Center for Environmental Research and Education

Abigail Ellert, Graduate Student

May 2019

DUQUESNE UNIVERSITY

ONE STEP AT A TIME:

Duquesne University's Seventh Greenhouse Gas Emissions Inventory

Table of Contents

Acknowledgements

We would like to recognize those who compiled the previous greenhouse gas inventory reports at Duquesne University from 2006 through 2016. They are David Deal, Lindsay Baxter, Judy Baker, Talisha Cox, Rebecca Day, Kelsy Johnson, Jacob Levine, Patrick McKee, Philip McConnell, Meagan Morrissey, Nathan Ribar, Josh Snedden, Gretchen Sterba, Colin Whitsett, Dr. David Kahler, Dr. Stanley Kabala, and Dr. John Stolz. The biennial inventories are funded by the Center for Environmental Research and Education at Duquesne University.

The greenhouse gas inventory is only possible with the cooperation of departments and personnel throughout Duquesne University. Those are:

- Angela Chirumbolo, *Office of Institutional Research and Planning*
- David Chismar, *Energy Management & Forecasting – Facilities Management*
- Jaclyn DeNardo, *Business Manager - Department of Public Safety*
- Danielle Genemore, *Assistant Director of Study Abroad Programs*
- Coleman Griffin, *Manager of Grounds, Sustainability, & Motor Pool Facilities Management*
- Mark Johnson, *Director of Energy Center & Utilities – Facilities Management*
- Jeff Kearney, *Copy Center Operator*
- Laurie Lewis, *Supervisor Receiving, Mailing, & Materials Handling*
- Chase Loper, *Budget Analyst – Facilities Management*
- Kenneth Mann, *Procurement & Payment Services*
- Mary Kate Ranii, *Center for Environmental Research and Education*
- Steven Scott, *Print Services Manager*
- William Spangler, *Associate Dean, Academic Affairs & Research – Palumbo-Donahue School of Business*

List of Figures

List of Tables

1. Executive Summary

The seventh greenhouse gas (GHG) emissions inventory was conducted for fiscal year (FY) 2018. This period began on July 1, 2017 and ended June 30, 2018. Assembled by graduate assistant Abigail Ellert at the Center for Environmental Research and Education (CERE), these findings were compared with those derived from the previous inventories to assess trends in Duquesne University's GHG emissions. Furthermore, this inventory discusses options for reducing Duquesne's carbon footprint in future years.

Duquesne University's total GHG emissions for FY 2018 were 52,296.04 metric tonnes carbon dioxide equivalent (MT eCO_2), equaling 5.65 MT eCO_2 per student. This is an 11.68 % increase in emissions compared to FY 2016, which totaled 46,826.58 MT eCO_2.

Despite an increase in the amount of purchased Renewable Energy Credits (RECs), emissions are at the highest levels recorded since Duquesne began conducting GHG inventories. This is attributed to a more thorough investigation of emission sources and the change of RECs from Offsets to Renewable Energy, which only counteracts Scope 2 emissions. GHG emissions from a range of sources were compiled and reported here (Figure 1).

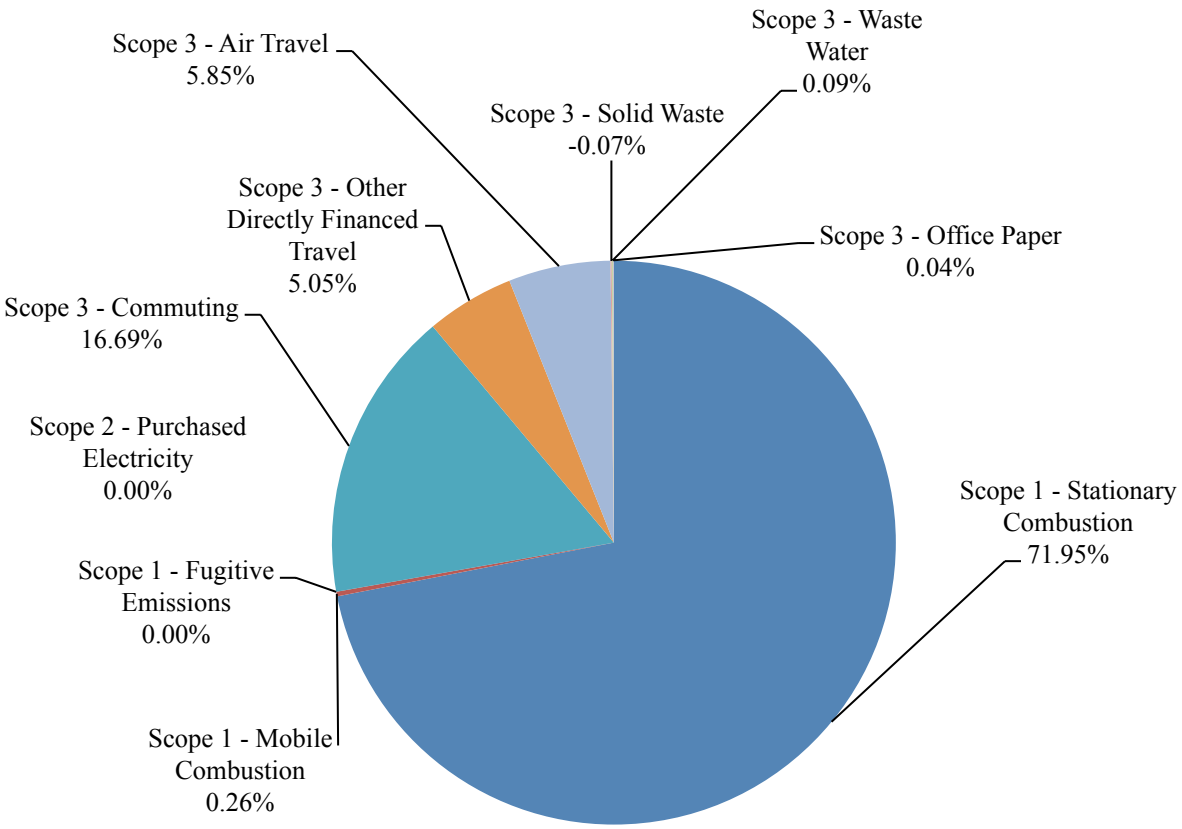


Figure 1. Distribution of emission sources for FY 2018.

The largest contributor to Duquesne's GHG emissions was on-campus stationary combustion, which includes the natural gas cogeneration plant and auxiliary boilers. This Scope 1 source contributed to 72% of campus emissions. Another significant contributor to University emissions was commuting at 16.69%. Directly financed travel contributed 5.05% of emissions, and air travel contributed 5.85% of emissions (Table 1). Purchased electricity had no impact on Duquesne's GHG emissions due to the purchase of RECs. Other emission sources such as wastewater and mobile combustion registered, however, the levels were insignificant when compared to the main sources.

Table 1. Comparison of major contributors of GHG emissions in FY 2016 and FY 2018.[9]

Emission Source Category	FY 2016 Emissions (MT eCO_2)	FY 2018 Emissions (MT eCO_2)	Percent Change
Stationary Combustion	31,374.57	37,453.55	+ 19%
Purchased Electricity	1,681.25	0.00	- 100%
Commuting	8,622.12	8,688.31	+ 0.77%
Directly Financed Travel	2,387.85	2,631.47	+ 10.2%
Air Travel	1,959.93	3,045.46	+ 55.4%

The largest factors that contributed to the increase in emissions from FY 2016 were the increase in stationary combustion and Study Abroad air travel. Emissions from stationary combustion increased by over 6,000 MT eCO_2. Despite this increase in emissions, it allowed Duquesne University to supply a large majority of the electricity required by campus, 31,825.4 mega-watt hours (MWh), and resulted in only 10,376.28 MWh of electricity to be purchased from an electric supplier. The GHG emissions generated as a result of the purchased electricity were completely offset by the purchase of 21,182.4 MWh of RECs from Direct Energy Business, LLC; a credit-trading enterprise[7]. Additionally, Study Abroad air travel emissions increased by more than 50 percent. This is attributed to a more accurate representation of all Study Abroad programs available at Duquesne, and thus an increase in student participation from 449 students to 595 students.

Emissions per student in FY 2018 were the highest ever recorded at Duquesne University. Total emissions were also higher than all previously completed GHG inventories (Table 2).

Table 2. Comparison of total emissions and per student emissions across all GHG inventories.[1, 2, 5, 6, 9, 10]

GHG Inventory Report (FY)	Total Emissions (MT eCO_2)	Per Student Emissions (MT eCO_2)
2006	46,800.0	4.60
2008	40,557.0	4.00
2010	42,044.4	4.05
2012	39,203.3	3.92
2014	51,187.7	5.13
2016	46,826.58	4.93
2018	52,296.04	5.65

This inventory suggests that commuting and travel have continuously been difficult to assess and remain top contributors to Duquesne's GHG emissions. However, there are numerous actions Duquesne can take to reduce emissions from all Scopes. These steps could include (1) purchasing campus electricity from a renewable energy supplier, (2) implementing or purchasing activities that generate offsets such as afforestation, reforestation, bio-digestion, and composting, (3) improving the energy and water efficiencies of all campus facilities, (4) and providing alternative transportation methods for commuters.

2. Background

The Center for Environmental Research and Education at Duquesne University conducted its first GHG emissions inventory based on data collected in 2006. This was the first inventory completed by any university in western Pennsylvania, and it provided campus officials, students, and community members with knowledge on the size and sources of Duquesne's GHG emissions. The University decided to update this information biennially to discover overall trends in emission generation, and has since published six GHG inventory reports. Data from all previous inventories were compared to the findings from FY 2018 to assess how the University has embraced global movements to reduce GHG emissions and what further actions can be taken to improve collegiate sustainability.

3. Methods

In 2017, the University of New Hampshire Sustainability Institute launched a new GHG emission inventory platform, the Sustainability Indicator Management & Analysis Platform (SIMAP). SIMAP uses state-of-the-art GHG emission knowledge and well-researched formulae to convert institutional data into emission figures.[17] This program was first used to complete the FY 2016 report after it replaced an older version of similar software known as Clean Air-Cool Planet.

SIMAP categorizes data into four broad functional fields:

- Scope 1: Direct emissions from sources owned or controlled by the University.
    - Cogeneration facility, auxiliary boilers, university fleet, and refrigerant use.
- Scope 2: Indirect emissions from sources neither owned nor operated by the University.
    - Purchased electricity, steam, chilled water, and renewable energy including credits.
- Scope 3: Directly financed outsourced emission sources and sources closely liked to campus activities.
    - Commuting, travel, solid and wastewater disposal, and paper usage.
- Sinks: Projects on or off campus that reduce the institutional carbon and/or nitrogen footprint.
    - Compost, non-additional sequestration, and offsets.[17]

3.1 Scope 1 Sources

3.1.1 Stationary Fuel

Stationary fuel data was provided by the Facilities Management Department through their monthly Energy Center summary that details output of the University's cogeneration facility. The Energy Center summary contains all information regarding the functionality of the University's cogeneration facility. Natural gas used by the cogeneration facility was reported in million cubic feet (MCF) and converted to million British Thermal Units (MMBTU). In order to obtain the amount of natural gas used by Duquesne University that is not associated with the cogeneration facility, *Energy Watchdog*, an online utility management tool, was used.[11] This tool records the total amount of natural gas purchased

by the University in MCF, which was also converted to MMBTU. The amount used by the cogeneration facility was subtracted from the total provided by *Energy Watchdog* to determine the amount of natural gas used for other processes on campus. The Energy Center summary also provided the data for electric and steam outputs as well as electric and steam efficiencies. Electric output, reported in kilowatt-hours (kWh), did not require a data conversion. Steam output is reported in million pounds (Mlbs), but was converted to MMBTU in order to be entered into SIMAP.

3.1.2 Transport Fuel

Gasoline used by the university fleet, Facilities Management and Public Safety vehicles, was entered as one value into the "Transport Fuels Data" section of Scope 1. Facilities Management reported the total amount spent to purchase gasoline for FY 2018. SIMAP requires the data to be entered in the form of U.S. gallons, so the monetary amount received by Facilities Management was divided by the average price of Regular, Conventional gasoline for the Pittsburgh area in 2018, which was $2.48.[20] Public safety reported that they operate six vehicles with a fuel economy of 12 miles per gallon (mpg). Additionally, they reported each vehicle travels approximately 13,000 miles each year. This allows for an approximation that Public Safety vehicles travelled 78,000 miles in FY 2018 and used 6,500 gallons of gasoline. The total gallons of gasoline used by Facilities Management and Public Safety was entered into SIMAP.

3.1.3 Fertilizer

Fertilizer usage was received from Facilities Management in total bags purchased for FY 2018. SIMAP requires fertilizer to be entered as pounds, so each bas was assumed to be 50 pounds to complete the conversion.[15]

3.1.4 Animals, Refrigerants, & Chemicals

Data on these sources were not reported for FY 2018 to remain consistent with previous inventories.

3.2 Scope 2 Sources

3.2.1 Utility Consumption

Purchased electricity was gathered from *Energy Watchdog*. This site reported the total amount of purchased electricity in kWh for the University. The impact of purchased electricity on Duquesne's carbon footprint was neutralized because of the purchase of RECs. Steam and hot water were not recorded as consumed by the University because it is produced by the cogeneration facility.

3.2.2 Renewable Energy

Duquesne has a Power Purchase Agreement with Direct Energy Business, LLC to support renewable energy generation and offset Scope 2 purchased electricity emissions. REC data is "Green-e" verified and entered as MWh in SIMAP.[7]

3.3 Scope 3 Sources

3.3.1 Commuting

Faculty, staff, and student commuting are entered separately into SIMAP to account for the different percentages of individuals who commute via automobile, bike, bus, carpool, light rail, public bus, and walking. These transportation habits were calculated based on a transportation survey that was provided to the campus community via *Blackboard* in 2010 (Appendix C). The Office of Institutional Research provided the number of faculty, staff, and students for fall 2017 and summer 2017. It was assumed that full-time faculty and staff traveled to the University five-days per week and part-time faculty and staff traveled to the University three-days per week. Students were assumed to have traveled to campus four-days a week if enrolled full-time and two-days a week if enrolled part-time. SIMAP requires commuting data to be entered as the number of one-way trips per commuter per week. In order to account for full- and part-time employees and students, the input line for "Number of commuters" was set to a value of one, and the input line for "Number of one-way trips" was calculated prior to input to allow for the reporter to assume different travel habits based on status (full- or part-time). To calculate the "Number of one-way trips,", the number of full-time faculty was multiplied by 10 (five-trips weekly) and the number of part time-faculty was multiplied by six (three-trips weekly). These values were added to provide the total "Number of one-way trips" by faculty each week. The same calculation was completed for staff and students using their respective number of trips to the University per week.

3.3.2 Business Travel & Study Abroad

This category is comprised of four subgroups: (1) faculty and staff travel, (2) athletic air travel, (3) athletic bus travel, and (4) study abroad travel. Subgroups 1-3 are considered "Other Directly Financed Travel" throughout this GHG inventory, whereas subgroup 4 is referred to as "Air Travel" due to the restraints imposed from the predetermined SIMAP categories.

SIMAP requires faculty and staff travel to be entered as either passenger miles or US Dollars. Previous inventories reported data as passenger miles, so that was again used for FY 2018. The amount of money spent by faculty and staff was obtained from Procurement and Payment Services. This value was converted to passenger miles using the average Standard Industry Fair Level (SIFL) from July 2017-December 2017 and January 2018-June 2018, which was $0.1717 per mile. It was estimated that the average miles flown was between 501 and 1500 miles per trip.[22]

Athletic travel was obtained from the Duquesne University Athletic webpage by analyzing all athletic schedules. When two or more events were scheduled 1-2 days apart on a weekend or during a University break, it was assumed that the team would not return to Duquesne in between. It was also assumed that any event greater than 8 hours away by ground would be traveled to via air transportation. Ground travel was calculated as round-trip miles via diesel charter bus; two buses were used football travel. These miles were gathered from *Google Maps*. Air travel miles were gathered from *Web Flyer*.[21] To

convert to passenger miles, round-trip air miles was multiplied by the number of athletes and staff that traveled to each destination. It was assumed that four staff members traveled with each team.

Study abroad data were obtained from the Study Abroad Office and the Palumbo-Donahue School of Business for any trip that left Duquesne University between July 1, 2017 and June 30, 2018. These data contained destinations as well as the number of students and faculty who traveled to each location. Round-trip mileages to each location were calculated using *Web Flyer*.[21] The total number of individuals that traveled to each site was multiplied by this mileage to obtain total passenger miles.

3.3.3 Paper

The Print Shop and Receiving offices at the University determined paper usage for FY 2018. Based on evaluation of office paper specifications from Office Depot, we assumed each ream weighed 2 pounds and contained 30% recycled content.[14] To get the total weight of paper used the total number of reams purchased by Duquesne University was multiplied by 2 pounds.

3.3.4 Waste & Wastewater

Waste from the University is sent to the Waste Management Inc. landfill in Monroeville, Pennsylvania. This landfill recovers methane produced during decomposition and uses it to generate electricity. Facilities Management provided the quantity of waste, in short ton, to the landfill during FY 2018. Wastewater generation was obtained from *Energy Watchdog* in gallons and entered into SIMAP with no data conversion. Emissions from wastewater generation are due to the treatment method(s) used at the designated treatment facility. The Allegheny County Sanitary Authority treats wastewater using anaerobic digestion.

3.4 Sinks

Sinks are a method to counteract emissions from Scope 1 and Scope 3 sources. This category can include projects that occur both on and off campus to reduce the institutional carbon and/or nitrogen footprint. Reductions can include composting, non-additional sequestration, and offsets. FY 2018 was the first year to register sinks. Composing of dining waste was obtained from Facilities Management in the amount of short ton. These data, although only available for calendar year 2018, were used for the FY 2018 GHG inventory. Composting is completed by a third-party, AgRecycle.

3.5 Method Challenges

One challenge that was encountered when compiling Duquesne's GHG inventory report was the need to convert some institutional data into units that are accepted in SIMAP. For example, Facilities Management records steam generation in Mlbs, but SIMAP only accepts this category as MMBTU. Although this conversion can be achieved, it leaves room for human error and could create an inaccurate value due to the assumed conversion from Mlbs to BTU.[3] Another challenge was the assumptions that are required when dealing with travel and fuel consumption. In previous reports, faculty and staff travel had always been reported in passenger miles; however, SIMAP now allows this category to be entered as a monetary, US Dollar, value. Future reporters should review SIMAPs documentation on the conversion of this monetary value into GHG emissions to determine if it would be more beneficial to switch to this data label. If this category continues to be reported as passenger miles, there will be a discrepancy in estimating the number of miles traveled for each faculty and staff trip to determine the SIFL rate. Fuel consumption. Additionally, sports travel could have inaccuracies because there is no direct contact with the Athletics Department to determine how the teams travel to each event and how many staff members accompany the team. A record keeping system that periodically records the mileage of Duquesne's Public Safety and Facilities Management vehicles, or a system that records the amount spent on gasoline for these vehicles, would also be beneficial to determine the exact gallons of gasoline used during the fiscal year. Finally, the commuting survey that was completed in 2010 could be inaccurate for this report due to the time that has passed since it was taken. It is recommended that a new commuter survey be given to faculty, staff, and students to determine current commuting habits of these individuals. If these data become more institutionalized, the presence and/or strength of these challenges could be overcome.

4. Results

Duquesne University's GHG emissions for FY 2018 were 52,296.04 MT eCO_2. The total student population, full- and part-time students, was 9,214. This resulted in a carbon footprint of 5.65 MT eCO_2 per student for FY 2018. Seventy-two percent of GHG emissions, totaling 37,592.89 MT eCO_2, came from Scope 1 sources. No emissions were reported from Scope 2 sources due to the purchase of RECs. Twenty-eight percent of emissions, 14,703.15 MT eCO_2, resulted from Scope 3 sources (Figure 2).

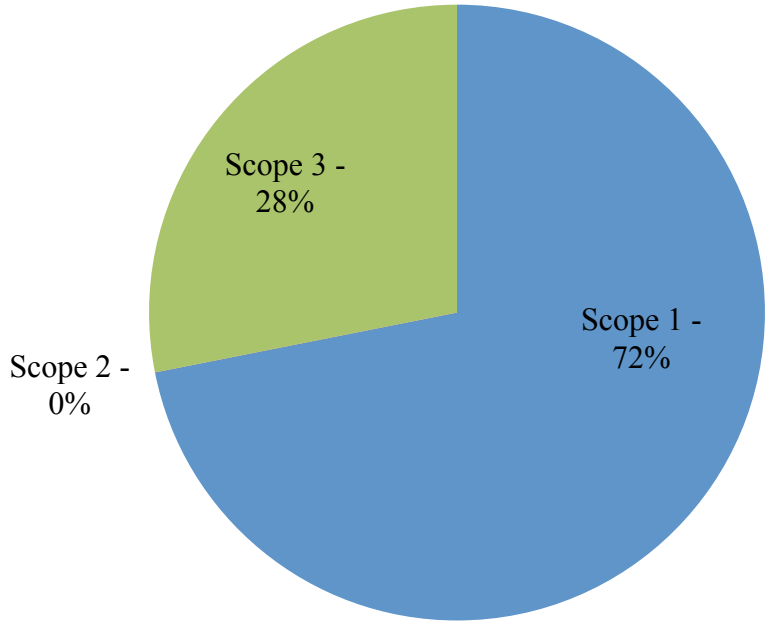


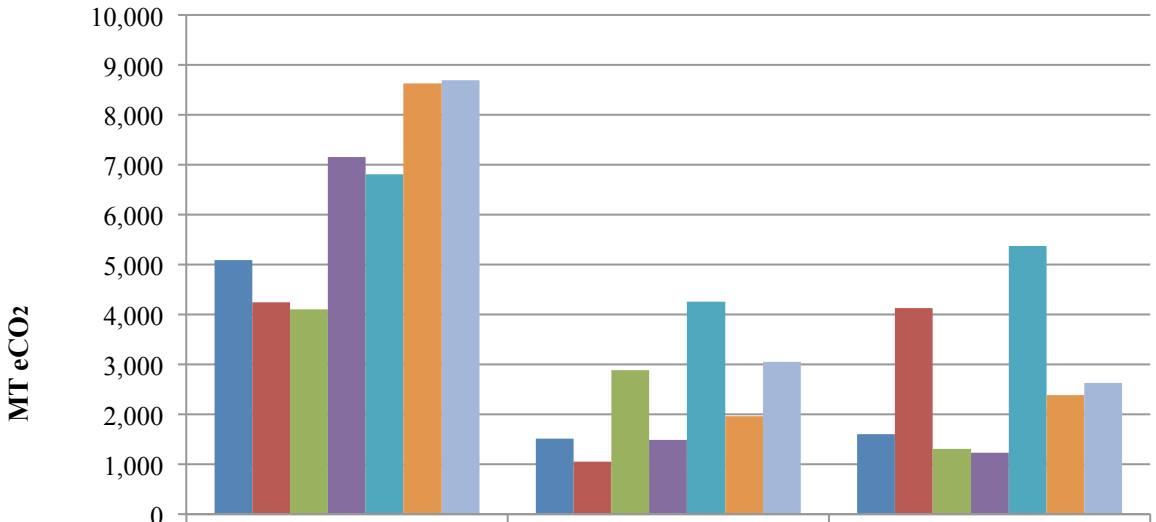
Figure 2. Distribution of FY 2018 GHG emissions by Scope.

4.1 Electricity and Heating

Electricity and heating contributed to seventy-two percent of Duquesne's GHG emissions for FY 2018. The cogeneration facility was responsible for all of these emissions. The facility consumed 672,167 MMBTU of natural gas to produce 31,825,401 kWh of electricity and 225,763 Mlbs of steam in FY 2018. Duquesne purchased an additional 32,067.58 MMBTU of natural gas for cooking and heating in some campus buildings. Electricity was purchased to supplement the electricity produced by the cogeneration facility in the amount of 10,367,281.00 kWh. Purchased electricity did not contribute to Duquesne's reported emissions because 100% of it was counterbalanced by the purchase of 21,182,400.00 kWh of RECs, the balance of the electrical RECs was not attributed to any offsets elsewhere in this inventory.

4.2 Transportation

Duquesne University has a variety of transportation related emissions including commuting, directly financed travel (faculty / staff travel and athletic travel), and study abroad air travel. These sources accounted for 14,703.15 MT eCO_2, 27.59%, of Duquesne's GHG emissions. Commuting accounted for more than half of all transportation emissions at 16.69%. Study abroad air travel was responsible for 5.85% of transportation emissions, and directly financed travel accounted for the remaining 5.05% of transportation emissions (Figure 3).



	Commuting	Study Abroad Air Travel	Directly Financed Travel
2006	5,095	1,509	1,607
2008	4,250	1,057	4,123
2010	4,099.50	2,887	1,313.90
2012	7,159	1,487	1,236.80
2014	6,808.95	4,259.08	5,375.59
2016	8,622.12	1,959.93	2,387.85
2018	8,688.31	3,045.46	2,631.47

Figure 3. Comparison of annual transportation GHG emissions.[1, 2, 5, 6, 9, 10]

4.3 Miscellaneous

There are minor campus activities that contribute to GHG emissions totaling 203.14 MT eCO_2, or 0.39% (Table 3).

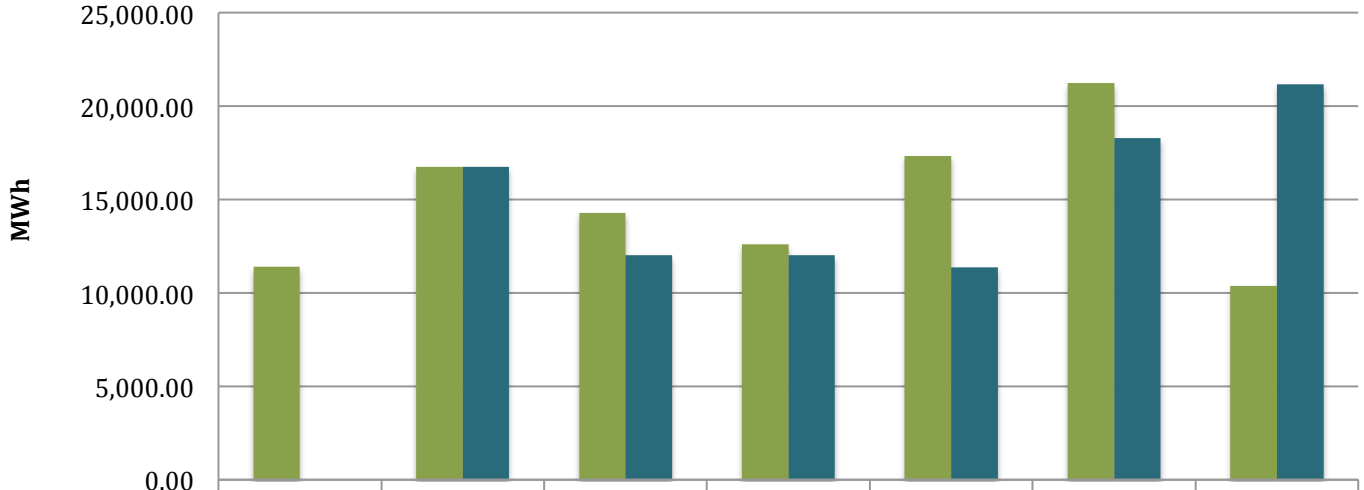
Table 3. Minor GHG emission categories and corresponding emission levels for FY 2018.

Emissions Source Category	GHG Emissions (MT eCO_2)
Mobile Combustion - Fleet Vehicle Usage	137.66
Fugitive Emissions – Fertilizer Application	1.68
Wastewater	45.09
Office Paper - Usage	18.71
Solid Waste*	-36.54

* Solid waste landfilling was reduced to -36.54 MT eCO_2 because of methane recovery and electricity generation.[13]

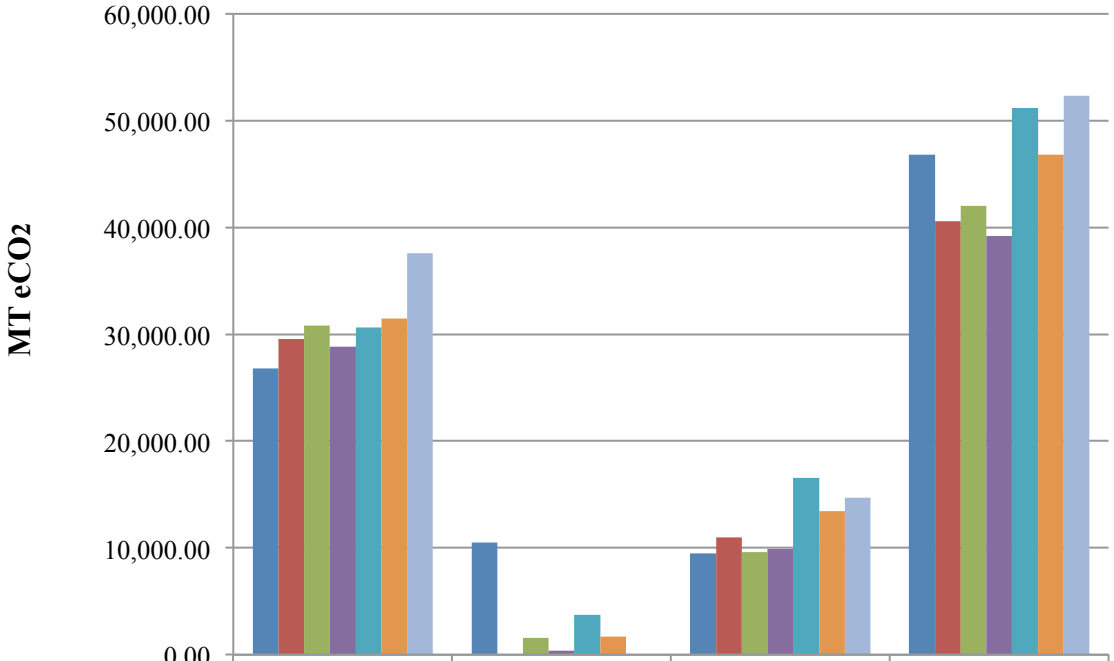
5. Comparison of GHG Inventory Report Results

The results of the FY 2018 GHG inventory showed the highest GHG emissions total and highest per student GHG emissions calculated for Duquesne University at 52,296.04 MT eCO_2 and 5.65 MT eCO_2, respectively. Purchased RECs increased by 2,876.9 MWh from FY 2016 to FY 2018, whereas purchased electricity decreased by 10,881.44 MWh. Thus, RECs offset 100% of purchased electricity at the University in FY 2018 (Figure 4). The drop in purchased electricity, and subsequent rise in Scope 1 emissions, is related to a newly installed auxiliary boiler in 2016 that has four times the capacity of the one it replaced. Compared to FY 2016, total GHG emissions rose by 5,496.46 MT eCO_2 due to the increased output of the cogeneration facility (Figure 5, Appendix B).



	2006	2008	2010	2012	2014	2016	2018
Purchased Electricity	11,393.40	16,761.07	14,299.37	12,622.81	17,346.79	21,248.74	10,367.30
RECs	0.00	16,761.07	12,011.47	12,020.00	11,387.37	18,305.50	21,172.40

Figure 4. Comparison of annual Scope 2 purchased electricity and RECs.[1, 2, 5, 6, 9, 10]



	Scope 1	Scope 2	Scope 3	Total
2006	26,816.50	10,513.20	9,471.10	46,800.00
2008	29,558.10	0.00	10,999.00	40,557.00
2010	30,822.40	1,568.39	9,625.50	42,044.40
2012	28,843.51	404.22	9,916.00	39,203.31
2014	30,639.45	3,760.63	16,568.57	51,187.70
2016	31,498.93	1,681.25	13,464.40	46,826.58
2018	37,592.89	0	14,703.15	52,296.04

Figure 5. Comparison of annual GHG emissions by Scope. [1, 2, 5, 6, 9, 10]

5.1 Changes Reflecting Variation in Data

The increase in GHG emissions from FY 2016 to FY 2018 is attributed to the increased output of the cogeneration facility. In FY 2016, the cogeneration facility released 31,498.93 MT eCO_2 whereas in FY 2018 emissions increased to 37,592.89 MT eCO_2. Output from this facility increased due to a newly installed auxiliary boiler that had a larger capacity and efficiency than the previous one. This resulted in a decreased need of electricity from the grid and thus a decrease in Scope 2 emissions. Despite the sale of Brottier Hall, a large residential building on Duquesne's campus, the demand for electricity remained the same because the University continued to provide electricity to this building; therefore, a rise in Scope 1 emissions could not be avoided.

RECs had an integral part in minimizing the rise in GHG emissions from FY 2016 to FY 2018. The increase in purchased RECs allowed all purchased electricity from the grid to be offset, resulting in no reportable Scope 2 GHG emissions.

Scope 3 emissions increased due to a rise in Study Abroad Air Travel from 1,959.93 MT eCO_2 in FY 2016 to 3,045.56 MT eCO_2 in FY 2018. This is largely due to an increased number of students participating in Study Abroad Programs as well as an improved method to capture all academic programs that sent students to international programs. In FY 2016, 449 students traveled abroad as compared to 595 students in FY 2018. This inventory had a more inclusive view of all Study Abroad programs by including those from the Palumbo-Donahue School of Business, which accounted for 90 students.

FY 2018 was the first time Duquesne registered offsets in the biennial GHG inventory. Although the small stature of compost offsets did not counteract emissions from Scope 1 and Scope 3 sources, it provides optimism that with improved compost methods this could be a viable option to reduce GHG emissions at the University.

5.2 Changes Reflecting Inventory Methodology

The approach to reporting commuting data for full- and part-time faculty, staff, and students was adjusted for this report to accurately portray the travel habits of each group individually. Full-time faculty and staff were assumed to have traveled to the University five-days per week and part-time faculty and staff traveled to the University three-days per week. Students were assumed to have traveled to campus four-days a week if enrolled full-time and two-days a week if enrolled part-time.

In regards to travel emissions, two changes were made for the FY 2018 report. First, when converting the amount of money spent by faculty and staff for travel to passenger miles the SIFL was adjusted to be the average of both halves of the FY rather than selecting one rate.[22] Second, the FY 2018 inventory reverted back to using *Web Flyer* to calculate air mileage for all Study Abroad programs and athletic air travel.[21] This change in methodology was selected because multiple destinations could be input into the system to allow for more accurate mileage estimates particularly for Study Abroad programs.

Reporting RECs was adjusted for the FY 2016 report and kept for FY 2018. RECs were previously input as "offsets," however this was found to be incorrect and adjusted in FY 2016. RECs are now properly input as Renewable Energy under the Scope 2 category to reduce Purchased Electricity GHG emissions. RECs provide the University a mechanism to ensure its electricity is provided by renewable sources that produce low- or zero-emissions. This change was made because RECs and offsets have different units of measure, MWh and MT eCO_2, respectively. RECs convey the use of renewable electric generation whereas offsets represent GHG emissions reductions, and RECs can lower an organizations Scope 2 emissions while offsets can mitigate emissions from Scope 1, 2, and 3 sources.[12] In order to reduce or avoid GHG emissions in the future, Duquesne will need to focus on offset projects to reduce Scope 1 and Scope 3 emissions.

5.3 Comparison with Atlantic-10 Universities

Duquesne University ranks fourth in GHG emissions and sixth in GHG emissions per student among 10 Atlantic-10 Universities that have measured their carbon footprint and reported the results. Multiple factors could be affecting a University's carbon footprint including climate zone, student population, campus setting, and athletic department size. Such factors should be reviewed before making comparisons between institutions.

Table 4. Atlantic-10 Universities reported GHG emissions.[16]

University	Location	GHG Inventory Year	Carbon Footprint (MT eCO_2)	Per Student Carbon Footprint (MT eCO_2)
Davidson College	Davidson, NC	2018	22,958	12.68
Duquesne University	Pittsburgh, PA	2018	52,296.04	5.65
Fordham University	Bronx, NY	2013	31,971	3.83
George Mason University	Fairfax, VA	2017	120,204	4.50
George Washington University	Washington, D.C.	2017	99,848	4.37
Virginia Commonwealth University	Richmond, VA	2017	158,126	18.74
University of Dayton	Dayton, OH	2017	74,461	7.38
University of Massachusetts – Amherst	Amherst, MA	2018	122,959	4.33
University of Rhode Island	Kingston, RI	2017	78,126	5.40
University of Richmond	Richmond, VA	2017	32,390	8.65

6. Existing Environmental Assets

6.1 Physical Facilities

Duquesne University has a cogeneration facility that is responsible for keeping GHG emissions low. The facility uses natural gas to produce electricity for nearly all of campus. Additionally, the heat recovery system captures the steam produced by burning natural gas to heat the University. This energy is also used in an on-campus ice making process to providing cooling to University buildings. In addition to improving the efficiency and capacity of the cogeneration facility, the Facilities Management Department has continuously worked to improve building efficiency throughout campus. Renovations to the heating, ventilation, and air conditioning (HVAC) of 17 buildings to allow for a Digital Control System that will implement a variable air system to minimize energy usage using off peak times is one project that will lessen the energy needs of the University. Another ongoing project is improvements to lighting systems. The conversion to LED lighting will reduce electrical needs and the amount of purchased electricity required by the University. Finally, all future construction projects will be completed to Leadership in Energy and Environmental Design (LEED) standards.

6.2 Institutional Approaches

Duquesne has a multitude of initiatives that support GHG emission reductions. The University is a member of the Association for the Advancement of Sustainability in Higher Education (AASHE), a national coalition of universities and colleges dedicated to environmental responsibility.[19] Duquesne has also adopted a policy of following LEED standards in all future construction and renovations on campus. CERE, a department within the Bayer School of Natural and Environmental Research and Education, focuses its education and research on critical environmental problems. The Palumbo-Donahue School of Business MBA in Sustainable Business Practices trains future business leaders to integrate responsible climate approaches into sound economic management. The program is ranked 5th overall in the U.S. and 13th in the world for its commitment to environmental and social issues by Corporate Knights.[4] A variety of clubs including *Net Impact*, *Evergreen*, and the *Ecology Club* are present at Duquesne University to implement sustainable practices and environmental stewardship.

7. Recommendations

7.1 Renewable Energy

Duquesne University has implemented renewable energy in a variety of ways across campus. During the construction of Des Places Living Learning Center solar panels were installed on the rooftop to provide supplemental electrical generation to the building. The University also purchases RECs to promote renewable energy generation throughout the U.S. while offsetting the decreasing amount of purchased electricity required for campus operation. In addition to these uses of renewable energy on campus there are more options that should be implemented to promote renewable energy at Duquesne including (1) purchasing electricity from renewable energy suppliers, (2) purchasing RECs generated in the southwest region of Pennsylvania to promote renewable energy expansion and innovation in the area, and (3) implement more renewable energy sources directly on campus such as solar tables and solar-powered sidewalk lights.

7.2 Improved Efficiency

To further reduce GHG emissions at the University, the energy and water efficiency of buildings should be improved. Currently, the Facilities Management department is working on renovating the HVAC systems in a majority of campus buildings. The new control systems will better regulate energy consumption in the buildings, and thus it will also decrease emissions because less energy is required for their operation. Another improvement to building efficiency at Duquesne is the installation of LED lighting. Despite these improvements, the University can take further steps to improve overall campus efficiency. Improvements to the energy efficiency of newly acquired campus buildings and old University buildings is necessary to reduce their electrical, heating, and cooling needs. Improvements should include updated double-paned windows, installing new insulation, LED motion-activated lights, renovating the HVAC systems, and improving the water efficiency of all campus facilities including updating faucets to be automatic and replacing toilets with 1.28 gallons-per-flush high efficiency toilets. These advances would decrease energy use by the University and reduce GHG emissions. Additionally, further improvements to the efficiency and capacity of the cogeneration facility could have the potential to reduce GHG emissions by producing more of the required electricity for campus and decrease the amount of purchased electricity from the grid.

7.3 Transportation

Commuting has continually been an aspect of Duquesne's GHG emissions that could be improved upon. Currently, there are various ways for faculty, staff, and students to reduce their carbon footprint by using vehicles with higher fuel efficiency, electric vehicles, carpooling, and using alternative transportation such as bicycling, taking public transit, and using the campus shuttle bus. However, Duquesne can improve students' knowledge of alternative transportation in the city of Pittsburgh, provide shuttle options to other areas in Pittsburgh, and give students incentives to use these alternative transportation methods to help reduce its carbon footprint.

7.4 Offsets

Offsets are a way in which Duquesne University can counteract its GHG emissions from Scope 1 and Scope 3 sources. FY 2018 was the first year that recorded offsets in the form of composting. Although small, this offset provides hope that University officials will improve their composting methods and educate students on its importance. Another way to offset Scope 1 and Scope 3 emissions is by implementing afforestation and reforestation projects. Finally, the University can look to counteract travel emissions by faculty, staff, and students by purchasing carbon offsets, which fund projects that reduce GHG emissions by producing renewable energy. *Terrapass*, a carbon offset vendor, sells offsets to counteract GHG emissions produced due to flight and ground travel.[18] These offsets could be purchased at no extra cost if the University only purchased enough RECs to offset the amount of purchased electricity for that year. For instance, in FY 2018, the University purchased double the amount of RECs as purchased electricity (Figure 4). If the extra amount of RECs were instead purchased as offsets, the University's carbon footprint would be lower.

8. Conclusion

Emissions from Duquesne University in FY 2018 showed an increase from previous inventories. Duquesne emitted 52,296.04 MT eCO_2 in FY 2018 from Scope 1 and Scope 3 sources, while Scope 2 had no reportable emissions. The decrease in Scope 2 sources is attributed to the increase in purchased RECs. Additionally, the increased capacity of the cogeneration facility allowed for the University to generate a majority of its own electricity, however this led to an unavoidable increase in Scope 1 emissions. Despite the increase in GHG emissions in FY 2018 there are recommendations Duquesne University can follow to reduce its carbon footprint such as (1) improving the purchasing and use of renewable energy, (2) improving electrical, water, and cogeneration efficiency, (3) providing more alternative transportation options to students with use incentives, and (4) purchasing offsets to neutralize Scope 1 and Scope 3 GHG emissions.

Rising GHG emissions will continue to impact the University as the institution continues to grow. However, if Duquesne makes sustainability a key mission by following the Catholic commitment to "the integrity of creation" the rise in campus GHG emissions can be diminished.[8] Continuation of environmental efforts will drive Duquesne University towards a sustainable future, one step at a time.

Appendix A: Acronyms

- AASHE – Association for the Advancement of Sustainability in Higher Education
- CACP – Clean Air-Cool Planet
- CERE – Center for Environmental Research and Education
- FY – Fiscal Year
- GHG – Greenhouse Gas
- HVAC – Heating, ventilation, and air conditioning
- kWh – Kilowatt hour
- LEED – Leadership in Energy and Environmental Design
- MCF – Million cubic feet
- Mlbs – Million pounds
- MMBTU – Million British thermal units
- MT eCO_2 – Metric tonnes carbon dioxide equivalent
- MWh – Megawatt hour
- RECs – Renewable Energy Credits
- SIFL – Standard Industry Fare Level
- SIMAP – Sustainability Indicator Management & Analysis Platform

Appendix B: Inventory Data

Emissions by Source from FY 2006 to FY 2018 measured in MT eCO_2.

FY	Source	2006	2008	2010	2012	2014	2016	2018
Scope 1	Stationary Combustion	26,625	29,140	30,477	28,633	30,548.98	31,374.57	37,453.55
	Fleet	190	196	205.4	207.65	87.26	121.54	137.66
	Refrigerants	*	220	139.6	*	*	*	*
	Agriculture	1.2	2.4	0.7	2.82	3.22	2.82	1.68
Scope 2	Purchased Electricity	10,513.2	0.00	1,568.39	404.22	3,760.63	1,681.25	0.00
	Renewable Energy (MWh)***	0.00	16,761.07	12,011.47	12,020.00	11,387.37	18,305.50	21,182.4
Scope 3	Commuting	5,095	4,250	4,099	7,159	6,808.95	8,622.12	8,688.31
	Directly Financed Travel	1,607	4,123	1,314	1,236	5,375.59	2,387.85	2.631.47
	Study Abroad Air Travel	1,509	1,057	2,887.20	1,487	4,259.08	1,959.93	3,045.46
	Solid Waste	221	211	206	-36	-40.26	-33.29	-36.45
	Wastewater		47	45.4	30.1	55.97	60.03	45.09
	Transmission Losses	1,040	1,175	990.1	**	**	**	**
	Paper Purchasing		136	82.9	39.68	109.24	14.96	18.71
Total GHG Emissions		46,800	40,557	42,044.4	39,203.30	51,187.70	46,826.58	52,296.04

* Refrigerant data was not obtained for the 2006, 2012, 2014, 2016, and 2018 reports.

** CACP software did not calculate transmission losses for 2012 and 2014. Updated figures from Duquesne Light Company, the local power distribution company, indicate a significantly lower transmission loss rate (0-2.9%) than the percent previously used (9.9%). As a result of uncertainty, it was not included in overall emissions calculated via SIMAP in FY 2016 and FY 2018.

*** Renewable Energy is not an emission source and is instead reported in MWh. It is included to provide background information on the amount of renewable energy purchased to offset Purchased Electricity.

Appendix C: Transportation Survey

Did you know that in 2008, Duquesne University became the first institution of higher learning in western PA to complete a greenhouse gas inventory? And that we've completed a second one since? The results of the first inventory show that transportation is a significant part of Duquesne's carbon footprint. Duquesne's Center for Environmental Research and Education (CERE) is now compiling data for the third biennial inventory. CERE would like your involvement to improve the data used in the inventory. Your input in this survey will help us accurately determine and quantify our transportation habits.

If you complete CERE's transportation survey in Black Board, you will be entered in a drawing for a chance to win one of three $50 gift cards (Starbucks, The Red Ring, Campus Barnes and Noble). For questions or more information please contact Josh Snedden sneddenj@duq.edu or Talisha Cox coxt@duq.edu.

Student Commuters:

1. What is your local zip code?
2. What is your local county?
    a. Allegheny
    b. Armstrong
    c. Beaver
    d. Butler
    e. Fayette
    f. Greene
    g. Indiana
    h. Lawrence
    i. Washington
    j. Westmoreland
    k. Other (please specify in the next question)
3. If you answered "other" to the previous answer, please type your region or county. If your region was listed in the previous question, just write "N/A"
4. On average, how many round trips to and from campus do you make per week?
    a. 1-3
    b. 4-6
    c. 7-9
    d. <9
5. How many miles do you travel per day (round trip)?
    a. 0-10
    b. 10-20
    c. 20-30
    d. >30
6. What is your **primary** mode of transportation to and from campus?
    a. Car- alone
    b. Carpool
    c. Bus
    d. Bike/Walk
    e. The T
    f. Other (please specify in the next question)
7. If you answered "other" to the previous question, please type in your response. If you did not answer "other" please just type "none".

8. What other modes of transportation do you use to go to and from campus? (check all that apply)
    a. Car- alone
    b. Carpool
    c. Bus
    d. Bike/Walk
    e. The T
    f. Other (please specify in the next question)
9. If you answered "other" to the previous question, please type in your response. If you did not answer "other" please just type "none".
10. If you do not use a mode of public transit, would you use one if your DUQ ID could be used as a pass?
    a. Yes
    b. No
11. How many times a week would you use your DUQ ID if it were a pass for public transportation?
    a. < 3
    b. 3
    c. 4
    d. > 5
    e. I would not use my DUQ ID as a pass for public transportation.
12. Will the reduction in bus routes (effective March 27, 2011) require you to use a car for transportation?
    a. Yes
    b. No
13. If a mode of transportation such as a student-only shuttle were available, would you use it?
    If yes, what features would you like to see?
    If no, why not?
14. Do you have any further suggestions regarding student transportation at Duquesne University?

Student Residents:

Question 1: What is your home zip code?

Question2: In what region do you live?

a. Local. One of the following counties: Allegheny, Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Lawrence, Washington, or Westmoreland
b. Western Pennsylvania: West of Harrisburg
c. Eastern Pennsylvania: East of Harrisburg
d. Northeast: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont
e. Southeast: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia
f. Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin
g. Southwest: Arizona, New Mexico, Oklahoma, Texas
h. West: Alaska, California, Colorado, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming

Question 3: Question How many times per year do you travel home?

a. 0-4
b. 5-8
c. 9-12

d. >12

Question 4: How do you get home?

a. Car- alone
b. Carpool
c. Bus
d. Plane
e. Train
f. Other (please specify in the next question)

Question 5: If you answered "other" to the previous question, please type in your response. If you did not answer "other" please just type "none".

Question 6: If Duquesne offered student-only buses to major metropolitan areas for holiday breaks, would you utilize them?

a. Yes
b. No

Question 7: Are you aware of Duquesne's rideshare board on Blackboard?

a. Yes
b. No

Question 8: If you do not use a mode of public transit, would you if your DUQ ID could be used as a pass?

a. Yes
b. No

Question 9: How many times a week would you use your DUQ ID if it were a pass for public transportation?

a. <3
b. 3
c. 4
d. >5
e. I would not use my DUQ ID as a pass for public transportation.

Question 10: Do you have any further suggestions regarding student transportation at Duquesne University?

University Faculty and Staff:

1. What is your primary role at the University?
    a. Faculty - Part-time/Full-time
    b. Staff - Part-time/Full-time
    c. Administrator
    d. Other
2. What is your local zip code?
3. What is your local county?
    a. Allegheny
    b. Armstrong
    c. Beaver
    d. Butler
    e. Fayette
    f. Greene
    g. Indiana
    h. Lawrence
    i. Washington

    j. Westmoreland
    k. Other (please specify in the next question)
4. If you answered "other" to the previous answer, please type your region or county. If your region was listed in the previous question, just write "N/A"
5. On average, how many round trips to and from campus do you make per week?
    a. 1-3
    b. 4-6
    c. 7-9
    d. <9
6. How many miles do you travel per day (round trip)?
    a. 0-10
    b. 10-20
    c. 20-30
    d. >30
7. What is your **primary** mode of transportation to and from campus?
    a. Car- alone
    b. Carpool
    c. Bus
    d. Bike/Walk
    e. The T
    f. Other (please specify in the next question)
8. If you answered "other" to the previous question, please type in your response. If you did not answer "other" please just type "none".
9. What other modes of transportation do you use to go to and from campus? (check all that apply)
    a. Car- alone
    b. Carpool
    c. Bus
    d. Bike/Walk
    e. The T
    f. Other (please specify in the next question)
10. If you answered "other" to the previous question, please type in your response. If you did not answer "other" please just type "none".
11. If you do not use a mode of public transit, would you use one if your DUQ ID could be used as a pass?
    a. Yes
    b. No
12. How many times a week would you use your DUQ ID if it were a pass for public transportation?
    a. < 3
    b. 3
    c. 4
    d. > 5
    e. I would not use my DUQ ID as a pass for public transportation.
13. Will the reduction in bus routes (effective March 27, 2011) require you to use a car for transportation?
    a. Yes
    b. No
14. Do you have any further suggestions regarding student transportation at Duquesne University?

Appendix D: References

[1] Baker, J., McConnell, P., McKee, P., Morrissey, M., & Kabala, S. (2015). One Step At A Time: Duquesne University's Fourth Biennial Greenhouse Gas Emissions Inventory. *Center for Environmental Research and Education – Duquesne University*.

[2] Baxter, L., Deal, D., Johnson, K., & Kabala, S. (2008). One Step At A Time: Reducing Duquesne's Carbon Footprint. *Center for Environmental Research and Education – Duquesne University*.

[3] *Convert Fuel Use to Source Worksheet*. Available from https://eber.ed.ornl.gov/benchmark/converta.pdf

[4] Corporate Knights. *2018 Better World MBA Ranking*. Available from https://www.corporateknights.com/reports/2018-better-world-mba-methodology/

[5] Cox, T., McKee, P., Snedden, S., & Kabala, S. (2012). One Step At A Time: Duquesne University's Third Biennial Greenhouse Gas Emissions Inventory. *Center for Environmental Research and Education – Duquesne University*.

[6] Day, R., Levine, J., Sterba, G., & Kabala, S. (2009). One Step At A Time: Duquesne University's Second Biennial Greenhouse Gas Emissions Inventory. *Center for Environmental Research and Education – Duquesne University*.

[7] Direct Energy Business. Available from https://business.directenergy.com/large-business/sustainability/rec.

[8] Duquesne University. *Duquesne University Mission Statement*. Available from https://www.duq.edu/about/mission-and-identity/mission-statement

[9] Ellert, A., McConnell, P., Ribar, N., Whitsett, C., Kabala, S., & Stolz, J. (2017). One Step At A Time: Duquesne University's Fifth Biennial Greenhouse Gas Emissions Inventory. *Center for Environmental Research and Education – Duquesne University*.

[10] Ellert, A., Ribar, N., Kabala, S., & Stolz, J. (2019). One Step At A Time: Duquesne University's Sixth Biennial Greenhouse Gas Emissions Inventory. *Center for Environmental Research and Education – Duquesne University*.

[11] Energy Watchdog. Available from https://www.energywatchdog.com/.

[12] Environmental Protection Agency. *Offsets and RECs: What's the Difference?* Available from https://www.epa.gov/sites/production/files/2018-03/documents/gpp_guide_recs_offsets.pdf

[13] Montauk Energy Monroeville. Available from http://montaukenergy.com/operations/monroeville/

[14] Office Depot. *Office Depot Brand Copy & Print, Letter Size Paper, 20 Lb, 500 Sheets Per Ream, Case of 10 Reams*. Available from https://www.officedepot.com/a/products/348037/Office-Depot-Brand-Copy-Print-Paper/;jsessionid=0000lFYomgTTO-vW66D3GPaAWpI:1crjkcgcd

[15] Penn State Extension. *Turfgrass Fertilization: A Basic Guide for Profession Turfgrass Managers*. Available from https://extension.psu.edu/turfgrass-fertilization-a-basic-guide-for-professional-turfgrass-managers

[16] Second Nature Reporting Platform. Available from http://reporting.secondnature.org/

[17] SIMAP. Available from https://unhsimap.org/.

[18] Terrapass. Available from https://www.terrapass.com/

[19] The Association for the Advancement of Sustainability in Higher Education. Available from https://www.aashe.org/

[20] U.S. Energy Information Administration. *Petroleum & Other Liquids*. Available from https://www.eia.gov/petroleum/gasdiesel/

[21] Webflyer. *Mileage Caculator*. Available from http://www.webflyer.com/travel/mileage_calculator/

[22] Wolters Kluwer Law & Business. *SIFL*. Available from http://news.wolterskluwerlb.com/?s=SIFL


DUQUESNE
UNIVERSITY