3.2%	4.9%	4.7%
	Walk	3.2%	4.9%	4.7%
	Drive Alone	71.0%	63.4%	49.4%
	Carpool	0.0%	0.0%	0.0%
	Bus	22.7%	26.8%	41.1%
Staff	Bike	3.2%	4.9%	4.7%
	Walk	3.2%	4.9%	4.7%
	Drive Alone	29.5%	30.0%	24.7%
	Carpool	9.6%	5.2%	4.6%
	Bus	54.6%	55.0%	61.2%

Attempt was made in holding the same assumptions as in the previous inventories; however, some of these assumptions have changed in an effort to incorporate all the known data shown in Table 12. The previous two inventories were based primarily on assumptions and incorporated only a portion of the UPitt provided data shown in Table 12. This new approach is expected to give a more comprehensive evaluation of the different factors influencing UPitt's commuter choices, and provides a firm and quantitative framework for the assessment. This change is reflected in the reduction of miles traveled by automobile in Table 14.

Table 14 – Summary of commuting.

	FY08	FY11	FY14
Automobile Commuting (miles)	26,843,062[a]	29,582,343[a]	9,310,993
Bus Commuting (miles)	31,347,922[a]	35,479,221[a]	37,617,623
GHG Emissions (MT CO_2e)	18,801[a]	20,225[a]	15,908

a - These are results reported in previous inventories and do not reflect the change in approach.

4.3.4 SOLID WASTE

Solid waste is managed by Republic Waste Services and is landfilled with a methane recovery system in place. Methane recovery is the process of trapping and storing methane before it is emitted to the atmosphere and then having it processed for use in electricity generation. The Republic Waste Services landfill utilized by UPitt captures methane, but does not process it for electricity generation on site. The same system was used in FY11 but not in FY08.

The solid waste stream data was reported by facilities management, housing services, food services, and property management. UPitt's solid waste stream increased by 230 short tons between FY11 and FY14 to a total of 6,398. The percentage of waste recycled has increased by over 2% between each inventory, climbing up to 27.6% in FY14, and accounting for 1,764 short tons of waste. The total emissions due to methane release from landfills accounted for 1,437 MT CO_2e.

Table 15 – Summary of solid waste.

	FY08	FY11	FY14
Landfilled (tons)	5,246	4,596	4,634
Recycled (tons)	1,543	1,572	1,764
% of Waste Recycled	22.7%	25.5%	27.6%
GHG Emissions (MT CO_2e)	5,688	1,404	1,437

4.3.5 WASTEWATER

Based on data from UPitt's Facilities Management, wastewater was assumed to be equal to the amount of water consumed in almost all campus buildings. It is not clear whether there is a possibility to measure the actual contribution of UPitt to the central treatment system, which was assumed to use aerobic treatment of wastewater. This problem has been stated by other researchers as well, but a solution to the problem could not be found. Even if the assumption made here is an overestimation of the actual situation, it results in 1,437

MT CO_2e from wastewater, which does not have a significant impact on the UPitt's total GHG emissions (0.06% of total emissions).

Table 16 – Summary of wastewater.

	FY08	FY11	FY14
Wastewater (million gallons)	278,350	246,450	280,055
GHG Emissions (MT CO_2e)	135	120	136

4.3.6 PAPER

Paper is vital for almost any type of business establishment. It is perhaps more important for educational facilities where printed material in great quantities is consumed daily. Therefore, capturing this potentially significant emission source was another objective of the study, although not mandatory based on ACUPCC guidelines. Information regarding the quantity of purchased regular and recycled paper was obtained through the Purchasing Department.

UPitt made great strides since 2008 to use higher grade post-consumer waste recycled paper and to raise recycling rates, and in FY11 the reported data supported this claim; however, in FY14 the paper purchasing numbers rapidly increased again. This was due to a more comprehensive accounting in FY14, and does not necessarily indicate an increase in paper consumption. The total paper purchased during FY14 came to a total of about 1.5 Million lbs. of paper, and the overall recycled content came to 9.4%. The total associated GHG emissions from paper purchasing came to 1,949 MT CO_2e (0.83% of total emissions).

Table 17 – Summary of paper consumption and emissions.

	FY08	FY11	FY14
Total Paper (lbs.)	1,113,740	730,725	1,488,165
Overall Recycled Content	4.2%	20.7%	9.4%
GHG Emissions (MT CO_2e)	1,626	1,477	1,949

5 DISCUSSION OF RESULTS

GHG emissions of UPitt for fiscal year 2014 amounted to 233,511 MT CO_2e. The percentage result distribution is presented in Figure 4. The fiscal year 2008 and 2011 GHG inventory results tables can be found in Appendix B for comparison.

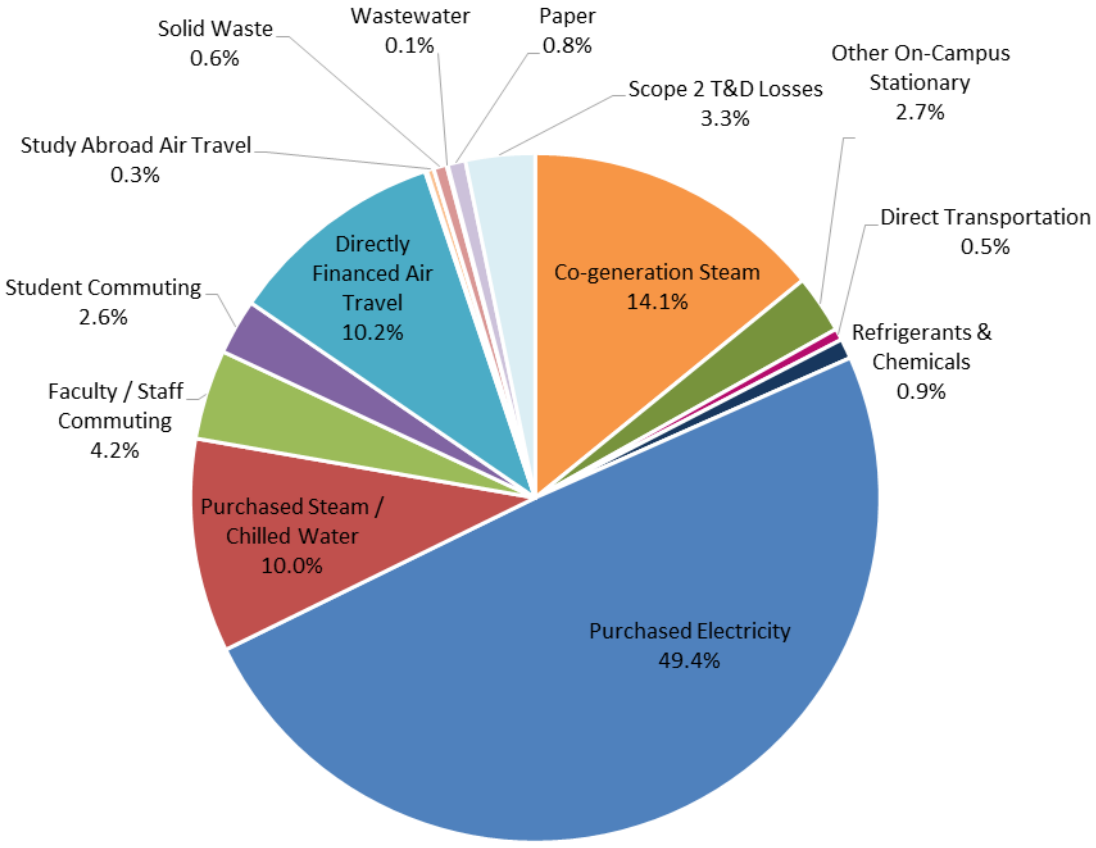


Figure 4 – Distribution of UPitt's FY14 GHG Results.

Table 18 – Summary of UPitt's GHG Emissions for Fiscal Year 2014.

		Energy Consumption	CO2	CH4	N2O	eCO2
		MMBtu	kg	kg	kg	Metric Tonnes
Scope 1	Co-gen Electricity	0	0	0	0	0
	Co-gen Steam	620,340	32,890,427	2,940	59	32,981
	Other On-Campus Stationary	120,120	6,368,762	569	11	6,386
	Direct Transportation	17,432	1,242,053	244	82	1,273
	Refrigerants & Chemicals	0	0	0	0	2,192
	Agriculture	0	0	0	6	2
Scope 2	Purchased Electricity	2,150,419	113,932,100	12,845	3,649	115,341
	Purchased Steam / Chilled Water	440,191	23,338,930	2,086	42	23,404
Scope 3	Faculty / Staff Commuting	132,725	9,706,561	1,002	379	9,845
	Student Commuting	81,383	6,003,029	399	170	6,064
	Directly Financed Air Travel	122,206	23,833,841	236	272	23,921
	Other Directly Financed Travel	2,869	209,278	11	5	211
	Study Abroad Air Travel	3,960	772,252	8	9	775
	Solid Waste	0	0	57,462	0	1,437
	Wastewater	0	0	0	456	136
	Paper	0	0	0	0	1,949
	Scope 2 T&D Losses	141,622	7,503,314	846	240	7,596
Offsets	Additional					0
	Non-Additional					0
Totals	Scope 1	757,892	40,501,243	3,753	159	42,834
	Scope 2	2,590,610	137,271,030	14,931	3,691	138,744
	Scope 3	484,765	48,028,274	59,964	1,532	51,933
	All Scopes	3,833,268	225,800,547	78,648	5,381	233,511
	All Offsets					0
					Net Emissions:	233,511

The scoped approach, as defined previously, categorizes emission sources based on level of responsibility but does not dictate the boundaries to be used for emissions reporting. The final decision is left to the discretion of the institution. Nevertheless, some guidelines by the GHG Protocol Initiative and the ACUPCC exist to ensure that reported results are compatible with each other. Proposed boundaries are as follows:

- *All Scope 1 and scope 2 emission sources*: Scope 1 and 2 are minimum levels for reporting emissions. The World Resources Institute (WRI) Corporate Accounting and Reporting Standard require reporting of all Scope 1 and Scope 2 emissions, but consider scope 3 emissions optional. ACUPCC on the other hand, additionally requires scope 3 emissions for commuting and directly financed air travel, on top of Scope 1 and Scope 2 emissions.

- *All directly financed emissions*: This boundary includes Scope 1 and Scope 2 emissions as well as directly financed Scope 3 emissions, such as air travel and solid waste management.

- *All directly financed emissions, and selected directly encouraged emissions*: In addition to the previous boundary, this boundary includes Scope 3 emissions that are encouraged, but not necessarily financed. A policy in effect 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 directly financed or significantly encouraged emissions as well as 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 paper category could be included in the inventory to observe the impact of paper reduction policy.

Selection of a study boundary is vital for a GHG inventory study. Selection of a limited boundary would result in the exclusion of some important emission sources and result in an underestimation of the actual emissions from the institution. On the other hand, developing an inventory for all actual emissions requires significant amounts of time and resource; further, data is often not available. Emission results for UPitt increased by 29% from selecting the most limited reportable boundary to the most extended reportable boundary. Reporting emissions by any one of these defined boundaries is allowed. This fact should be recognized during comparison of results with respect to other institutions, since different studies use different boundaries, which directly affect end results.

For comparing results found here 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 their net emissions only results in misleading conclusions since every school has different student enrollment numbers as well as different number of buildings to continue their educational and research activities. For a logical comparison, emission results are usually converted into one of the metrics given below. If institutional data such as student numbers and gross building area are input into the CA-CP calculator, such conversions are done automatically and presented together with results in the spreadsheet.

5.1 COMPARISON OF RESULTS WITH PEER INSTITUTIONS

Numerous sources and GHG Inventory reports published by other higher education institutions were reviewed in order to determine UPitt's performance when ranked according to greenhouse gas emissions. Table 6 below shows UPitt's performance among a group of peer institutions commonly used for benchmarking purposes. As was discussed previously, selection of an extended operational boundary for UPitt increases emissions by close to one third when compared to reporting only mandatory emission sources. Both results are provided in Table 6.

Table 19. Comparative Results of Higher Education Institutions used for Peer Group Benchmarking, Sorted According to Net Emissions [12-14].

Institution	Year of Study	Net emissions MT CO2E	MT CO2E /FTE student	MT CO2E /1000 ft2
Carnegie Mellon University	2012	64,977	5.6	13.0
SUNY - Buffalo	2014	120,332	4.3	10.8
University of Delaware	2012	131,280	7.0	16.9
Univ. of Pittsburgh – mandatory sources only	**2014**	**181,578**	**7.0**	**17.8**
Temple University	2014	186,493	5.6	17.8
Univ. of Pittsburgh – all accountable sources	**2014**	**233,511**	**9.0**	**22.9**
University of Maryland - College Park	2013	279,187	8.2	18.9
Penn State - University Park	2012	397,621	9.0	19.1
The Ohio State University	2014	648,397	13.0	28.4

6 RECOMMENDATIONS FOR FUTURE GHG INVENTORY STUDIES

Some of the categories studied in this inventory would not be able to be completed without making some general assumptions. This means that some of the categories may lack precision and accuracy, and may have resulted in under or over estimation of the associated emissions. These assumptions were made using external sources and best judgement of the investigators and are expected to roughly represent the emission levels. This year's study had a good foundation in this aspect from the previous two inventories and attempted to improve or solidify some of the assumptions made. Future inventories should continue this effort and should either try to eliminate the need for assumptions, or should search for support from scientific sources, such as other studies, reports, and surveys.

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

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 2008 and 2011 even though total steam consumption increased due to the addition of new facilities. In 2014 steam demand further increased, and even though the CSSP was finally in full operation, it did not prevent from the steam related emissions from increasing as well. Future studies should examine the increase in steam demand in more detail, and investigate different options and feasibility of implementing steam reduction strategies.

Purchased electricity has remained the largest source of emissions for UPitt, making up more than half of the total emissions. Varying fuel mixes between the three inventories have shown the great differences in emissions associated with a variety of fuel sources. The Pittsburgh region has always been a coal dominated fuel mix region; however, federal emissions regulations have forced a shift away from coal, and in the case of Pittsburgh towards natural gas and nuclear power. It would be worth investigating the cost benefit of purchasing green power, since it could further reduce emissions from electricity. Some universities already employ this strategy, and may be a good resource in exploring this option for UPitt.

Recording of air travel improved since FY08 with the upgrading of network systems designed to simplify the travel reimbursement process for UPitt faculty and staff. The FY11 inventory first received data gathered through this system, but not all departments were fully transitioned to this system at the time of the inventory. In FY14 majority of the UPitt departments were expected to use this system, but participation was still not at 100%. The next inventory should examine the completeness of the next set of data, and make comparisons accordingly. Attention should also be given to the switching of athletic conferences and the effect on travel financed by UPitt.

Since information on commuting preference of faculty and students was not available, assumptions were required to calculate emissions. Previous inventories suggested the use of campus-wide commuting survey; however, this was not feasible from a financial and time perspective. Instead, regional surveys administered by government or other organizations, such as the American Community Survey or the Make My Trip Count survey, could be implemented in future inventories.

7 CONCLUSIONS

The calculated emissions of UPitt in FY14 have shown an overall reduction in GHG emissions. UPitt emitted 181,578 MT CO_2e from mandatory sources (Scope 1 & 2) and 233,511 from all accountable sources. Steam plant efficiencies and change in electricity fuel mix had the largest impacts on these reductions. Electricity reduction strategies in UPitt's buildings appeared as a success as electricity use remained similar to previous years even though building area has increased by about 6%. Steam usage, on the other hand, has been rapidly increasing every year and would benefit from further investigation and implementation of reduction strategies. Commuting and travel activities could also benefit from further tracking and consequential implementation of reduction strategies.

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

CO_2 – Carbon dioxide

CSSP – Carrillo Street Steam Plant

FTE – Full Time Equivalent

GHG – Greenhouse Gas

GWP – Global Warming Potential

IPCC – Intergovernmental Panel on Climate Change

MMBtu – Million British thermal unit

MT CO_2e – Metric ton of carbon dioxide equivalent

UPitt – University of Pittsburgh, Oakland Campus

WRI – World Resources Institute

Appendix A

Meetings and communication with several UPitt staff were necessary in order to gather data for the CA-CP calculator. Table 20 shows the list of contacts as well as data and information received from them.

Table 20. List of Contacts and Information Received.

Contact	Information Received
Laura Zullo	Building list Purchased electricity and steam Electricity fuel mix Solid waste Wastewater Landscaping Steam plant data
Kevin Sheehy	Parking permits Carpooling & vanpooling
Thurman Wingrove	Budget
Renee Galloway	Paper Computer
Jay Frerotte	Introduction to contacts
Keith Duval	Refrigerants & chemicals
Cindy Comer	University fleet
Vince Johns	Directly financed air travel
Diane Denezza	Directly financed air travel reimbursements
Jeffrey Whitehead	Study abroad air travel
Anthony Tripolone	Chartered bus athletic travel

Appendix B

Table 21 - Summary of UPitt's GHG Emissions for Fiscal Year 2011.

		Energy Consumption	CO2	CH4	N2O	eCO2
		MMBtu	kg	kg	kg	Metric Tonnes
Scope 1	Co-gen Electricity	0	0	0	0	0
	Co-gen Steam	419,297	22,120,324	2,212	44	22,189
	Other On-Campus Stationary	107,587	5,675,832	568	11	5,693
	Direct Transportation	10,221	714,884	130	45	732
	Refrigerants & Chemicals	0	0	0	0	2,251
	Agriculture	0	0	0	3	1
Scope 2	Purchased Electricity	2,163,603	134,812,989	1,782	2,242	135,526
	Purchased Steam / Chilled Water	556,161	29,340,701	2,934	59	29,432
Scope 3	Faculty / Staff Commuting	203,367	14,377,434	2,336	827	14,682
	Student Commuting	76,028	5,484,669	389	165	5,543
	Directly Financed Air Travel	170,480	33,471,585	330	379	33,593
	Other Directly Financed Travel	639	46,280	3	1	47
	Study Abroad Air Travel	5,587	1,096,922	11	12	1,101
	Solid Waste	0	0	56,173	0	1,404
	Wastewater	0	0	0	402	120
	Paper	0	0	0	0	1,477
	Scope 2 T&D Losses	213,983	13,333,153	176	222	13,404
Offsets	Additional					0
	Non-Additional					0
Totals	Scope 1	537,105	28,511,039	2,910	104	30,866
	Scope 2	2,719,764	164,153,690	4,716	2,301	164,957
	Scope 3	670,084	67,810,043	59,418	2,008	71,371
	All Scopes	3,926,953	260,474,772	67,043	4,413	267,194
	All Offsets					0
					Net Emissions:	267,194

Table 22 - Summary of UPitt's GHG Emissions for Fiscal Year 2008.

		Energy Consumption	CO2	CH4	N2O	eCO2
		MMBtu	kg	kg	kg	Metric Tonnes
Scope 1	Co-gen Electricity	0	0	0	0	0
	Co-gen Steam	0	0	0	0	0
	Other On-Campus Stationary	173,169	9,135,679	913	18	9,162
	Direct Transportation	6,794	474,287	80	28	484
	Refrigerants & Chemicals	0	0	0	0	799
	Agriculture	0	0	0	1	0
Scope 2	Purchased Electricity	1,516,172	138,141,644	961	1,824	138,704
	Purchased Steam / Chilled Water	762,771	49,293,289	5,173	402	55,093
Scope 3	Faculty / Staff Commuting	188,794	13,342,553	2,189	774	13,622
	Student Commuting	71,069	5,124,457	375	157	5,180
	Directly Financed Air Travel	125,950	24,728,701	244	280	24,817
	Other Directly Financed Travel	1,533	110,924	6	3	112
	Study Abroad Air Travel	0	0	0	0	0
	Solid Waste	0	0	247,311	0	5,688
	Wastewater	0	0	58,454	412	1,466
	Paper	0	0	0	0	1,626
	Scope 2 T&D Losses	190,097	16,256,744	367	202	16,618
Offsets	Additional					0
	Non-Additional					0
Totals	Scope 1	179,963	9,609,966	993	47	10,446
	Scope 2	2,278,943	187,434,933	6,134	2,226	193,796
	Scope 3	577,443	59,563,379	308,945	1,827	69,129
	All Scopes	3,036,349	256,608,278	316,073	4,101	273,372
	All Offsets					0
					Net Emissions:	273,372

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