University of Pittsburgh

Department of Civil and Environmental Engineering

FINAL REPORT

Greenhouse Gas Inventory of University of Pittsburgh for FY 2011

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Preface

This report presents the greenhouse gas inventory results for University of Pittsburgh (UPitt) for FY 2011.

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 FY 2011 GHG emissions inventory from direct and indirect activities of UPitt and is an update from the previously completed GHG inventory (FY 2008) [1]. 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 levels is a necessary step towards developing strategies to lower GHGs.

For this study, fiscal year 2011 was selected as the temporal boundary with the goal of comparing results to FY 2008 GHG inventory, essentially pre- and post-construction of the Carrillo Street Steam Plant (CSSP). The CSSP is an ultra-low NOx control plant, the lowest known to be used by any higher educational institute in the U.S. [2]. Currently, the CSSP services UPitt and the University of Pittsburgh Medical Center, meeting 49% of UPitt's steam demand with additional production expected to be transferred to CSSP in the coming years. It should be noted, however, that during FY2011, the CSSSP was not operating at 100%, reducing the 'direct comparison' from FY2008 to FY2011.

Through incorporation of the highly efficient CSSP to UPitt and accurate UPitt-specific electrical fuel-mix data, total CO2E emissions decreased 2.0% from FY2008 to FY2011. Contributions of categories are given as a percent of total emissions in Figure 1. In addition, different operational boundaries (i.e., Scopes) may be chosen for the GHG inventory of a campus. Having different boundaries restrains equal comparison of results among different schools. Emission results obtained through using four different operational boundaries are presented in Table 1.

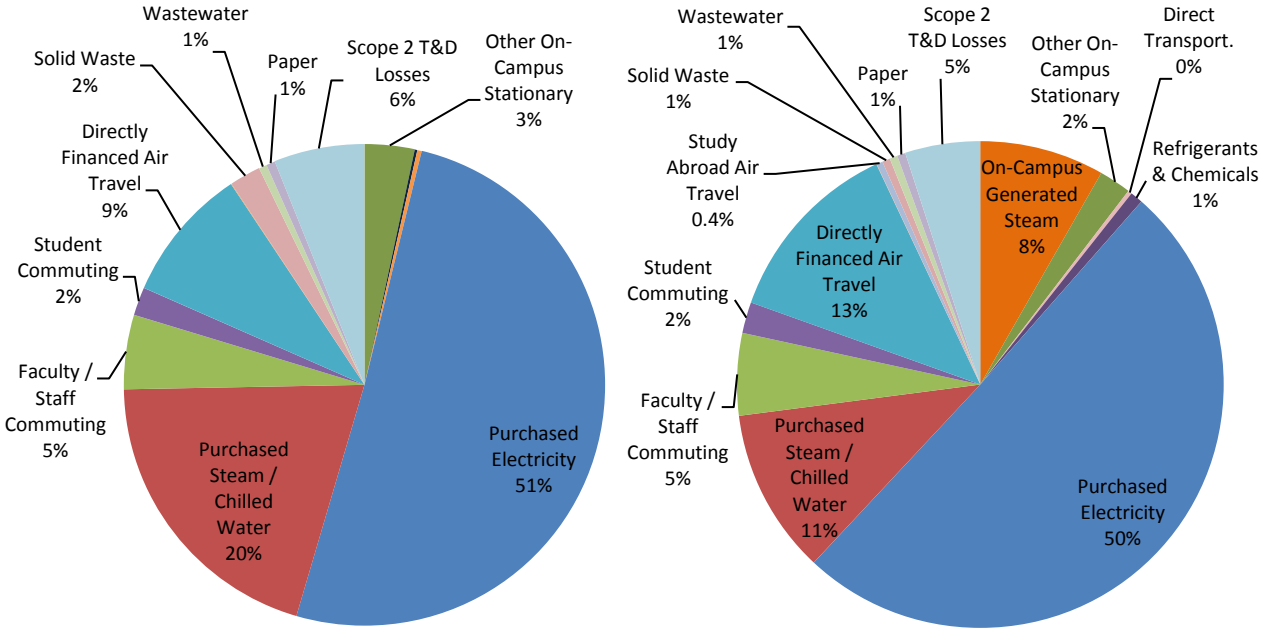

Figure 1. Detailed distribution of Greenhouse Gas Emission Results for Fiscal Year 2008 (left) and 2011 (right)

Similar to FY2008 findings, the vast majority of emissions were from purchased electricity (50%) and steam (11%), accounting for 61% of total emissions. From 2008 to 2011, purchased electricity CO2E emissions decreased by 2%. This decrease is largely due to fuel mix data collected from the electricity supplier in place of using the U.S. Environmental Protection Agency's (EPA) E-GRID program [3]. In 2011, this translated to a 12% reduction in coal-generated electricity, replacing it with increases in hydroelectric, 8%, and natural gas, 5%, generated electricity.

Because of the switch of a portion of the steam production from Bellefield Boiler Plant (BBP) to the on-campus CSSP, major changes in steam-associated emissions were captured. While purchased steam/chilled water CO2E emissions decreased by 47%, on-campus generated steam accounted for 8% of total CO2E emissions, not an emission source during FY2008. However, total CO2E emissions associated with steam production dropped 6% from FY2008 to FY2011 despite a 31% increase in overall UPitt campus steam demand. This is in large part due to the higher efficiency CSSP facility.

Table 1. Summary of Greenhouse Gas Emissions for University of Pittsburgh for Fiscal Year 2008 (left) and 2011 (right)

Category	Metric ton CO2E
Purchased Electricity	**138,700**
Purchased Steam	**55,100**
Directly Financed Air Travel	**24,800**
Generated Steam	**-**
Steam Transmission Losses	**16,600**
Faculty / Staff Commuting	**13,600**
Natural Gas	**9,200**
Solid Waste	**5,700**
Student Commuting	**5,200**
Study Abroad Air Travel	**N/A**
Paper	**1,600**
Wastewater	**1,500**
Refrigerants	**800**
University Fleet	**500**
Total Emissions	**273,400**
Reporting Metric	
Required reporting (Scope 1 and 2)	**204,200**
Scopes 1 and 2, Air Travel, Solid Waste Management	**234,700**
Scopes 1 and 2, Transportation and Solid Waste Management	**253,600**
All Accountable Emissions	**273,400**

Category	Metric ton CO2E
Purchased Electricity	**135,500**
Purchased Steam	**29,400**
Directly Financed Air Travel	**33,600**
Generated Steam	**22,200**
Steam Transmission Losses	**13,400**
Faculty / Staff Commuting	**14,700**
Natural Gas	**5,700**
Solid Waste	**1,400**
Student Commuting	**5,500**
Study Abroad Air Travel	**1,100**
Paper	**1,500**
Wastewater	**1,400**
Refrigerants	**2,300**
University Fleet	**700**
Total Emissions	**268,500**
Reporting Metric	
Required reporting (Scope 1 and 2)	**195,800**
Scopes 1 and 2, Air Travel, Solid Waste Management	**231,900**
Scopes 1 and 2, Transportation and Solid Waste Management	**252,200**
All Accountable Emissions	**268,500**

Directly financed air travel saw the largest increase at 35%. A new network-based program for recording reimbursements and P-card purchases at UPitt allowed for a greater level of detail. The inclusion of study abroad air travel, data not available for the FY08 report, also accounted for additional air travel financed emissions.

Moving forward there are several possible improvements that could be implemented at the facility-level or faculty/staff-level. At the facility-level, the largest impacts to the net CO2E emissions are from steam and purchased electricity. Currently, CSSP provides roughly 47% of UPitt's yearly steam demand with the remainder coming from BBP. Further implementation of CSSP into campus steam generation could reduce CO2E emissions through the higher efficiency CSSP boilers and its closer proximity to high-use campus buildings in comparison to the BBP.

Additionally, a move from coal-fired electrical generation towards renewable or natural gas electrical generation would result in the largest impact to CO2E emissions from purchased electricity. While electrical consumption increased by 13,000 MWh in FY2011, primarily due to new facilities, net emissions decreased by 2%. A fuel mix consisting of 60-9-9-2% coal-natural gas-hydroelectric-wind/solar, obtained from the UPitt electrical supplier, versus a fuel mix consisting of 70-4-1-1% coal, from 2011 E-GRID numbers, reduced total calculated emissions by 5%. This was a product of better data collection and not a policy change by UPitt to purchase lower CO2E electricity. At a ratio of roughly 2:1 (coal to natural gas) CO2E emissions, small moves from coal-generated to natural gas-generated electricity produce large reductions in net emissions. Furthermore, with renewable sources like hydro, wind, or solar producing negligible CO2E emissions per kWh of electricity, greater reductions to net emissions could be reached. Regulatory action by the US EPA on new fossil fuel-fired power plants is furthering reductions of CO2 emissions by setting a limit to CO2 emissions per MWh with announcement of regulations for existing power plants planned for June 2014 [4].

At the faculty and staff-level, the majority of emissions were from directly financed air travel (12%) and commuting (5%). For faculty, it is important to participate in conferences and speak at other universities. However, these opportunities require the faculty to travel resulting in a large portion of the total 36 million air miles in FY2011. As technology continues to advance in telecommunications, faculty should consider this as a means to reach their audience at the conferences and universities in lieu of travel.

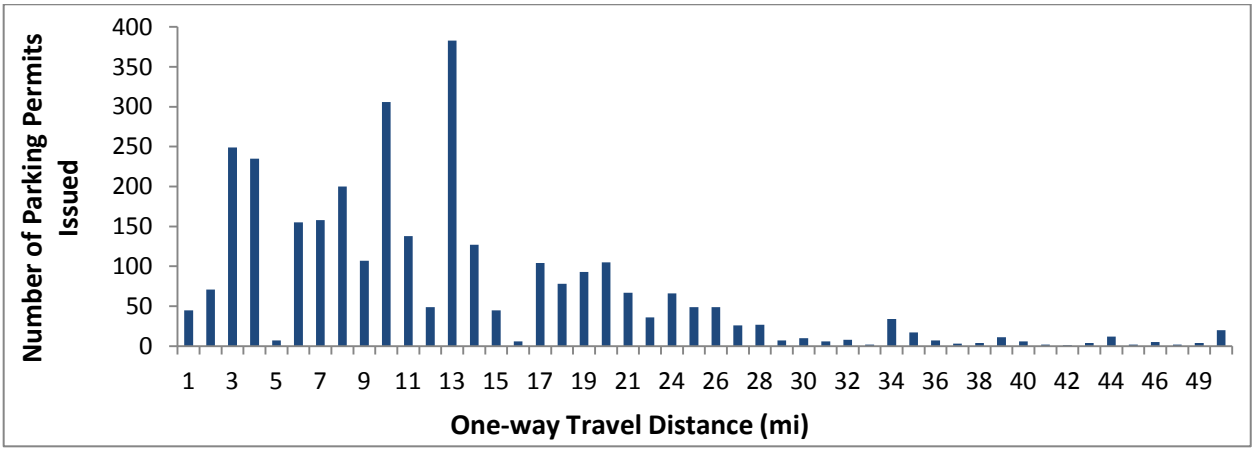

Figure 2. A histogram of the number of parking permits issued by one-way travel distance to the University of Pittsburgh - Oakland Campus

UPitt operates a carpool program that facilitates those faculty and staff interested in lowering commuting costs by sharing rides. The average carpool parking permit one-way distance to UPitt is roughly 20 miles. The average individual parking permit one-way distance to UPitt is roughly 26 miles. While parking permits are issued for postal codes over 50 miles, these represent less than 1% of drivers, as seen in Figure 2. UPitt could focus on converting those drivers with individual parking permits between 5 and 30 miles to carpool parking permits. For those individual parking permits with postal codes under 5 miles from campus, UPitt could attempt to further incentivize those drivers to use public transportation, which is provided fare-free with a valid Pitt ID for current faculty, staff, and students

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 [5-6].

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, and then boundaries are defined. Results are presented under each category together with the various assumptions made during calculations. Discussion of results and comparison to 2008 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 Campus Carbon Calculator

The CA-CP calculator is a widely used tool to calculate GHG, and is specifically designed for schools. Currently, it is used by over 500 schools in North America [7].

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 "business as usual" 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 [7]. CA-CP calculator version 6.75 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 buildings 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.

Table 2. A list of new construction and acquisitions between FY2008 and FY2011.

Building Name		Gross sq. ft.
University Club	Acquisition	**85,000**
Mascaro Center for Sustainable Innovation	New Construction	**20,480**
Carrillo Street Steam Plant	New Construction	**23,500**
O'Hara Student Center	New Construction	**40,000**
Petersen Sports Complex	New Construction	**23,200**
Chevron Science Center	Addition	**32,367**
Falk School	Addition	**38,000**
Benedum Interstitial Space	Addition	**28,835**
Total		**291,382**

Within this organizational boundary, buildings owned and managed by UPitt at the Oakland Campus consisted of 83 buildings and had a gross building area of 9.65 million ft^2, up 291,000 ft^2 from 2008. Since 2008, construction and acquisition of 5 new buildings accounted for the majority of this increase, see Table 2, including the Mascaro Center for Sustainable Innovation (MCSI), Carrillo Street Steam Plant (CSSP), The University Club, O'Hara Student Center, and the Petersen Sports Complex. During the study period, 26,740 full–time equivalent (FTE) students were enrolled at UPitt, an increase of 1,985 FTE students. Undergraduate student housings near the campus were included into the analysis. However, housing buildings owned by UPitt but are outside campus boundaries were not included in this analysis since each tenant is directly billed by utility companies in these buildings.

3.2 Operational Boundaries

The operational boundaries identify sources to include in the inventory. The GHG protocol uses scopes, in which all emissions are categorized into three scopes [7-8].

Direct emissions from sources that are owned and controlled by UPitt fall under scope 1. Emissions coming from university fleet vehicles and refrigerants are also examples of scope 1 emissions.

Scope 2 emissions are indirect emissions from sources that are neither owned nor operated by UPitt, but whose products are linked to campus energy consumption. Purchased electricity is an example of a scope 2 emission source.

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 and landscaping activities are included in this field.

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 use fiscal years to report results. Fiscal years typically begin on July 1st and end on June 30th.

For this study, fiscal year 2011 was completed. The first UPitt GHG inventory was completed in FY 2008. One aim of this work was to understand the GHG changes pre- and post- construction of the Carrillo St. steam plant. The steam plant uses natural gas instead of coal and has ultra-low NO_x control technology.

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 managed by UPitt and so are directly under its responsibility.

4.1.1 Stationary combustion

A major change at UPitt from 2008 was the construction and completion of the Carrillo Street Steam Plant (CSSP). The CSSP replaced nearly half of the steam from the nearby Bellefield Boiler Plant (BBP) with more efficient, lower NO_x emitting boilers. On-campus stationary sources at UPitt also include individual building's combustion of natural gas used for heating air and water. **From 2008, close to 80% of steam was from BBP, but in 2011, 51% of steam was purchased from BBP.** In 2008, the BBP was considered purchased steam (or Scope 2) because this plant is part of a consortium of which UPitt is one entity. CSSP, however, is owned and operated by UPitt and the University of Pittsburgh Medical Center, and the steam usage and associated emissions in 2011 are now deemed Scope 1 emissions. UPitt takes 47% of CSSP's steam production, which covers the 49% of steam demand not purchased from BBP with additional production to be transferred to CSSP in the coming years. As such, natural gas used in on-campus generation of steam stationary combustion levels rose dramatically, totaling 27,882 metric ton CO2 equivalent (MT CO2E). These are offset by the reduction in purchased steam, discussed later. It should be noted that outside of CSSP natural gas consumption, UPitt campus as a whole reduced natural gas consumption by 10%. Small amounts of natural gas used in laboratories and backup generators are also included in this value.

Conversion factors required to convert the amount of natural gas into energy units were obtained from EPA's Energystar website [9]. Carbon emission factors (included in CA-CP protocol and in accordance with the GHG protocol) were used to calculate kg of CO_2-equivalents

- FY2011, Stationary combustion: 526,884 MMBtu for natural gas
- FY2008, Stationary combustion: 173,169 MMBtu for natural gas

4.1.2 University Fleet

Another source of scope 1 emissions is the University Fleet. Emissions from the production of vehicles are neglected since the majority of emissions over the life cycle of a vehicle are created during its use phase from combustion of fossil fuels. Gallons of fuel consumed over the period of study, separated according to type of fuel are required to estimate emissions.

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 [10]. Although different grades of biodiesel are currently available in the market, only two biodiesel mixtures exist in

Pittsburgh, B5 or B100 [11]. 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, fuel consumption quantities were determined. Accordingly, 71,800 gallons of gasoline and 9,500 gallons of biodiesel of B5 blend were consumed. The associated GHG emissions are 732 MT CO2E.

Retrospective vehicles lists were available for fiscal year 2011, and this information showed a total count of 241 vehicles owned by UPitt. Out of 241 registered vehicles in December 2011, 48 belonged to other regional campuses and were excluded from the total. The remaining 193 vehicles were in operation during the 2011 fiscal year as a part of the UPitt Oakland campus.

In 2008, assumptions were made regarding fuel use, because at the time of the GHG Inventory report UPitt was transitioning 80% vehicle's fuel records from one system, Guttman Oil Tracking System, to a second, Voyager Tracking System. In 2011, the switch was completed and access to records was made available through Transportation Services.

For those vehicles monitored in Guttman Oil, weekly fuel consumption reports were obtained covering the entire 2011 fiscal period. The same was done for vehicles monitored using Voyager. The difference from 2008 to 2011 for gasoline consumption was an increase of 29,500 gallons, while B5 diesel decreased ~1,700 gallons. The reason for the differences in fuel use, especially the large increase in gasoline consumption, can likely be attributed to the upgraded tracking system, and not necessarily a large increase in vehicle miles.

- FY 2011, University fleet: 71,800 gallons of gasoline and 9,500 gallons of biodiesel of B5 blend
- FY 2008, University fleet: 42,300 gallons of gasoline and 11,220 gallons of biodiesel of B5 blend

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 [7]. Under ideal conditions, these gases are used in a closed loop system and do not contribute to GHG 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. Table 3 presents the type and amount of refrigerant used at UPitt together with the GWP of each refrigerant. The total GHG potential from refrigerants was 2,250 MT CO2E. The increase of 1,450 MT CO2E from 2008 totals was determined to be associated with annual fluctuations in demand for refrigerant maintenance and cannot be attributed to any change in facilities or campus policies. Refrigerants: Individual amounts given in Table 3 were input into the CA-CP calculator. GWP were also modified accordingly.

Table 3. Fugitive Emissions for Fiscal Years 2008 and 2011

Refrigerant Type	GWP for 100 years	Source	Amount Used (lb)	
			FY2008	FY2011
R12	10,890	[12]	20	36
R123	77	[13]	400	200
R134a	1,300	[14]	41	840
R22	1,700	[15]	657	778
R404a	3,900	[16]	1	1
R414	1,450	[17]	19	0
R500	8,100	[16]	3	0
R503	15,000	[16]	1	0
R11	4,750	[12]	0	400
R410a	1,980	[16]	0	107
R408a	5,780	[16]	0	5

4.1.4 Agricultural activities

Since there are no herding animals at the Pittsburgh Campus, GHGs from animals were assumed zero. An agricultural activity that has GHG emissions is the use of fertilizers for landscaping activities, which is accounted under Scope 1 emissions. Synthetic fertilizers are used around the campus for landscaping purposes. Synthetic fertilizers are labeled with their chemical makeup using three numbers to represent the percentages of nitrogen (N), phosphorus (P), and potassium (K). Therefore, a fertilizer having the numbers 10-15-20 would possess a nitrogen content of 10%, phosphorus content of 15%, and potassium content of 20%. Fertilizers 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 pounds 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.

- FY 2011, Fertilizers: 1,125 pounds with average nitrogen content of 18%
- FY 2008, Fertilizers: 475 pounds with average nitrogen content of 13%

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 and Steam

Purchased electricity and steam are a part of scope 2 emissions of the GHG inventory. Electricity consumption was 211 million kWh for this study period compared to 198 million kWh in FY2008.

The CO_2 emissions from purchased electricity were calculated using the emission factors present in the CA-CP calculator. In the 2008 GHG report the primary source for the campus fuel mix was from U.S. EPA's E-GRID program [3]. E-GRID has fuel mix information both on a state level, and on a sub-region level based on fuel mix. UPitt is located in the RFC West power pool (RFCW) (Figure 2) with the majority of electricity generated from coal as presented in Figure 3. The given regional fuel mix and emissions factors were used to convert electricity consumption into MT CO2E emissions for FY 2008. However, for FY 2011, the University of Pittsburgh electricity supplier fuel mix was obtained and is shown in Figure 4. Because the fuel mix did not disaggregate oil and gas, it was assumed that the total percentage in "Gas/Oil" was evenly distributed between natural gas, distillate oil (#1-#4), and residual oil (#5-#6), for the purposes of the CA-CP calculator.

The major differences between the E-GRID fuel mix and the actual fuel mix utilized by the electricity supplier is in the percentage of coal and hydro utilized. A reduction of 12% in quantity of coal used in FY 2011 versus FY 2008 was the primary source for reducing CO2E emissions. UPitt's proximity to hydroelectric facilities along the three rivers surrounding the Pittsburgh region is reflected in the increase in hydro of roughly 8%. Lastly, an increase of 5.5% for natural gas use in generation was seen, corresponding with the rise of natural gas production in western Pennsylvania.

The results yield 135,500 MT CO2E for electricity consumption. This represents a 2% decrease in CO2E emissions from 2008 to 2011. Nearly half of UPitt campus buildings saw reductions in electrical consumption during this time period, but these reductions were offset by several renovation projects and rises in use at several buildings leading to an overall increase of 13,000 MWh in FY 2011. Therefore, the decrease in CO2E emissions for FY 2011 is a product of better fuel mix data with any offsets from the new buildings.

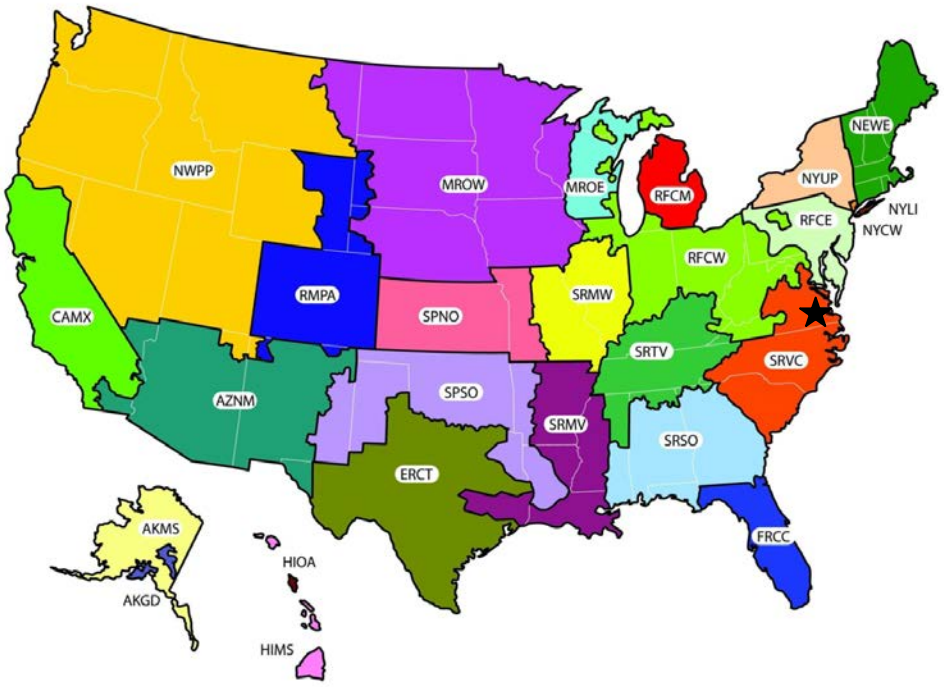

Figure 3. Sub-regions as defined by e-GRID [3]

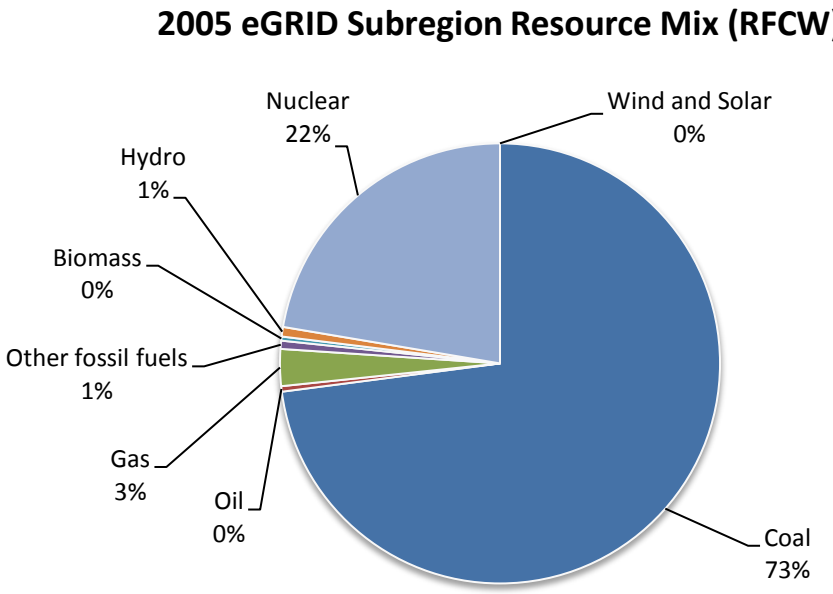

Figure 4. Fuel Mix of electricity consumed by University of Pittsburgh in FY 2008 [3]

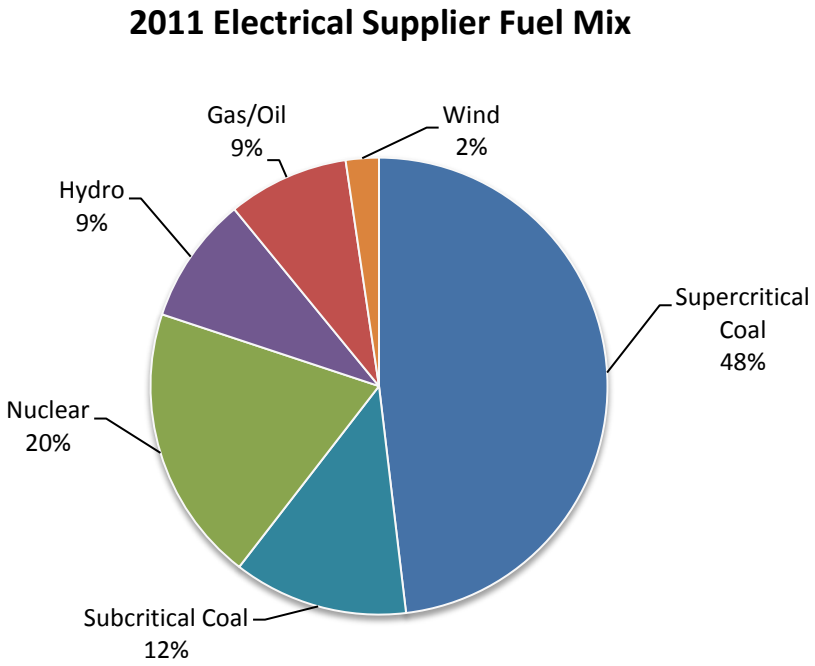

Figure 5. Fuel mix of electricity consumed by University of Pittsburgh in FY 2011

Steam is a common energy source for campuses in cities with centralized steam production [7]. The amount of steam used by individual buildings was obtained from UPitt's Facilities Management Department. The amount of steam was recorded in pounds and converted to energy units [9]. In FY2011, CSSP was operating at about ~50% with remainder demand requirements from BBP. *As such, the purchased steam was not reduced to zero from BBP. The* total purchased (BBP) steam consumption decreased from 636,000 million British thermal units (MMBtu) in 2008 to 425,500 MMBtu currently. This represents a 33% decrease in purchased steam, largely because in 2011, 49% of steam consumption was supplied by the on-campus CSSP, as previously discussed.

By default, the CA-CP calculator assumes a fuel mix of 50% natural gas and 50% distillate oil for steam production. *However, in the 2008 the Bellefield Boiler Plant operated on 50% coal and 50% natural gas. By 2011, the BBP had retrofitted the remaining boilers to operate on 100% natural gas*. New for the 2011 report is the boiler plant efficiency, which was measured on-site by facilities management and recorded at 76.51% for the BBP. By using the exact fuel mix and the measured efficiency of the boiler plant obtained for the study period, total GHG emissions were found to be 29,400 MT CO2E, which is a 47% decrease from FY2008.

- FY2011, Purchased electricity: 211,000,000 kWh
- FY2008, Purchased electricity: 198,000,000 kWh
- FY2011, Purchased steam: 425,500 MMBtu
- FY2008, Purchased steam: 636,000 MMBtu

4.3 Scope 3 Emissions

Sources that emit GHGs but that are indirectly related to UPitt are under scope 3. For example, UPitt contracts solid waste management, but emissions coming from solid waste are the responsibility of UPitt. Another example is directly financed air travel.

4.3.1 Directly Financed Outsourced Travel

UPitt finances different modes of transportation for its operations, which include air travel, rental car, bus, and personal mileage reimbursement. In FY2008, 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. While UPitt's current accounting system for FY2011 does not permit an analysis of total travel distances, it does make available information that was undetermined in the 2008 report. A new network-based program for recording reimbursements and P-card purchases allowed for a greater level of detail of directly financed travel costs at UPitt during the 2011 fiscal year. Costs for faculty, staff, and students travel was available for FY 2011.

Air travel data in monetary values was converted into miles traveled. The Association for the Advancement of Sustainability in Higher Education (AASHE) proposes to use guidelines given by the Air Transport Association (ATA) for air travel [18-19]. ATA has historical records of nominal air travel prices given in passenger miles. For 2011, the nominal price was 13.65 cents per passenger mile. However, in order to include taxes and certain fees, AASHE advises to increase unit costs by 20%, resulting in 16.4 cents per passenger mile. The use of this

coefficient yields just over 36 million miles of air travel at UPitt, which includes financed travel for faculty, staff, and the Athletic Department.

An additional 4 million miles of air travel occurred during the 2011 fiscal year compared to 2008;. Increases to the student population and faculty and staff positions, account for a portion of this difference, while the majority of the difference is directly related to the updated recording system. Access to P-card purchases and reimbursements data accounted for a portion of the difference, but was indefinable. Some reimbursement data was accounted for in 2008, while P-card purchases have supplanted personal reimbursements for many faculty and staff.

Cost information was obtained from UPitt's Transportation Services regarding the amount spent towards chartered bus travel by faculty, staff and the Athletic Department. For outsourced bus transportation, the distance travelled totaled 188,500 miles, which was a decrease of 251,500 miles from 2008.

Based on the data available, financed air travel emits 33,600 MT CO2E, bus transportation emits 50 MT CO2E, and study abroad air travel emits 1,100 MT CO2E.

- FY2011, Directly financed air travel: 36,000,000 air miles
- FY2008, Directly financed air travel: 32,000,000 air miles
- FY2011, Other directly financed travel: 188,500 miles
- FY2008, Other directly financed travel: 440,000 miles

4.3.2 Study Abroad 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. Students have the choice of many countries to apply, like China, United Kingdom, Australia, Brazil, to name a few. The CA-CP calculator separates these miles from the Directly Financed Outsourced Travel section, but they carry the same weights, and are calculated no differently.

In the 2008 report, study abroad travel was not included because of similar issues to those in Directly Financed Outsourced Travel. In 2011, accurate travel cost data was obtained through the Study Abroad Office. Air miles traveled during the 2011 fiscal year were 1.4 million miles. The GHG emissions associated with these miles were 1,100 MT CO2E.

- FY2011, Study abroad air travel: 1,400,000 air miles
- FY2008, Study abroad air travel: Data not available

4.3.3 Commuter travel

Several important factors influence commuter habits of UPitt population. Subsidized and accessible public transportation, combined with the proximity of neighborhoods, in which the students prefer to reside, present an advantageous situation for reducing campus emissions from commuting.

Currently there are 4,400 parking spaces within UPitt parking lots and 150 metered parking spaces allocated for public use, totaling 4,550 parking spaces at UPitt Oakland campus. Of these spaces, UPitt currently has 3,173 parking permits issued to faculty and staff. Remaining parking spaces are allocated for daily parking.

There are currently 1,670 bike racks distributed around the campus. During warmer months, these racks are typically full, implying that 1,670 students bike to school when weather conditions permit. However, use of bike racks decreases during winter months, which forms the majority of the school year. In order to include this in the analysis, it was assumed that 30% of bike racks overall are used throughout the year.

Residence hall capacity in Oakland is 7,200 students. In addition, there are many student housing options in South Oakland. All of these students are assumed to walk to UPitt accounting for approximately 35% of student population.

Although their numbers are low, some students drive to campus. Detailed information regarding the number of students who drive daily could not be found. Although the university faculty and student populations have grown, the number of parking spaces in and around campus has remained relatively unchanged. Therefore, it is assumed the same number of students drive to school as was estimated in the previous inventory at 1,250 students.

The remaining portion of students was assumed to use bus transportation to commute to the campus, which makes 60% of the total student population. Due to an agreement between UPitt and Port Authority of Pittsburgh, students ride buses without daily charge, which is an incentive aimed at increasing ridership.

Excluding faculty working for UPMC, Pitt had 2,487 faculty members during fiscal year 2011. The vast majority of faculty is assumed to prefer to drive to work. The ratio of driving to work was assumed to be 90% for faculty. The remaining portion is assumed to use bus transportation to commute to work. Ratio of faculty using bikes to commute to work was neglected.

Carpooling data did not distinguish between faculty and staff, therefore, all carpooling personnel were assumed to be staff rather than faculty. This assumption is further supported by the fact that working hours of staff are more consistent allowing for carpooling. Faculty hours tend to be irregular. Number of participants for carpooling was 188. Combined with 57 people using vanpooling, the total number of shared ridership is close to 250, corresponding to less than 5% of UPitt staff.

Staff not commuting via carpooling is assumed to be equally divided among car and bus transportation. Similar to students and faculty, Pitt staff can ride buses without charge. This incentive together with regular work hours is assumed to result in higher ratio of bus transportation of staff compared to faculty. Data regarding actual bus usage of UPitt personnel and students was not available. Therefore, estimates were used for bus transportation. UPitt is currently using IDs which allow for better data collection of student, faculty, and staff travel habits and distances via the public transportation, but the system was in the early phases of incorporation during the fiscal period of record.

In order to calculate emissions, distances travelled were input into the CA-CP calculator. For students not living at residence halls in Oakland or nearby neighborhoods, the average commuting distance was assumed to be 4 miles each way for driving and bus transportation. The area within a 4-mile radius of Oakland includes several

neighborhoods where students prefer to reside such as Shadyside, Squirrel Hill, Greenfield, and several neighborhoods to the west of Oakland including half of Downtown.

For faculty, an average 13 miles was assumed for one-way commuting distance, as compared to 4 miles for students, to increase the number of neighborhoods. The distance of 13 miles is the calculated weighted average distance for faculty and staff that drive to work and have parking permits. This is a half mile increase from the 2008 inventory, and highlights the fact that faculty and staff are moving further from campus, possibly to the suburbs of the city of Pittsburgh.

Another input required to calculate emissions was the number of days students commuted, which can be assumed to be equal to the number of weeks they have classes. Majority of students attend school for Fall and Spring semesters. Attendance drops significantly during Summer semester. Excluding all holidays and break periods, students have 30 weeks of class period. They are assumed to commute to school for this period only.

For faculty and staff, 47 working weeks in a calendar year were assumed. Due to winter recess and other observed holidays, UPitt is closed approximately 3 weeks for faculty and staff. Assuming a 2 week paid vacation time, the number of working weeks in a year becomes 47.

In all, faculty and staff commuting totaled 14,700 MT CO2E per the CA-CP calculator, increasing by 8% from 2008. Student commuting GHG emissions totaled 5,500 MT CO2E, increasing by 7% from 2008.

- FY2011, Commuting Faculty: 28,138,383 miles for personal vehicles and 15,360,045 miles for bus
- FY2008, Commuting Faculty: 25,357,793 miles for personal vehicles and 13,316,745 miles for bus
- FY2011, Commuting Students: 1,443,960 miles for personal vehicles and 20,119,176 miles for bus
- FY2008, Commuting Students: 1,485,270 miles for personal vehicles and 18,031,178 miles for bus

4.3.4 Waste

Solid waste is managed by Republic Waste Services and is landfilled with a methane recovery system in place. Landfills release methane and CO2 emissions as organic waste decomposes. However, the CO2 emissions are not included in the inventory since same, or even greater amounts of CO2 would have emitted to the atmosphere under normal aerobic decomposition, as part of the natural life cycle of the biomass [10, 20]. Therefore, only methane emissions occurring at landfills need to be accounted for the inventory. 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.

Through the efforts of the Facilities Management, Food Services, Housing, and Property Management departments, UPitt was able to decrease solid waste by 650 short tons from 2008 totals, and maintain the percentage of waste diverted to recycling at 40%. During fiscal year 2011, 4,596 tons of solid waste was generated by UPitt. The CA-CP calculator yields 1,404 MT CO2E due to methane released from landfills. This is a 75% reduction in calculated CO2E emissions from a scenario where the landfill did not use a methane recovery system.

- FY2011, Solid waste: 4,596 short tons of solid waste with CH_4 recovery
- FY2008, Solid waste: 5,246 short tons of solid waste with no CH_4 recovery

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 municipal sewage stream. 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 1,400 MT CO2E from wastewater, which does not have a significant impact when compared to total emissions of UPitt. However, UPitt managed an 1% decrease in water consumption from 2008, attributed to the upgrading of facilities around campus.

- FY2011, Wastewater: 246,450,000 gallons to the sanitary system
- FY2008, Wastewater: 278,350,000 gallons to the sanitary system

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 Budget Department. UPitt made great strides since 2008 to use higher graded post-consumer waste (PCW) paper and to raise recycling rates, and the data shows these efforts were successful. Based on this data, 39% of purchased paper includes some grade of PCW, of which 96% includes 30% post consumer waste, up from 85% in 2008. During fiscal year 2011, 383,000 less lbs of 0% PCW paper, 15,300 less lbs of 10%, and 4,800 less lbs of 20% PCW paper were consumed, while increases to 30% and 100% PCW highlight UPitt's move to higher graded PCW paper products. Recycling rates of paper increased going from 15% in 2008 to 64% in fiscal year 2011. GHG emission from paper consumption is 1,477 MT CO2E.

- FY2011, Paper: 730,728 lb of 0% recycled, 629 lb of 10% recycled, 650 lb of 20% recycled, 453,342 lb of 30% recycled, and 15,275 lb of 100% recycled paper use was input into CA-CP calculator.
- FY2008, Paper: 1,113,742 lb of 0% recycled, 15,900 lb of 10% recycled, 5,463 lb of 20% recycled, 140,465 lb of 30% recycled, and 2,155 lb of 100% recycled paper use was input into CA-CP calculator.

5 Discussion of Results

GHG emissions of UPitt for fiscal year 2011 amounted to 268,500 MT CO2E. The percentage result distribution is presented in Figure 6 and Table 4. The fiscal year 2008 GHG inventory results table can be found in Appendix B.

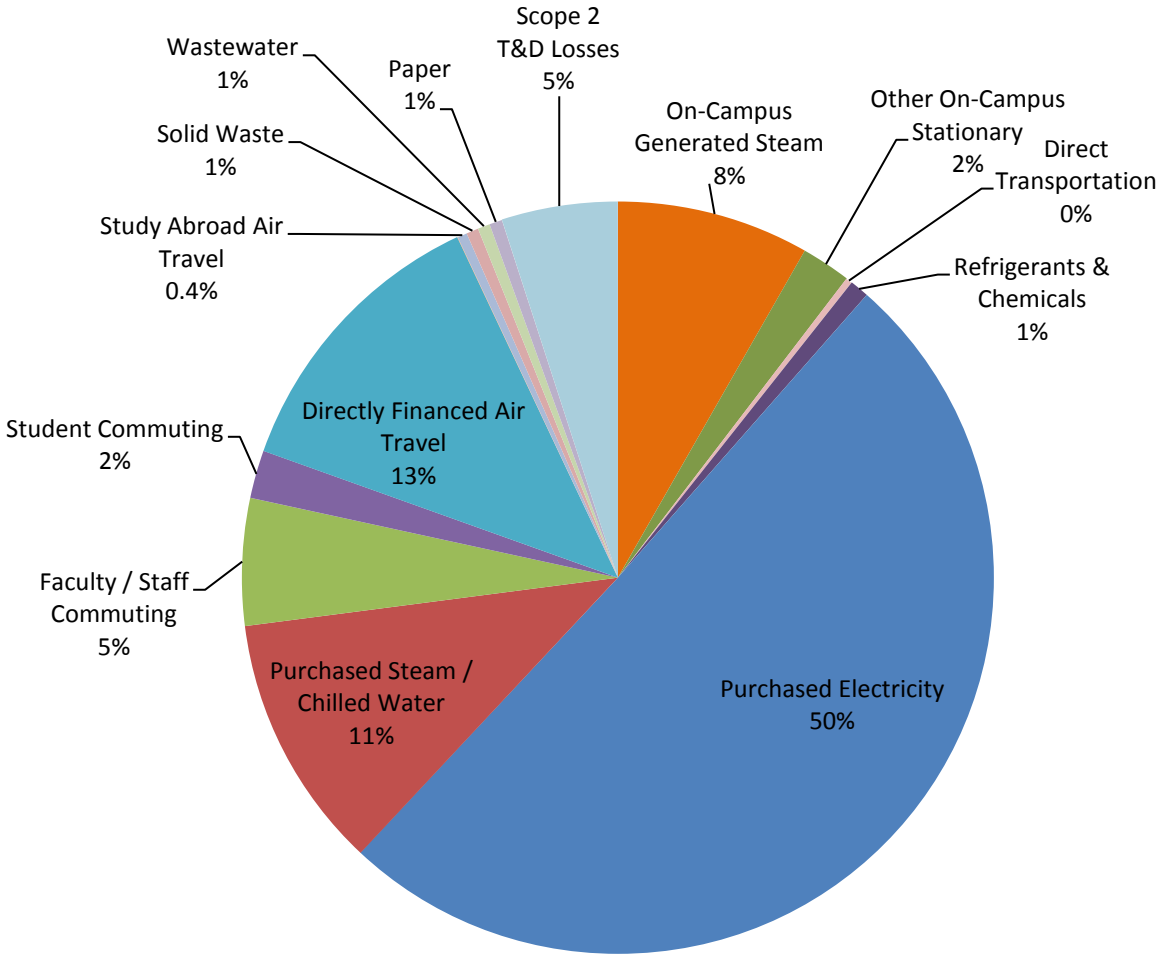

Figure 6. Distribution of UPitt's FY2011 GHG Results

Table 4. Summary of UPitt's GHG Emissions for Fiscal Year 2011

	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	44.2	22,200
	Other On-Campus Stationary	107,587	5,675,832	567.52	11.4	5,700
	Direct Transportation	10,221	714,884	130.43	45.5	700
	Refrigerants & Chemicals	0	0	0	0	2,300
	Agriculture	0	0	0	2.86	1
Scope 2	Purchased Electricity	2,163,603	134,812,989	1,782	2,242	135,500
	Purchased Steam/Chilled Water	556,161	29,340,701	2,934	58.7	29,400
Scope 3	Faculty / Staff Commuting	203,367	14,377,434	2,336	827	14,700
	Student Commuting	76,028	5,484,669	389.35	165	5,500
	Directly Financed Air Travel	170,480	33,471,585	329.59	379	33,600
	Other Directly Financed Travel	639.4893295	46,280	2.6275	1.19	50
	Study Abroad Air Travel	5,587	1,096,922	10.801	12.4	1,100
	Solid Waste	0	0	216,687	0	1,400
	Wastewater	0	0	49,806	351	1,400
	Paper	0	0	0	0	1,500
	Scope 2 T&D Losses	213,960	13,331,753	176.24	222	13,400
Offsets	Additional					0
	Non-Additional					0
Totals	Scope 1	537,105	28,511,039	2,910	104	30,900
	Scope 2	2,719,537	164,139,535	4,716	2,301	165,000
	Scope 3	670,062	67,808,643	269,738	1,957	72,700
	All Scopes	3,926,704	260,459,217	277,363	4,362	268,500
	All Offsets					0
				Net Emissions:		**268,500**

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 [7]:

- *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. The impact of selection of any one of the above four boundaries is demonstrated in Table 5 below. Emission results for UPitt increased by 37% 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, as shown in Table 5. 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.

Table 5. GHG Emission Results for University of Pittsburgh Reported Using Different Metrics to Facilitate Comparison with respect to Other Institutions, FY2011

Metrics	Scope 1 and Scope 2	Scopes 1 and 2, Air Travel, Solid Waste Management	Scopes 1 and 2, Transportation and Solid Waste Management	All Accountable Emissions
Operating Budget, g CO_2E / $	120.8	143.1	155.6	165.7
Students, MT CO_2E/ FTE student	7.3	8.7	9.4	10.0
Community Members, MT CO_2E / Person	5.8	6.8	7.4	7.9
Building Space, MT CO_2E / 1000 ft_2	20.3	24.0	26.1	27.8

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 6. Comparative Results of Higher Education Institutions used for Peer Group Benchmarking, Sorted According to Net Emissions [21-24]

Institution	Year of Study	Net emissions, MT CO2E	MT CO2E/FTE student	MT CO2E/1000 ft^2
SUNY - Buffalo	2009	151,414	5.4	16.6
University of Delaware	2009	152,542	8.7	29.1
Carnegie Mellon University	2010	168,274	16.5*	32.0
University of Pittsburgh – mandatory sources only	2011	195,800	7.3	20.3
Temple University	2011	215,115	6.7	23.8
University of Maryland - College Park	2010	251,956	7.4	18
University of Pittsburgh – all accountable sources	2011	268,500	10.0	27.8
Rutgers University	2008	309,060	9.4*	16.7
Pennsylvania State University	2010	432,955	10.1*	22.2
The Ohio State University	2011	701,245	12.8	30.7

* Number of full time students only was used instead of number of full time equivalent students

6 Recommendations for Future GHG Inventory Studies

Several assumptions were required during this study in order to include as many emission sources as possible. However, some of these assumptions may have resulted in over- or under-estimation of actual values. For the next inventory study, aggregation of prior inventory results with this study into a single file database will create a somewhat standardized process for collecting, analyzing, and interpreting data and results, improving the efficiency of study as well as equivalent comparisons. This database will allow researchers to allocate more time towards some of the assumptions made in this GHG inventory report for UPitt, therefore, increasing the accuracy of comparing GHG inventory emission results.

The vehicles registered in the University fleet and the fuel consumed is tracked under two separate programs. Acquisition of these records is simple; however, processing the data is time-intensive. One recommendation is to develop a database to separate UPitt-Oakland campus vehicles from other campuses and UPMC. The next inventory conducted should begin this process early in the inventory study.

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. Currently, UPitt receives approximately 50% of steam from each plant. Future inventory studies should perform a cost benefit analysis for other ratios including the ideal scenario of 100% supply of steam from CSSP. In addition, a risk assessment might be useful in determining the feasibility of acquiring 100% of campus steam from CSSP.

Purchased electricity is the largest source of emissions for UPitt, which makes up more than half of the total CO2E amount. Pittsburgh is located in a coal dominant fuel mix region, inevitably impacting the total emissions of UPitt and resulting in higher emissions for all metrics. For this study, fuel mix information given by electricity supplier was used. Future GHG inventories should examine emission factors for the types of coal-fired processes used at the power plants, e.g. supercritical versus subcritical coal. It is expected that the fuel mix for electricity suppliers will continue to change as regulatory requirements become more stringent. Cost benefit analysis of purchasing green power is also another area that is worth investigating, since this strategy can reduce total GHG emissions significantly. However, UPitt's strategy has been to invest heavily in energy conservation projects that provide a direct energy reduction and subsequent GHG emission reduction on campus in lieu of purchasing green power.

Recording of air travel improved since FY 2008 with the upgrading of network systems designed to simplify the travel reimbursement process for UPitt faculty and staff. However, not included in this upgrade was a method to track flight departure and arrival zip codes, which would greatly increase the accuracy of total air miles made by faculty and staff. Currently, an air mile per dollar spent conversion is applied to the total dollar value spent on air travel in the fiscal year to calculate total miles. Tracking of departure and arrival zip codes is a more accurate way to estimate total air miles travelled, and would benefit the next inventory.

Since information on commuting preference of faculty and students was not available, rough estimates were required to calculate emissions. These assumptions could result in overestimation of emissions from commuting but this was the preferred approach to make sure that emissions were not underestimated. Future inventories could implement a campus-wide survey at the beginning of the study to learn about commuting behavior of students, faculty, and staff. Preparation, data collection, and interpretation of a

survey require long periods of time. Therefore, surveys should be planned and executed from the beginning of a study.

7 Conclusions

FY 2011 GHG emissions of UPitt were quantified in this study. Emissions originating from different sources are reported, along with operational boundaries and associated results. The difference between these boundaries was found to be significant. GHG emissions equal 7.3 MT CO2E/FTE students if only Scope 1 and Scope 2 emissions are included, which is the minimum that can be reported. Instead, if all emission sources found throughout the study were used, this number increases to 10.0 MT CO2E/FTE student. These figures represent a decrease of 11.5% and 9.5% respectively from FY2008. When compared to other higher education institutions, UPitt ranks average with respect to GHG emissions per FTE student.

While UPitt completed the Carrillo Street Steam Plant with the potential to reduce GHG emissions, this plant is not operating at full capacity with Bellefield providing ~50% of the remaining steam. Emissions are also a result of where Pittsburgh is located, and the fuel mix used to generate electricity. Coal is used to generate close to 60% of electricity for the University of Pittsburgh Oakland-campus. Under these circumstances, an analysis should be conducted to compare green power purchasing versus on-site energy reduction strategies, such as the CSSP, to minimize GHG emissions. In the short term the university should continue its emphasis on energy conservation strategies, since the most sustainable energy is the energy that is never consumed.

Acronyms

AASHE – Association for the Advancement of Sustainability in Higher Education

ACUPCC – American College and University Presidents Climate Commitment,

http://www.presidentsclimatecommitment.org/

ATA – Air Transport Association

BBP – Bellefield Boiler Plant

CA-CP – Clean Air-Cool Planet, http://www.cleanair-coolplanet.org/

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 CO2E – Metric ton of carbon dioxide equivalent

UPitt – University of Pittsburgh, Oakland Campus

WRI – World Resources Institute, http://www.wri.org/

Appendix A

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

Table 7. List of Contacts and Information Received

Contact	Information Received
Laura Zullo	Building list Purchased electricity and steam Solid waste Wastewater Landscaping CSSP and BBP steam plant data
Kevin Sheehy	Parking permits Carpool
Art Ramicone	Budget
Maureen Beal	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
Nicole Acierno	Chartered bus athletic travel

Appendix B

Table 8. Summary of UPitt's GHG Emissions for Fiscal Year 2008

	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	9,200
	Direct Transportation	6,794	474,287	80	28	500
	Refrigerants & Chemicals	0	0	0	0	800
	Agriculture	0	0	0	1	0
Scope 2	Purchased Electricity	1,516,172	138,141,644	961	1,824	138,700
	Purchased Steam/Chilled Water	762,771	49,293,289	5,173	402	55,100
Scope 3	Faculty / Staff Commuting	188,794	13,342,553	2,189	774	13,600
	Student Commuting	71,069	5,124,457	375	157	5,200
	Directly Financed Air Travel	125,950	24,728,701	244	280	24,800
	Other Directly Financed Travel	1,533	110,924	6	3	100
	Study Abroad Air Travel	0	0	0	0	0
	Solid Waste	0	0	247,311	0	5,700
	Wastewater	0	0	58,454	412	1,500
	Paper	0	0	0	0	1,600
	Scope 2 T&D Losses	190,097	16,256,744	367	202	16,600
Offsets	Additional					0
	Non-Additional					0
Totals	Scope 1	179,963	9,609,966	993	47	10,400
	Scope 2	2,278,943	187,434,933	6,134	2,226	193,800
	Scope 3	577,443	59,563,379	308,945	1,827	69,100
	All Scopes	3,036,349	256,608,278	316,073	4,101	273,400
	All Offsets					0
					Net Emissions:	**273,400**

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