FEBRUARY 2011

Mohawk College

2007 Greenhouse Gas Emissions Inventory

zerofootprint™

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1.0 INTRODUCTION

→ Mohawk College of Applied Arts and Technology ('Mohawk') has engaged Zerofootprint Software Inc. ('Zerofootprint') to calculate the corporate greenhouse gas ('carbon') emissions arising from the college's operations for the baseline year 2007. Mohawk College is committed to operating in an environmentally sound and responsible manner. Conducting a carbon inventory establishes a baseline to accurately assess current operational practices. This enables the development of meaningful and appropriate emission reduction strategies as well as creates a benchmark for future assessments. Creating a baseline carbon inventory is also a critical and necessary step for a number of initiatives organizations, including universities and colleges, are taking to combat climate change. These initiatives include voluntary emissions reporting through carbon registries such as the Canadian Greenhouse Gas ('GHG') Challenge Registry or signing emission reduction statements such as versions of the University and College President's Climate Change Statement of Action. In choosing to track and measure carbon emissions, Mohawk College demonstrates its commitment towards responsible leadership and environmental stewardship.

Through a process of data collection, calculation and analysis, Zerofootprint has determined the carbon emissions of Mohawk College's operations for 2007. This report describes the results of that process and is comprised of five main sections:

The background section describes the methodology Zerofootprint uses for carbon assessments and emissions classifications. The following is an overview of Mohawk College's key operational practices that affect its carbon inventory and the scope of this carbon assessment. The results of this assessment are then provided followed by an analysis of these findings. 'Future Tracking' describes areas and methods Mohawk College can use to strengthen the tracking and accounting of their carbon emissions for future assessments. Finally, a brief summary concludes this report.

1.1 BACKGROUND

→ Methodology

This corporate greenhouse gas inventory was undertaken in accordance with the World Resources Institute and World Business Council for Sustainable Developments' Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, Revised Edition (WRI/WBCSD, 2004).

The GHG Protocol is recognized internationally as the preeminent methodology for quantifying and reporting corporate GHG emissions, and forms the basis of National and International voluntary reporting frameworks such as The Climate Registry's Climate

Registry Information System (CRIS), and the Canadian Standard's Associations CleanStart™ registry.

About WBCSD

The World Business Council for Sustainable Development (WBCSD) is a coalition of 170 international companies united by a shared commitment to sustainable development via the three pillars of economic growth, ecological balance and social progress. Members are drawn from more than 35 countries and 20 major industrial sectors.

About WRI

World Resources Institute is an independent nonprofit organization with a staff of more than 100 scientists, economists, policy experts, business analysts, statistical analysts, mapmakers, and communicators working to protect the Earth and improve people's lives. WRI strives to harness the power of business to create profitable solutions to environment and development challenges.

A number of additional best practice documents were used where appropriate to calculate carbon emissions for this report including the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, (USEPA, 2006).

DATA SOURCES

Zerofootprint used information collected from Mohawk College to calculate emissions in carbon dioxide equivalents (CO_2e). When data was unavailable, Zerofootprint conservatively estimated Mohawk College carbon emissions by applying industry, national, or regional averages for emissions, energy use, or other metrics.

All greenhouse gas emissions were calculated using GHG emission factors sourced predominantly from Environment Canada as well as others. Where emissions factors differ, the local emission factor or calculation methodology took precedence. The 100-year Global Warming Potentials (GWP) provided by the Intergovernmental Panel on Climate Change (IPCC) in its *Second Assessment Report* (SAR) were used to convert individual gases to a carbon dioxide equivalent (CO_2e). Environment Canada states that the 100-year GWPs from IPCC's 2nd Assessment Report are to be used for inventory reporting under the United Nations Framework Convention on Climate Change (UNFCCC), despite the release of updated GWPs in the 4th Assessment Report.

Appendix A outlines the emission factors used in Zerofootprint's calculations.

EMISSION CLASSIFICATIONS

In accordance with the GHG Protocol, emissions are divided into three categories: scope 1, scope 2, and scope 3.

Scope 1 emissions are direct emissions that occur from sources owned or controlled by the college, such as natural gas used to heat campus buildings or emissions due to campus owned fleet vehicles.

Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the college. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the college. Scope 2 emissions physically occur at the facility where electricity is generated.

Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the college, but occur from sources not owned or controlled. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services (such as paper use or shipping services).

2.0 MOHAWK COLLEGE

→ Mohawk College of Applied Arts and Technology is a post-secondary institution that offers a diverse set of programs at the apprenticeship, continuing education, diploma and collaborative degree levels. Mohawk operates three main campuses: The Fennell Creek campus in Hamilton, the Brantford campus located in Brantford, and the STARRT institute located in Stoney Creek. The college's 1,100 staff and faculty members instruct a student body of approximately 11,280 full-time students across these three campus locations. Mohawk students also attend classes at the McMaster Institute for Applied Health Sciences located at McMaster University in Hamilton. This facility is not included within the boundaries of this study due to the operational and organizational boundaries as determined in Section 2.1. However, for informational purposes, the IAHS building's 2007 emissions were 460 tonnes CO_2e from steam, 325 tonnes CO_2e from electricity, and 108 tonnes CO_2e from chilled water, for a total of 893 tonnes CO_2e.

Mohawk College is committed to operating in an environmentally responsible manner, and has numerous environmental programs already in place. The GoGreen program, already in place at Mohawk, is a comprehensive sustainability strategy designed to reduce the college's overall environmental impact using a combination of administrative

decisions and student-run programs. The GoGreen program includes initiatives focused on reducing waste, greening student and faculty transportation, encouraging students to become involved in the local environmental community, and improving the efficiency of the college's buildings and grounds.

2.1 BOUNDARIES

→ The scope of this inventory report is defined by both organizational and operational boundaries.

ORGANIZATIONAL BOUNDARIES

To collect and report on data, a control approach (operational control), as outlined in the GHG Protocol, is taken towards an organization's operations. It is assumed that the business accounts for 100 percent of the GHG emissions from operations over which it, or one of its subsidiaries, has operational control.

OPERATIONAL BOUNDARIES

Zerofootprint has addressed the scope 1, 2 and 3 emissions resulting from three campus locations, totaling 13 individually metered buildings. Under the guidelines of the GHG Protocol, the reporting of scopes 1 and 2 emissions is required while scope 3 is optional. Mohawk's emissions predominantly result from the operation and maintenance of Mohawk buildings. The report also contains some emissions due to direct fuel consumption on site. Table 1 shows the breakdown of activity types, along with the scope classification,

Table 1: Total emissions summary by activity and scope

Activity	Scope
Fleet vehicle & groundskeeping fuel consumption (gasoline & diesel)	1
Automotive shop fuel consumption (gasoline)	1
Natural gas consumption	1
Backup generator fuel consumption (diesel)	1
Fertilizer Use	1
Electricity use	2
Campus Shuttle	3
Faculty air travel	3
Athletics dept. air and ground travel	3
Paper use (promotional materials, copier paper)	3
Student & Faculty bus travel	3
Student & Faculty car travel	3

Table 2: Location Descriptions

Location	Buildings	Scope 1 Heating	Scope 2 Electricity	Building Area (m^2)
Stoney Creek	5	3 heated with NG	2 heated with electricity All 5 with electricity consumption	30,586
Brantford	2	2 heated with NG	2 with electricity consumption	13,266
Residence	1	1 heated with NG	1 with electricity consumption	10,219
Wentworth	1	1 heated with NG	1 with electricity consumption	3,917
Fennell	4	3 heated with NG	1 heated with electricity All 4 with electricity consumption	69,292

3.0 RESULTS

→ Zerofootprint has assessed the emissions resulting from the 5 locations for which Mohawk has provided data as well as emissions arising from some direct fuel consumption. Information and calculations based on Mohawk's 2009 waste audit were also used as a proxy for 2007. This section describes Mohawk's greenhouse gas emissions by scope and activity for 2007.

3.1 OVERVIEW

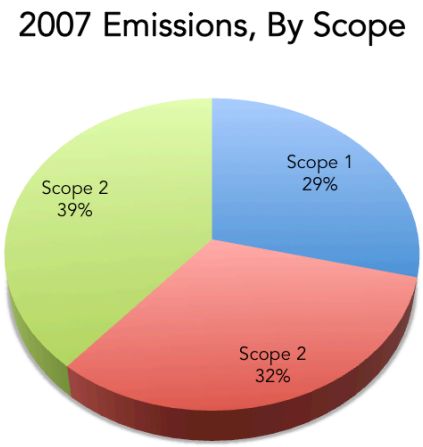
Table 3 presents a summary of Mohawk College's emissions broken down by activity type, consumption and scope. Figure 1 shows the percentage breakdown by scope. Scopes 1, 2 and 3 emissions totaled 3,647 (29% of total), 4,093 (32%) and 4,896 (39%) respectively. Total Scopes 1 and 2 emissions were 7,740 tonnes CO_2e.

Table 3: Total emissions summary by source and scope

Activity type		Total Consumption	Total GHG emissions (t CO2e)
Scope 1 total			**3,646.63**
Fleet Fuel Consumption	Gasoline Diesel	30,674 L 14,169 L	109.94
Natural Gas Consumption	330 Leaside 336 Leaside Stoney Creek Main Building Brantford Main Building Brantford West Building Fennell Storage Building Fennell Student Centre Fennell Main Building Alumni House Student Residence	698 m^3 natural gas 84,431 m^3 natural gas 198,094 m^3 natural gas 152,220 m^3 natural gas 52,246 m^3 natural gas 100,625 m^3 natural gas 33,181 m^3 natural gas 1,032,571 m^3 natural gas 37,257 m^3 natural gas 172,581 m^3 natural gas	3,523.95
Fertilizer	Fertilizer- 24% Nitrogen, 6% Potash, 70% filler	907 kg	1.27
Backup Generator	Diesel	3,573 L	11.47
Scope 2 total			**4,093.44**
Mohawk College Electricity	Electricity consumption	20,318,484 kWh	4,093.44
Scope 3 total			**4,895.87**
Student and Faculty Commute	km driven (estimated based on parking pass data)	14,379,319 km	2,895.08
Faculty Air Travel	# of flights	59 flights of varying lengths	25.95
Athletics Dept. Air Travel	# of flights	86 flights of varying lengths	39.35
Scope 3 total			

Athletics Dept. Bus Travel	km driven by coach bus	19,065 km	20.01
Campus Shuttle	Diesel	45,400 L	122.19
Shuttle Service Taxi	km driven by taxi	9085	3.34
Paper Use	Type & amount of paper used	100,300,100 pages	1,246.99
Recycling	Tonnes of waste sent to recycling	246 Tonnes	218.95
Waste	Tonnes of waste sent to landfill	185 Tonnes	323.03

Figure 1: Percentage breakdown of emissions by scope



3.2 DETAILED BREAKDOWN OF SCOPE 1 EMISSIONS

→ Mohawk College's 2007 scope 1 emissions (fleet vehicle, groundskeeping and automotive shop fuel use, natural gas consumption and diesel backup generator fuel consumption) totaled 3,647 tonnes CO_2e. Table 4 summarizes the emissions results, by individual greenhouse gases (CO_2, CH_4 and N_2O) and in carbon dioxide equivalents (CO_2e). All emissions are expressed in units of tonnes. Figure 2 illustrates the breakdown of scope 1 emissions, displayed in tonnes of CO_2e by activity type and Figure 3 shows the percentage breakdown for each. Natural gas consumption accounts for 97% of scope 1 emissions, therefore a detailed breakdown of emissions from natural gas consumption by building on campus is provided in Figure 4. Fleet & groundskeeping gasoline use, and fleet & groundskeeping diesel use followed far behind at 2% and 1% respectively. The remainder of scope 1 emissions are negligible and result from the operation of the diesel backup generator (0.3%) and groundskeeping fertilizer use (0.03%).

Table 4: Scope 1 emissions breakdown by greenhouse gases

Activity	Tonnes CO_2	Tonnes CH_4	Tonnes N_2O	Tonnes CO_2e
Fleet fuel consumption (Gasoline)	70.21	0.0037	0.0050	71.81
Fleet Fuel Consumption (Diesel)	37.73	0.0020	0.0012	38.13
Natural gas consumption	3,502.28	0.069	0.065	3,523.95
Diesel backup generator	10.95	0.00055	0.0016	11.47
Fertilizer Use	1.21	0.000061	0.00018	1.27
Global Warming Potential	1	21	310	
			TOTAL	3,646.63

Note: Table may not sum due to rounding

Figure 2: Scope 1 emissions breakdown

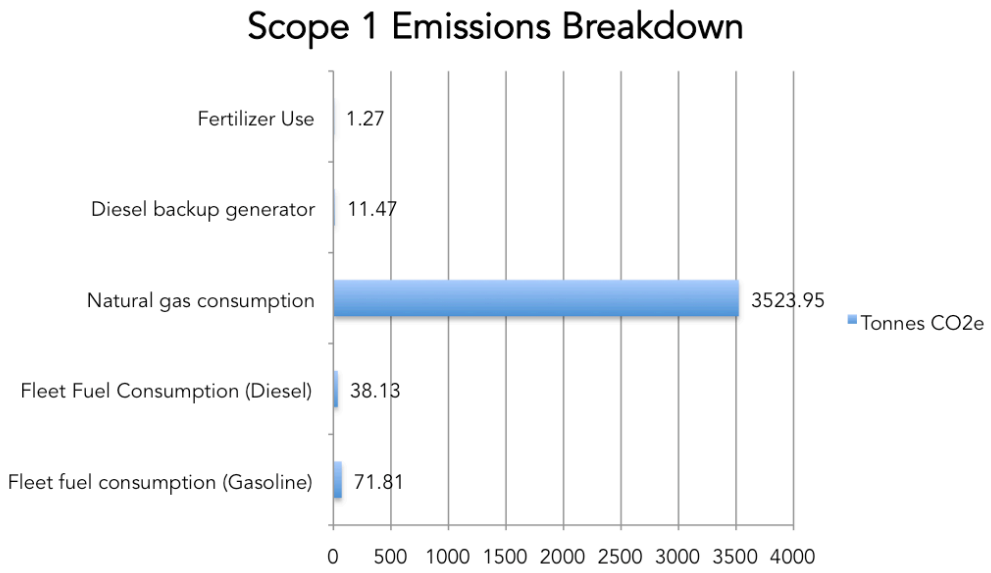


Figure 3: Percentage breakdown of scope 1 emissions by activity

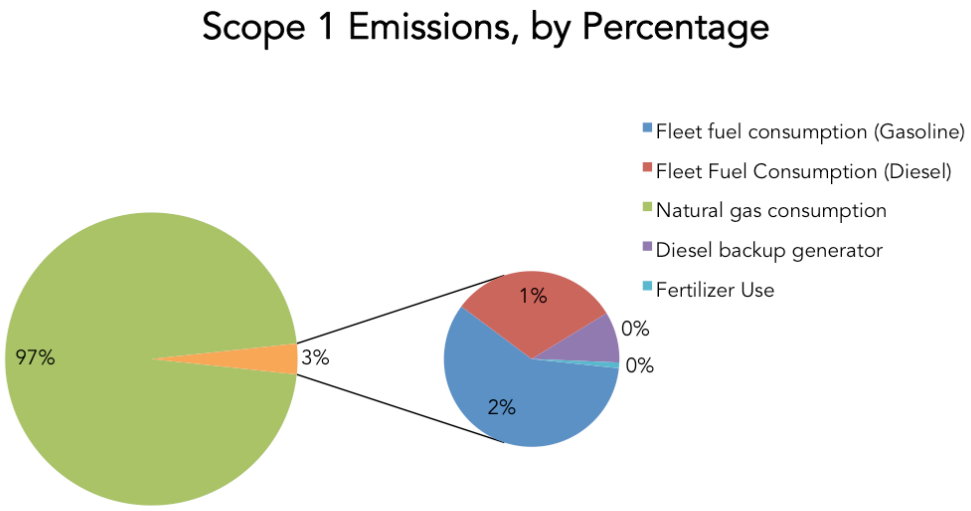
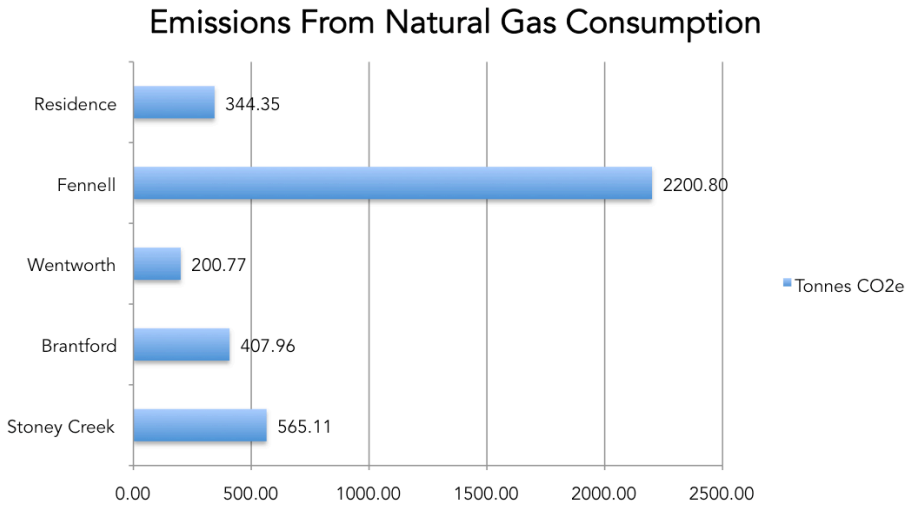


Figure 4: Scope 1 emissions from campus buildings (natural gas consumption)



→ Figure 4 shows the emissions arising from each of the five locations that consumed natural gas, grouped by campus, under the natural gas consumption category in scope 1 emissions. Note that the overwhelming majority of natural gas, and indeed scope 1 emissions in total, arise from the Fennell Main building.

3.3 DETAILED BREAKDOWN OF SCOPE 2 EMISSIONS

→ In 2007, scope 2 emissions (electricity consumption) totaled 4,093.44 tonnes CO_2e. Table 5 shows electricity consumption and the associated carbon emissions for each location. Figure 6 graphically presents the final emissions associated with each location. Note again the high electrical consumption and associated emissions of the Fennell Main building. These emissions account for approximately 64% of scope 2 emissions and 21% of total emissions from scopes 1, 2 and 3. Figure 7 shows trending information, displaying month-by-month emissions from electricity.

Table 5: Total building electricity consumption and emissions

Location	Electricity consumption (kWh)	Tonnes CO_2	Tonnes CH_4	Tonnes N_2O	Tonnes CO_2e
349 Leaside	33,029	6.6	0.0003	0.0001	6.65
330 Leaside	119,812	24.0	0.0012	0.0005	24.14
336 Leaside	458,318	91.7	0.0046	0.0018	92.33
Stoney Creek Main	1,867,696	373.6	0.0187	0.0075	376.27
Brantford Main	1,720,383	344.1	0.0172	0.0069	346.60
Brantford West	638,123	127.6	0.0064	0.0026	128.56
Fennell Vehicle Shed	46,032	9.2	0.0005	0.0002	9.27
Fennell Storage Area	257,009	51.4	0.0026	0.0010	51.78
Fennell Student Centre	913,680	182.7	0.0091	0.0037	184.07
Fennell Main	12,909,237	2,582.0	0.1291	0.0516	2,600.75
Fennell Alumni House	17,184	3.4	0.0002	0.0001	3.46
Fennell Residence	1,337,981	267.6	0.0134	0.0054	269.55
Total	**20,318,484**	**4,064.0**	**0.2032**	**0.0813**	**4,093.44**

Note: Table may not sum due to rounding

Figure 6: Emissions from electricity, by location

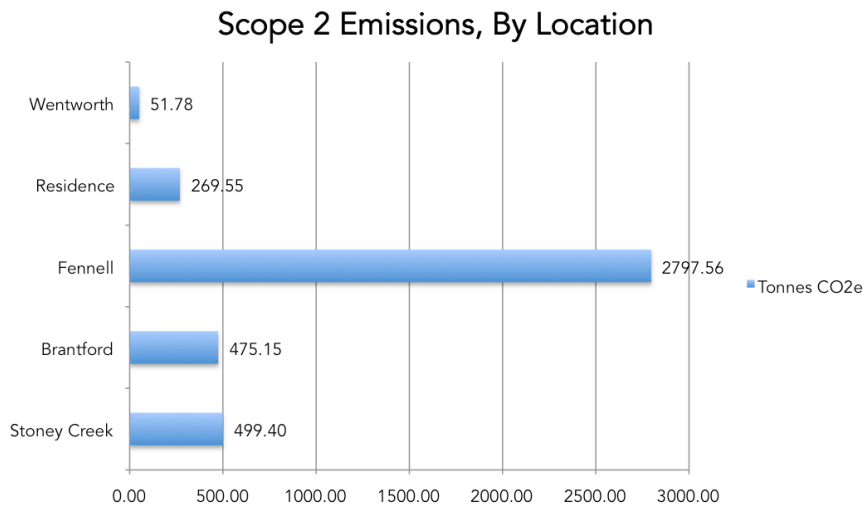
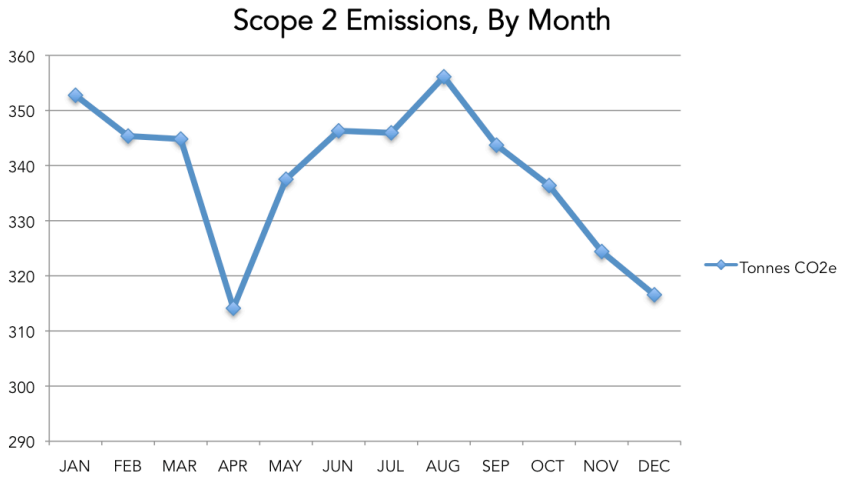


Figure 7: Emissions from electricity, by month



3.4 DETAILED BREAKDOWN OF SCOPE 3 EMISSIONS

→ This section provides a detailed breakdown of scope 3 emissions from the following activities for 2007: student and faculty vehicle travel, faculty air travel, athletics department air travel, shuttle and taxi fuel consumption, paper use, waste and recycling.

Table 6 summarizes scope 3 emissions results, by individual greenhouse gases (CO_2, CH_4 and N_2O) and in carbon dioxide equivalents (CO_2e). Note that for several scope 3 emissions types, the $CO_2/CH_4/N_2O$ breakdown is not applicable. In the case of air travel, the radiative forcing factors applied to high-altitude emissions, which changes the standard global warming potential multipliers applied to different greenhouse gases. In

our calculations, we use a radiative forcing factor of 1.9 (DEFRA, 2008). In the case of paper use, recycling and landfilling waste the emissions arise in different forms than those typical of fuel combustion. In all cases where a breakdown by greenhouse gas is not applicable, results are presented in carbon dioxide equivalents only.

Table 6: Scope 3 emissions breakdown by greenhouse gases

Activity	Tonnes CO_2	Tonnes CH_4	Tonnes N_2O	Tonnes CO_2e
Faculty Air Travel	NA	NA	NA	25.95
Athletics Air Travel	NA	NA	NA	39.35
Athletics Bus Travel	19.8	0.0010	0.00061	20.01
Student and Faculty Commute	2,830.62	0.15	0.20	2,895.08
Campus Shuttle	120.90	0.0064	0.0037	122.19
Shuttle Service Taxi	3.26	0.00017	0.00023	3.34
Paper Use	NA	NA	NA	1,246.99
Waste- Recycling (Based on 2009	NA	NA	NA	218.95
Waste- Landfill (Based on 2009	NA	NA	NA	323.03
Global Warming Potential	1	21	310	
			Total	**4,895.87**

Note: Table may not sum due to rounding

Figure 8 displays scope 3 emissions in tonnes CO_2e broken down by activity type and Figure 9 shows the percentage breakdown. The largest quantity of emissions comes from student and faculty travel to Mohawk Campuses followed by paper use.

Figure 8: Scope 3 emissions breakdown by activity type

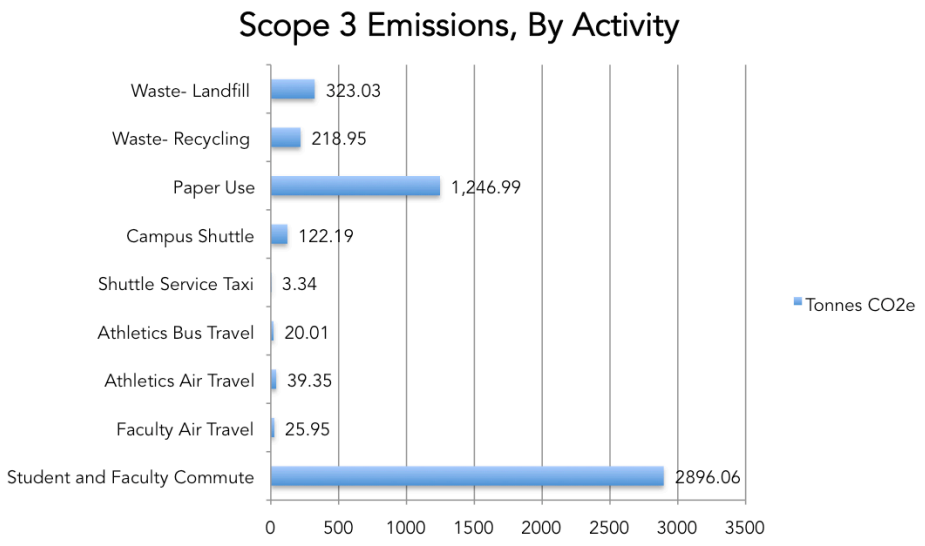
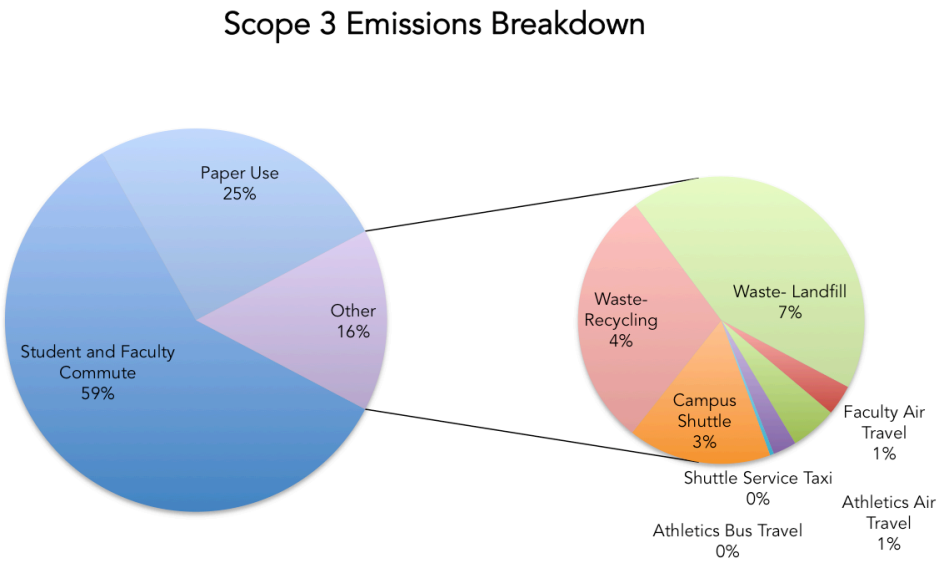


Figure 9: Percentage breakdown of scope 3 emissions by activity



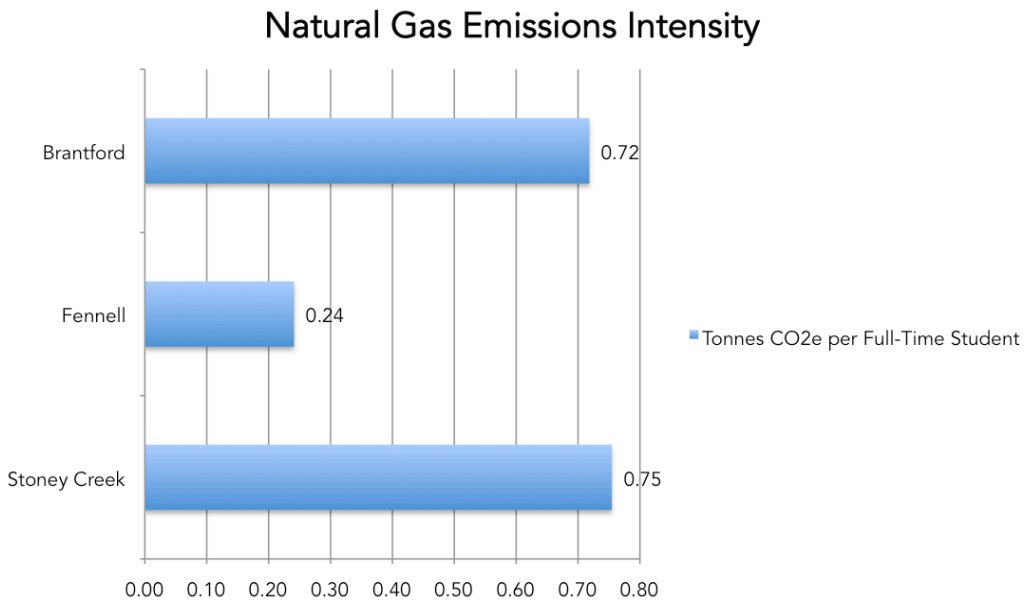
4.0 ANALYSIS

→ The analysis section provides an interpretation of the findings shown above. This gives a greater understanding of the emission sources and identifies key metrics that may be hidden in the final aggregated results. As per the results section, the analysis will consider scopes 1, 2 and 3 emissions separately.

SCOPE 1 EMISSIONS ANALYSIS

As seen in Figure 3, building emissions from natural gas consumption across the three campuses account for approximately 97% of scope 1 emissions. The results from Figure 4 show that the vast majority of these emissions are due to heating the Fennell main building. However, high absolute emissions do not necessarily indicate inefficiency. The Fennell campus serves more than seven times as many students as the Brantford and Stoney Creek locations combined. When emissions are normalized in terms of tonnes CO_2e per student served, the results differ (Figure 10). The Fennell campus is actually the most efficient, on a tonnes-per-student-per-year basis.

Figure 10: Building emissions intensity (tonnes CO_2e / full time student)



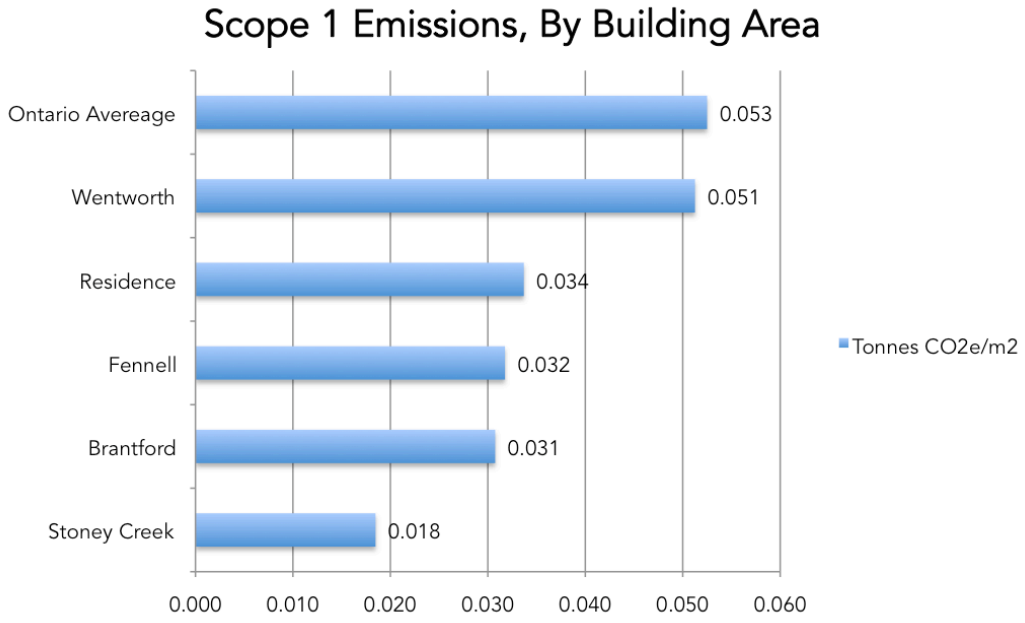
(note that Figure 10 excludes the residence buildings, as equivalents are not present at all three campuses)

The greater efficiency of the large campus speaks to the economies of scale that are present in many aspects of greenhouse gas management. The marginal emissions from adding additional students or faculty are small relative to the baseline operational emissions of a school building. Thus, the more students and faculty that are able to share a given resource, the more efficient it becomes for each of them. This trend is noticeable throughout the college's inventory; the Fennell campus tends to have higher

absolute emissions, but lower per-student emissions than either Stoney Creek or Brantford.

Tonnes CO_2e per square meter of building area is the most common method of comparing emissions intensity between buildings, institutions and industries. Figure 11 illustrates a comparison of Mohawk's emissions from natural gas consumption normalized by building area.

Figure 11: Building natural gas emissions intensity (tonnes CO_2e per m^2)



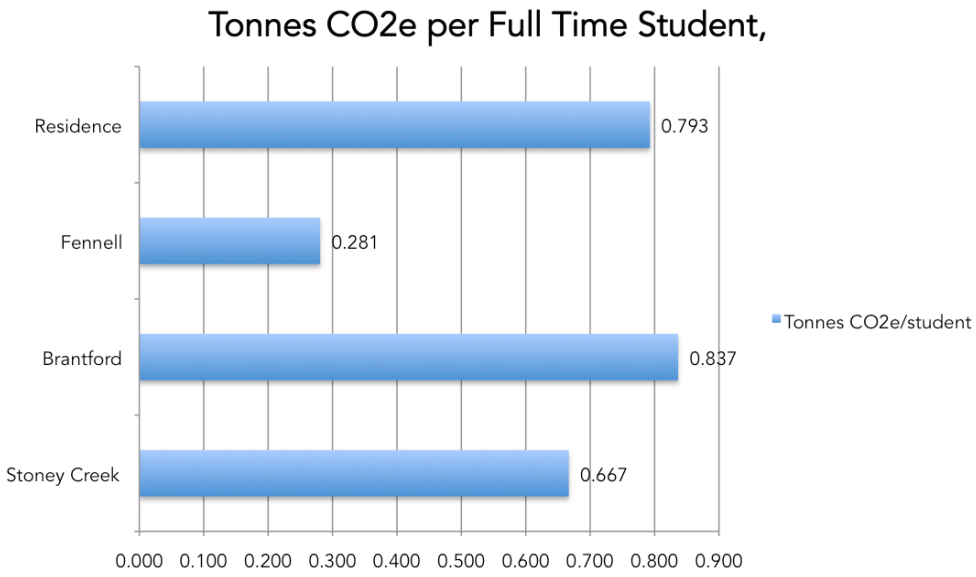
Mohawk's facilities vary in size, usage, and population, but all were more efficient than the 2007 average for Ontario educational facilities, as reported by Natural Resources Canada's office of Energy Efficiency. Visualizing emissions intensity by building area highlights the effects of building age, building systems and insulation on carbon emissions.

SCOPE 2 EMISSIONS ANALYSIS

It is clear from the previous sections that electricity consumption is a major source of carbon emissions, accounting for 32% of total scopes 1, 2 and 3 emissions, and 53% of total scopes 1 and 2 emissions (i.e. those emissions whose quantification is mandated under the guidelines of the GHG protocol). Figure 12 displays student normalized carbon emissions from electricity for each location where electricity data exists. The

results are displayed in tonnes CO_2e per full-time student. On a per-student normalized basis, the Brantford campus has the highest emissions, due to the economies of scale discussed in the preceding scope 1 analysis. As all electricity used is ultimately drawn from the Ontario electricity grid, the CO_2e intensity is directly correlated to both the electrical consumption and population at each location.

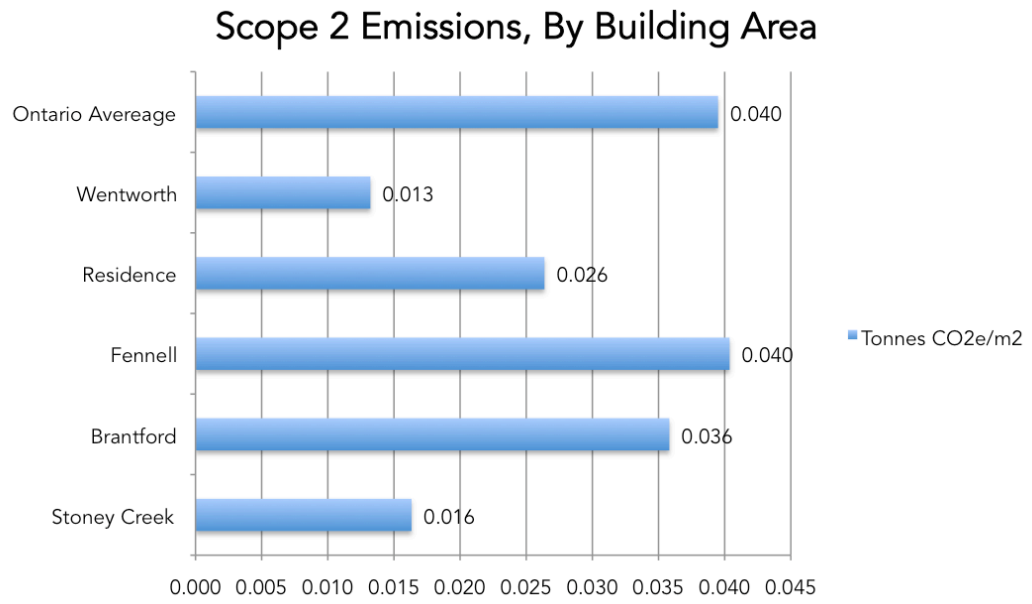
Figure 12: Building electricity emissions intensity (tonnes CO_2e per full time student)



In addition to the standard economy of scale at work in Figure 12, it is important to take usage behaviour into account when gauging efficiency. More so than natural gas, which is generally used only for heating, electricity is consumed in a variety of ways. Climate control and lighting are the two main uses of electricity, accounting for approximately two thirds of electricity consumption in North America (32% space heating, 13% water heating, 12% lighting and 11% air conditioning).

As with scope 1 emissions, building area is the most common method of calculating scope 2 emissions intensity. Figure 13 shows electricity emissions intensity, normalized by building area. The Ontario average emissions for educational institutions is also included for comparison purposes.

Figure 13: Building electricity emissions intensity (tonnes CO_2e per m^2)



Note that, as with scope 1 emissions relative to building area, electricity consumption is strongly influenced by building occupancy. Mohawk's buildings meet or exceed the average electrical efficiency for Ontario educational institutions. This efficiency could be attributed to pre-existing environmental programs (insulation, lighting, etc), building age, or campus energy use policies.

When evaluating the energy efficiency of buildings, it is important to consider its usage- that is, the number of hours per day and days per year that a building is occupied. An example of this would be the residence building- while the majority of the campus is only active during business hours, the residence is occupied at all times throughout the year. Therefore, it would be expected to have higher per-student or per-m^2 carbon intensity than a standard campus building of equivalent size. Another consideration is specialized equipment. Industrial or laboratory equipment employed in college classes can have a high power draw that is not obvious from raw electricity consumption data.

Based on the information in Figures 12 and 13, we can draw qualitative conclusions about the relative efficiency of Mohawk's campus buildings, but more precise data regarding building occupancy hours, seasonal occupancy and building systems and equipment would be needed in order to make efficiency recommendations based on emissions intensity.

NORMALIZED BUILDING EMISSIONS

As scope 1 & 2 emissions tracking fulfills the requirements outlined in the GHG protocol, and building emissions account for the overwhelming majority of Mohawk College's scope 1 & 2 emissions, a breakdown of normalized total building emissions (scopes 1 & 2) for each campus location is provided in Figure 14.

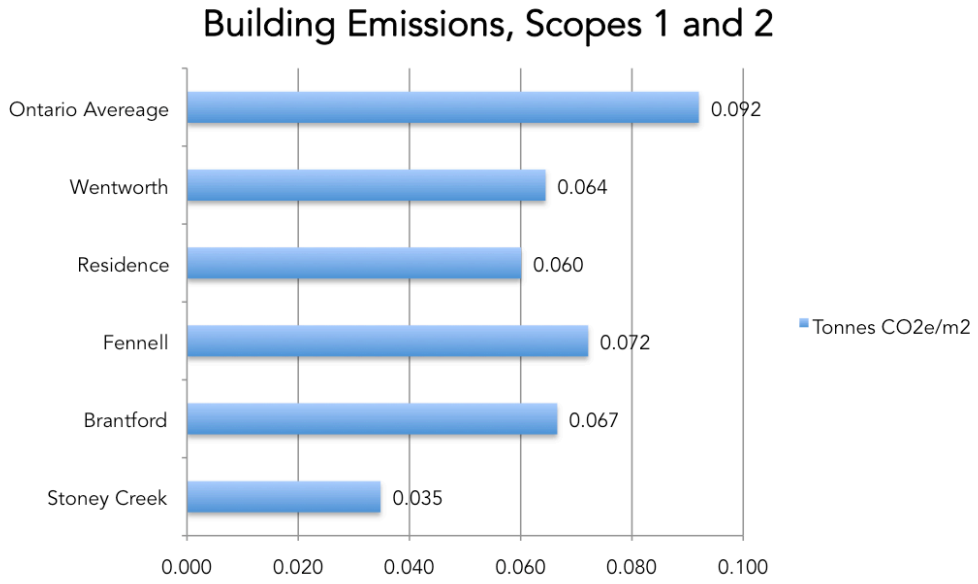
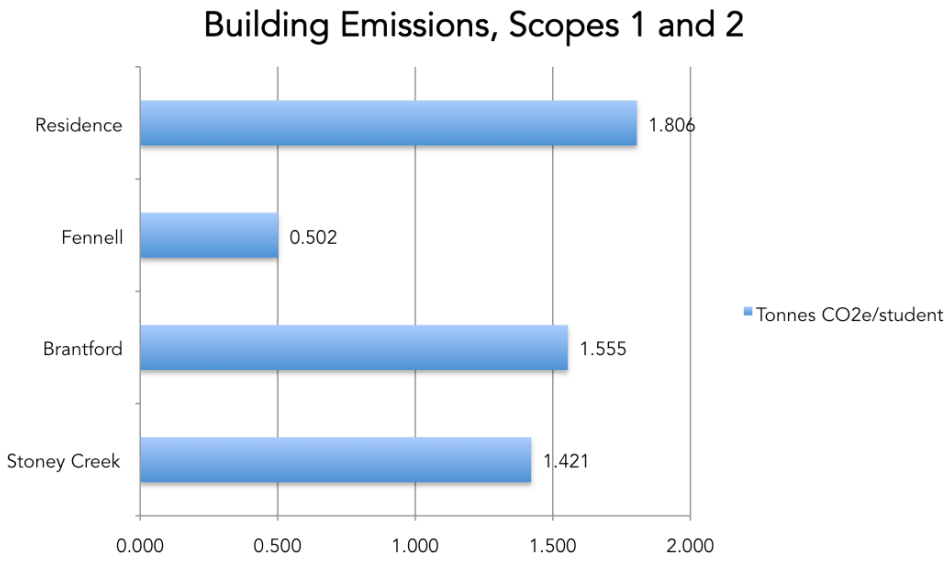


Figure 14: Building electricity & natural gas emissions intensity (tonnes CO_2e per m^2)

This combined analysis of the energy efficiency of Mohawk's campus buildings indicates that the college's facilities outperform the Ontario average, with Stoney Creek having approximately half the emissions per m^2 of any of the other facilities.

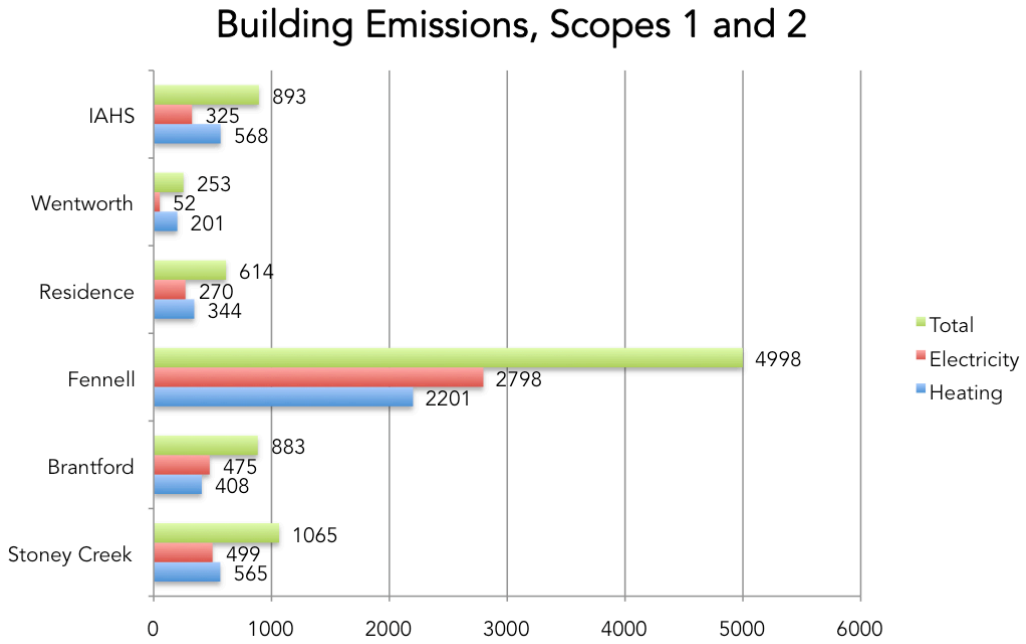
Figure 15 shows the same combined emissions per location, normalized per-student rather than by building area.

Figure 15: Building electricity & natural gas emissions intensity (tonnes CO_2e per student)



Although the Institute for Applied Health Sciences is not included in the scope of this inventory, it has been included in Figure 16 to provide a comparison of the absolute emissions arising from each building. Note that the heating and cooling technologies employed in the IAHS building differ from those in use at Mohawk's other locations, which may produce difference in efficiency between campuses.

Figure 16: Building electricity & heating emissions (Tonnes CO_2 equivalent)



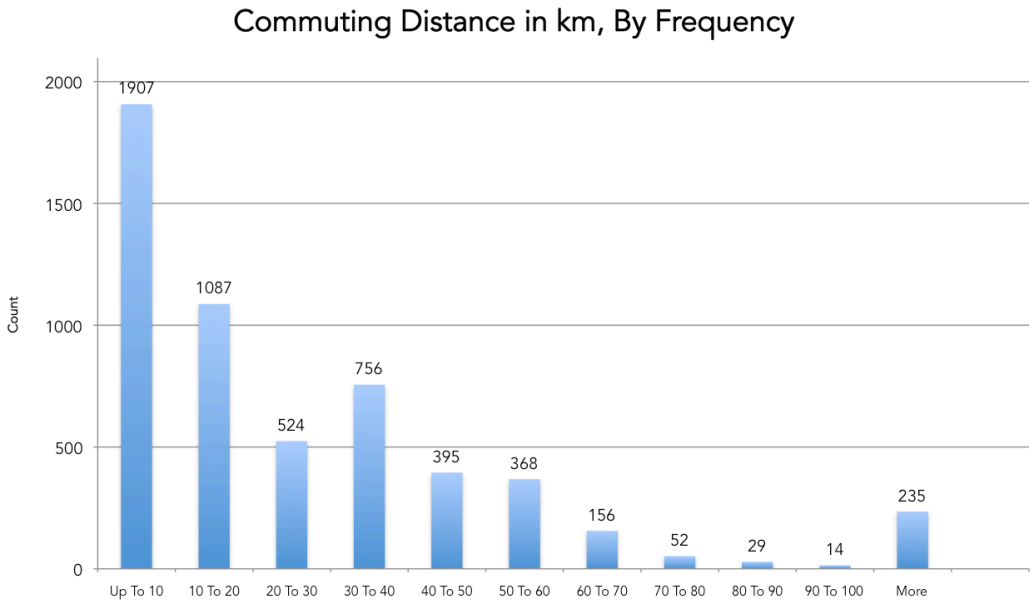
SCOPE 3 EMISSIONS ANALYSIS

Obtaining accurate scope 3 data, and indeed deciding which scope 3 emissions can reasonably be calculated, is one of the most complex tasks in a GHG inventory creation. As per Mohawk's request, we have captured emissions arising from paper use, travel, and waste. In many cases, direct consumption data was not available and hence, alternative calculation methods were used, based on appropriate assumptions.

Scope 3 emissions make up the largest portion of Mohawk's organizational carbon footprint. Although scope 3 emissions are indirect emissions outside of the college's control, tracking and reporting these emissions is extremely important and provides valuable information in understanding the carbon impact of Mohawk's operations. As illustrated in Section 3.4, the majority of scope 3 emissions are generated by student and faculty's personal vehicles. This alone was responsible for 60% of scope 3 emissions, and 23% of overall emissions.

It should be noted that no direct measure of commuting distance existed prior to this inventory, therefore an estimate was created based on parking pass sales and the relative populations of each campus. As students are required to provide a postal code when purchasing parking passes, these postal codes were used as a starting point for all distance calculations. In order to avoid having commuting distance skewed by out-of-province students, any postal codes corresponding to an address more than 100km from any Mohawk campus were excluded. For the remaining parking pass holders, a weighted average distance was calculated based on the relative populations of the three campuses (88% Fennell, 5% Brantford, 7% Stoney Creek). Using Google's geolocation algorithms, the distance between each commuter and each campus was calculated. The sum of these weighted average distances, multiplied by the number of assumed commuting days (five days per week, two trips per day) to give a total number of commuter kilometers per year. Figure 16 displays the student commuting distance frequencies.

Figure 17: Commuting distance for students, by frequency



The total commuting distance is an estimate, but provides a baseline for comparison in future years. As this estimate is based on parking pass sales, it will accurately reflect changes in commuter behaviour regardless of cause.

The second most significant contributor to scope 3 emissions was paper use. This total of 1,247 tonnes CO_2e represents the impact of the paper only and does not include printing (inks, cutting, shipping, waste etc.) for off-campus printing and publication. The emissions associated with student and staff printing on-campus are captured in scope 2, electricity consumption. Therefore the actual scope 3 emissions associated with this activity are potentially greater than indicated in this report. Mohawk's annual printing of course catalogues and brochures exceeds 500,000 documents with a total of over 88,000,000 pages. These materials have a significant cost, both financially and environmentally. For example, 225,000 continuing education course catalogues were printed in 2007 for the fall semester, a number nearly five times as large as the total population of the continuing education program. Mohawk College's printing expenses represent a significant source of emissions, but also a significant area for savings, through smaller print runs, digital distribution of catalogue materials or recycling initiatives.

In terms of areas for carbon reduction, consideration should be given to the inter-campus shuttle service. Ridership on the shuttle itself is low, based on the usage numbers given, and therefore the intensity-adjusted emissions from the shuttle service are quite high. Assuming that the shuttle service employs a standard mid-sized bus, Mohawk is expending over 54 litres of fuel (approximately 0.14 tonnes CO_2e) per shuttle

passenger per semester; however, there may be opportunities for emission reductions elsewhere as well.

5.0 FUTURE TRACKING

→ This baseline report is a strong basis for future reporting of scope 1, 2 and 3 greenhouse gas emissions. This section describes areas where Mohawk College can strengthen and improve their carbon inventory. Carbon inventories can be continually improved as greater data and knowledge becomes available. Operational changes and expansions will also affect inventory results, and as a consequence, it is necessary to regularly update carbon inventories. This report creates an initial baseline for Mohawk College's carbon inventory; in order to expand the inventory in the future, specific steps will help to increase the accuracy and completeness of Mohawk's greenhouse gas reporting. Developing more detailed inventories will also yield stronger analysis, consequently assisting the development of accurate and appropriate emission reduction strategies. This section focuses on three general areas where Mohawk could strengthen their carbon tracking and reporting: significant emission sources, scope of reporting, and depth of reporting. The following sub-sections describe each of these areas.

SIGNIFICANT EMISSION SOURCES

As described in the Methodology section, an organization is responsible for all scope 1 and scope 2 emissions arising from the operations over which the organization has operational control. Typically, these emissions arise predominantly from building energy use and mobile combustion from fleet vehicles. Building energy use is the largest single contributor to these emissions, and therefore any improvements in data granularity will significantly improve the accuracy of the inventory. If buildings owned and operated by Mohawk have not been accounted for in this report (e.g. the 340 Leaside building on the Stoney Creek campus), including such buildings would increase the accuracy of Mohawk emissions inventory. Zerofootprint understands that many of Mohawk's buildings are linked, and therefore electricity and natural gas consumption are measured by large, centralized meters. More precise breakdowns of these facilities' consumption data would allow for precise emissions tracking and comparison.

Refrigerants and industrial gases are potent sources of greenhouse gases. If any operations at Mohawk College require the use of certain industrial gases or refrigerants, including, but not limited to, Sulfur Hexafluoride (SF_6), Hydroflorocarbons (HFCs), or Perflorocarbons (PFCs), these gases must be accounted for in a carbon inventory.

SCOPE OF REPORTING

Mohawk has taken significant steps to include scope 3 emissions (thanks to the cooperation and expertise of Mohawk College's staff and administration) in order to produce a more complete and accurate carbon footprint. If all scope 1 and 2 emissions are counted for, carbon inventories can be strengthened by including scope 3 emissions and engaging third parties that participate in college activities but operate independently. Recall, scope 3 emissions are a consequence of the activities of an organization, but occur from sources not owned or controlled by the organization. Significant scope 3 emissions for Mohawk College include waste, recycling, employee business travel, subcontracted vehicles, printed materials, or paper used for office administration. Accounting for scope 3 emissions will allow Mohawk to track the effectiveness of many of its GoGreen initiatives. Mohawk College has already started to include these scope 3 emissions in its inventory. Additional scope 3 emissions that may be considered in future inventories include catering and food providers, waste data across all three campuses, and shipping and delivery contractors.

DEPTH OF REPORTING

Depth of reporting refers to the level of detail provided in an inventory. Greater detail can include breaking down emission sources by specific metrics or sub-categories, such as temporal electricity or fuel consumption data or detailed data reflecting individual buildings, departments, or end users. So long as an inventory accounts for all major scope 1 and 2 emission sources, providing further depth does not enhance the accuracy of the inventory, but it does significantly strengthen the ability for analysis and development of accurate reduction strategies. Mohawk provided heating and electrical data for specific buildings as well as gross building area, but providing specific building-by-building square footage would allow for another dimension of intensity measurements. This would then enable a clear indication of high energy consuming areas and intensity analysis. A next step could be to further isolate the electrical consumption into end uses, such as water heating, lighting, space cooling, etc. to identify specific target areas for reductions.

As it is impossible to isolate individual components of the combined electricity consumption for a building, future reports could be improved in both accuracy of reporting and strength of recommendations by including building systems data along with electricity consumption (lighting types, high-powered equipment, HVAC system information etc.). The additional insight provided by this information would provide Zerofootprint with insight into the reasons for the normalized emissions of each building, as outlined in Figure 10.

Depth of reporting can refer to departmental fuel consumption as well. This can be particularly useful for understanding emissions from fleet vehicles or identifying where efficiency opportunities exists, including behavioral pattern changes, that are lost in aggregated data.

FUTURE EMISSIONS TRACKING

As discussed in the introduction to this report, Mohawk College's 2007 inventory will serve as a baseline year for comparison in future inventories. In order to make the most of this inventory, future calculations of equivalent organizational and operational scope may be compared to the baseline inventory in order to quantify any changes in absolute or normalized emissions.

The GHG protocol includes detailed guidelines on accounting for emissions reductions, comparisons to baseline year data, accounting for new equipment and facilities, and setting reductions targets. Essentially, a GHG-protocol compliant inventory conducted at any point in the future may be compared to this baseline year, providing the same organizational boundaries and operational boundaries are used.

This future emissions tracking can take the form of greenhouse gas inventories conducted by Mohawk, Zerofootprint or another third party. Care should be taken to duplicate data collection and calculation methodologies as closely as possible to ensure cross-comparable results. Future inventories can be calculated at any time, but are typically performed on a recurring basis once every three to five years.

Greenhouse gas management software is an alternative to inventory calculation. Instead of manually gathering data and making calculations, the software is continually updated with emissions data from utility providers and facilities operators. This allows for real-time monitoring of emissions, trending over time and automated reporting. Greenhouse gas management software is typically used by medium and large-scale organizations in place of GHG inventories as it offers the ability to generate reports at any time and provides a high degree of transparency into the calculation and accounting process. Zerofootprint offers the VELO enterprise carbon management suite of software, whereas alternatives are available offering varying levels of usability, data granularity and automation.

Regardless of whether Mohawk opts for first party audits, third party audits or software as a means of future emissions tracking, this baseline year inventory will provide a valuable basis for comparison and analysis of the success of building retrofits, environmental initiatives and carbon-reduction strategies.

6.0 CONCLUSIONS

→ Mohawk College engaged Zerofootprint Software Inc. to complete a Greenhouse Gas Inventory for 2007, which included scopes 1, 2 and 3 emissions following the operational controlled approach from the Greenhouse Gas Protocol. Zerofootprint calculated a total of 3,647, 4,093 and 4,896 tonnes CO_2e from scopes 1, 2 and 3 emissions, respectively. The sum of scopes 1 and 2 emissions were 7,740 tonnes CO_2e and the sum of all scopes were 12,636 tonnes CO_2e. The results also showed that 39% of total emissions were due to scope 3 or indirect emissions. The electrical demands at Mohawk facilities contributed to 32% of total emissions while the remaining 29% resulted from scope 1 or direct emissions.

By undertaking the initiative to calculate its carbon impact, Mohawk College has demonstrated its commitment towards becoming a sustainable, carbon conscious company.

APPENDIX A: EMISSIONS REFERENCES

→ The following table provides the emission factor (EF) references used in Zerofootprint's calculation for Mohawk College's greenhouse gas inventory.

Activity	Scope	Source of emission factors
Natural gas	1	*Canada's National Inventory Report: 1990-2008*. Environment Canada.
Fuel consumption	1	*Canada's National Inventory Report: 1990-2008*. Environment Canada. Statistics Canada gasoline and fuel prices.
Fertilizers	1	*Energy and alternatives for fertilizer and pesticide use*. University of California.
Electricity	2	*Canada's National Inventory Report: 1990-2008*. Environment Canada.
Ground travel	3	Greenhouse Gas Protocol.
Air travel	3	*Guidelines to Defra's GHG Conversion Factors, 2008*. United Kingdom, Department for Environment, Food and Rural Affairs.
Paper usage	3	United States Environmental Defense Fund.
Waste	3	*Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, 2006*. United States Environmental Protection Agency.
Recycling	3	Environmental Protection Agency's report Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks, 2006.
Normalized Emissions	1 & 2	National Resources Canada's Office of Energy Efficiency Commercial/Institutional Sector (Ontario) Educational Services Secondary Energy Use and GHG Emissions by Energy Source

APPENDIX B: REDUCTION TIPS

→ Mohawk's emissions arise primarily from the operation of its campus facilities (buildings, vehicles, etc.) and therefore any significant reductions in overall footprint will come from top-down improvements to efficiency. Investments in insulation, building retrofits, heating and cooling systems and lighting will have the greatest impact on scope 1 and 2 emissions. However, it is equally important to engage faculty and students in the process for two primary reasons. Firstly, "culture of use" has a huge impact on the overall energy efficiency of buildings. That is to say that the way in which people interact with buildings and technology, be it turning off lights in empty rooms, or minimizing air conditioning use during warm weather, can have a significant impact on a building's overall efficiency. Secondly, support and understanding among faculty and students is extremely important in terms of generating support for large-scale retrofits or other environmental programs. Simply, if individual students and staff are already "doing their part" they will be more likely to follow, understand and support top-down institution-wide projects and programs.

There are a number of simple steps that Mohawk's staff and students can take to reduce the college's environmental impact. As many of these programs are already being put in place by the GoGreen team, this guide serves as a generalized set of recommendations endorsed by Zerofootprint.

1. Drive Green

Ground travel is the largest scope 3 emissions source at Mohawk College, which presents opportunities to save fuel and prevent CO_2 emissions. Driving habits can significantly impact a vehicle's fuel efficiency and CO_2 emissions. Aggressive starts and stops, driving at higher speeds, excessive idling and carrying excess weight can all significantly impact fuel efficiency. Save gas by moderating your driving, keeping the speed down and using cruise control when possible.

Furthermore proper maintenance of your vehicles can increase your fuel efficiency up to another 5%. Make sure your tires are properly inflated and your air filter is clean. For business travel, consider renting fuel-efficient vehicles or using public transit. If possible, upgrade to more fuel-efficient vehicles for personal travel.

Total driving emissions for Mohawk College (fleet vehicles plus student and faculty commute) totaled 3,006 tonnes CO_2e. A 5% reduction resulting from proper maintenance and/or green driving habits represents an annual savings of 150.3 tonnes of CO_2, the equivalent of taking 37 cars off the road each year.

2. Recycle

Make it easy for staff and students to recycle by having recycling bins throughout your office. Employees are more likely to recycle or compost when it's easier than throwing out their trash! You should also fill photocopiers and printers with 100% recycled, chlorine-free paper.

Switching all of Mohawk's copier paper from 0% recycled to 100% recycled would result in an annual savings of 57 tonnes CO_2e, the equivalent of nearly 4.5 million sheets of copier paper.

3. Power down your computers

Did you know that it takes the equivalent of 200 coal-fired plants to run the world's screensavers? Despite popular belief, screensavers don't generally help you save energy. To minimize your footprint, activate the energy-saving settings on your office computers and make sure they are turned off when not in use. Remember, computers will continue to draw power in standby mode.

4. Save energy by unplugging your gadgets and appliances.

Cell phones, coffee machines, microwaves, computers, and printers all draw energy when they are idle. If everyone working in Canada made sure to unplug their cell phone chargers, more than 1.5 billion kilowatt-hours worth of electricity would be saved, equating to over $152 million and 337,944 tonnes of CO_2.

You can reduce your footprint by plugging these products into a power bar that can be switched off at the end of the workday. Leave non-essential items like scanners unplugged until they are needed.

5. Shop for the right equipment

Install water-saving devices, such as faucet aerators. It's shocking, but every day we flush away around 19 gallons of water per person. Reduce your footprint by investing in dual flush low-flow toilets.

Don't focus exclusively on the price tag of new equipment. You should also consider the energy and water the equipment will require over the course of its lifetime. Purchase Energy Star products, as they are more efficient and use 10 – 50% less energy and water than traditional models. The savings on your utility bill will often more than make up for the cost of the investment.

6. Avoid cafeteria waste

The lunch you bring to work can leave a large footprint, particularly if you eat out regularly. Avoid unnecessary packaging by inviting employees to bring meals to work in reusable containers. You should also ensure your office has a kitchen stocked with reusable mugs, plates, and cutlery. This can go a long way in terms of eliminating your meal-related impacts.

Reducing, recycling and composting food waste can have a significant impact on scope 3 emissions. Each tonne of waste diverted from landfill saves between 0.5 and 1.5 tonnes of CO2.

7. Investigate green lighting options

Choose compact fluorescents. These bulbs last 10 times longer and require one-fourth the energy of traditional incandescent. In particular, try LED desk lamps, which run on very little energy. You can also install sensors so that the lights in your office only turn on when workers are present.

8. Minimize Heating and Air Conditioning Use

Heating and air conditioning make up a large part of your campus footprint. Minimize what you can by setting the temperature to a more moderate level. A difference of one degree Celsius can add around 10% to your heating or cooling costs and will generate considerably more CO_2. If you can't control your heating and cooling, talk to your landlord or property manager.

Mohawk College's natural gas heating systems were responsible for 3,524 tonnes of CO_2e in 2007. A 10% reduction in heating and cooling emissions from moderate temperature settings could save more than 350 tonnes of CO_2 annually, enough to power 130 average Canadian homes for a year.

APPENDIX C: CAP & TRADE

→ Cap and trade legislation refers to a market-based emissions reduction strategy whereby the federal or provincial government establishes a limit on the quantity of a pollutant (in this case, greenhouse gas in tonnes CO_2 equivalent) that can be emitted. Under these emissions trading schemes, organizations' emissions are "capped" at the level of a baseline year (depending on the specifics of the law, this can be a cap on absolute emissions, or on emissions intensity). Organizations quantify and track their greenhouse gas emissions via audits like the one just performed by Mohawk. Those organizations emitting less than their allotted amount are able to sell their excess emissions allocation in the form of carbon credits. Those organizations that exceed their allocation are forced to purchase these credits at a price determined by the market. Thus, emissions for the system are "capped" (i.e. they remain equal to the baseline in terms of total emissions or emissions intensity), while those organizations best able to reduce their emissions are rewarded for doing so.

Cap and trade legislation and carbon markets are already in place in the United Kingdom, the European Union, and numerous locations throughout North America, including the province of British Columbia. Although the government of Canada has expressed hesitation in implementing federal cap-and-trade legislation, there is the possibility that Ontario could follow British Columbia's lead in implementing emissions caps at the provincial level. British Columbia and Ontario are both part of the Western Climate initiative, an alliance of provinces and states focused on reducing carbon emissions independent of national governments. While it is unlikely that Mohawk College would be subject to this legislation should it be implemented (the proposed cap-and-trade system for Ontario applies only to emitters with a scope 1 & 2 total greater than 25000 tonnes per year), this report is compliant with the reporting guidelines outlined in Ontario regulation 452/09- Greenhouse Gas Emissions Reporting.

The price of carbon under a cap-and-trade system determines Mohawk's possible exposure should it exceed its cap, as well as its possible savings from reducing emissions below baseline levels. The Cap and Trade act in British Columbia established a base price of $10 CAD per tonne in 2008, with a plan to increase this price annually until it reaches $30 CAD per tonne. However, it is not necessarily the case that a cap and trade system in Ontario would set the same price points due to differing industries, budgets and offset project types. According to a 2010 Bloomberg report on the State of the Voluntary Carbon Market, the average over-the-counter price on the voluntary market (i.e. the average price in Ontario today) is $6.5 CAD per tonne. Contrast this to the Carbon Reduction Commitment program in place in the United Kingdom, where credits trade at $18.84 CAD per tonne and it is apparent that the price of carbon under a proposed cap-and-trade system is uncertain.

Limitations and Use of this Report

The statements in this report are the professional opinions of the writers. Zerofootprint does not guarantee the accuracy of information provided by other persons or agencies, or reliability of conclusions drawn from information provided by other persons or agencies.

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