

**Mohawk College 2012
Greenhouse Gas Emissions
Inventory**

FINAL REPORT



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Executive Summary

Mohawk College set a baseline year for measuring greenhouse gases (GHG) as 2007 and completed an initial GHG inventory. In 2013, Mohawk College retained Stantec Consulting Ltd. (Stantec) to complete the emission inventory for the 2012 reporting year. The objective was to complete a transparent inventory that could be meaningfully compared to the baseline emission inventory, as well as compare against performance indicators for similar institutions.

Since 2011, Mohawk College has undertaken a number of improvement initiatives that directly impact the performance of the Mohawk facilities and student engagement. These projects included lighting upgrades, chiller replacement and replacing boilers and generators with more efficient and cleaner natural gas burning equipment. Students and faculty at Mohawk have shown a strong commitment to sustainability and continue to make sustainability a priority at the college.

In February 2011, Mohawk College completed a baseline GHG emission inventory based on 2007. Table ES-1 presents the GHG emissions for 2007 and 2012 by Scope.¹

Table ES-1: 2007 and 2012 GHG Emissions by Scope			
Scope	2007 tCO ₂ e	2012 tCO ₂ e	Change in 2012
Scope 1	3,647	2,811	-23%
Scope 2	4,876	2,108	-53%
Scope 3	5,201	5,535	6%
TOTAL	13,724	10,454	-24%

Total emissions for 2012 are 10,454 t CO₂e and have decreased by 24% since 2007. Scope 1 and 2 emissions are 2,811 t CO₂e and 2,108 t CO₂e and have decreased by 23% and 53% respectively. Scope 3 emissions, beyond the control of Mohawk, have increased by 6%. Scope 3 emissions are mainly impacted by student and staff commuting and the majority of the increase was the result of increased commuter activity (as measured by parking pass data) related to higher attendance at Mohawk over the baseline year. During this same period, commuting emissions replaced facility emissions (combined natural gas and electricity) as the largest source of emissions

¹ Stantec revised several categories of emissions for the 2007 baseline emission inventory. These changes are discussed in Section 3.1 of the report.

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under the GHG emission inventory. In part this was driven by a 35% increase in student enrollment - the number of full-time equivalent students (FTE) has increased from 11,750 to 15,882 an increase of 35%. In spite of this increase Mohawk College was able to decrease the emissions on a per student basis by 44%. Table ES-2 presents the emission intensities for 2007 and 2012.

Table ES-2: 2007 and 2012 GHG Emissions by Emission Intensities			
Parameter	2007	2012	Change in 2012
Total Emissions (tCO ₂ e)	13,724	10,454	-24%
tCO ₂ e /FTE	1.17	0.66	-44%
tCO ₂ e /m ²	0.11	0.08	-24%

The emission intensity in 2012 was 0.66 tCO₂e /student compared to 1.17 tCO₂e /student in 2007 (decrease of 44%) (Figure ES-1). This is attributed to the decrease in overall GHG emissions by 24% and the increase in FTE enrollment by 35% from 2007.

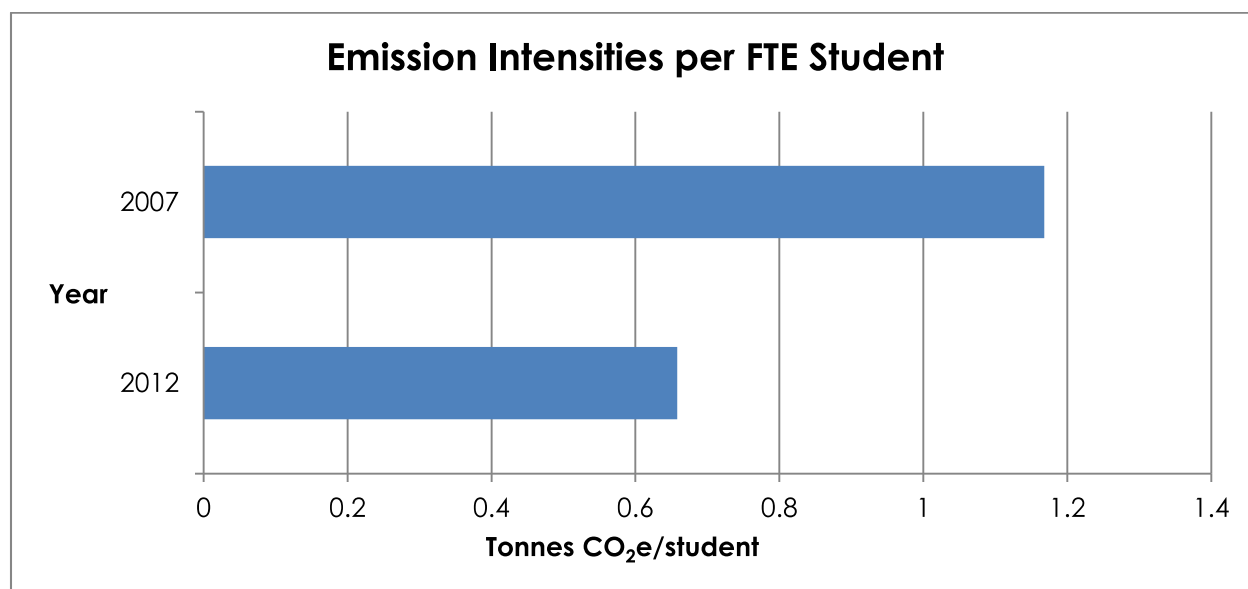


Figure ES-1: GHG Emission Intensity (tonnes CO₂e/student) for 2007 and 2012

While GHG benchmarking for colleges is challenging, perhaps the most relevant comparison between colleges is based on energy intensity. In 2012 Mohawk College's

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energy intensity (7 GJ per student basis) is less than a third of the average college in Ontario in 2003 (24 GJ per student).

Mohawk College has taken important steps in developing a baseline emission inventory, developing sustainability initiatives and the 2012 GHG inventory provides a basis for assessing the success of the sustainability initiatives at Mohawk College. After the completion of each inventory, Mohawk is encouraged to assess the achievements that have been made with the implementation of sustainability measures.

An integral part of completing a GHG Emission Inventory is the collection of accurate data. This can particularly be a challenge with Scope 3 data. Mohawk is encouraged to meet with stakeholders to reiterate the importance of accuracy, transparency and consistency in how activity data is collected. Particularly, improvements to parking pass activity data is one area where significant improvements could be made. Specifically, it would be beneficial to differentiate between permanent address and school year address as well as how often the student intends on commuting. Further refinements could also be made if data was collected on the type of vehicle including any electric or hybrid models.

Mohawk is encouraged to assess the success of their initiatives and check that the objectives have been accomplished, and make revisions to the sustainability strategy where necessary. Increasing the frequency of reporting may also allow Mohawk to identify deficiencies or successes earlier on in the process.

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Abbreviations

Abbreviation	Description
AASHE	The Association for the Advancement of Sustainability in Higher Education
ACCC	Association of Canadian Community Colleges
BF	Brantford Campus
CH ₄	Methane
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
DBARC	David Braley Athletic and Recreation Centre
EMP	Environmental Management Plan
EMPSC	Environmental Management Plan Steering Committee
FF	Fennell Campus
FTE	Full Time Equivalent Students
GEA	Green Energy Act
GHG	Greenhouse Gas
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
N ₂ O	Nitrous Oxide
SC	Stoney Creek

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1.0 CONTEXT FOR ACTION

1.1 Global Climate Change

There is increasing evidence that global climate change resulting from emissions of carbon dioxide and other greenhouse gases is having an impact on the climate system of the planet. The Fifth Assessment Report (2013) of the Intergovernmental Panel on Climate Change (IPCC), states the consensus of scientific opinion that:

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level;
- Most of the observed increase in global average temperatures since the mid-20th century is extremely likely due to the observed increase in human-caused GHG concentrations, and;
- There is high agreement and much evidence that with current climate change mitigation policies and practices, global GHG emissions will increase over the next few decades.²

In addition, climate change impacts are expected to have serious negative effects on global economic growth and development. In 2005, the UK government commissioned an independent economic review called The Stern Review, which concluded that “the benefits of strong and early action far outweigh the economic costs of not acting.”³ Using results from economic models, the Review estimated that if we don’t act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global Gross Domestic Product (GDP) annually – potentially as much as 20% of GDP. In contrast, the costs of implementing actions to reduce GHG emissions and mitigate the impacts of climate change could be limited to around 1% of global GDP annually.

1.2 Globally Coordinated Action

On a global scale GHG reduction policies are managed through the United Nations Inter-governmental Panel on Climate Change (IPCC). This process has resulted in a number of protocols and accords (the best known is the “Kyoto Protocol”) which define

² IPCC 5th Assessment Report (2013). <http://www.ipcc.ch/report/ar5/wg1/>

³ Nicholas Stern. *The Economics of Climate Change: The Stern Review*. Cambridge University Press, January 2007. http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

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each country's commitment to make reductions. Subsequent policy commitments have been made at a number of meetings of this body.

In Canada, senior levels of government have made commitments to reducing GHG emissions, and have developed policies, programs and initiatives to meet those commitments. Actions that affect Mohawk College emissions include:

1.2.1 FEDERAL INITIATIVES

- In January 2010, the federal government set a national target to reduce GHG emissions by 17 percent, relative to 2005 levels, by 2020.
- In 2010, the federal government announced proposed Passenger Vehicle and Light Truck Greenhouse Gas Emission Regulations under the Canadian Environmental Protection Act (CEPA) to create national vehicle efficiency standards that harmonize with the US standards by 2011. If implemented, new vehicles sold in 2016 are expected to be 40% more efficient than vehicles sold in 2008. They also announced upcoming Heavy Duty Vehicle regulations which are not yet defined.

1.2.2 PROVINCIAL INITIATIVES

- The Province of Ontario established a GHG emissions reduction target of 15% below 1990 levels by 2020. To meet this target, the Province has instituted the Feed-in Tariff (FIT) program for support of alternative energy generation, has enacted regulations to phase out coal-fired electricity generation, and requires reporting of annual emissions under the *Green Energy Act*.
- In 2009, the *Green Energy and Green Economy Act (GEA)* was enacted. The intent of the GEA is to stimulate renewable energy production, encourage greater energy conservation, and create green jobs within the Province. The GEA also compels public agencies (including Mohawk College) to develop and implement energy conservation programs and report on annual energy consumption and GHG emissions.

1.2.3 CITY OF HAMILTON INITIATIVES

The City of Hamilton's Vision 2020 plan sets a goal of reducing CO₂ levels by 20% within their municipal operations by 2020, against a 1994 baseline. The City's Air Quality and Climate Change Corporate Strategic Plan (2006) sets out five major action categories that will help to advance this goal focusing around policy,

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engagement and communication, adaption to smog and climate change, reducing emissions, and program development.⁴

1.3 Local Action: Mohawk

Mohawk has made sustainability a prominent part of its strategic plan. Mohawk has committed to operating in an environmentally responsible manner by engaging in various sustainability reporting initiatives and has implemented numerous environmental programs, including:

- Mohawk is as a signatory to the Association of Canadian Community Colleges (ACCC) Pan-Canadian Protocol for Sustainability. As a Signatory to the Protocol, Mohawk agrees to provide leadership to their internal and external communities and to maximize their contribution to a sustainable future.
- Mohawk is a registered member under the Association for the Advancement of Sustainability in Higher Education (AASHE) which provides administrators, faculty, staff and students with a unique framework for demonstrating the value and competitive edge created by sustainability initiatives. As a registered member Mohawk reports under the Sustainability Tracking, Assessment & Rating System (STARS).
- Mohawk established the Environmental Management Plan Steering Committee (EMPSC), the Sustainability Office, and the Environmentally Committed Organization of Students (ECOS) which identify and coordinate corporate and grassroots sustainability activities and initiatives.
- In 2011, Mohawk prepared its first GHG greenhouse gas (GHG) emissions report which established a 2007 baseline. The baseline enables the development of meaningful and appropriate emission reduction strategies as well as creates a benchmark for all future GHG inventories.
- In 2011, Mohawk College published its Environmental Management Plan (EMP) which committed Mohawk to act as the leading policy document and blueprint that will shape the College's transformation towards a greener, prosperous future as an environmental, social and financially conscious institution. The EMP recognizes the interconnection between economy, society and the environment and stakeholders include students, staff and the community at large. The target is

⁴ Air Quality and Climate Change Corporate Strategic Plan
http://www.hamilton.ca/NR/rdonlyres/2AA18AA9-0D9A-4A54-A000-0862D7CDB17B/0/FINAL_AQCCStratPlanPhase1.pdf

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to achieve a campus-wide emissions reduction of 20% below the 2007 baseline by 2020. The plan provides direction, sets priorities, and seeks performance improvements in eight focus areas, including:

1. Waste Management and Paper Consumption
2. Facility Operations and Future Buildings
3. Procurement
4. Local Food and Health and Wellness
5. Transportation and Vehicle Emissions
6. Alternative Energy
7. Tracking, Reporting & Communication
8. Change Management

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2.0 PROJECT OBJECTIVE, METHODS & ASSUMPTIONS

2.1 Overview & Objective

Mohawk College of Applied Arts and Technology is a post-secondary institution operating on three main campuses: The Fennell Creek campus in Hamilton, the Brantford campus located in Brantford, and the STARRT Institute located in Stoney Creek. Mohawk employees approximately 1,300 full-time equivalent staff and faculty members and have a student body of approximately 15,900 full-time equivalent students across the three campus locations. Students may also attend classes at the Institute for Applied Health Sciences located at McMaster University in Hamilton, Ontario. This facility is not included within the boundaries of this study due to the operational and organizational boundaries as determined in Section 2.3.

This project focused on quantifying Mohawk College's 2012 GHG emissions. This provided data that was compared to the 2007 GHG Inventory in order to track the effectiveness of implemented measures as well as provide a basis for establishing new GHG emission reduction objectives.

2.2 GHG Emission Quantification Methods

The Greenhouse Gas Protocol is the most widely used international accounting tool for the purposes of understanding, quantifying, and managing greenhouse gas emissions. The protocol was developed based on a partnership between the World Resources Institute and the World Business Council for Sustainable Development. Since the first GHG Protocol accounting and reporting standards were released in 2001, more than 1,000 corporations and organizations across the globe have developed GHG inventories using the GHG Protocol. It also serves as the foundation for nearly every GHG standard and program worldwide.

To quantify GHG emissions for Mohawk College a higher educational institution where no protocol has been prescribed, the *GHG Protocol: A Corporate Accounting and Reporting Standard, (Revised Edition)*, developed by the World Resources Institute (WRI) and the World Business Council on Sustainable Development (WBCSD) is employed in this assessment as the best practice guidance document. Methodologies and quantification methods were replicated from Mohawk's 2007 GHG inventory where

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possible. Appendix B contains the data and emission calculations broken down for 2012.

The following is a summary of methods used for determining emissions from various sources utilizing the GHG Protocol, unless otherwise stated. The following equation is the general equation that was applied to Mohawk College's 2012 GHG inventory for calculating emissions.

$$CO_2e \text{ (tonnes)} = \text{Fuel Use or Activity Level (Unit)} * \text{Emission Factor} \left(\frac{\text{tonnes of } CO_2e}{\text{Unit}} \right) * GWP$$

Where GWP is the Global Warming Potential which refers to ability of each GHG to trap heat in the atmosphere relative to carbon dioxide (CO₂) over a 100 year period.⁵

The emission inventory is generally broken down into categories of GHG emissions (referred to as "Scopes" by the GHG Protocol) and Mohawk's emission categories and sources are presented below in Table 1.

Table 1: GHG Emissions and Scope	
Scope	Corporate Inventory
Scope 1	Direct emission sources owned and/or operated by Mohawk College (e.g., natural gas, gasoline or diesel use by fleet vehicles).
Scope 2	Indirect emission sources that result from the use of purchased electricity to operate Mohawk College facilities.
Scope 3 (Optional)	Indirect emission sources from items that are not owned or controlled by Mohawk College (e.g., student commuting, paper usage, waste, etc.).

The 2012 GHG Inventory that Stantec has prepared for Mohawk College has been developed in accordance with the standards of the GHG Protocol.

2.3 Project Assumptions

To collect and report on data, a control approach (operational control), as outlined in the GHG Protocol, was applied. This approach assumes that the organization (Mohawk) accounts for 100 percent of the GHG emissions from operations over which it, or one of

⁵ Environment Canada <http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=CAD07259-1>

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its subsidiaries, has operational control. A list of the facilities and vehicles is included in Appendix C. This approach is consistent with the 2007 baseline emission inventory.

The following section identifies data collected and assumptions applied for the 2012 GHG inventory.

2.3.1 FACILITY OPERATIONS (ELECTRICITY AND NATURAL GAS)

Emissions resulting from energy consumption and from the stationary combustion of natural gas are calculated by utilizing the appropriate emission factor. The electricity emission factor is taken from the Canada's 2013 National Inventory Report for the province of Ontario. Since 2012 CO₂ intensity per kWh is not yet available, 2011 preliminary data is used as proxy. The emission factor for natural gas is based on the properties of the fuel and generally do not fluctuate significantly from year to year. Mohawk was able to provide full accounting of electricity and fuel consumption activity data.

2.3.2 VEHICLES AND TRANSPORTATION

Data for the vehicles and transportation were provided by Mohawk, either by fuel use, mileage and/or cost of fuel. Fuel efficiency and emission factors were based on Canada's 2013 *National Inventory Report* for the province of Ontario.

Student and staff commuting data was based on parking pass data and commuting distances which were extracted based on average distance from home address, duration of the parking pass, and the application of student attendance assumptions (approved by Mohawk). These assumptions included:

- Staff attending work 48 weeks of the year, 5 days per week;
- Student parking pass holders commuted 3.5 days/week;
- The average distance for student commuting was based on the postal code to determine the commuting distance each way for each of the three campuses. The average commuting distance was determined based on prorating the trips between the campuses in accordance with student occupancy breakdown per campus (76% to Fennell, 12% to Brantford, 12% to Stoney Creek);
- The average distance for staff commuting was based on the postal code to determine the commuting distance each way for each of the three campuses. The average commuting distance was determined based on prorating the trips

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between the campuses in accordance with occupancy breakdown (87.6% to Fennell, 5.6% to Brantford, 6.8% to Stoney Creek); and

- Commuters use the equivalent of a light duty vehicle manufactured after 2004.

The 2012 GHG emission inventory differed from the baseline, which assumed that students commuted to campus 5 days per week. The increase in the number of programs offering many student workforce experiential learning opportunities have offset the number of days in the typical week that many students are required to be on-campus. These students are instead travelling to employment centers around the region in order to complete placements, co-op terms, and internships. Under the Greenhouse Gas Protocol, these commutes are not considered College-activity and would be captured within Scope 3 of the respective workplaces' GHG inventories.

2.3.3 PAPER CONSUMPTION

Data for paper consumption was provided for the number of page used for various paper sizes and properties. Emissions were calculated based on overall paper weights, recycled content and emission factors provided by the Paper Task Force⁶.

2.3.4 WASTE AND RECYCLING

Data for volumes of waste and recycling were provided directly by Mohawk. Waste emissions were updated in the baseline period (2007) to be consistent with the 2012 methods. To calculate waste emissions in both the baseline and 2012 reporting period, the USEPA LandGem model⁷ was used. This industry accepted model uses the contribution of waste deposited in the current year to determine the GHG emissions that would be emitted over the next 150 years. The use of the model assumes that the landfill in question has no methane capture, flaring or energy production.

Recycling emissions were removed from the baseline and excluded from the 2012 GHG emission inventory. Recycling emissions are often negative and life cycle based creating a false reduction in the total emissions profile. Furthermore, the methods to assess recycling emissions vary by model, are frequently limited by data availability and data uncertainties. For instance, emission factors for a particular recycled product, such as paper or plastic, can range by order of magnitudes based upon a number of variables (how the study was conducted, the energy intensity of the material inputs, the

⁶ Source: The Paper Task Force Final Report: Paper Task Force Recommendations for Purchasing and Using Environmentally Preferable Paper. Available online: http://c.environmentalpaper.org/documents/813_PTFcomplete.pdf Table A-2

⁷ U.S. EPA (2003), Landfill Gas Emissions Model Version 3.02 (xls), Accessed in October 2013, Available at: www.epa.gov/nrmrl/appcd/combustion/cec_models_dbases.html

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destination and final use of recycle products, etc.). As such, recycling emissions were conservatively excluded from the 2012 GHG inventory.

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3.0 Mohawk College's GHG BASELINE (2007)

3.1 Baseline Update

In February 2011, a GHG inventory for Mohawk College was completed by Zerofootprint Software Inc. for the 2007 baseline year. This inventory was stated to be conducted 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*. All data used to calculate emissions was provided by Mohawk College or was estimated by applying industry, national, or regional averages for emissions and energy use. To allow for consistency between reporting years, several revisions were required to the 2007 baseline emission inventory. The revision of baseline emissions is generally an acceptable practice to increase the accuracy of calculations and adjust for better data. These changes are not only appropriate for a corporate emission inventory but align with the how Canada's National Inventory Report submitted to the UNFCCC is adjusted back every year it is published. The activity data that forms the baseline emission factor has not been adjusted, only emission factors where they have been revised and published for 2007 and quantification methods which are more accurate than those used in the baseline. A breakdown of the 2007 baseline GHG emissions by Scope is provided in Table 2 below.

Table 2: 2007 GHG Emissions (Baseline)		
GHG Emissions Scope	tCO ₂ e	Percentage Change
Scope 1	3,647	0%
Scope 2*	4,876 (revised from 4,093)	19%
Scope 3*	5,201 (revised from 4,896)	6%
TOTAL	13,724 (revised from 12,636)	8.6%

Notes to Table:

*For consistency in reporting between baseline (2007) and 2012, adjustments were made to the electricity, student commuting, recycling and waste emissions categories for 2007 to better align with the GHG Protocol and industry norms for determining GHG emissions. Recycling has been excluded from the inventory and waste was recalculated using the LandGEM model which includes 150 years of methane generation from waste landfilled in a given year. Student commuting was revised based on Ontario data for fuel efficiency and emissions for fuel consumption. Emissions from electricity were based on updated emission factors for 2007 in the 2013 Canada's National Inventory Report.

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Table 3 provides an updated summary of 2007 baseline GHG emissions by scope and activity.

Table 3: Summary of 2007 GHG Inventory by Scope and Activity Type			
Activity Type		Total Consumption	Total GHG Emissions (t CO ₂ e)
Scope 1 Total			3,646.63
Fleet Fuel Consumption	Gasoline Diesel	30,674 L 14,169 L	109.94
Natural Gas Consumption	SC- 330 Leaside	698 m ³ natural gas	3,523.95
	SC - 336 Leaside	84,431 m ³ natural gas	
	SC - Main Building	198,094 m ³ natural gas	
	BF - Main Building	152,220 m ³ natural gas	
	BF - West Building	52,246 m ³ natural gas	
	FF - Storage Building	100,625 m ³ natural gas	
	FF - Student Centre	33,181 m ³ natural gas	
	FF - Main Building	1,032,571 m ³ natural gas	
	FF- Alumni House	37,257 m ³ natural gas	
	FF - Student Residence	172,581 m ³ natural gas	
Fertilizer	24% Nitrogen, 6% Potash, 70% filler	907 kg	1.27
Backup Generator	Diesel	3,573 L	11.47
Scope 2 Total			4,876
Mohawk College Electricity (revised)	Electricity Consumption	20,318,484 kWh	4,876
Scope 3 Total			5,221
Student and Faculty Commute (revised)	Km driven (estimated based on parking pass data)	14,379,319 km	3,504
Faculty Air Travel	# of flights	59 flights of varying length	25.95
Athletics Dept. Air Travel	# of flights	86 flights of varying length	39.35
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 km	3.34
Paper Use	Type/amount of paper used	100,300,100 pages	1,246.99
Waste (revised)	Tonnes of waste sent to landfill	185 tonnes	259
Total Emissions			13,724

The top 3 sources of emissions by activity in 2007 were:

- Electricity Consumption
- Natural Gas Consumption

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- Student and Faculty Commuting.

The original 2007 Greenhouse Gas Emission Inventory by Zero Footprint™ is provided in Appendix A.

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4.0 GHG EMISSIONS INVENTORY (2012)

4.1 Facility Changes

Between the 2007 and 2012 reporting year, several changes were made to the Mohawk College facility portfolio. The Wentworth Campus was sold, the Learning Exchange (H-Wing) opened and the David Braley Athletic and Recreation Centre was under construction (officially opened September 2013). Facilities data for 2012 was provided by Mohawk College and is provided in Table 4.

Table 4: 2012 Facility Data provided by Mohawk College				
Location	Buildings	Address	Building Area (m ²)	Full-time Equivalent Students
Fennell Main	Fennell Main (including H-Wing)	135 Fennell Avenue West Hamilton, ON L9C 1E9	73,814	13,408
	Fennell Student Centre			
	Fennell NDE			
	Fennell Shed			
	Fennell DBARC			
	Fennell Conference House			
Brantford	Brantford Main	411 Elgin Street Brantford, ON N3S 7P5	13,266	2,076
	Brantford West Building			
Stoney Creek	Stoney Creek Main	481 Barton Street Stoney Creek, ON L8E 2L7	30,586	2,110
	Stoney Creek 330 Leaside			
	Stoney Creek 336 Leaside			
	Stoney Creek 349 Leaside			
Residence		245 Fennell Ave. West Hamilton, ON L9C 7V7	10,219	350

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4.2 Emissions Summary by Scope

The 2012 GHG emission inventory was conducted in accordance with the World Resources Institute and World Business Council for Sustainable Development's *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, Revised Edition*. All data used to calculate emissions was provided by Mohawk College or was estimated by applying industry, national, or regional averages for emissions and energy use.

A breakdown of the 2012 GHG emissions and activity data by Scope and Activity is included in Table 5.

For Scope 1, the emissions were mainly from natural gas consumption in buildings (96%). For Scope 2, all emissions were from the use of electricity. For Scope 3, the major sources of emissions were from the emissions related to Student and Faculty Commute (82% of Scope 3), followed by the emissions related to paper use (11% of Scope 3) and emissions from waste (4% of Scope 3).

The top 3 sources of emissions by activity in 2012 were:

- Student and Faculty Commuting (Scope 3 emissions);
- Natural Gas Consumption (Scope 1 emissions); and
- Electricity Consumption (Scope 2 emissions).

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Table 5: Summary of 2012 GHG Inventory by Scope and Activity Type			
Activity Type		Total Consumption	Total GHG Emissions (tCO ₂ e)
Scope 1 Total			2,811
Fleet Fuel Consumption	Gasoline Diesel	43,677 L 3,143 L	112
Natural Gas Consumption	FF - Main Building FF - Shed FF - Conference House BF - Main Building BF - West Building SC - Main Building SC - 330 Leaside SC - 336 Leaside SC- 349 Leaside FF - Residence FF - DBARC	751,147 m ³ natural gas 0 m ³ natural gas 29,991 m ³ natural gas 184,729 m ³ natural gas 39,805 m ³ natural gas 186,626 m ³ natural gas 857 m ³ natural gas 77,829 m ³ natural gas 0 m ³ natural gas 155,672 m ³ natural gas 0 m ³ natural gas	2,697
Fertilizer	24% Nitrogen, 6% Potash, 70% filler	0 kg	0
Generator	Diesel	815 L	2
Scope 2 Total			2,108
Mohawk College Electricity	Electricity Consumption	19,160,094 kWh	2,108
Scope 3 Total			5,535
Student/Faculty Commute	Km driven (estimated from parking pass data)	18,606,484 km	4,534
Faculty Air Travel	Km flights	326,532	28
Athletics Dept. Air Travel	Km flights	2,624	0.2
Athletics Dept. Bus Travel	Km driven by coach bus	22,671 km	13
Campus Shuttle	Diesel	34,177 L	94
Shuttle Service Taxi	Km driven by taxi	12,445 km	3
Paper Use	Amount of paper used	36,225,100 pages	619
Waste	Tonnes of waste to landfill	174 tonnes	244
Total Emissions			10,454

5.0 DISCUSSION & ANALYSIS

5.1 Changes between the Baseline and the 2012 Reporting Year

Total emissions for 2012 are 10,454 t CO₂e and have decreased by 24% since 2007. Scope 1 and 2 emissions are 2,811 t CO₂e and 2,108 t CO₂e and have decreased by 23% and 53% respectively. Scope 1 and 2 emissions are generally under the direct control of Mohawk and reflect the sustainability initiatives undertaken at Mohawk. Scope 3 emissions, beyond the control of Mohawk, have increased by 6%. Scope 3 emissions are mainly impacted by student and staff commuting and the majority of the increase was the result of increased commuter activity (as measured by parking pass data) related to higher attendance at Mohawk over the baseline year.

While the overall GHG emissions have decreased by 24% between 2007 and 2012, during this same period, the number of full-time equivalent students (FTE) has increased from 11,750 to 15,882 an increase of 35%.

A side-by-side comparison of activity data between 2007 and 2012 is provided in Table 6.

The comparison of GHG emissions by activity between 2007 and 2012 is provided in Table 7.

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Table 6: Comparison of 2007 and 2012 the Activity data			
Activity Type		2007 Consumption	2012 Consumption
Scope 1			
Fleet Fuel Consumption	Gasoline Diesel	30,674 L 14,169 L	43,677 L 3,143 L
Natural Gas Consumption	All facilities	1,863,904 m ³	1,426,655 m ³
Fertilizer	24% Nitrogen, 6% Potash, 70% filler	907 kg	0 kg
Backup Generator	Diesel	3,573 L	815 L
Scope 2			
Mohawk College Electricity	Electricity Consumption	20,318,484 kWh	19,160,094 kWh
Scope 3			
Student and Faculty Commute	Km driven (estimated based on parking pass data)	14,379,319 km	18,606,484 km
Faculty Air Travel	# of flights or km	59 flights of varying length	326,532 km
Athletics Dept. Air Travel	# of flights or km	86 flights of varying length	2,624 km
Athletics Dept. Bus Travel	Km driven by coach bus	19,065 km	22,671 km
Campus Shuttle	Diesel	45,400 L	34,177 L
Shuttle Service Taxi	Km driven by taxi	9085 km	12,445 km
Paper Use	Type/amount of paper used	100,300,100 pages	36,225,100 pages
Waste	Tonnes of waste sent to landfill	185 tonnes	174 tonnes

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Table 7: Comparison of 2007 and 2012 GHGs by Activity			
Activity Type	2007 Total GHG Emissions (t CO ₂ e)	2012 Total GHG Emissions (t CO ₂ e)	Increase or Decrease (-) over Baseline
Scope 1 Total	3,647	2,811	-23%
Fleet Fuel Consumption	109	112	3%
Natural Gas Consumption	3,524	2,697	-23%
Fertilizer	1	0	-100%
Backup Generator	11	2	-82%
Scope 2 Total	4,876	2,108	-57%
Mohawk College Electricity	4,876	2,108	-57%
Scope 3 Total	5,201	5,535	6%
Student and Faculty Commute	3,504	4,534	30%
Faculty Air Travel	26	28	8%
Athletics Dept. Air Travel	40	0.2	-67%
Athletics Dept. Bus Travel	0.2	13	
Campus Shuttle	122	94	-22%
Shuttle Service Taxi	3	3	
Paper Use	1247	619	-50%
Waste	259	244	-6%
TOTAL	13,724	10,454	-24%

The contribution of emissions by source to Mohawk's emission inventory for 2007 and 2012 are graphically presented in Figure 1.

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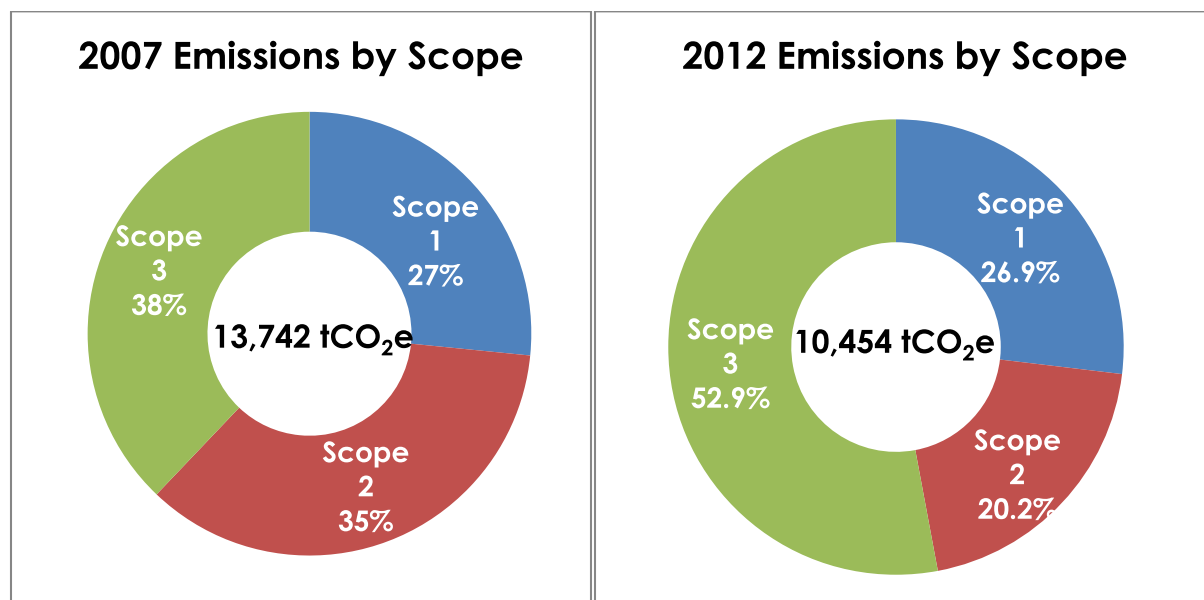


Figure 1 Contribution of Source of Overall Emission Inventory in 2007 and 2012

The largest contribution of GHG emissions are related to commuter activities, followed by the operation of the facilities at Mohawk. Facility emissions combine to include emissions from natural gas combustion and electricity consumption. In 2012, there was a shift in GHG emissions by sector. Figure 2 shows the contribution of sectors to the overall emission inventory for 2007 and 2012.

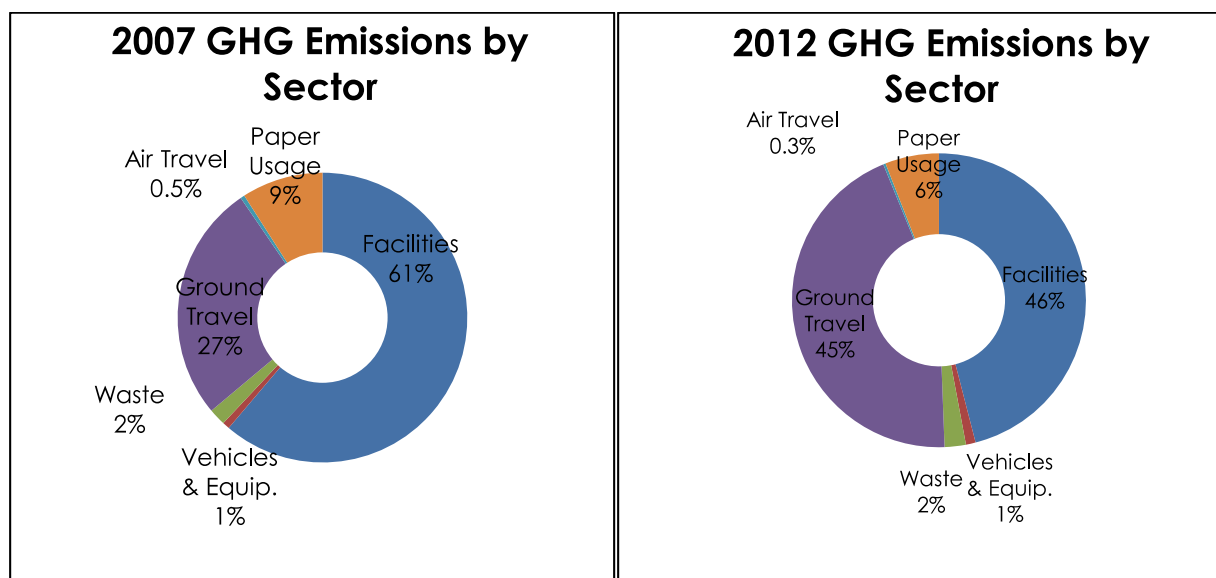


Figure 2 GHG emissions by sector for 2007 and 2012

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5.1.1 COMMUTER TRAVEL

An increase in student enrollment at Mohawk between 2007 and 2012 resulted in higher volumes of students and staff commuting to Mohawk and an increase of 30% in overall GHG emissions associated with increased commuter travel. Student enrolment at Mohawk increased 35% between 2007 and 2012 to a total enrolment of 15,882 students. A profile of commuter travel distances (one way) is provided in Figure 3.

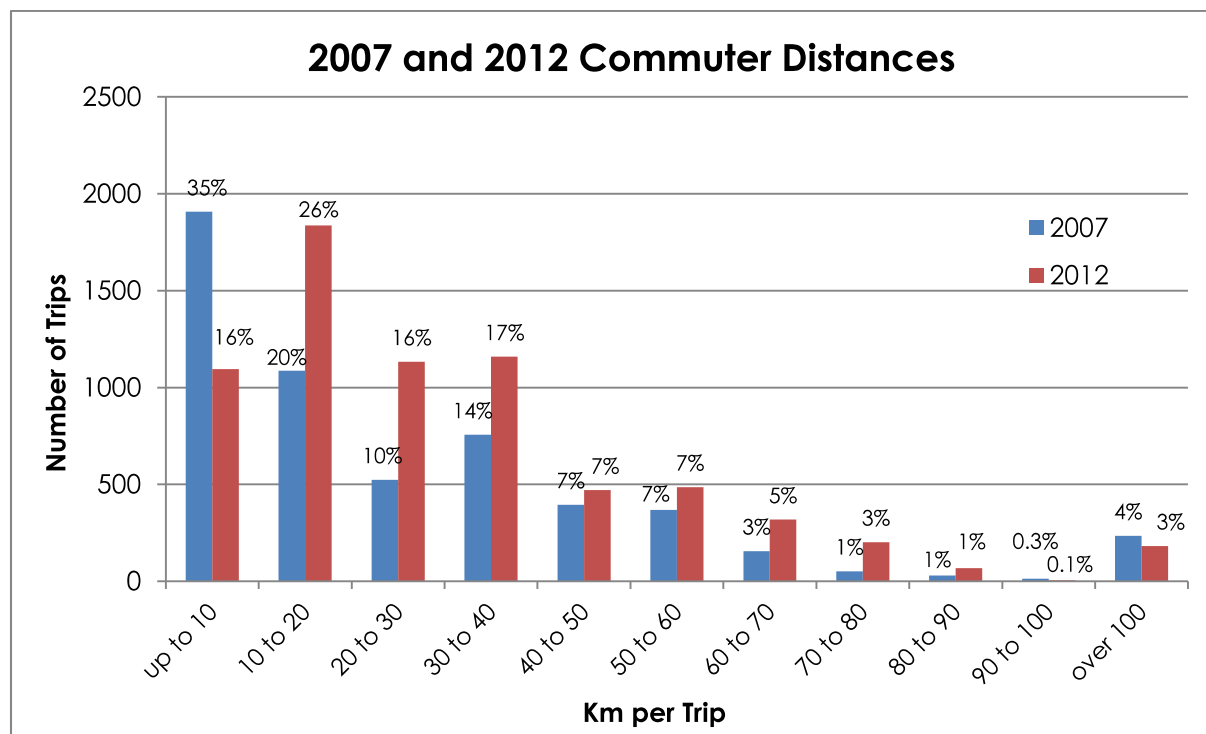


Figure 3 Commuter Profiles 2007 and 2012

5.1.2 NATURAL GAS

Natural gas consumption and emissions decreased by 23% and while much of this decrease is associated with sustainability measures, the decrease in the number of heating degree days in 2012 (3338 heating degree days) was lower than the number of heating degree days in 2007 (3866 heating degree days) helping Mohawk to achieve lower GHGs. Table 7 provides annual consumption of natural gas for 2012 by facility.

5.1.3 ELECTRICITY

Mohawk was able to reduce electricity consumption by 6% between 2007 and 2012 during this same time the emission factors for electricity were decreased significantly over the same period. This resulted in a 57% decrease in GHG emission associated with

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electricity was the result of several factors including the closing of coal-fired power plants in Ontario and the shift to cleaner sources of electricity required by the Green Energy Act. Table 7 provides annual consumption of electricity for 2012 by facility.

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Table 7: Electricity and Natural Gas by Building 2012					
Campus ID	Facility Name	Electricity		Natural Gas	
		Usage (kWh)	tCO ₂ e	Usage (m ³)	tCO ₂ e
Administrative & Maintenance					
FF	Main Campus Building	17,770,681	1,955	1,270,983	2,403
FF	Shed	12,847,864	1,413	751,147	1,420
FF	Conference House	35,788	4	-	-
BF	Main Building	14,402	2	29,991	57
BF	West Building	1,312,325	144	184,729	349
SC	Main Building	512,841	56	39,805	75
SC	330 Leaside	2,594,286	285	186,626	353
SC	336 Leaside	87,832	10	857	2
SC	349 Leaside	344,644	38	77,829	147
		20,700	2	-	-
	-		-		-
Residences					
FF	Residence	1,372,702	151	155,672	294
Athletics					
FF	DBARC	16,711	2	-	-
			-		-
All Facilities					
		19,160,094	2,108	1,426,655	2,697

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Figure 4 shows electricity consumption for a select number of buildings during 2007 and 2012 periods in order to isolate the change to consumption rather than GHGs which are heavily influenced by the change in GHG emissions associated with electricity production between 2007 and 2012.

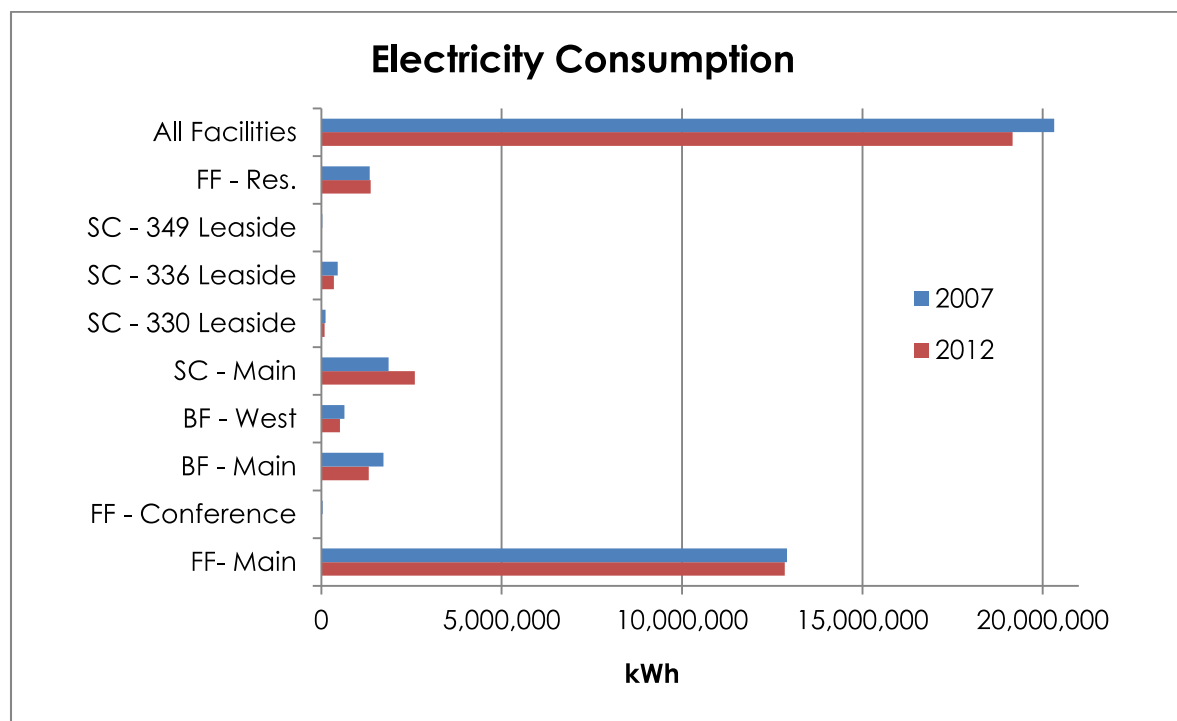


Figure 4 Electricity Consumption for Select Buildings 2007 and 2012

5.1.4 ATHLETIC TRAVEL

There was a shift from air travel to bus travel from 2007 to 2012. Overall, the emission decrease associated with athletic travel was 67%.

5.1.5 SHUTTLE SERVICES

There was a decrease in the emissions related to the shuttle bus operation as the average number of runs throughout the year was reduced. Overall, shuttle related emissions were reduced by 22%.

5.1.6 PAPER CONSUMPTION

Mohawk was able to reduce emissions from paper consumption by 50% in part through the creation of on-line tools.

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5.1.7 WASTE

Emissions from waste decreased 6% in the 2012 reporting year over 2007. Mohawk has undertaken measure to increase diversion and despite a rise in FTE, achieved an overall emission reduction from waste activities (Figure 5).

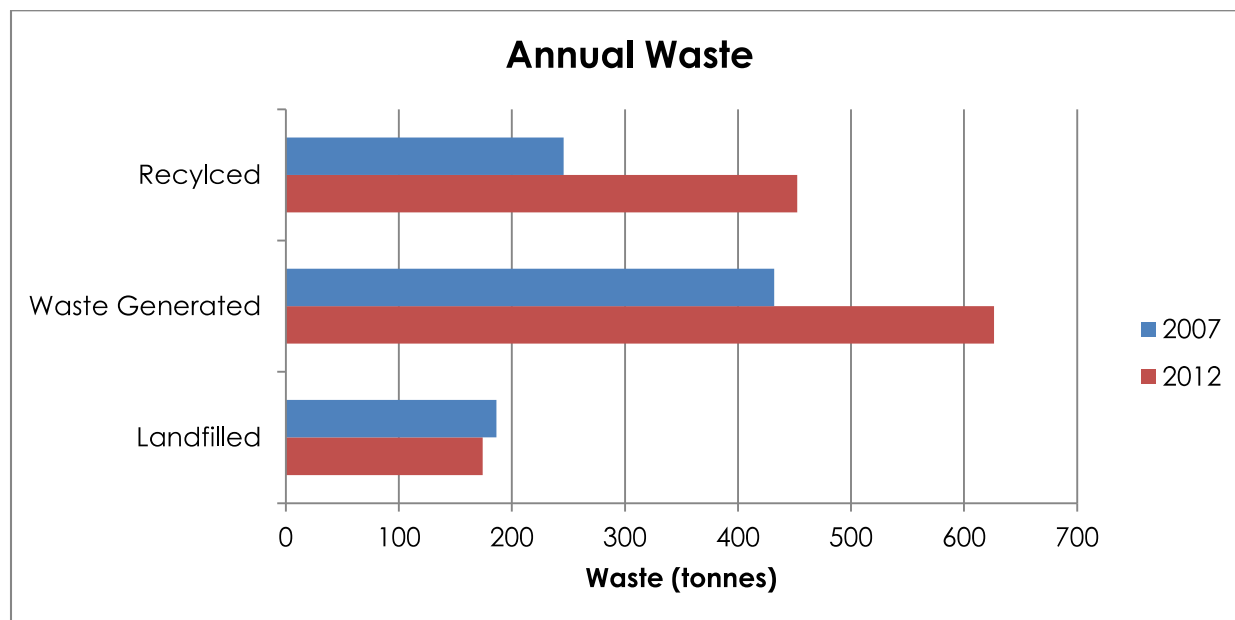


Figure 5 Annual amount (tonnes) of waste for 2007 and 2012

5.2 Emission Intensities

Total GHGs year over year are one way of assessing the change in emissions and assessing performance relative to targets and goals. It is often important to look at intensity metrics to identify progress and where there may be opportunities to further reduce emissions. For Mohawk College, there are two ways that Mohawk can look at the intensity of GHG (i.e. unit of GHGs for a functional unit), these could be the area of Mohawk (m²) or the number of full-time student equivalents (FTE). Figures 6 and 7 below provide the annual GHGs per unit area for each of the campuses for electricity and natural gas respectively.

5.2.1 EMISSION INTENSITY ON A M² BASIS

In 2012, the GHG emissions per the space area (m²) from the use of electricity were lower than the baseline for all types of space considered in this GHG inventory. However, emissions have decreased primarily as a result of cleaner electricity production – i.e. the emission factor dropped from 0.0024 to 0.0011 as Ontario closed its

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coal fired power plant and shifted towards lower emission electricity production. On an area basis in 2012, the Fennell campus has the highest electricity consumption per unit area followed by Brantford, and the residence. The lowest electricity consumption per unit area is the Stoney Creek Campus.

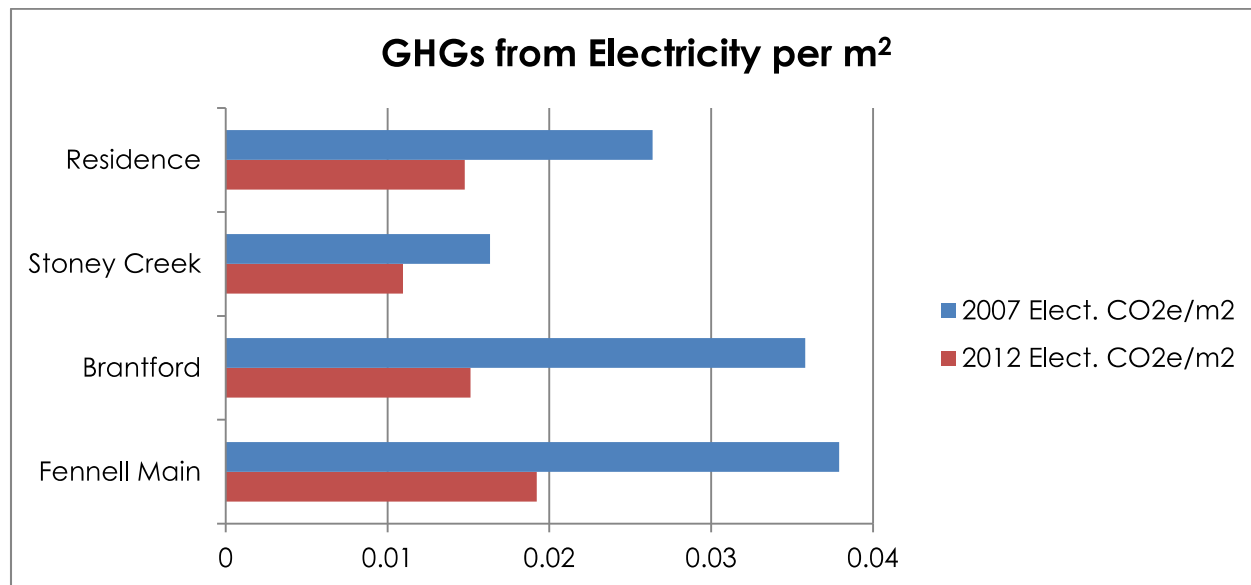


Figure 6 Annual GHGs from Electricity Consumption for 2007 and 2012 by Campus

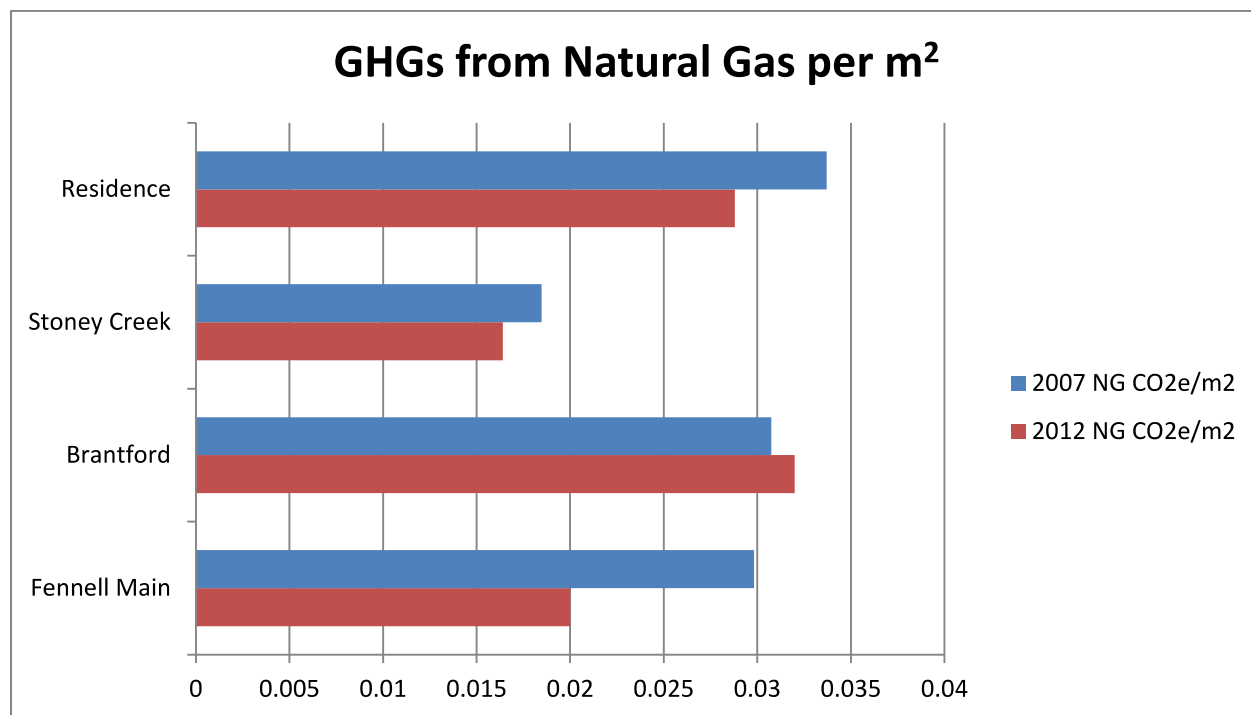


Figure 7 Annual GHGs from Natural Gas Consumption for 2007 and 2012 by Building

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In 2012, the GHG emissions per the space area (m²) from natural gas combustion are lower than the baseline for all types of space considered in this GHG inventory, with one exception for the Brantford building, the emissions per square meter were slightly higher than the baseline. On an area basis in 2012, Brantford was the highest consumption of natural gas, followed by the Residence, and Fennell Main. Stoney Creek had the lowest natural gas consumption per unit area.

5.2.2 EMISSION INTENSITY ON A PER STUDENT BASIS

The emission intensity in 2012 was 0.67 tCO₂e /student compared to 1.17 tCO₂e /student in 2007 resulting in an emission intensity decrease of 44%. This is attributed by the decrease in overall GHG emissions by 24% and the increase in FTE enrollment by 35% from 2007. Emission intensities per FTE for 2012 compared to the baseline are provided in Figure 8.

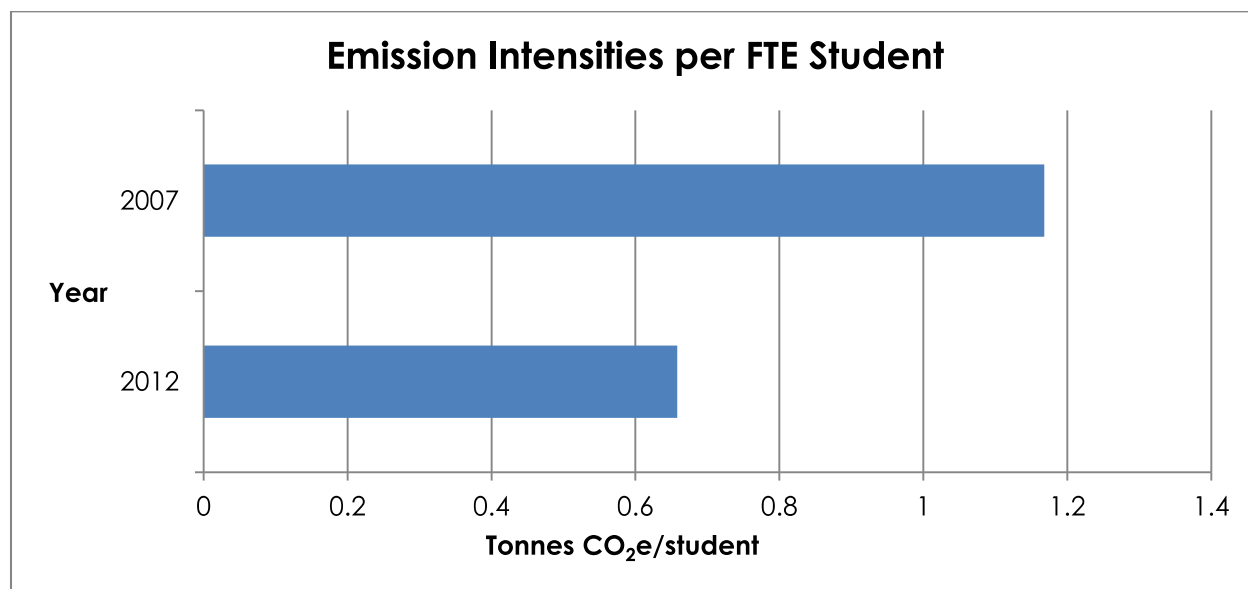


Figure 8 GHG Emission Intensity (tonnes CO₂e/student) for 2007 and 2012

5.2.3 EMISSIONS RELATED TO WASTE

Emissions related to waste in 2012 were 6% lower than in 2007. While overall generated waste increased, there was a higher diversion rate to recycling during 2012 (72% in 2012 compared to 57% in 2007) and the amount of landfilled waste per FTE student decreased from 0.016 tonnes/student in 2007 to 0.011 tonnes/student in 2012.

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6.0 GHG REDUCTION OPPORTUNITIES

6.1 PAST AND CURRENT INITIATIVES

Mohawk College has carried out a number of initiatives with the aim of reducing GHG emissions while expanding its buildings and facilities. For example, energy efficiency upgrades and conservation efforts have saved enough energy to run the new H-Wing facility without any added energy consumption at Mohawk. Some of the GHG reduction initiatives that have contributed to this and other achievements include:

- Replacement in 2008 of approximately 9000 T12 fluorescent bulbs with more energy efficient T8 bulbs, reducing overall energy consumption from lighting by 25%;
- Installation in 2010 of a solar wall at the Engineering Wing to preheat fresh air in the winter months. This passive feature can increase incoming air temperature by up to 20°C on sunny days;
- Upgrading from pneumatic to Direct Digital Controls of valves and dampers, providing more accurate and energy-efficient control;
- Replacement of older and less efficient pumps, motors and cooling tower at Central Plant. Variable Frequency Drives added to improve efficiency and add better control.
- Replacement of dual-fired boiler system at Central Plant with more efficient and cleaner-burning natural gas-fired boiler system.
- Conversion of diesel-fired emergency generators at Central Plant to natural gas-fired emergency generators;
- Replacement of one large chillers with two smaller ones, increasing efficiency by running only one small chiller when reduced capacity required;
- Addition of 64,000 square foot LEED Gold facility. The David Bradley Athletic and Recreation Centre, R-Wing, opened September 3, 2013 and an application for certification has been submitted;
- Sale in 2011 of Wentworth Campus building. Built in the early 20th century, the removal of this inefficient building is expected to have a positive impact on Mohawk College's overall energy efficiency;

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- Campus intensification with the transfer of more than 1200 students and staff of the now-closed Brantford (Elgin) Campus to the Fennell Campus. This transfer has resulted in no net increase in water or electricity use. Programs such as MoCoModal, a custom travel planner, and a shuttle service from Brantford have provided green alternatives to students and staff; and,
- Student and staff engagement. Various programs are underway promoting awareness of the sustainability initiatives at Mohawk. These programs include promotion of ban on plastic bottles and bags, environmental course offerings, enhanced signage, creation of a waste management zone, partnership with Smart Commute Hamilton and student-run ECOS Committee.

6.2 FUTURE INITIATIVES

While many significant GHG reduction initiatives have taken place at Mohawk College, there are numerous initiatives that could be carried out in order to maximize GHG emissions savings while aligning with the Pan-Canadian Protocol for Sustainability, the Mohawk College Strategic Plan, the Mohawk College Environmental Management Plan and Mohawk College's reporting commitments as a member of the Association for the Advancement of Sustainability in Higher Education (AASHE). This section outlines some of Mohawk College's previously assessed, planned and future potential initiatives.

6.2.1 SOLAR ENERGY PANELS

Mohawk College is considering the installation of solar energy panels facilitated through an application to submit to the third phase of the Ontario Power Authority's Feed-in Tariff (FIT) Program, which requires a community partnership to meet approval standards. An assessment of the optimal location of the solar panels needs to be made before following through, since older building roofs do not provide the soundest infrastructure for this initiative.

6.2.2 BIOMASS

Mohawk College has considered the use of biomass for energy production on a small scale only, providing students with a demonstration of the technologies that tie incineration to energy production. The proximity of Mohawk to surrounding neighborhoods could pose a challenge in pursuing biomass as a source of energy.

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6.2.3 UPGRADE SENSORS

A study using data from the already-installed upgraded sensors for chillers and towers at the Central Plant could lead to energy savings for Mohawk College. Data collected from the sensors would allow targeted operational changes that could result in a 10% increase in efficiency. A six-week study is planned to take place in the summer of 2014 to make use of this data.

6.2.4 MULTI-MODAL TRANSPORTATION HUB

This project proposes a multi-faceted facility that will serve as a central place of connectivity for multiple forms of public and active transportation to complement Mohawk's ongoing commitment to travel alternatives.

6.3 RECOMMENDED INITIATIVES

The following recommendations are put forth for future consideration by Mohawk College. In accordance with the EMP, these should be assessed in terms of sustainability, social and economic indicators.

6.3.1 ASHRAE ENERGY AUDITS

Conduct a level 3 Energy Audit. Energy audits may identify poor performing areas and identify savings from an operation standpoint and associated energy and greenhouse gas reductions. Energy audits will identify the anticipated payback period for capital improvements and this can be used to easily identify priorities and assist in making the go/no-go decision. For instance a 1,000,000 kWh reduction in electricity (approximately 5%) could save the college approximately \$80,000 and 110 tonnes of CO₂e emissions.

6.3.2 PURCHASING & PROCUREMENT STRATEGY

Develop a Purchasing & Procurement Strategy that focuses on the triple bottom line. The framework for purchasing decisions should take into account economic, social and environmental considerations and allow for trade-offs where conflicting priorities may exist.

6.3.3 EMERGENCY GENERATORS

Mohawk College currently tests their emergency generators 2 to 4 hours per month. The manufacturer recommended testing time for many such generators is often only 1 hour per month. A review of the generators and their suggested testing times is

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recommended as reduced generator run times would result in direct fuel and emissions savings.

6.3.4 PROGRAMMABLE THERMOSTATS

Programmable thermostats can reduce energy consumption and improve comfort, convenience and operational efficiencies. Heating and cooling of facilities make up a large proportion of Mohawk College's GHG emissions, therefore ensuring that all buildings have appropriate temperature set points throughout the day and throughout the seasons could have a significant impact on total GHG emissions.

6.3.5 OUTDOOR LED LIGHTING

While light-emitting diode (LED) lighting may not be appropriate for all types of lighting applications, the conversion of parking lot and outdoor signage to LED has been successfully applied by many corporations, with the outcome of reduced energy use and GHG emissions.

6.3.6 DIMMERS AND MOTION SENSORS

Installation of light switches connected to dimmers and motion sensors can result in energy savings in rooms and areas where light usage is expected to vary throughout the day. Motion sensors will eliminate the reliance of individuals turning off the lights in unoccupied rooms by causing the lights to turn off automatically after a pre-determined amount of time, while dimmers will allow users to adjust the light according to their needs.

6.3.7 GREEN DRIVING TRAINING

In order to optimize fuel efficiency while driving any vehicle, it is important to educate staff and students on the proper operation of the vehicle. One way to accomplish this is to offer a green driving training course. These courses, usually a few hours long, are offered online by reputable companies and provide guidance on idling, acceleration techniques, and driving at the right speed all of which can reduce GHG emissions and improve driver safety.

6.3.8 PAPER RECYCLED CONTENT

At Mohawk College, approximately 2% of the total quantity of paper used is from recycled material. This quantity could be increased significantly, without affecting printing or copying quality for many applications. While switching to 100% recycled paper content throughout Mohawk would be difficult to accomplish, increasing

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recycled content in most of the paper used is a relatively easy way to reduce GHG emissions as well as achieve other sustainability goals, such as waste reduction.

6.3.9 SUSTAINABILITY OUTREACH

Mohawk can continue to engage students and staff especially with regard to commuter travel and modal shifting (e.g. provides bus pass programs, bike share programs, etc.). This poses one of the larger opportunities for Mohawk to reduce the future year's emission intensities further.

6.3.10 INTERNALIZING THE COST OF CARBON

Mohawk College is encouraged to look at options for internalizing the cost of carbon. By setting caps or targets by department, and implementing a monetary penalty the college may provide incentives for choosing more sustainable activities. Alternatively, look for opportunities to provide other disincentives such as a college 'carbon tax' on parking pass sales. Funds collected could be funneled to support initiatives that might otherwise not get approval,

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7.0 BENCHMARKING AGAINST SIMILAR INSTITUTIONS

Commonly, GHG emissions can be compared to GHG benchmarks for similar facilities. To provide a meaningful benchmark for Mohawk against other college a slightly different approach has been employed to overcome these limitations. Energy use (natural gas and electricity) accounts for 98% of Scope 1 and 2 emissions at Mohawk College and is a good indicator to compare performance.

Figure 9 show the performance of similar colleges in Ontario in 2011/2012 and is taken from the Ontario College Facilities Management Association. Of the four (4) similar colleges in Figure 9, Mohawk College is outperforming similar facilities as assess by energy intensity (equivalent Kilowatt hours per full time equivalent student). When compared to the average energy intensity for Seneca, Niagara, Humber and Seneca Colleges, Mohawk's energy intensity is approximately 20% less.

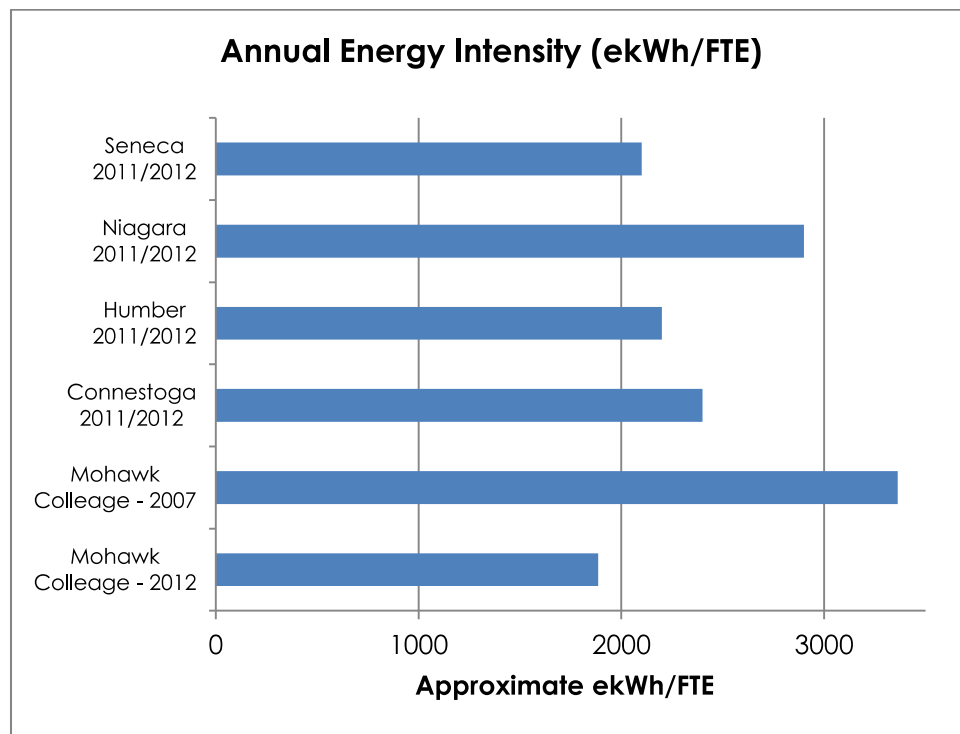


Figure 9 Energy Intensity (GJ/student) for Similar Institutes⁸ and Mohawk

⁸ Ontario College Facilities Management Association, 2011/2012 Facilities Benchmarking Report (excerpts provided by Mohawk College). Energy Intensities are approximate as read from the Energy Intensity Chart provided in the report.

8.0 IMPLEMENTATION AND MONITORING

8.1 IMPLEMENTATION STRATEGY

Mohawk's Environmental Management Plan provides the Implementation Strategy for Mohawk College. The Implement Strategy contains the direction and decision making criteria, specifically, the impact on environmental, social and financial indicators. The Implementation Strategy is reviewed and updated on an annual basis by the EMPSC. Objectives are included in yearly work plans aligning with the Pillars of change and champion of the initiative.

8.2 RECOMMENDATIONS FOR THE ENVIRONMENTAL MANAGEMENT PLAN

The following recommendations are made with regard to the Environmental Management Plan:

- To ensure that the Environmental Management Plan is engaged, particularly with regard to facilities, the Capital Assets Management Plan should include energy reduction targets and ensure that evaluation criteria include energy reduction and GHG emissions along with financial considerations.
- Mohawk College is encouraged to develop evaluation criteria to prioritize sustainability initiatives. Evaluation criteria should promote the overall sustainability strategy and consider existing Mohawk College Policy and financial decision making. Evaluation tools should be incorporated in the Environmental Management Plan for transparency and prioritization.

8.3 PERFORMANCE MONITORING FRAMEWORK

Mohawk College has taken important steps in developing a baseline emission inventory, developing sustainability initiatives and the 2012 GHG inventory provides a basis for assessing the success of the sustainability initiatives at Mohawk College. After the completion of each inventory, Mohawk is encouraged to assess the achievements that have been made with the implementation of sustainability measures.

An integral part of completing a GHG Emission Inventory is the collection of accurate data. This can particularly be a challenge with Scope 3 data. Mohawk is encouraged

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to meet with stakeholders to reiterate the importance of accuracy, transparency and consistency in how activity data is collected. Particularly, improvements to parking pass activity data is one area where significant improvements could be made. Specifically, it would be beneficial to differentiate between permanent address and school year address as well as how often the student intends on commuting. Further refinements could also be made if data was collected on the type of vehicle including any electric or hybrid models.

Mohawk is encouraged to assess the success of their initiatives and check that the objectives have been accomplished, and make revisions to the sustainability strategy where necessary. Increasing the frequency of reporting may also allow Mohawk to identify deficiencies or successes earlier on in the process.

9.0 CONCLUSIONS

Mohawk College has made significant progress and achieved emission reductions between 2007 and 2012. An absolute decrease of 24% between the baseline and 2012 GHG emission inventory was accomplished as well as a 44% decrease on a FTE basis. The commitment to sustainability initiatives both by the college and its students is apparent. While Scope 3 emission, beyond the control of Mohawk, increased by 6%, this growth occurred at a much slower rate than the 35% increase in enrollment at Mohawk. The college's commitment to reducing energy has resulted in a number of upgrades and replacement of major pieces of equipment, therefore, the key to future initiatives is student engagement and reducing Scope 3 emissions.

Mohawk is encourage to revise their implementation plan after reviewing the 2012 emission inventory and look for additional measures that may further reduce GHG emissions. Student/staff engagement will be important in any future initiatives as commuter data is now the largest source of emissions at Mohawk.

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10.0 CLOSURE

Stantec has completed Mohawk College's 2012 greenhouse gas (GHG) emissions inventory using reasonably ascertainable information obtained from Mohawk staff. The work in this report represents the conditions in the subject area at the time of the assessment. Stantec did not conduct direct GHG emissions monitoring, site visits or other environmental sampling and analysis in conjunction with this report. Per our Project Agreement with Mohawk College, Stantec's liability is limited to the amount of Stantec's fees for undertaking this work. Stantec disclaims liability for use by any other party and for any other purpose.

This report, entitled, "Mohawk College 2012 Greenhouse Gas Emissions Inventory" was produced by Nicole Flanagan.

This report was senior reviewed by Daniel Hegg.

Respectfully Submitted,

Stantec Consulting Ltd.



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MOHAWK COLLEGE 2012 GREENHOUSE GAS EMISSIONS INVENTORY

Appendix A
2007 Greenhouse Gas Emission Inventory
January 6, 2014

Appendix A 2007 Greenhouse Gas Emission Inventory

MOHAWK COLLEGE 2012 GREENHOUSE GAS EMISSIONS INVENTORY

Appendix B
2012 Data and Emission Calculations
January 6, 2014

Appendix B 2012 Data and Emission Calculations

Corporate Buildings

Year	Total CO ₂ e (t)	Total CO ₂ e (t)	CO ₂ e from Electricity (t)	CO ₂ e from Natural Gas	CO ₂ e from Diesel (t)
2007	8,411	8,411	4,876	3,524	12
2012	4,807	4,807	2,108	2,697	2
2013	-	-	-	-	-
2014	-	-	-	-	-
2015	-	-	-	-	-

Step 1: Facility descriptions in light blue are automatically populated based on data in Step 2: Record the consumption values for Step 3: Account numbers, water consumption and cost data can be added to light green Step 4: Greenhouse Gas emissions are

Facilities		2012					
Campus ID	Facility Name	Electricity			Natural Gas		
		Use (kWh)	CO ₂ e (t)	Cost (\$)	Use (m ³)	CO ₂ e (t)	Cost (\$)
Administrative & Maintenance		17,770,681	1,955	-	1,270,983	2,403	-
FF	Main Campus Building	12,847,864	1,413	-	751,147	1,420	-
FF	Shed	35,788	4	-	-	-	-
FF	Conference House	14,402	2	-	29,991	57	-
BF	Main Building	1,312,325	144	-	184,729	349	-
BF	West Building	512,841	56	-	39,805	75	-
SC	Main Building	2,594,286	285	-	186,626	353	-
SC	330 Leaside	87,832	10	-	857	2	-
SC	336 Leaside	344,644	38	-	77,829	147	-
SC	349 Leaside	20,700	2	-	-	-	-
Residences		1,372,702	151	-	155,672	294	-
FF	Residence	1,372,702	151	-	155,672	294	-
Athletics		16,711	2	-	-	-	-
FF	Althetic and Recreation Centre	16,711	2	-	-	-	-
All Facilities		19,160,094	2,108	-	1,426,655	2,697	-

Facilities		2012	
Facility ID	Facility Name	Use (L)	CO ₂ e (t)
All		815	2
			1,013

Note: Diesel invoices provided cost, used average cost for diesel (Toronto - West) in 2012 (\$1,242/5 per L) available at <http://www.energy.gov.on.ca/en/fuel-prices/fuel-price-data/?fuel=ds&yr=2012>

Vehicle and Small Engines

Year	Total CO ₂ e (t)	Scope 1	Scope 2	Scope 3
2007	110			
2012	112	112	-	-

Year	Total CO ₂ e (t)	CO ₂ e from Diesel (t)	CO ₂ e from Gasoline (t)
2007			
2012	112	9	103

- Step 1: Record the equipment descriptions in the white cells
- Step 2: Record the consumption data for each piece of equipment in the medium
- Step 3: Cost data can be added to light green cells but is not necessary for
- Step 4: Greenhouse Gas emissions are automatically calculated in the yellow cells.

Department / Usage	Vehicle Year	Vehicle Model	Fuel Type	2012					
				Gasoline Fuel Use (L)	CO2e (t)	Cost (\$)	Diesel Fuel Use (L)	CO2e (t)	Cost (\$)
				43877.01	103	56168.64	3142.823529	9	3739.76
		All Vehicles							

Fuel Cost for Regular Unleaded Gasoline Toronto 2012 (August):
<http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ154a-eng.htm> 1.286

Fuel Cost for Diesel Toronto 2012 (August) average:
<http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ15a> 1.19

Waste

Year	Total CO ₂ e (t)	Scope 1	Scope 2	Scope 3
2007	259			259
2012	244			244
2013				
2014				
2015				
2016				

Landfill			
Type of waste	2012		
	Amount of waste produced (tonnes)	Mass % of Total	CO ₂ e (t)
Mixed Waste	174.19	100%	244.00
Total	174.19	100%	244.00

Recycle			
Type of waste	2012		
	Amount of waste produced (tonnes)	Mass % of Total	CO ₂ e (t)
OCC	33.89	7%	0.00
Mixed Paper	222.82	49%	0.00
Plastics and cans	15.2	3%	0.00
Organics	180.34	40%	0.00
Total	452.25	100%	0.00

Diversion Rate	72%
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Note: CO₂e calculated in accordance with Canada's National Inventory Report using the USEPA LandGEM <http://www.epa.gov/ttn/catc/dir1/landgem-v302-gu>

Air Travel

Year	Total CO ₂ e (t)	Scope 1	Scope 2	Scope 3
2007	65.3			
2012	28	-	-	28
2013	-	-	-	-
2014	-	-	-	-
2015	-	-	-	-
2016	-	-	-	-

Year	Total CO ₂ e (t)	CO ₂ e from Aviation Gasoline (t)
2007		
2012	28	28
2013	-	-
2014	-	-
2015	-	-
2016	-	-

Contact	Data Source	
	File Type / Name	Date

Step 1: Record the total passenger kilometres travelled in the medium green cells.
Step 2: Total aviation gasoline fuel usage is automatically calculated in the light blue
Step 3: Cost data can be added to light green cells but is not necessary for
Step 4: Greenhouse Gas emissions are automatically calculated in the yellow cells.

Air Travel	2012				2013			
	Travelled Distance (km)	Fuel Use (L)	CO ₂ e (t)	Cost (\$)	Travelled Distance (km)	Fuel Use (L)	CO ₂ e (t)	Cost (\$)
Faculty Air Travel	326,532	11,429	28.1	68,623.1		-	-	
Athletics Dept. Air Travel	2,624	92	0.2					
TOTAL	329,156	11,520	28	68,623				

Paper

Year	Total CO ₂ e (t)	Scope 1	Scope 2	Scope 3
2007	1246.99			
2012	619	-	-	619

Step 1: Paper descriptions, and sizes in light blue are

Step 2: Record the consumption values for each energy type in the medium green cells.

Step 3: Account numbers, water consumption and cost

Step 4: Greenhouse Gas emissions are automatically

Paper	Quantity (Sheets)	Dimension	Amount Purchased (lbs)	Amount Purchased (short ton)	Average Recycled Content (%)	Purchased Virgin Paper (short tons)	Purchased Recycled Paper (short tons)	Amount of Virgin Paper (short tons)	Total CO ₂ e (lbs)	Total Metric Tons of CO ₂ e
Mixed Paper (8.5x11)	7,400,000	8.5x11	74,000	37	10%	33.3	4	33.30	361,809	164
Mixed Paper (8.5x14)	180,000	8.5x14	2,290	1	10%	1.03032	0	1.03	11,195	5
Mixed Paper (11x17)	107,500	11x17	2,150	1	10%	0.9675	0	0.97	10,512	5
School Books	6,052,500	8.5x11	28,316	14	0%		-	14.16	148,205	67
Calendars	847,000	8x10.625	21,175	11	0%	10.5875	-	10.59	110,830	50
Calendars (Cover)	11,000	8x10.625	275	0	0%		-	0.14	1,439	1
Comic Books	40,000	6.5x10	1,200	1	0%		-	0.60	6,281	3
Health	50,000	8.5x11	500	0	0%	0.25	-	0.25	2,617	1
Engineering	140,000	8.5x11	1,400	1	0%	0.7	-	0.70	7,328	3
Justice and Wellness	40,000	8.5x11	400	0	0%	0.2	-	0.20	2,094	1
Business	90,000	8.5x11	900	0	0%	0.45	-	0.45	4,711	2
Grad Certificates	40,000	8.5x11	400	0	0%		-	0.20	2,094	1
Human Services	50,000	8.5x11	500	0	0%		-	0.25	2,617	1
Interdisciplinary	2,100	8.5x11	21	0	0%		-	0.01	110	0
Media & Entertainment	60,000	8.5x11	600	0	0%		-	0.30	3,140	1
Skilled Trades	100,000	8.5x11	1,000	1	0%		-	0.50	5,234	2
Programs at a Glance	15,000	6.5x10	150	0	0%		-	0.08	785	0
CE Catalogues	20,700,000	8.5x11	121,053	61	0%	60.5263158	-	60.53	633,589	288
CE Catalogues Cover	300,000	8.5x11	9,000	5	0%	4.5	-	4.50	47,106	21
TOTAL	36,225,100		265,329	132.6645105						619

Coefficients

Ontario kWh Coefficients / Year

Inventory Year	Coefficient	
	kg CO2e / kWh	t CO2e / kWh
1990	0.19	0.00019
1991	0.196	0.000196
1992	0.197	0.000197
1993	0.127	0.000127
1994	0.103	0.000103
1995	0.12	0.00012
1996	0.135	0.000135
1997	0.172	0.000172
1998	0.232	0.000232
1999	0.237	0.000237
2000	0.3	0.0003
2001	0.29	0.00029
2002	0.29	0.00029
2003	0.3	0.0003
2004	0.22	0.00022
2005	0.25	0.00025
2006	0.21	0.00021
2007	0.24	0.00024
2008	0.17	0.00017
2009	0.12	0.00012
2010	0.15	0.00015
2011	0.11	0.00011
2012*	0.11	0.00011
2013	-	-
2014	-	-
2015	-	-
2016**	-	-
2017	-	-
2018	-	-
2019	-	-
2020	-	-
2021**	-	-
Notes and References:		
Emission factors from 2005 to 2011 are from the National Inventory Report 1990-2011 - Part 3 - Greenhouse Gas Sources and Sinks in Canada, Annex 13. Released April 15, 2013. Available to download from: http://www.ec.gc.ca/ges-ghg/ . All other factors are from the PCP GHG Accounting Tool.		
The 2005 to 2011 factors for Ontario are consumption intensities and incorporate unallocated energy and SF6 transmission emissions. 2011 is still preliminary data and may change.		
* The 2012 emission factor is unavailable until 2014 and as such 2011 has been used as proxy for 2012 emission factors		

Ontario Natural Gas Combustion

Province	CO ₂	CH ₄	N ₂ O	CO ₂ e
	(tonnes/m ³)	(g/m ³)	(g/m ³)	(t CO ₂ e / m ³)
Ontario	0.001879	0.027	0.035	0.001891
Notes and References:				
Emission factors are from the National Inventory Report 1990-2011 - Part 2 - Greenhouse Gas Sources and Sinks in Canada, Annex 8. Released April 15, 2013. Available to download from: http://www.ec.gc.ca/ges-ghg/ .				
The emission factors have not been broken down by year as fuel properties, such as carbon content, density, heating value, and to a lesser extent the combustion technology, remain relatively constant over time.				

Global Warming Potentials

Greenhouse Gas	100 Year GWP
CO ₂	1
CH ₄	21
N ₂ O	310
Notes and References:	
Global warming potentials (GWP) obtained from Intergovernmental Panel on Climate Change, Second Assessment Report, Climate Change 1995.	

Mobile Fuel Combustion

Vehicle Category	CO ₂	CH ₄	N ₂ O	CO ₂ e
	(g/L)	(g/L)	(g/L)	(t CO ₂ e / L)
Light Duty Gasoline Vehicles >= 2004	2289	0.14	0.02	0.0024
Light Duty Gasoline Vehicles < 2004	2289	0.23	0.47	0.0024
Light Duty Gasoline Trucks >= 2004	2289	0.14	0.02	0.0023
Light Duty Gasoline Trucks < 2004	2289	0.24	0.58	0.0025
Light Duty Diesel Vehicles >= 1996	2663	0.05	0.22	0.0027
Light Duty Diesel Vehicles < 1996	2663	0.07	0.21	0.0027
Light Duty Diesel Trucks >= 1996	2663	0.07	0.22	0.0027
Light Duty Diesel Trucks < 1996	2663	0.07	0.21	0.0027
Heavy Duty Gasoline Vehicles >= 1996	2289	0.07	0.20	0.0024
Heavy Duty Gasoline Vehicles < 1996	2289	0.29	0.05	0.0023
Heavy Duty Diesel Vehicles >= 1996	2663	0.11	0.15	0.0027
Heavy Duty Diesel Vehicles < 1996	2663	0.14	0.08	0.0027
Off-Road Gasoline Vehicles	2289	2.70	0.05	0.0024
Off-Road Diesel Vehicles	2663	0.15	1.10	0.0030
Notes and References:				
Emission factors are from the National Inventory Report 1990-2011 - Part 2 - Greenhouse Gas Sources and Sinks in Canada, Annex 8. Released April 15, 2013. Available to download from: http://www.ec.gc.ca/ges-ghg/ .				

Aircraft Fuel Efficiency	
Litres per 100 passenger kilometres	3.3
Litres per passenger kilometre	0.035
Notes and References:	
Fuel efficiency obtained from International Air Transport Association, August 2013. Assumed average modern aircraft. Available to download from: http://www.iata.org/whatsnew/aps-sfra/Pages/fuel-efficiency.aspx	

Stationary Combustion

Fuel	CO ₂	CH ₄	N ₂ O	CO ₂ e
	(g/L)	(g/L)	(g/L)	(t CO ₂ e / L)
Diesel	2663	0.133	0.40	0.0028
Propane	1507	0.027	0.108	0.0015
Notes and References:				
Emission factors are from the National Inventory Report 1990-2011 - Part 2 - Greenhouse Gas Sources and Sinks in Canada, Annex 8. Released April 15, 2013. Available to download from: http://www.ec.gc.ca/ges-ghg/ .				

PAPER

Paper			
	Virgin Production + Landfilling	Recycled Production + Recycling	
Environmental Releases (lbs/ton)	Tree Harvesting/Transport	Virgin Milling Energy/Releases	Total (per ton of OCC Recycled)
Total Greenhouse Gases (lbs CO ₂ Equivalents/ton paper)	305	10163	3574.1

Source: The Paper Task Force Final Report: Paper Task Force Recommendations for Purchasing and Using Environmentally Preferable Paper. Available online: http://c.environmentalpaper.org/documents/813_FTFcomplete.pdf Table A-2: Office Paper Energy, Air Emissions etc.

Fuel Type	CO ₂	CH ₄	N ₂ O	CO ₂ e
	(g/L)	(g/L)	(g/L)	(t CO ₂ e / L)
Gasoline	2289	0.54	0.20	0.0024
Diesel	2663	0.09	0.31	0.0028
Ethanol	1494	0.54	0.20	0.0016
Aviation Gasoline	2342	7.7	0.23	0.0025
Notes and References				
Emission factors are from the National Inventory Report 1990-2011 - Part 2 - Greenhouse Gas Sources and Sinks in Canada, Annex 8. Released April 15, 2013. Available to download from: http://www.ec.gc.ca/ges-ghg/ .				
The emission factors for CH ₄ and N ₂ O are an average of the factors for all types of vehicles and off road mobile sources, for each fuel type since no data on the type of vehicle was available.				
The ethanol emission factors for CH ₄ and N ₂ O are assumed to be the same as those for gasoline, as per the guidance in the Canadian National Inventory Report.				

<http://www.ec.gc.ca/ges-ghg/>

10.6 L/100km efficiency for Ontario

http://www.epa.gov/climateleadership/documents/resources/commute_1
<http://www.greyhound.ca/en/about/factsandfigures.aspx>

<http://www.uoa.claska.edu/sustainability/upload/GHGReport2012.pdf>

Average Emission Factors - Gasoline Light Duty Vehicles and Trucks				
Fuel Type	CO ₂	CH ₄	N ₂ O	CO ₂ e
	(g/L)	(g/L)	(g/L)	(t CO ₂ e / L)
Gasoline	2289.00	0.19	0.27	0.0024
Notes and References				
Emission factors are from the National Inventory Report 1990-2011 - Part 2 - Greenhouse Gas Sources and Sinks in Canada, Annex 8. Released April 15, 2013. Available to download from:				

The emission factors for CH₄ and N₂O are an average of all light gasoline vehicles and truck for all years since no data on type of vehicle was available.

MOHAWK COLLEGE 2012 GREENHOUSE GAS EMISSIONS INVENTORY

Appendix C
Facility and Asset Inventory
January 6, 2014

Appendix C Facility and Asset Inventory

Appendix C - Mohawk College Facilities and Equipment

Mohawk College Assets		
Campus ID	Campus Name	Facility Name
Administrative & Maintenance		
FF	Fennell	Main Campus Building
FF	Fennell	Shed
FF	Fennell	Conference House
BF	Brantford	Main Building
BF	Brantford	West Building
SC	Stoney Creek	Main Building
SC	Stoney Creek	330 Leaside
SC	Stoney Creek	336 Leaside
SC	Stoney Creek	349 Leaside
Residences		
FF	Fennell	Residence
Athletics		
FF	Fennell	Althetic and Recreation Centre

Vehicles and Equipment

Vehicles and Equipment are not provided on a piece by piece basis - estimates are based on fuel consumption and kilometers travelled.