FINAL REPORT

OCTOBER 2, 2018

2017 GREENHOUSE GAS EMISSIONS REPORT

PRESENTED BY: AMERESCO, INC.

MARK WILHELM

TARA HAVILAND

MITCHELL ROBITAILLE

Mohawk College 2017 Greenhouse Gas Emissions Report

Final Report, October 2018

Technical Report

Ameresco Project Director
M. Wilhelm

Ameresco, Inc. ● 30 Leek Cres, Suite 301 ● L4B 4N4 Richmond Hill, Ontario ● Canada
888.483.7267 ● information@ameresco.com ● www.ameresco.com

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES

This document was prepared by Ameresco, Inc. and Quest Energy Group, LLC to provide Mohawk College decision-makers with an inventory of the greenhouse gas emissions produced by Mohawk College during 2017. It also provides high-level recommendations for actions that can be taken at Mohawk to better understand GHG emissions on an on-going basis. This knowledge will help Mohawk leaders to develop more effective strategies to reduce GHG emissions in the future. The goals and scope of this consulting project were defined by leaders at Mohawk College. Ameresco, Inc. and subcontractor Quest Energy Group, LLC were hired by Mohawk College to complete this technical report due to their unique experience in this area.

Neither Ameresco, Inc. nor Quest Energy Group, LLC make any (A) warranty or representation whatsoever, expressed or implied, with respect to the use of any information, process, or findings in this Report, nor (B) assumes responsibility for any damages or liability whatsoever resulting from the selection or use of this document or any information, process, or findings disclosed in this document.

Organization(s) that prepared this document:

Ameresco, Inc.

Quest Energy Group, LLC

CITATIONS

This report was prepared by:

Ameresco, Inc.
30 Leek Cres, Suite 301
M2N 6X3 Richmond Hill, Ontario
Canada

and

Quest Energy Group, LLC
1620 West Fountainhead Parkway, Suite 303
Tempe, AZ 85282

Project Director

Mark D. Wilhelm

Project Manager

Tara Haviland

Project Engineer

Mitchell Robitaille

AMERESCO
Green • Clean • Sustainable

TABLE OF CONTENTS

ABBREVIATIONS

AASHE – Association for the Advancement of Sustainability in Higher Education

CCCM – Centre for Climate Change Management

CH_4 – methane

CO_2 – carbon dioxide

CO_2e – carbon dioxide equivalent

CRM – carbon reduction measure

DBARC – David Braley Athletic and Recreation Centre

ECM – energy conservation measure

EPA – U.S. Environmental Protection Agency

FTE – full-time equivalent students

GHG – greenhouse gas

HFC - hydrofluorocarbon

IPCC – Intergovernmental Panel on Climate Change

kWh – kilowatt hour

N_2O – nitrous oxide

MTCDE – metric tons of carbon dioxide equivalent

PFC - perfluorocarbon

tCO_2e – tonnes of carbon dioxide equivalent

WARM – Waste Reduction Model

WBCSD – World Business Council on Sustainable Development

WRI – World Resources Institute

METHODOLOGY AND APPROACH

The Mohawk College Greenhouse Gas (GHG) Emissions Inventory was conducted in 2017-2018 by Ameresco, working with representatives from the Mohawk's Campus Sustainability and Climate Change Department, the Centre for Climate Change Management (CCCM) at Mohawk, and the Facilities Department at the College.

This is the third GHG emissions inventory commissioned by Mohawk College:

- The 2007 Baseline GHG Emissions Inventory was completed by Zerofootprint Software, Inc. This baseline assessment was completed to help define realistic GHG reduction goals, to serve as a benchmark for future emissions inventories, and to help determine the benefits of implemented GHG emissions reduction strategies.
- In 2013 Mohawk College retained Stantec Consulting Ltd. (Stantec) to complete the GHG emissions inventory for the 2012 reporting year.
- The 2017 inventory presents an estimate of Mohawk College's greenhouse gas (GHG) emissions for the calendar year 2017. This report exceeds the requirements of O. Reg. 397/11 reporting and thus provides a more comprehensive and transparent measurement of Mohawk's GHG emissions.

This report presents an estimate of Mohawk College's greenhouse gas (GHG) emissions for calendar year 2017. It includes emissions for all activities that have been determined to be material sources of Scope 1 and Scope 2 emissions. It also provides information pertinent to key Scope 3 emissions activities. This comprehensive inventory will help Mohawk leadership better understand where progress has been made and where future efforts should focus to reach GHG emissions reduction goals.

The 2017 GHG emissions inventory was conducted using Scope 5 GHG Emissions software. This software provides best-of-class GHG emissions estimates based upon a large library of appropriate emissions factors and accepted greenhouse gas accounting methodologies.

Our assessment and inventory approach are directed by the best practices presented in the *GHG Protocol: A Corporate Accounting and Reporting Standard, (Revised Edition)* (GHG Protocol), which was developed and distributed by the World Resources Institute (WRI) and the World Business Council on Sustainable Development (WBCSD).

A specific GHG emissions inventory protocol has not yet been developed for the Higher Education Sector. There are, however, several informal best practices that have been adopted for some aspects of GHG emissions accounting by higher education trade organizations. Mohawk College has been a leader in this space over the past decade, and as a result, the College has adopted several of these accounting practices, like tracking and reporting Scope 3 Commuting, Paper Purchases, Athletics Travel and Landfilled Waste. We have leveraged an informed approach to GHG emissions accounting for Mohawk that improves reporting methodologies and emissions factors when appropriate.

The 2017 GHG inventory leverages a new approach to accounting for Student, Staff, and Faculty Commuting that is more accurate that approaches used in the past two inventories. This

updated approach will allow Mohawk sustainability leaders to effectively compare inventory results and evaluate mitigation strategies more effectively.

The appendices contain pertinent information regarding targeted emissions sources/activities, quantities and units associated with each source, and a set of appropriate GHG emissions factors to generate the attributed emissions.

PROJECT OBJECTIVES

1. Develop a 2017 GHG Inventory to fulfill the five-year interim reporting requirement.
2. Establish data to assist Mohawk College leadership in identifying projects that will result in future GHG emissions reductions.
3. Test Scope 5 Software for Mohawk College sustainability professionals and the Centre for Climate Change Management @ Mohawk College (CCCM).
4. Identify best management practices and develop wisdom and knowledge for the CCCM.
5. Streamline reporting approaches for both AASHE and the Provincial Government, as required.
6. Communicate results of GHG reduction measures to stakeholders through the final report.
7. Complete a GHG emissions inventory that will help Mohawk College provide leadership to the communities served and to the higher education sector in the Province of Ontario.

BOUNDARIES

The scope of this GHG emissions inventory is first defined according to organizational and operational boundaries.

Organizational Boundaries

The assets included in this GHG inventory include those that are under *operational control* by Mohawk College, which has the full authority to introduce and implement its operating policies at all the included assets. This approach is consistent with the current GHG accounting and reporting practice of many similar higher education institutions that report on emissions from facilities that they operate. Under the operational approach, an entity accounts for 100% of emissions over which it or one of its subsidiaries has operational control.

Operational Boundaries

Consistent with GHG Protocol standards, organizations are expected to track and report the emissions of the six greenhouse gases listed under the Kyoto Protocol as they pertain to their organizational operations, including: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

The primary focus of GHG accounting for Mohawk should be on CO2 and CH4 since those emissions typically represent the largest quantity of GHG emissions for any college or university. N2O emissions will represent only a small percentage of overall GHG emissions. PFC and SF6 emissions are highly unlikely to be found on a higher education campus. HFC emissions are a small percentage of overall college campus emissions; they aren't currently being tracked by Mohawk College but should be in the future to be consistent with GHG Protocol standards.

HFC emissions are associated with refrigeration systems that are located throughout both Mohawk campuses (chillers, air conditioning units, walk-in refrigerators and freezers, etc.). A typical unit of HFC gas emitted from a refrigeration system on a college campus may have 1,300 (HFC-23) to 12,400 (HFC-134a) times the global warming impact over a 100-year timeframe when compared to an equal quantity of carbon dioxide (see table below). The study and comparison of GWPs for various GHGs presents a valuable learning opportunity for students, staff, and faculty at Mohawk.

Global Warming Potential (GWP) Values Relative to CO_2 for Select Greenhouse Gases, per the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5)		
Industrial Designation or Common Name	**Chemical Formula**	**GWP Values for 100-Year Time Horizon**
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265
Substances Controlled by the Montreal Protocol		
CFC-11	CCl_3F	4,660
HCFC-22	$CHCLF_2$	79
Hydrofluorocarbons (HFCs)		
HFC-23	CHF_3	12,400
HFC-134a	CH_2FCF_3	1,300
Perfluorocarbons (PFCs) and Sulfur Hexafluoride		
Trifluormethyl sufur pentafluoride	SF_5CF_3	17,400
Sulfur hexafluoride	SF_6	23,500

Source: Greenhouse Gas Protocol: Global Warming Potential Values

This report accounts for material Scope 1, 2, and 3 emissions associated with the two Mohawk Campuses that were operating in 2017. The emissions records were accumulated in four key groupings (nodes), with discrete activities (trackers) associated with each, as follows:

1. Fennell Campus Records
    a. 135 Fennell
        i. Fennell DBARC Natural Gas
        ii. Fennell Main Electricity
        iii. Fennel Main Natural Gas
    b. 293 Fennell (Shed)
        i. Fennell Shed Electricity
    c. 295 Fennell (Alumni House)
        i. Fennell Alumni Electricity
        ii. Fennell Alumni Natural Gas
2. Old Horizon Utilities Transfer Station Building Records
    a. 117 Market
        i. 117 Market Electricity
3. Shared Records
    a. Shared
        i. Student Commuting
        ii. Staff (Non-Faculty Employees) Commuting
        iii. Faculty Commuting
        iv. Athletics Commuting
        v. College Fleet
        vi. Fennell Landfilled Waste
        vii. Stoney Creek Landfilled Waste
        viii. Fennell Water Consumption
        ix. Stoney Creek Water Consumption
        x. Generators
        xi. Paper Recycling
4. Stoney Creek Campus Records
    a. 328 Leaside
        i. 328 Leaside Natural Gas
    b. 330 Leaside
        i. 330 Leaside Electricity
    c. 336 Leaside
        i. 336 Leaside Electricity
        ii. 336 Leaside Natural Gas
    d. 349 Leaside
        i. 349 Leaside Electricity
    e. 481 Barton
        i. Stoney Creek Main Electricity
        ii. Stoney Creek Main Natural Gas

The Brantford Campus was closed in 2013. It was not an active campus for Mohawk during 2017 and therefore was not included in the inventory.

Discrete data associated with each asset and emissions source, including quantities of resources consumed and associated emissions factors and total GHG emissions, are presented in the appendices of this report.

SCOPES AND ACTIVITIES

Greenhouse gas emissions accounting protocols break the sources of the material emissions into three GHG emissions Scopes, as follows:

1. **Scope 1 emissions** refer to direct emissions, attributable to fuel burned in facilities or in equipment owned or operated by Mohawk College
2. **Scope 2 emissions** are indirect emissions due only to purchased electricity for facilities and campuses that are owned or operated by Mohawk College
3. **Scope 3 emissions** are also indirect and include any emissions that are not included in Scopes 1 and 2 but that may be part of Mohawk's value chain

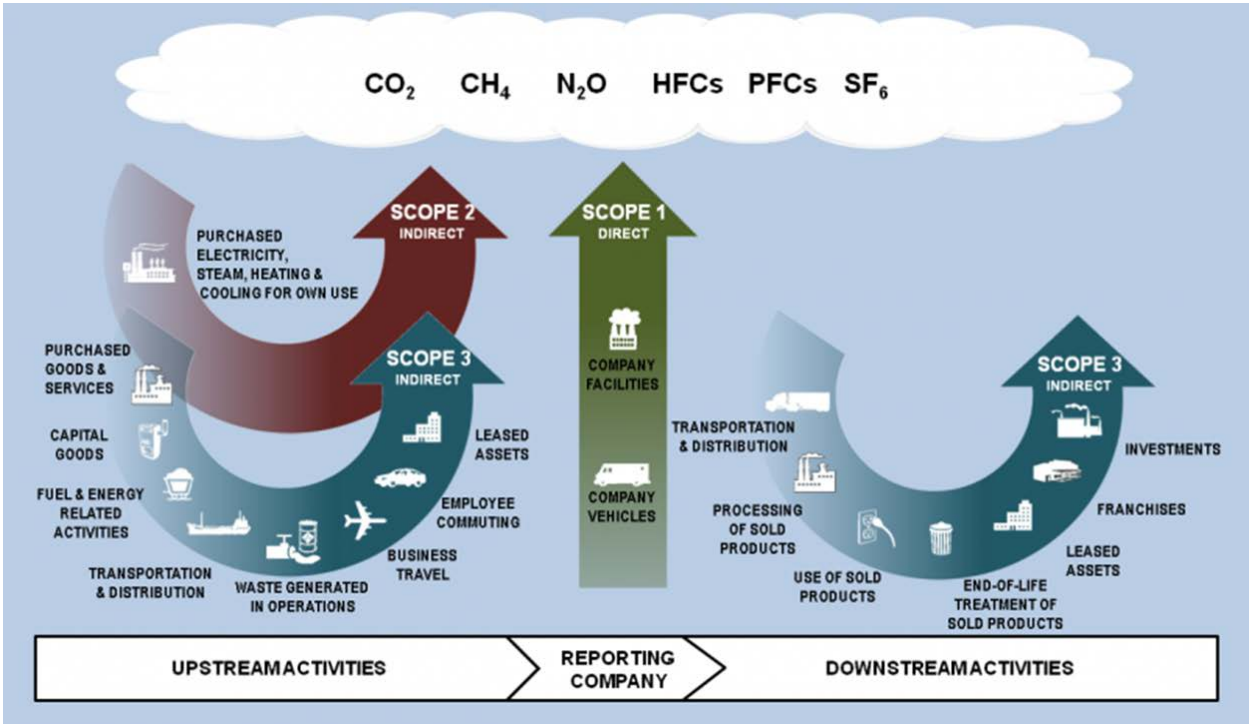


Image source: WRI/WBCSD 2011

Targeted Scope 3 emissions are tracked in this report, even though organizations are typically not required to report Scope 3 emissions under the GHG Protocol. Several of these emissions

activities represent significant opportunities for emissions reductions, however, and as a result, Mohawk College and many other leaders in the global higher education sector have chosen to track and report material Scope 3 emissions.

It is important to point out that this inventory represents an emissions estimate, as opposed to a complete, accurate and precise quantification of emissions. The GHG emissions accounting and inventory process is new, evolving, and improving every year. The results shared in this report should be considered as or more accurate than most other GHG emissions inventories for the sector.

DISCUSSION OF DISCRETE EMISSIONS SOURCES/ACTIVITIES AND ASSUMPTIONS

All pertinent data inputs for the GHG inventory were provided by Kate Flynn and Emily Vis on behalf of Mohawk College.

INSTITUTIONAL INFORMATION

Utility and Waste Expenses

Expenditures for electricity, natural gas, and landfill waste were collected from invoices provided by Mohawk. The totals were input into the Scope 5 software and will thus be available as pertinent data for comparisons with future GHG emissions inventories. The total annual expenses for each are listed in the *Appendix 1: Mohawk College Usage and Cost Report*.

Population

Student, faculty, and staff (aka non-faculty employees) population data was provided by Mohawk. The figures used to generate the number of FTE (full-time equivalent) students for the basis of our metric calculations are taken from the Fall Semester of 2017, which is a common approach for the higher education sector. This included 13,296 full-time students and 999 part-time students. Typical accounting methodology assumes that half-time students are 50% time, so the total number of assumed FTE students is 13,796.

FTE Student population figures are summarized and compared with those used for the Baseline 2007 and 2012 inventories in Table 1.

Building Area

Building area is summarized and compared with the data used for the Baseline 2007 and 2012 inventories in Table 1.

Table 1: FTE Student Population and Total Building Square Footage						
Parameter	**2007**	**2012**	**Change in 2012**	**2017**	**Change from 2012**	**Change from Baseline**
FTE Students	11,750	15,882	35%	13,796	-13%	17%
Square Meters of Buildings	127,280	127,885	0.5%	118,258	-7.4%	-7.1%
Square Feet of Buildings	1,370,031	1,376,543	0.5%	1,272,913	-7.4%	-7.1%

Building area by campus for 2017 is summarized in Table 2 below.

Table 2: 2017 Facility Data provided by Mohawk College				
Location	**Buildings**	**Address**	**Building Area (m^2)**	**Building Area (ft^2)**
Fennell Main	Fennell Main (including H-wing)	135 Fennell Avenue West Hamilton, ON L9C 1E9	93,413	1,005,486
	Fennell Student Centre			
	Fennell NDE			
	Fennell Shed			
	Fennell DBARC			
	Fennell Conference House			
	Residence			
Stoney Creek	Stoney Creek Main	481 Barton Street Stoney Creek, ON L8E 2L7	24,845	267,427
	Stoney Creek 330 Leaside			
	Stoney Creek 336 Leaside			
	Stoney Creek 349 Leaside			
	Centrum Building			
TOTAL			**118,258**	**1,272,913**

SCOPE 1 – FLEET (MOBILE COMBUSTION)

The Mohawk Fleet includes 22 light duty vehicles (LDV). One vehicle is electric, one runs on diesel fuel, and the remaining vehicles use gasoline. Fuel costs were provided for the months of September through December 2017. The fleet data was compiled as a Shared Record since they served both campuses.

Table 3: 2017 Fleet Vehicle and Fuel Type

Vehicle Number	Model Year	Manufacturer	Model Name	Fuel Type	Fuel Cost (Sep-Dec only)
1001	2016	KIA	SOUL EV	EV	N/A
1002	2017	KIA	SEDONA	Gasoline	$ 212.35
1003	2016	FORD	F-250	Gasoline	$ 559.63
1004	2008	FORD	E250	Gasoline	$ 424.60
1005	2010	FORD	FUSION	Gasoline	$ -
1006	2010	TOYOTA	MATRIX	Gasoline	$ 205.19
1007	2010	CHEVROLET	SILVERADO 2500HD	Gasoline	$ -
1008	2009	FORD	E250	Gasoline	$ 108.49
1009	2010	FORD	E250	Gasoline	$ 384.40
1010	2012	FORD	F-250	Gasoline	$ 799.10
1011	2012	CHEVROLET	SILVERADO 3500	Gasoline	$ 160.29
1012	2012	CHEVROLET	VOLT	Gasoline	$ 33.16
1013	2011	CHEVROLET	EXPRESS 2500	Gasoline	$ 381.76
1014	2012	MITSUBISHI FUSO	FEC72S	Diesel	$ 548.29
1015	2013	CHEVROLET	VOLT	Gasoline	$ 110.85
1016	2013	FORD	TRANSIT CONNECT	Gasoline	$ 125.01
1017	2014	JEEP	PATRIOT	Gasoline	$ 646.29
1018	2015	TOYOTA	RAV4	Gasoline	$ 148.76
1019	2015	TOYOTA	RAV4	Gasoline	$ 535.27
1020	2015	SCION	XB	Gasoline	$ 80.55
1021	2015	TOYOTA	CAMRY	Gasoline	$ 1,016.61
1022	2016	FORD	F-650	Gasoline	$ -
				TOTAL	**$ 6,480.60**

SCOPE 1 – NATURAL GAS CONSUMPTION (STATIONARY COMBUSTION)

Natural gas is used at individual buildings and at a central plant at the Fennell Campus to support both space heating and domestic hot water needs. There are three natural gas meters at each campus, as per Table 4 below.

Table 4: 01/01/2017 - 12/31/2017 Mohawk College Emissions and Activities Report - Natural Gas Only			
Trackers by Node	**Emissions tCO_2e**	**Activity**	**Mixed Activity Units**
Fennell Campus Records			
135 Fennell	**1,865.67**	**34,707,488.27**	**Cubic Feet**
Fennell DBARC Natural Gas	16.98	8,943.92	Cubic Metres
Fennell Main Natural Gas	1,848.69	973,862.70	Cubic Metres
295 Fennell (Alumni House)	**50.32**	**936,111.94**	**Cubic Feet**
Fennell Alumni Natural Gas	50.32	26,507.74	Cubic Metres
Totals	**1,915.99**	**35,643,600.21**	**Cubic Feet**
Stoney Creek Campus Records			
328 Leaside	**2.26**	**42,104.10**	**Cubic Feet**
328 Leaside Natural Gas	2.26	1,192.26	Cubic Metres
336 Leaside	**118.47**	**2,203,896.06**	**Cubic Feet**
336 Leaside Natural Gas	118.47	62,407.39	Cubic Metres
481 Barton	**412.47**	**7,673,194.68**	**Cubic Feet**
Stoney Creek Main Natural Gas	412.47	217,280.68	Cubic Metres
Totals	**533.20**	**9,919,194.85**	**Cubic Feet**
Totals for All Records			
TOTALS	**2,449.19**	**45,562,795.06**	**Cubic Feet**

SCOPE 1 – FERTILIZER (PROCESS EMISSIONS)

Synthetic fertilizers were not used at Mohawk College in 2017. They were also not in use for the 2012 inventory.

SCOPE 1 – BACK UP GENERATION (STATIONARY EMISSIONS)

Back up generators are all diesel powered. The fuel used for these units at all campuses were totaled as a Shared Record.

SCOPE 1 – REFRIGERANTS (FUGITIVE EMISSIONS)

Direct fugitive emissions include those from refrigeration, air conditioning, and fire suppression systems, in addition to those from industrial gases. Refrigerants are the key source to track and report in this category. Mohawk College has not tracked or reported emissions from these sources in the past but should do so in the future to be consistent with the GHG Protocol standards.

SCOPE 2 – PURCHASED ELECTRICITY

Electricity is provided to both campuses through 8 meters, including 3 meters at the Fennell Campus, 1 meter at 117 Market, and 4 meters at the Stoney Creek Campus. Table 5 below.

Table 5: 01/01/2017 - 12/31/2017 Mohawk College Emissions and Activities Report - Electricity Only			
Trackers by Node	**Emissions tCO_2e**	**Activity**	**Units**
Fennell Campus Records			
135 Fennell	**601.99**	**14,333,106**	**kWh**
Fennell Main Electricity	601.99	14,333,106	kWh
293 Fennell (Shed)	**1.66**	**39,618**	**kWh**
Fennell Shed Electricity	1.66	39,618	kWh
295 Fennell (Alumni House)	**0.22**	**5,240**	**kWh**
Fennell Alumni Electricity	0.22	5,240	kWh
Totals	**603.87**	**14,377,964**	**kWh**
Old Horizon Utilities Transfer Station Building Records			
117 Market	**0.45**	**10,808**	**kWh**
117 Market Electricity	0.45	10,808	kWh
Totals	**0.45**	**10,808**	**kWh**
Stoney Creek Campus Records			
330 Leaside	**4.41**	**105,119**	**kWh**
330 Leaside Electricity	4.41	105,119	kWh
336 Leaside	**14.94**	**355,614**	**kWh**
336 Leaside Electricity	14.94	355,614	kWh
349 Leaside	**0.39**	**9,312**	**kWh**
349 Leaside Electricity	0.39	9,312	kWh
481 Barton	**104.01**	**2,476,352**	**kWh**
Stoney Creek Main Electricity	104.01	2,476,352	kWh
Totals	**123.75**	**2,946,397**	**kWh**
Totals for All Records			
TOTALS	**728.07**	**17,335,169**	**kWh**

SCOPE 3 – STUDENT, FACULTY, AND STAFF COMMUTING

As is common with most colleges, Commuting represents the largest source of GHG emissions by far for Mohawk College, totaling 62.1% of all material GHG emissions in 2017. For this reason, we chose to utilize a more accurate method to track and disaggregate Commuting emissions for the 2017 inventory. We believe that this will offer Mohawk College leadership an opportunity to develop targeted strategies to reduce these Scope 3 emissions and track the success of those strategies with more clarity. Our approach includes the following:

- Emissions are now being tracked for three separate user groups, including Students, Faculty, and Staff (sometimes referred to as non-faculty employees). Staff commuting emissions were not tracked separately in either the 2007 Baseline or the 2012 GHG

inventories.[1] Students and Faculty were reported together in the 2007 baseline inventory. Staff was blended with Faculty in the 2012 inventory.

- Home addresses are tracked at the time that parking permits are issued, which provides a much more accurate estimate of round-trip distance traveled to-and-from the College when drivers are commuting.
- The College tracks the number of days that each vehicle is on campus, which allows us to more accurately estimate total miles traveled each year commuting to Mohawk.
- The automobile manufacturer, model, and age are also tracked, which permits us to estimate emissions factors for the vehicles more accurately.

Key commuting data for 2017 is presented in Table 6 below.

Table 6: 2017 Student, Faculty, and Staff Commuting Data and Results

Population	Total KM Commuting / Year	Total # of Parking Accounts	# of Parking Accounts with KM Traveled	Average KM / Year	Average # of Days on Campus	Average KM/Day Commuting
Students	21,139,771	5,339	3,759	5,624	92.6	60.7
Staff	6,894,495	784	760	9,072	221.2	41.0
Faculty	2,294,098	570	466	4,923	96.5	51.0
Total	**30,328,364**	**6,693**	**4,985**	**19,618**		

SCOPE 3 – FACULTY AND STAFF AIR TRAVEL

Faculty and Staff Air Travel was not tracked by Mohawk and is currently unavailable for GHG emissions reporting. It is reasonable not to include faculty air travel in the inventory for the following reasons:

- We considered Faculty and Staff Air Travel to be a de minimis source of GHG emissions, meaning that it is a small discrete source of emissions, totaling less than 1% of total Mohawk College emissions. When this source is added together with Athletics Department Air Travel and the Shuttle Service Taxi it represents less than 5% of total Mohawk GHG emissions, which is the accounting limit of total emissions that can be omitted from a compete GHG emissions inventory report.
- Faculty and Staff Air Travel is typically mission-critical, meaning that it is difficult to make meaningful reductions in total impact without impacting the Mohawk teaching and research mission.

While Faculty and Staff Air Travel is small, the impacts of air travel are quite large. We believe that Mohawk College leadership should track this discrete source of emissions as a learning moment, so that student, faculty, and administration can see the GHG impacts of maintaining a global footprint.

[1] Staff commuting results were included may have been included with the Faculty commuting figures in previous inventories. We could not determine if this was the case in time for this 2017 report.

SCOPE 3 – ATHLETICS DEPARTMENT AIR & BUS TRAVEL

Athletics Department Air Travel

Athletics Department Air Travel was tracked but not included in the GHG emissions inventory for the following reasons:

- The Athletics Department made a significant switch from air travel to bus travel before the 2012 GHG emissions inventory. This preference for bus travel was also evident in 2017.
- There were only two round trip flights recorded for the Athletics Department in 2017: one round trip to Edmonton, and another to Nanaimo.
- We considered Athletics Department Air Travel to be a de minimis source of GHG emissions, meaning that it is a small discrete source of emissions, totaling less than 1% of total Mohawk College emissions. When this source is added together with Faculty and Staff Air Travel and the Shuttle Service Taxi it represents less than 5% of total Mohawk GHG emissions, which is the accounting limit of total emissions that can be omitted from a compete GHG emissions inventory report.

Athletics Department Bus Travel

Athletics Department Bus Travel was tracked and reported for 2017 as a Shared Record.

SCOPE 3 – CAMPUS SHUTTLE AND SHUTTLE SERVICE TAXI

- The Campus Shuttle was not active in 2017 so that activity has no associated GHG emissions.
- We considered the Shuttle Service Taxi to be a de minimis source of GHG emissions, meaning that it is a small discrete source of emissions, totaling less than 1% of total Mohawk College emissions. When this source is added together with Faculty and Staff Air Travel and Athletics Department Air Travel it represents less than 5% of total Mohawk GHG emissions, which is the accounting limit of total emissions that can be omitted from a compete GHG emissions inventory report.

SCOPE 3 – PAPER USE

Paper use was tracked and reported as a Shared Record for the 2017 GHG emissions inventory. We believe that paper use GHG emissions reduction is a success story for Mohawk and the CCCM:

- Paper use emissions dropped by 50% from the 2007 Baseline report to the 2012 inventory.
- Paper use emissions dropped significantly again in 2017, registering a 55% reduction versus the 2012 inventory and a 78% reduction versus the Baseline Year.
- Paper consumption is a ubiquitous Scope 3 emissions source, so as a result, theoretically all public and private institutions that track and report GHG emissions

should be interested in the successful strategies employed by Mohawk to reduce these emissions.

- If the success reducing paper consumption is determined to be unique then we recommend that the CCCM consider this to be an appropriate subject to highlight for targeted audiences

SCOPE 3 – LANDFILLED WASTE

Waste that was sent to the landfill in 2017 was reported for each campus and tracked under Shared Records.

The tonnage of landfilled waste increased by 24% in 2017 versus the 2012 inventory. Associated emissions increased by 45%. This was partly due to selection of a more appropriate mixed waste designation, which calls for a higher GHG emissions factor per tonne than that used in previous GHG emissions inventories.

We recommend that Mohawk sustainability leadership focus on reducing the quantity of landfilled waste by including the following tasks:

- Mohawk completes an annual waste audit with students. Mohawk should continue to conduct a detailed waste audit at each campus for an appropriate amount of time (possibly a week) to determine the types and quantities of each waste stream.
- Require waste haulers to provide more specific, detailed, and timely records, including monthly reports that detail the various types of waste, where they were delivered, and the weights and associated costs; this is a critical path requirement for a sustainability-focused institution, and we have often seen waste haulers provide records that are not specific, detailed, or timely, which makes true accounting difficult.
- Work with waste haulers to develop a Mohawk Landfill Waste Reduction Plan, where specific strategies are developed to address each waste stream, specific individuals are assigned roles in the process, specific and measurable targets are set, and measurement and reporting are included.
- Use the U.S. EPA WARM tool to measure and better understand the GHG impacts of each waste stream and the landfills that receive the waste.

This is an excellent opportunity for students to develop skills relating to waste stream auditing, planning, metrics, recycling, and attitude and behavior modification techniques. These are skills that will be important in the new low-carbon economy.

BIOGENIC OFFSETS – RECYCLING AND COMPOSTING

Recycling and composting are critically important diversion strategies that should be undertaken to reduce the quantity and types of landfilled waste streams.

Recycling and composting emissions were not included in the 2017 GHG emissions inventory. These activities result in negative emissions, which can result in a confusing reduction of GHG emissions. Further, the actual positive and negative impacts of recycling and composting are very difficult to quantify. As a result, we believe that the benefits of recycling and composting are already recognized in a conservative manner in the reduction of landfilled waste, which would have been higher if tonnes of waste stream material weren't recycled, and in the use of compost as fertilizer, which reduces the need for synthetic fertilizers at Mohawk.

Also, the benefits of composting to "store" carbon in the topsoil has other benefits that are as important as they are hard to measure. We expect that this could be a worthwhile area for research and education for the low-carbon economy, as directed by the CCCM.

Further, ICLEI-USA has developed a useful Recycling and Composting Emissions Protocol (RC Protocol) in recognition of the benefits that these strategies can contribute to overall GHG emissions reduction. This is a stand-alone document that can be used in tandem with other emissions accounting and reporting protocols. It leverages the U.S. EPA Waste Reduction Model (WARM) which was used to determine emissions factors for waste streams and recycling for the 2017 GHG emissions inventory. The RC Protocol is most effective when used in a community-wide environment to track overall reductions and estimate any further reductions that may accrue because of larger-scale recycling and composting. This protocol should serve as a cornerstone of community-wide strategies, since these larger strategies deliver the economies of scale needed to develop effective, on-going strategies for diversion. We believe that this approach would be worthy of consideration as a CCCM strategy.

Table 7: Organics Totals per Calendar Year

Campus	Organics (tonnes)	Organics Cost (CAD)
Fennell	242.22	No price given
Stoney Creek	22.44	No price given
Total	**264.66**	

Table 8: Waste Quantities and Values for Landfill and Recycling				
Month	Landfill (tonnes)	Landfill Waste Cost (CAD)	Recycled (Commingled) (tonnes)	Recycling Cost (CAD)
Fennell Campus				
17-Jan	19.24	$ 2,185.93	50.52	$ 2,875.10
17-Feb	20.72	$ 2,214.29	47.73	$ 2,873.32
17-Mar	17.35	$ 2,371.65	52.75	$ 1,828.27
17-Apr	20.66	$ 2,212.98	44.07	$ 2,650.46
17-May	18.33	$ 2,220.47	39.99	$ 3,286.10
17-Jun	12.58	$ 1,682.36	18.09	$ 2,934.37
17-Jul	11.47	$ 1,321.55	22.85	$ 3,159.99
17-Aug	15.86	$ 1,607.97	25.93	$ 3,254.72
17-Sep	27.12	$ 2,631.22	38.83	$ 3,111.67
17-Oct	19.53	$ 2,118.49	24.61	$ 2,786.82
17-Nov	16.77	$ 2,043.20	21.88	$ 2,543.33
17-Dec	16.66	$ 1,776.38	27.04	$ 2,863.55
Total	**216.29**	**$ 24,386.49**	**414.29**	**$ 34,167.70**
Stoney Creek Campus				
17-Jan	3.59	$ 311.17	9.82	$ 504.40
17-Feb	0.00	$ -	16.95	$ 421.21
17-Mar	4.64	$ 377.32	20.55	$ 461.21
17-Apr	5.23	$ 414.49	17.50	$ 429.16
17-May	0.00	$ -	12.37	$ 528.50
17-Jun	7.51	$ 648.17	8.30	$ 437.11
17-Jul	0.00	$ -	9.21	$ 496.45
17-Aug	1.48	$ 553.67	5.57	$ 461.21
17-Sep	1.42	$ 211.00	10.46	$ 429.16
17-Oct	7.37	$ 719.31	11.87	$ 496.45
17-Nov	2.34	$ 281.87	9.59	$ 422.00
17-Dec	3.69	$ 317.47	9.93	$ 429.16
Total	**37.27**	**$ 3,834.47**	**142.12**	**$ 5,516.02**
Total for All Records				
Total	**253.56**	**$ 28,220.96**	**556.42**	**$ 39,683.72**

COMPARISON OF 2007 BASELINE, 2012, AND 2017 EMISSIONS INVENTORIES, BY SCOPE

Table 9 provides a comparison, by Scope, of each of the past two emissions inventories with the 2017 inventory. The extra effort taken to dig deeper into commuting emissions has provided more accuracy regarding the emissions for each stakeholder group. It has also resulted in higher total Scope 3 emissions when compared with the Baseline and the 2012 inventories.

Table 9: Summary of Baseline, 2012 and 2017 GHG Emissions Inventories and Changes, by Scope

GHG Emissions Scope	Baseline	2012 GHG Inventory		2017 GHG Inventory		
	2007 tCO_2e	2012 tCO_2e	Change from Baseline	2017 tCO_2e	Change from 2012	Change from Baseline
SCOPE 1 - *direct* emissions from fuel burned in fleet and equipment owned by Mohawk	3,645	2,811	-23%	2,507	-11%	-31%
SCOPE 2 - *indirect* emissions from purchased electricity	4,876	2,108	-57%	728	-65%	-85%
SCOPE 3 - *indirect* emissions not included in Scopes 1 or 2 but important to Mohawk	5,201	5,535	6%	7,068	28%	36%
Total	**13,722**	**10,454**	**-24%**	**10,303**	**-1%**	**-25%**

Table 10 below provides a discrete, line-item comparison of each of the activity types that produce GHG emissions in each of the three Scopes. It provides useful summary notes relating to each line item. It also presents a better understanding of the trends that we are seeing for each emissions source and a relative percentage each activity emits as part of total annual emissions.

- Commuting is the largest overall line item, with 62.1% of total emissions.
- Natural gas combustion is the second largest emissions source, with 23.8% of total 2017 emissions.
- Electricity emissions have dropped by 85% from the Baseline inventory. This dramatic decrease is partly due to improved conservation and efficiency projects that have been implemented at Mohawk and the closure of the coal-fired generating plants in Ontario.

Table 10: Comparison of Baseline, 2012 and 2017 GHG Inventories, by Activities (aka Emission Sources)								
Activity Type	Baseline	2012 GHG Inventory		2017 GHG Inventory			2017 GHG Inventory	
	2007 tCO_2e	2012 tCO_2e	Change from Baseline	2017 tCO_2e	Change from 2012	Change from Baseline	% of Total 2017 Emissions	Quick Notes
Scope 1	**3,645**	**2,811**	**-23%**	**2,507**	**-11%**	**-31%**	**24.3%**	
Fleet Fuel Consumption	109	112	3%	54	-52%	-51%	0.5%	Brantford campus closed
Natural Gas Consumption	3,524	2,697	-23%	2,449	-9%	-31%	23.8%	**KEY SOURCE**: Energy Conservation (ECMs); 13% fewer students; 7% less building area
Fertilizer	1	-	-100%	-		-100%	0.0%	No synthetic fertilizer use
Backup Generator	11	2	-82%	4	101%	-63%	0.0%	Little overall impact; business critical
Scope 2	**4,876**	**2,108**	**-57%**	**728**	**-65%**	**-85%**	**7.1%**	
Purchased Electricity	4,876	2,108	-57%	728	-65%	-85%	7.1%	Closed coal plants & ECMs
Scope 3	**5,201**	**5,535**	**6%**	**7,068**	**28%**	**36%**	**68.6%**	
Student and Faculty Commuting	3,504	4,534	29%		12%	44%		**KEY SOURCE**: 2017 report used more accurate method
Student Commuting				*4,599*			44.6%	2007+2012 data not discrete, can't compare
Faculty Commuting				*463*			4.5%	2007+2012 data not discrete, can't compare
Staff Commuting				*1,336*			13.0%	2007+2012 data not tracked
Faculty and Staff Air Travel	26	28	8%	de minimis				< 5% of total emissions; business critical; not tracked for GHG inventory
Atheletics Dept. Air Travel	40	0.2	-67%	de minimis	201%	-1%		< 5% of total emissions; only 2 air trips completed in 2017
Atheletics Dept. Bus Travel	0.2	13		40			0.4%	Little impact overall; should research
Campus Shuttle	122	94	-23%	N/A				Shuttle is no longer in service
Shuttle Service Taxi	3	3	0%	de minimis				<5% of total emissions; not worth reporting
Paper Use	1,247	619	-50%	276	-55%	-78%	2.7%	Big reduction worth researching for learning, sharing at CCCM
Waste	259	244	-6%	355	45%	37%	3.4%	24% increase landfill tonnage; recommend further research, waste audit, and use of EPA WARM tool
TOTAL	**13,722**	**10,454**	**-24%**	**10,303**	**-1%**	**-25%**	**100.0%**	

IMPROVING EFFORTS TO TRACK COMMUTING EMISSIONS

Mohawk leadership could update the 2007 and 2012 GHG emissions reports to better reflect the new methodology used to track commuting emissions in the 2017 inventory. *This will provide Mohawk with more realistic 2030 and 2050 GHG reduction targets.* Further, this approach will allow for more accurate comparisons with the 2017 inventory and future inventories. Much of this data was available and leverage for the 2012 report. At worst case, for 2007, the data needed to complete this update would include the following:

- Total number of parking accounts for Students, Faculty, and Staff. This can be estimated based upon making reasonable business judgements regarding the number of commuters in each group.
- Average number of kilometers traveled each way for each commuter. If this is not available, then this could be estimated based upon the 2017 averages, and adjusted based upon good business judgement, accounting for the use of the Brantford Campus and the known status of mass transit alternatives.
- Average number of days spent commuting by members of each group. This could also be estimated based upon the averages determined for the 2017 inventory.
- Average emissions factors for light duty vehicles that would have been in use.

INTENSITY METRICS

Greenhouse gas emissions accounting is a relatively new practice. As a result, reporting requirements and metrics for comparison often change and become more detailed. Organizations in many sectors report only Scope 1 and Scope 2 emissions, since that is all that is required by reporting agencies and accounting protocols.

Some sectors – like the Electric Utility Sector – have much more extensive reporting requirements and guidelines to direct their GHG accounting practices and reporting. Others, like the Higher Education Sector, have been driven by sector norms and precedence from trade organizations like the American Association of Sustainability in Higher Education (AASHE) and Second Nature. As a result, common inventory and reporting practices have evolved to include several Scope 3 emissions activities, including:

1. **Student, Staff, and Faculty Commuting** – this is typically the largest emissions source for colleges and school boards across North America
2. **Travel (sports teams and business activities)** – while this emissions source isn't typically large, Travel does present opportunities to lower high-visibility emissions and educate the community
3. **Solid Waste Disposal** – this activity is highly visible, has environmental implications beyond climate change, and offers associated educational opportunities, including impacts of life cycle analysis and transitioning to the low-carbon economy
4. **Paper Purchases** – paper is a ubiquitous resource at most every organization; it is highly visible and easy to reduce purchases through environmentally preferred purchasing policies and operations guidelines; paper purchases offer unique cultural and behavioral opportunities to influence key stakeholder groups (as do Durable Electronics Purchases)

The Province of Ontario's Green Energy Act 397/11 reporting requirements have typically been focused on reporting building energy consumption Scope 1 and Scope 2 emissions sources. Most of the 24 colleges in Ontario have reported only natural gas, diesel, and electricity consumption, and have rarely included fleet emissions.

For these reasons, we have developed two tables to evaluate and compare Emissions Intensities for Mohawk College, as shown below.

Table 11: Baseline, 2012 and 2017 GHG Inventories, by Emission Intensities (All Scopes, International)						
Sector Parameters	Baseline	2012 GHG Inventory		2017 GHG Inventory		
	2007 tCO_2e	2012 tCO_2e	Change from Baseline	2017 tCO_2e	Change from 2012	Change from Baseline
Total Emissions (tCO2e)	13,722	10,454	-24%	10,303	-1%	-25%
tCO_2e / FTE Student	1.17	0.66	-44%	0.75	13%	-36%
tCO_2e / 1,000 m^2	108	82	-24%	87	6%	-19%
tCO_2e / 1,000 ft^2	10.02	7.59	-24%	8.08	6%	-19%

Table 11 (All Scopes) – focuses on all three emissions Scopes (1, 2, and 3) and includes three metrics: tonnes of CO2 equivalent per full time equivalent (FTE) student (tCO2e/FTE), per 1,000 square meters of built space (tCO_2e/m^2), and per 1,000 square feet of built space (tCO_2e/ft^2). *The metric values in this table can be compared internationally with other colleges and universities, such as those reported through AASHE and Second Nature.*

Table 12: Baseline, 2012 and 2017 GHG Inventories, by Emission Intensities (Scopes 1+2 Energy, Ontario)						
Sector Parameters	Baseline	2012 GHG Inventory		2017 GHG Inventory		
	2007 tCO_2e	2012 tCO_2e	Change from Baseline	2017 tCO_2e	Change from 2012	Change from Baseline
Total Emissions - Scopes 1+2 building energy only (tCO_2e) (natural gas, electricity, diesel)	8,510	4,917	-42%	3,235	-34%	-62%
tCO_2e / FTE Student	0.72	0.31	-57%	0.23	-24%	-68%
tCO_2e / 1,000 m^2	67	38	-42%	27	-29%	-59%
tCO_2e / 1,000 ft^2	6.21	3.57	-42%	2.54	-29%	-59%

Table 12 (Scopes 1+2, Energy) – shows metrics for Scope 1 and Scope 2 building energy emissions only (stationary source natural gas and diesel, plus electricity) for the same discrete metric categories; this is the common way that GHG emissions are reported to the Provincial government of Ontario under the Green Energy Act (O.reg. 397/11); Scope 1 emissions sources for this total do not include emissions fleet vehicles or refrigerants. *The metric values in Table 12 can be compared with those reported by other colleges and universities in Ontario, as reported under compliance with the Green Energy Act.*

ACHIEVING SIGNIFICANT GHG REDUCTIONS IS CHALLENGING

Comparing the results presented in Tables 11 and 12 tells a compelling story for leaders at Mohawk College:

- **Table 11 (All Scopes)** – The reductions that are apparent from the 2007 Baseline to this 2017 GHG inventory are significant and range from 19% to 36%, depending upon the line item. This highlights the importance of the continued focus on building energy consumption. It also reinforces the importance and impact of improved efficiency in use of energy and of space, since the growing number of students and campus intensification has resulted in more efficient use of space over time. It also highlights the need to focus more intently on Scope 3 (commuting, waste) emissions sources.
- **Table 12 (Scopes 1+2, Energy)** – The significant reductions in GHG emissions (59%-68% reductions from Baseline) from building-related energy consumption shown in Table 12 indicates that Mohawk College facilities and sustainability leadership have increased the efficient use of energy and space while serving more students. This is commendable and must be continued to reach the targeted GHG reduction goals.

Analyzing the data in this way underscores the difficulty of achieving significant, transformational reductions in GHG emissions, especially considering the magnitude of the reductions targeted by the Province of Ontario (37% by 2030 and 80% by 2050), which feed into federal GHG emissions reduction mandates:

- It is unrealistic to believe that **commuting emissions** will easily be driven down significantly or toward zero. Students, staff, and faculty will always need to travel to-and-from home and work, even if they live close, or take advantage of mass transit, creative scheduling or telecommuting arrangements. Only so many people will move close to campus, take mass transit, car pool, or purchase zero emissions vehicles.
- It is also challenging to find ways to drive **building energy-related emissions** down significantly or toward zero. Even the most efficient buildings will continue to use electricity, and many will also continue to use natural gas in the future. How much more efficient can Mohawk leaders make these buildings? What is the true "technical potential" of conservation, efficiency, fuel switching, and renewable energy strategies for each building or campus?
- Since it will be impossible to mitigate all travel-related and building energy-related GHG emissions it will be necessary to identify both onsite and offsite offsets that can make up for the remaining emissions that cannot be mitigated.

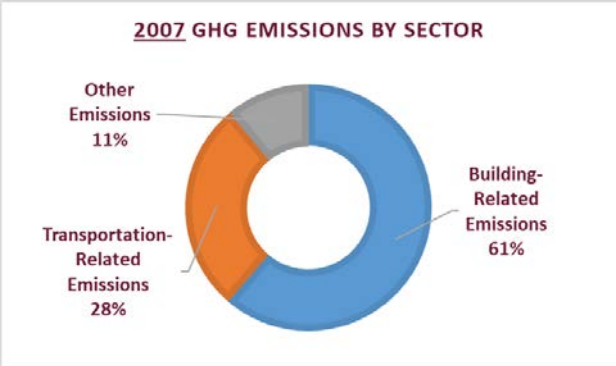
To demonstrate true leadership in the Higher Education Sector, Mohawk leaders should carefully examine the results of this GHG emissions inventory to better understand which strategies and develop strategies that will meet goals. This could best be realized through efforts to update the campus GHG Reduction Roadmap, since that will address multiple goals and challenges to implementation.

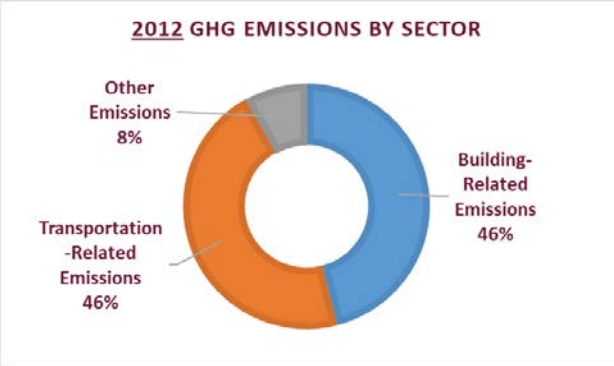
COMPARISON OF 2007 BASELINE, 2012, AND 2017 EMISSIONS INVENTORIES, BY SECTOR EMISSIONS

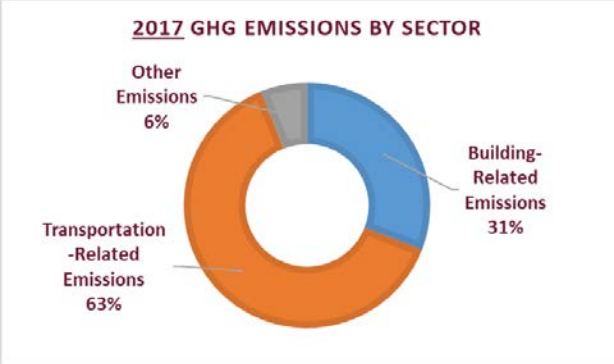
We believe that it is useful to understand the magnitude of emissions associated with energy use in buildings and energy use in transportation. Building-related emissions will be harder to reduce now that the coal plants have been closed and funding from the Climate Change Action Plan programs and the cap and trade program have been reduced or eliminated. While the economics and funding picture may change, the urgency to reduce GHG emissions to stem the rate and magnitude of climate change has only increased. In any case, it will be more challenging to implement the projects needed to get significant reductions in Scope 1 building-related GHG emissions.

Table 13: Baseline, 2012 and 2017 GHG Inventories, by Sector Emissions

Sector Parameters	Baseline	2012 GHG Inventory		2017 GHG Inventory		
	2007 tCO_2e	2012 tCO_2e	Change from Baseline	2017 tCO_2e	Change from 2012	Change from Baseline
Building-Related Emissions	8,411	4,807	-43%	3,181	-34%	-62%
Transportation-Related Emissions	3,804	4,784	26%	6,491	36%	71%
Other Emissions	1,507	863	-43%	631	-27%	-58%
TOTAL	**13,722**	**10,454**	**-24%**	**10,303**	**-1%**	**-25%**







Building-related emissions include:

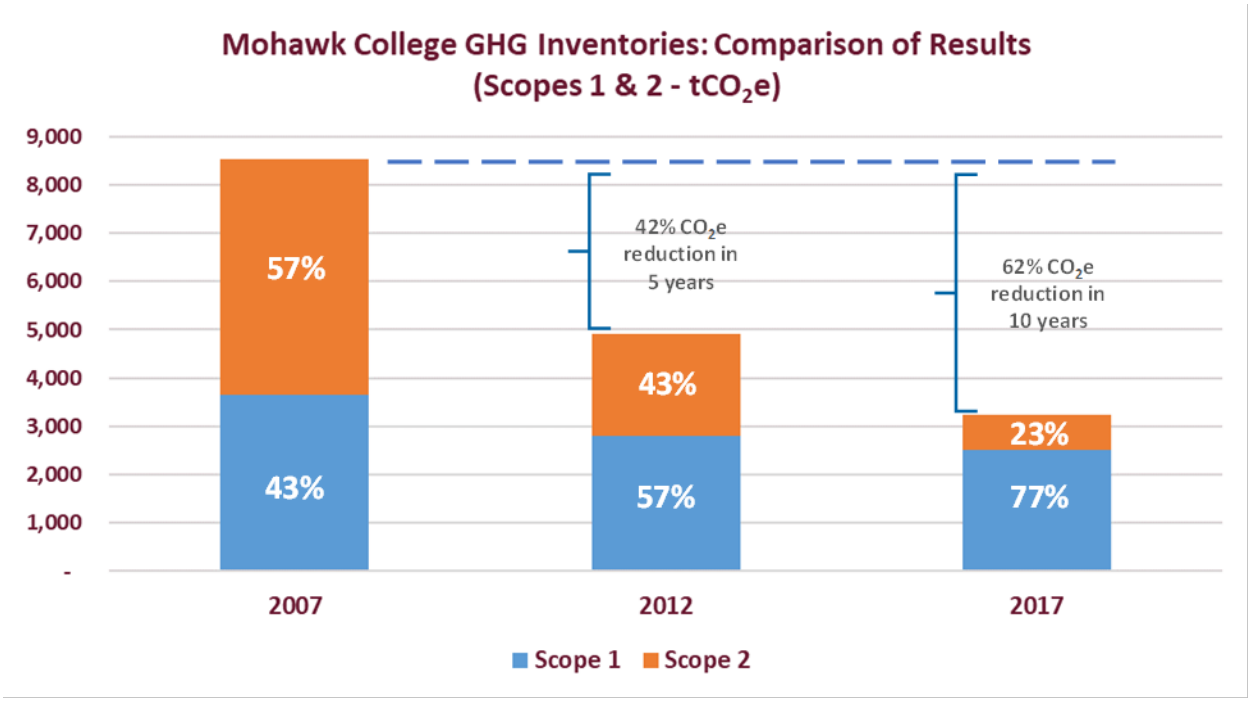
- Stationary source natural gas
- Backup generator diesel
- Purchased electricity

Transportation-related emissions include:

- Fleet fuel consumption
- Student, staff, and faculty commuting
- Athletics department travel

COMPARISON OF 2007 BASELINE, 2012, AND 2017 GHG EMISSIONS SCOPE RESULTS

The bar charts below provides a visual comparison of the three major GHG emissions inventories and how their Scope emission totals have changed over time. It also provides an understanding of how far leadership at Mohawk must go to meet targeted 2030 and 2050 GHG emissions reduction goals.

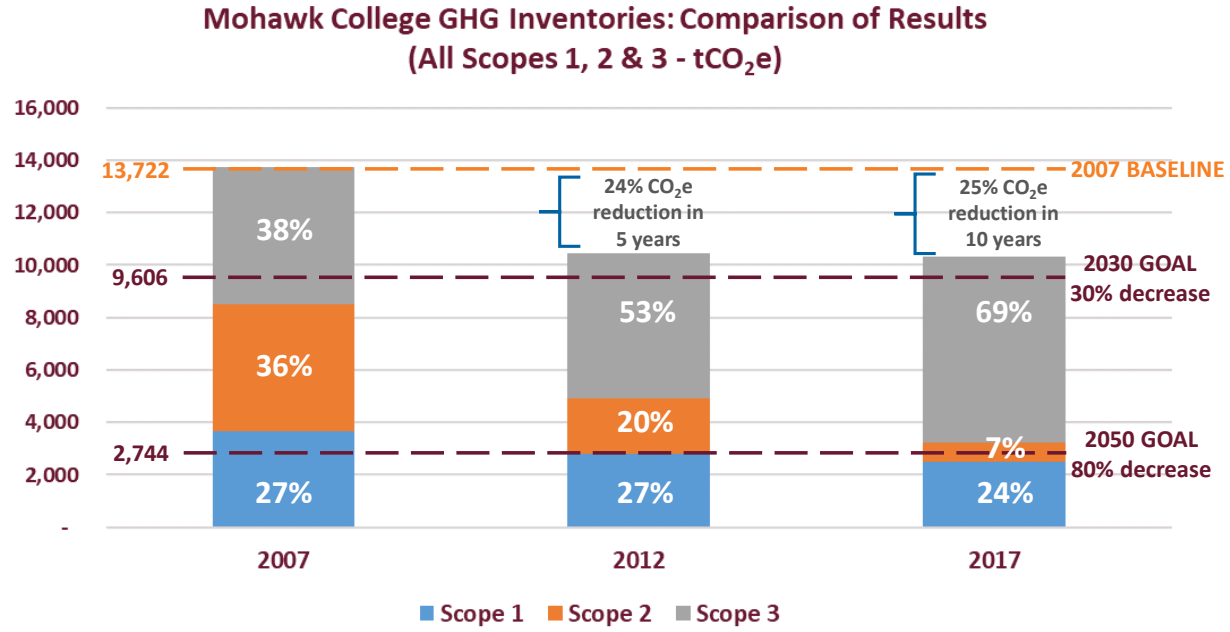


Comparison of Scopes 1 & 2 GHG emissions over time – The chart above shows that Scope 1 & 2 GHG emissions have dropped by 62% since the 2007 Baseline. Fully 98% of Scope 1 & 2 emissions are due to building-related energy consumption sources, including electricity, natural gas, and back-up diesel generators.

There was an 85% drop in Scope 2 emissions associated with purchased electricity. The reasons for this decrease include:

- An 82% decrease in the emissions factor (EF) for grid electricity due to increased use of renewable energy sources and closure of the all coal-fired generating plants in Ontario
- A 15% decrease in grid electricity purchases due to increased conservation and efficiency, 7% less building area, 13% fewer FTE students, and closure of the Brantford Campus

The 31% drop in Scope 1 emissions relates almost entirely to the decreased use of natural gas on-site for space and domestic water heating. Natural gas consumption dropped by 31% since the 2007 Baseline due to increased conservation and efficiency, 7% less building area, 13% fewer FTE students, and closure of the Brantford Campus.



Comparison of Scopes 1, 2, & 3 GHG emissions over time – The chart above shows that GHG emissions from all Scopes have dropped by 25% since the 2007 Baseline.

While Scope 1 & 2 emissions have dropped 62% since the 2007 Baseline, Scope 3 emissions have increased by 36% since 2007 for the following reasons:

- A 44% increase in Student and Faculty Commuting, partly due to using an improved tracking and estimation method in the 2017 assessment, and possibly also due to the inclusion of Staff Commuting in the overall total
- A 37% increase in emissions from Landfilled Waste, partly due increased attention to the tracking and reporting process followed by waste haulers, which has resulted in a reported 24% increase in tonnage of landfilled waste materials

The targeted goals adopted by the Province of Ontario and Colleges Ontario are included in the above chart. There are several general comments and lessons to be learned relating to these goals, Mohawk's performance to date, and to Mohawk's potential to achieve these goals:

- While the Ford Administration recently ended Ontario's Carbon Cap and Trade program and introduced legislation to repeal the Green Energy Act, these actions do not change current GHG emissions reduction goals and anticipated federal carbon pricing impacts:
    - The provincial GHG emissions reduction targets – 30% reduction by 2030 and 80% reduction by 2050 (2005 baseline) – as stated in the Ontario Climate Change Action Plan (2016-2020), are still currently in place.[2]

[2] http://ecozonetest.wcdsb.ca/wp-content/uploads/sites/60/2016/08/Climate-Action-Plan.pdf

  - The federal GHG emissions reduction targets – 40% reduction by 2030 and 80% reduction by 2050 (2005 baseline) – are still currently in place.[3]
  - The federal "backstop" carbon pricing plan will impose a $20/tCO$_2$e price on GHG emissions starting in January 2019 for the Province of Ontario. The program guidelines indicate that the price will increase by $10/tCO$_2$e each year, to $50/tCO$_2$e in 2022.[4]
- Mohawk has benefitted from an 82% decrease in the grid electricity emissions factor and a 15% reduction in the quantity of purchased electricity. Barring any significant increases in energy consumption or Scope 3 emissions it seems that Mohawk College will meet the 2030 goal through a continued focus on building energy conservation and efficiency, the use of on-site renewable energy, and programs to reduce GHG emissions from commuting and landfilled waste streams.
- The chart shows that the goal to reduce GHG emissions by 80% by 2050 will be extremely difficult to achieve. A successful effort will require transformational strategies for buildings, infrastructure, on-site generation, energy storage, fuel-switching, commuting, and off-site GHG offset projects. Traditional, incremental efforts to renovate buildings, install renewable energy systems, and promote the use of carpooling and mass-transit will not be sufficient to reach this goal – assuming that capital will even be available to fund such aggressive projects. ***We recommend that Mohawk College leadership commit to update the GHG Emissions Roadmap as soon as possible to better understand the transformational strategies that must be developed to achieve significant GHG emissions reductions.*** This Roadmapping effort will identify:
  - Transformational building renovation projects that will leverage deep building energy retrofits, deep retrofits over time, and cross-cutting energy conservation and efficiency measures to drive buildings toward net zero carbon operations
  - Infrastructure and on-site renewable energy and storage projects that will increase energy efficiency, improve resiliency, reduce the use of on-site natural gas for space and domestic water heating, and extend the use of on-site renewable energy, energy storage technology, and microgrids
  - Transportation solutions that will expand the use of reduced or zero carbon transportation methods, telecommuting, residentialization strategies, and the potential integration of fleet and commuting vehicles with microgrids as mobile energy storage technology
  - Off-site GHG offset projects that will be developed in partnership with other organizations to offset Mohawk's direct and indirect emissions, since it isn't

[3] https://www.canada.ca/en/treasury-board-secretariat/news/2017/12/government_of_canadasetsambitiousghgreductiontargetsforfederalop.html
[4] https://www.canada.ca/en/environment-climate-change/news/2017/05/pricing_carbon_pollutionincanadahowitwillwork.html

technically possible to reach 80% GHG emissions reduction through on-site projects alone

- Approaches to strategically bundle projects so that they meet an integrated set of aggressive goals for the College:
  - Reducing GHG emissions, deferred maintenance, and energy costs
  - Improving resiliency and asset utilization
  - Supporting the teaching, research, and community engagement mission of the College
  - Creatively leveraging multiple funding sources
- Approaches to leverage available capital for targeted, bundled projects and to secure the additional funding needed to ensure implementation
- Institutional initiatives and operational changes that will enable the implementation of projects over time at the lowest possible cost
- Strategies that can be co-developed with the Center for Climate Change Management (CCCM) at Mohawk College that show leadership in achieving cost-effective GHG emissions reductions and that can be delivered to CCCM stakeholders

ACTIVITIES TRACKED

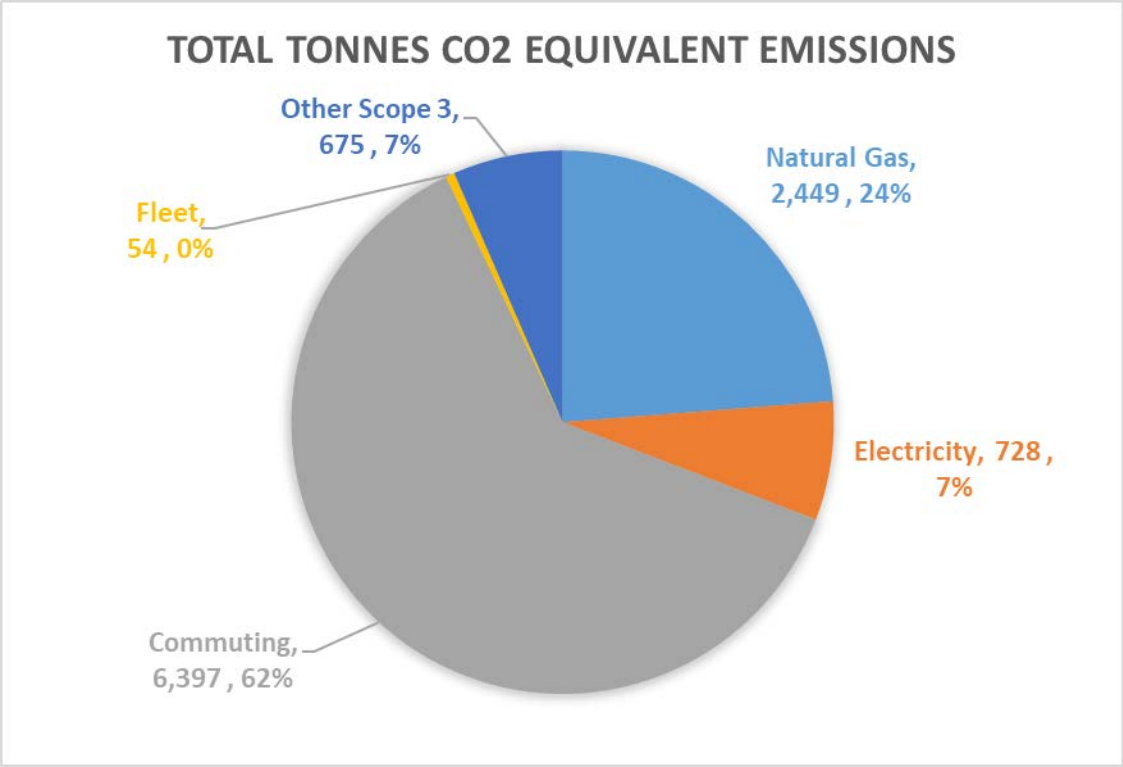
Table 14 provides a line-by-line overview of the specific activities and emissions associated with each GHG emissions source.

Table 14: 01/01/2017 - 12/31/2017 Mohawk College Emissions and Activities Report			
Trackers by Node	**Emissions tCO_2e**	**Activity**	**Mixed Activity Units**
Fennel Campus Records			
135 Fennell			
Fennell DBARC Natural Gas	16.98	8,943.92	Cubic Metres
Fennell Main Electricity	601.99	14,333,106.03	kWh
Fennell Main Natural Gas	1,848.69	973,862.70	Cubic Metres
293 Fennell (Shed)			
Fennell Shed Electricity	1.66	39,618.11	kWh
295 Fennell (Alumni House)			
Fennell Alumni Electricity	0.22	5,240.33	kWh
Fennell Alumni Natural Gas	50.32	26,507.74	Cubic Metres
Old Horizon Utilities Transfer Station Building Records			
117 Market			
117 Market Electricity	0.45	10,807.81	kWh
Shared Records			
Shared			
Athletics Commuting	39.72	23,290.39	km
College Fleet	53.69	22,923.36	Litres
Faculty Commuting	462.69	197,538.23	Litres
Fennell Landfill	302.81	216.29	Tonnes
Fennell Water	-	49,289.96	Litres
Generators	4.02	1,435.07	Litres
Non-Faculty Employee Commuting	1,335.72	570,270.12	Litres
Paper	276.29	28.98	Tonnes
Stoney Creek Landfill	52.18	37.27	Tonnes
Stoney Creek Water	-	6,231.93	Litres
Student Commuting	4,598.84	1,963,423.35	Litres
Stoney Creek Campus Records			
328 Leaside			
328 Leaside Natural Gas	2.26	1,192.26	Cubic Metres
330 Leaside			
330 Leaside Electricity	4.42	105,118.53	kWh
336 Leaside			
336 Leaside Electricity	14.94	355,614.03	kWh
336 Leaside Natural Gas	118.47	62,407.39	Cubic Metres
349 Leaside			
349 Leaside Electricity	0.39	9,311.68	kWh
481 Barton			
Stoney Creek Main Electricity	104.01	2,476,352.40	kWh
Stoney Creek Main Natural Gas	412.47	217,280.68	Cubic Metres
Totals for All Records			
TOTALS	**10,303.22**		

Table 15 provides detail in a single table regarding the assumptions made for determining the impacts of each activity. It also provides the emissions factors and sources associated with each activity.

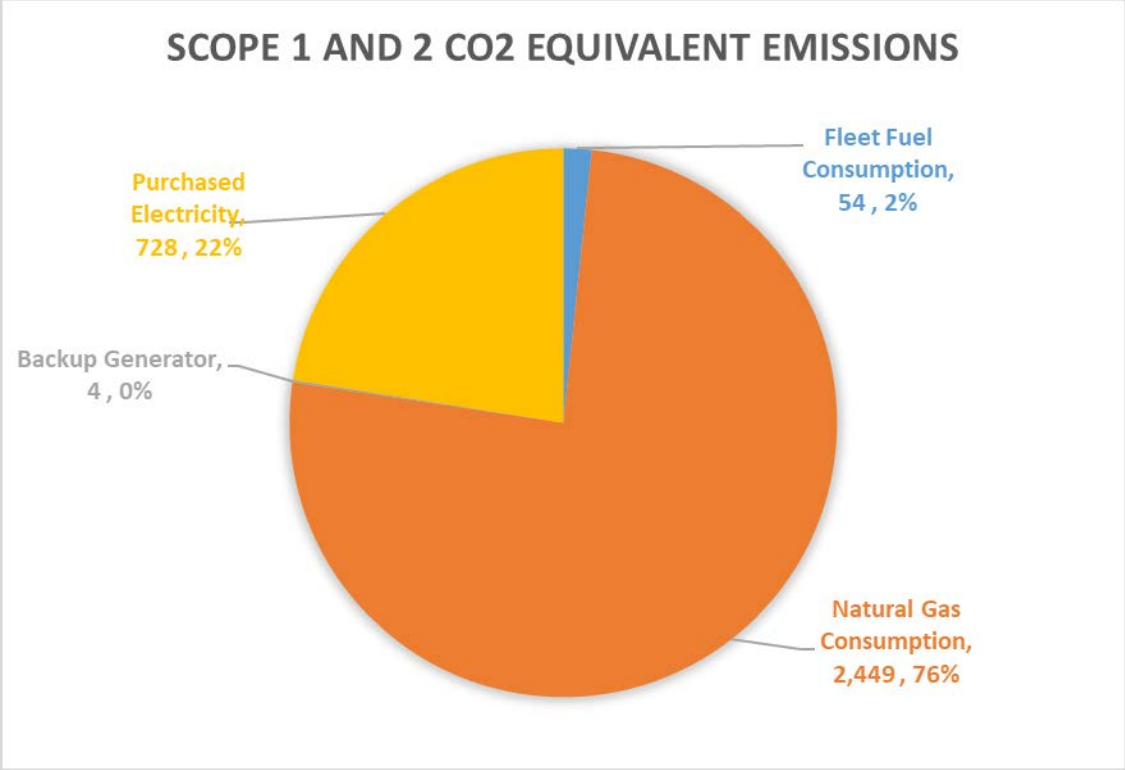
Table 15: Activities Tracked			
Resource	**Conversion Factor/Unit**	**Assumptions**	**Scope (1,2, or 3)**
Natural Gas	1.888kg/m^3 from Table A6-1 of Environment Canada National Inventory Report (2018) on Greenhouse Gases and Sinks 1990-2016		Scope 1
Purchased Electricity	0.042kg/kWh from Alectra Sustainability Report 2017	Alectra Utilities provides all grid-sourced electricity to both Mohawk College campuses	Scope 2
Fleet Fuel	0.00549 MTCDE/liter of gasoline from WRI transport by fuel use	Numbers were based on the average fuel price per liter for the city of Hamilton for the months given (September-December) from Kent Group Ltd. These values were then used to determine the amount of fuel consumed for the given month based on fuel purchased. For September the average fuel price was $1.183/liter for gasoline and $1.063/liter for diesel. For October the average fuel price was $1.144/liter for gasoline and $1.076/liter for diesel. For November the average fuel price was $1.22/liter for gasoline and $1.167/liter for diesel. For December the average fuel price was $1.206/liter for gasoline and $1.211/liter for diesel. These values were then extrapolated over the course of the year.	Scope 1
Student Commuting	0.00549 MTCDE/liter of gasoline from WRI transport by fuel use	All fuel efficiency values found contained units of x amount of liters / 100 km. Always chose gasoline powered vehicles above hybrid or diesel-powered vehicles where applicable, as this is the most conservative approach. Always chose values which included a combination of highway driving and urban driving; all fuel efficiency values chosen fell within the range of the low end highway driving and the high end urban driving for the specific vehicle. Multiple sources were viewed to increase accuracy of chosen value. Always chose values relating to automatic transmission instead of manual transmission, as this is the most conservative approach. Always chose values that related to 2-wheel drive when 4-wheel drive was available, since 2-wheel drive is most common. Not all values chosen were based on the most fuel-efficient vehicle models. However, most of the values chosen were for vehicles with a model year of 2015 or newer (except for discontinued vehicle models; in which the most fuel efficient model was used).	Scope 3
Faculty and Staff Commuting	0.00549 MTCDE/liter of gasoline from WRI transport by fuel use	All fuel efficiency values found contained units of x amount of liters / 100 km. Always chose gasoline powered vehicles above hybrid or diesel-powered vehicles where applicable, as this is the most conservative approach. Always chose values which included a combination of highway driving and urban driving; all fuel efficiency values chosen fell within the range of the low end highway driving and the high end urban driving for the specific vehicle. Multiple sources were viewed to increase accuracy of chosen value. Always chose values relating to automatic transmission instead of manual transmission, as this is the most conservative approach. Always chose values that related to 2-wheel drive when 4-wheel drive was available, since 2-wheel drive is most common. Not all values chosen were based on the most fuel-efficient vehicle models. However, most of the values chosen were for vehicles with a model year of 2015 or newer (except for discontinued vehicle models; in which the most fuel efficient model was used).	Scope 3
Athletics Commuting	0.00724 MTCDE/liter of diesel from WRI transport by fuel use	Assumed all the vehicles were diesel fueled heavy duty vehicles (buses). Assumed that the total distance travelled for each vehicle was a two-way trip from destination to campus.	Scope 3
Paper	8.65kg CO_2/kg paper from EPA WARM Calculator v.14 Net Emissions for Paper Products	The only paper being consumed is 8.5' x 11' printing paper. The timeframe for paper consumption data provided was from June 1st – December 31st; paper was previously supplied from McMaster University. The average paper consumption per month was estimated and extrapolated for the entire year.	Scope 3
Waste	0.43 MTCDE/tonne waste from Inventory of US GHG Emissions and Sinks 1990-2016.		Scope 3
Recycling	-2.83 MTCDE/tonne recycling from WARM Mixed Recyclables (absolute)		Scope 3
Organics	-0.14MTCDE/tonne organics from WARM Mixed Organics		Scope 3

TOTAL TONNES CO2 EQUIVALENT EMISSIONS



Activity	Scope	2017 tCO_2e	% of total CO_2e
Fleet Fuel Consumption	1	54	0.5%
Natural Gas Consumption	1	2,449	23.8%
Backup Generator	1	4	0.0%
Purchased Electricity	2	728	7.1%
Student Commuting	3	4,599	44.6%
Faculty Commuting	3	463	4.5%
Staff Commuting	3	1,336	13.0%
Athletics Dept. Bus Travel	3	40	0.4%
Paper Use	3	276	2.7%
Waste	3	355	3.4%
TOTALS		**10,303**	**100.0%**

SCOPE 1 AND SCOPE 2 CO2 EQUIVALENT EMISSIONS FOR 2017



Activity	Scope	2017 tCO_2e	% of total CO_2e
Fleet Fuel Consumption	1	54	1.7%
Natural Gas Consumption	1	2,449	75.7%
Backup Generator	1	4	0.1%
Purchased Electricity	2	728	22.5%
TOTALS		**3,235**	**100.0%**

Intensity Factors

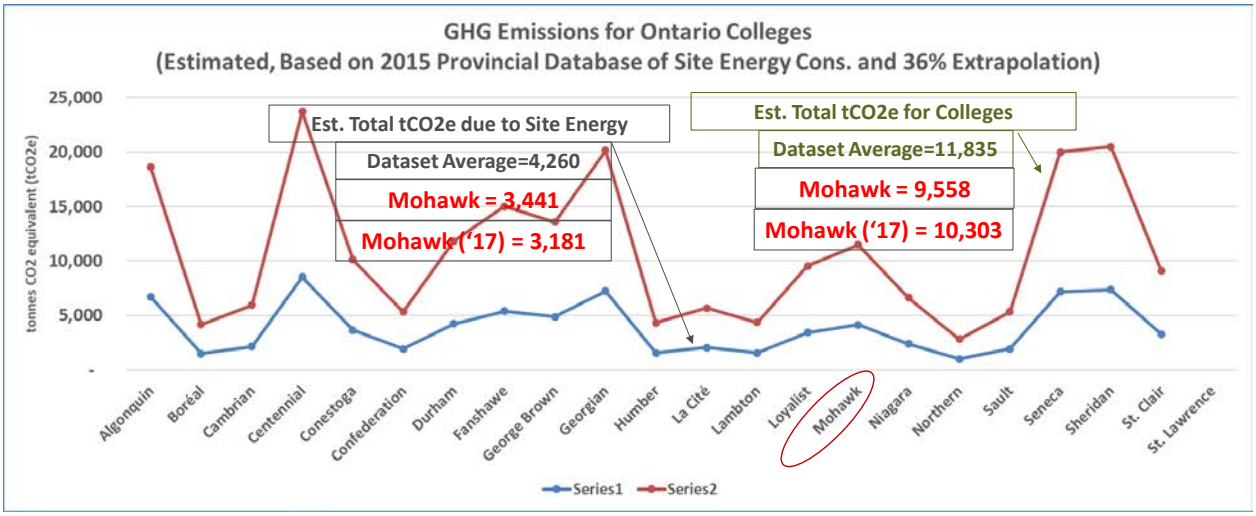
Sector Parameters	Baseline	2012 GHG Inventory		2017 GHG Inventory		
	2007 tCO_2e	2012 tCO_2e	Change from Baseline	2017 tCO_2e	Change from 2012	Change from Baseline
Total Emissions - Scopes 1+2 building energy only (tCO_2e) (natural gas, electricity, diesel)	8,510	4,917	-42%	3,235	-34%	-62%
tCO_2e / FTE Student	0.72	0.31	-57%	0.23	-24%	-68%
tCO_2e / 1,000 m^2	67	38	-42%	27	-29%	-59%
tCO_2e / 1,000 ft^2	6.21	3.57	-42%	2.54	-29%	-59%

COMPARISON WITH OTHER COLLEGES IN ONTARIO

The following four charts provide a comparison of the GHG emissions metrics associated with higher education for the 22 of the 24 colleges in the Province of Ontario[5].

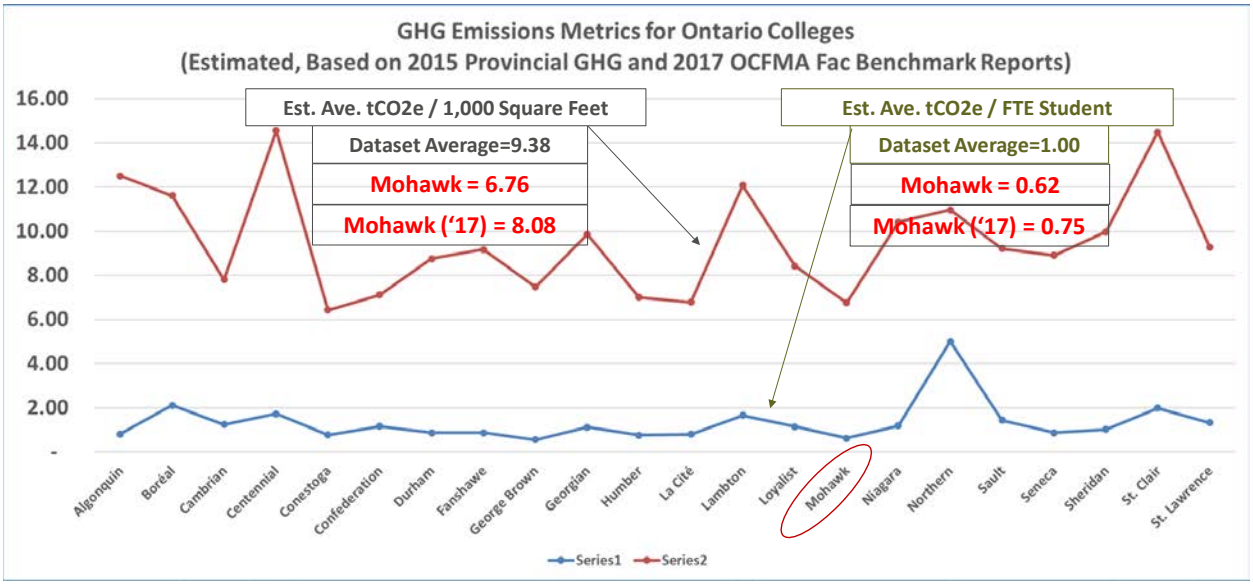
- The primary energy consumption and resulting GHG emissions data used to generate these charts is from the GHG emissions reports filed in 2015 to comply with the Green Energy Act (O.Reg.397/11).
- The FTE student population figures and gross area of built space (gross square feet) estimates were taken from the OCFMA 2016/2017 Facilities Benchmarking Report.

Note that this data has not been validated, and as a result, some of the inputs and results may be suspect. In any case, it is always interesting to compare results with those of peers.

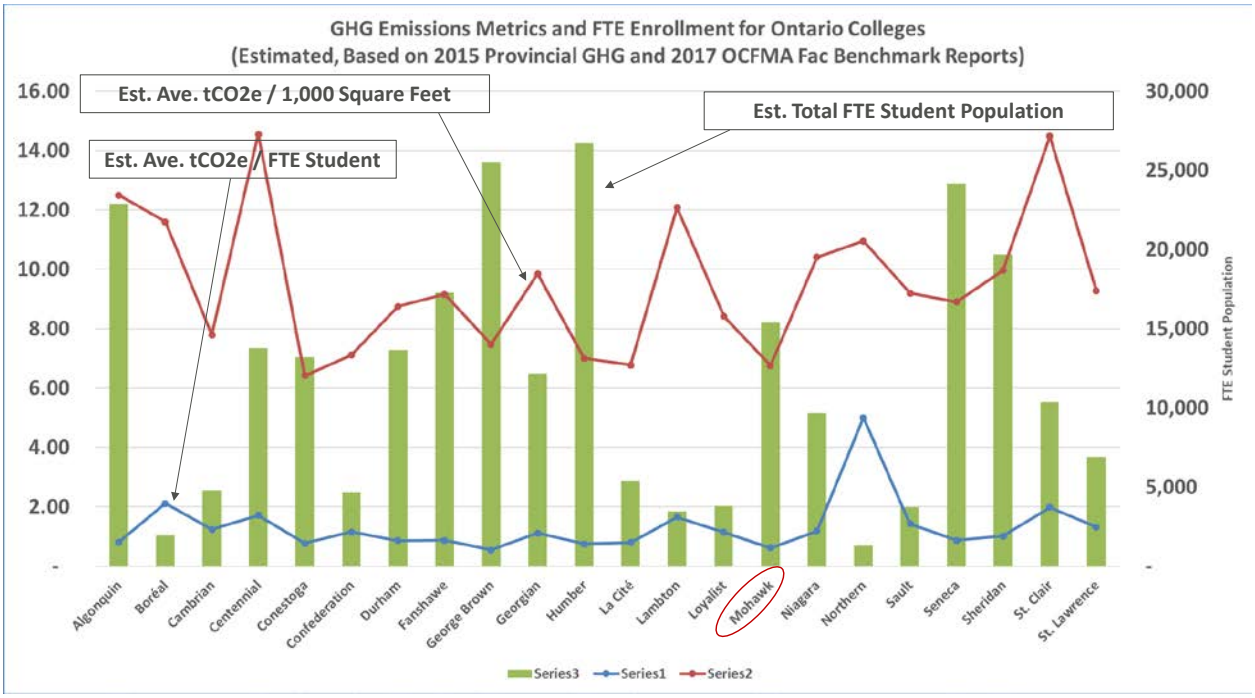


GHG Emissions for Ontario Colleges – The chart above compares reported GHG emissions due to site energy and estimated GHG emissions from all sources for each college. Series 1 above (lower blue line) represents the building energy-related Scope 1 and Scope GHG emissions reported by each college for the 2015 MOECC provincial database of GHG and energy consumption. Series 2 above (upper red line) represents an estimate of the total GHG emissions for each college, including all Scope 1 (including fleet, refrigerants, fertilizers) and Scope 2 and select Scope 3 end uses (including commuting, business travel, paper, solid waste), based upon experience with Mohawk College and the 2017 Colleges Ontario/Perkins and Will GHG reporting template. We assumed that Reported stationary emissions for building energy use would be 36% of total GHG emissions for each college.

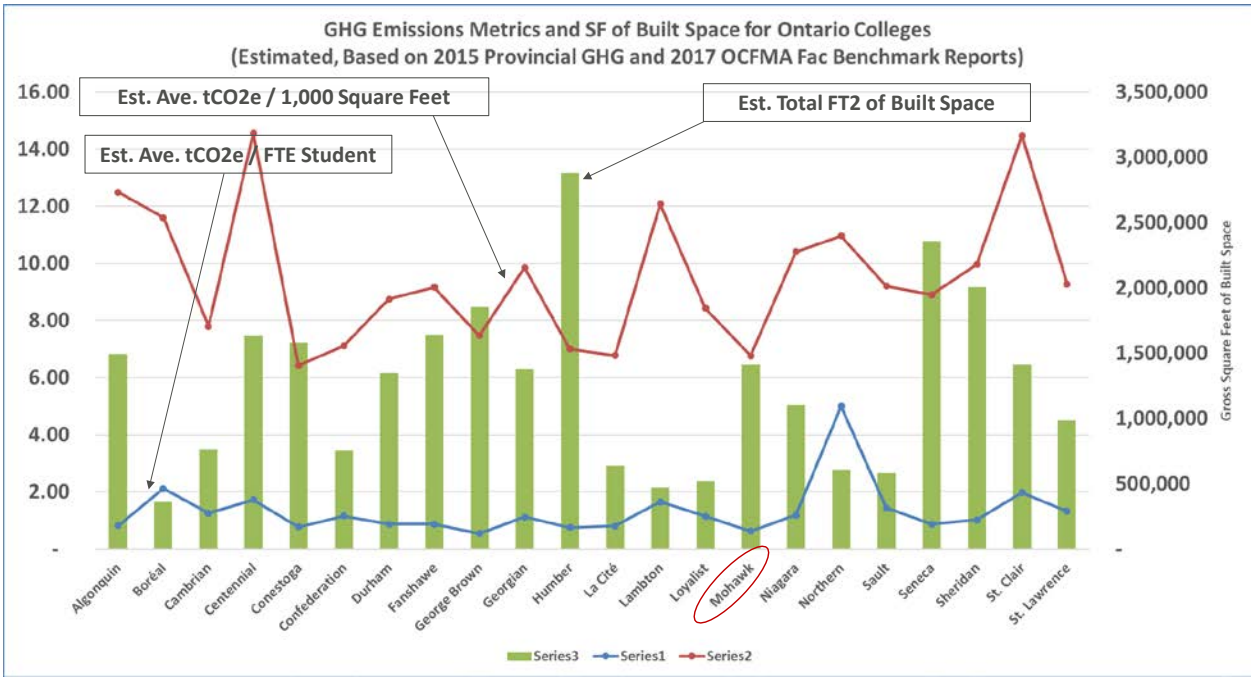
[5] Data is from the MOECC Broader Public Sector 2015 GHG and Energy Report and the OCFMA 2016/2017 Facilities Benchmarking Report (for GSF and FTE figures). Fleming did not provide data for the Ontario BPS report. Canadore and OCAD did not provide data for the OCFMA report. As a result, these three Colleges were excluded from the summary charts in this Appendix.



GHG Emissions Metrics for Ontario Colleges – The chart above compares Ontario colleges through common metrics in the sector across North America, including **Estimated Average Total GHG Emissions per 1,000 Gross Square Feet** and **Estimated Average Total GHG Emissions per FTE Student**. These same metrics are used to compare hundreds of colleges and universities through the Association for the Advancement of Sustainability in Higher Education (AASHE) and through Second Nature. For this chart, we used the estimated total GHG Emissions for all Scopes since that is what is used for the comparisons by both AASHE and Second Nature. These metrics are useful because they capture the GHG emissions intensity of the institutions by both gross built space and by FTE student. In the future, as emissions inventories become more comprehensive and accurate, then these metrics can be compared with other institutions based upon Carnegie Class, including Master's Colleges and Universities, Associate's and Tribal Colleges, and Baccalaureate Colleges.



GHG Emissions Metrics and FTE Enrollment for Ontario Colleges – The chart above shows the two common metrics overlaid with estimated total FTE student population figures. This assessment can be used to better understand where data may be suspect, where buildings may be operating more efficiently than others, or where the types of facilities (residence halls, labs, classrooms) and their energy intensity yield different results.



GHG Emissions Metrics and SF of Built Space for Ontario Colleges – The chart above shows the two common metrics overlaid with estimated gross square footage of built space for each college. This assessment can be used to better understand where data may be suspect, where buildings may be operating more efficiently than others, or where the types of facilities (residence halls, labs, classrooms) and their energy intensity yield different results.

APPENDICES

Appendix 1: Mohawk College Usage and Cost Report

Appendix 2: Mohawk College Student, Faculty, and Non-Faculty Commuting Report

Appendix 3: Mohawk College Energy Report

Appendix 4: Mohawk College Scope 2 Emissions Report

APPENDIX 1: MOHAWK COLLEGE USAGE AND COST REPORT

Trackers by Node	Activity (Mixed Activity Units)	Cost (CAD)
328 Leaside	42,104.10 cubic feet	371.81 (CAD)
328 Leaside Natural Gas	1,192.26 cubic meters	371.81 (CAD)
330 Leaside	105,118.53 kWh	16,058.79 (CAD)
330 Leaside Electricity	105,118.53 kWh	16,058.79 (CAD)
336 Leaside		82,263.37 (CAD)
336 Leaside Electricity	355,614.03 kWh	75,035.86 (CAD)
336 Leaside Natural Gas	62,407.39 cubic meters	7,227.51 (CAD)
349 Leaside	9,311.68 kWh	1,820.97 (CAD)
349 Leaside Electricity	9,311.68 kWh	1,820.97 (CAD)
481 Barton		452,108.64 (CAD)
Stoney Creek Main Electricity	2,476,352.40 kWh	429,776.87 (CAD)
Stoney Creek Main Natural Gas	217,280.68 cubic meters	22,331.77 (CAD)
Totals		552,623.59 (CAD)

Totals for All Records

	Activity (Mixed Activity Units)	Cost (CAD)
Totals		3,102,335.33

APPENDIX 2: MOHAWK COLLEGE STUDENT, FACULTY, AND NON-FACULTY COMMUTING REPORT

01/01/2017 - 12/31/2017 Mohawk College Student, Faculty and Non-faculty Commuting Report

Shared Records

Collapse All

Trackers by Node	Volume (Cubic Feet)	Emissions (tonnes CO_2e)
Shared	96,452.54 Cubic Feet	6,397.24
Faculty Commuting	197,538.23 liters	462.69
Non-Faculty Employee Commuting	570,270.12 liters	1,335.72
Student Commuting	1,963,423.35 liters	4,598.84
Totals	96,452.54 Cubic Feet	6,397.24

APPENDIX 3: MOHAWK COLLEGE ENERGY REPORT

01/01/2017 - 12/31/2017 Mohawk College Report

Fennell Campus Records

Collapse All

Trackers by Node	Activity / Emissions (Mixed Activity Units / tonnes CO_2e)	Energy (kWh)
135 Fennell		24,939,228.24
Fennell DBARC Natural Gas		96,519.82
Fennell Main Electricity		14,333,106.03
Fennell Main Natural Gas		10,509,602.40
293 Fennell (Shed)		39,618.11
Fennell Shed Electricity		39,618.11
295 Fennell (Alumni House)		291,303.02
Fennell Alumni Electricity		5,240.33
Fennell Alumni Natural Gas		286,062.70
Totals		25,270,149.38

Old Horizon Utilities Transfer Station Buiiding Records

Expand All

Trackers by Node	Activity / Emissions (Mixed Activity Units / tonnes CO_2e)	Energy (kWh)
117 Market		10,807.81
Totals		10,807.81

Shared Records

Collapse All

Trackers by Node	Activity / Emissions (Mixed Activity Units / tonnes CO_2e)	Energy (kWh)
Shared		26,491,818.34
Athletics Commuting		
College Fleet		220,496.30
Faculty Commuting		1,900,090.52
Fennell Landfill		
Fennell Organics		
Fennell Recyclables		
Fennell Water		
Generators		15.27
Non-Faculty Employee Commuting		5,485,342.45
Paper		
Stoney Creek Landfill		
Stoney Creek Organics		
Stoney Creek Recyclables		
Stoney Creek Water		
Student Commuting		18,885,873.80

https://mowhawk.scope5.com/reports/1725/print 1/2

Trackers by Node	Activity / Emissions (Mixed Activity Units / tonnes CO_2e)	Energy (kWh)
Totals		26,491,818.34

Stoney Creek Campus Records

Collapse All

Trackers by Node	Activity / Emissions (Mixed Activity Units / tonnes CO_2e)	Energy (kWh)
328 Leaside		12,866.42
328 Leaside Natural Gas		12,866.42
330 Leaside		105,118.53
330 Leaside Electricity		105,118.53
336 Leaside		1,029,093.79
336 Leaside Electricity		355,614.03
336 Leaside Natural Gas		673,479.76
349 Leaside		9,311.68
349 Leaside Electricity		9,311.68
481 Barton		4,821,173.20
Stoney Creek Main Electricity		2,476,352.40
Stoney Creek Main Natural Gas		2,344,820.80
Totals		5,977,563.63

Totals for All Records

	Activity / Emissions (Mixed Activity Units / tonnes CO_2e)	Energy (kWh)
Totals		57,750,339.16

AMERESCO
Green • Clean • Sustainable

APPENDIX 4: MOHAWK COLLEGE SCOPE 2 EMISSIONS REPORT

01/01/2017 - 12/31/2017 Mohawk College Scope 2

Fennell Campus Records

Collapse All

Trackers by Node	Energy (KWh)	Emissions (tonnes CO_2e)
135 Fennell	14,333,106.03	601.99
Fennell Main Electricity	14,333,106.03 kWh	601.99
293 Fennell (Shed)	39,618.11	1.66
Fennell Shed Electricity	39,618.11 kWh	1.66
295 Fennell (Alumni House)	5,240.33	0.22
Fennell Alumni Electricity	5,240.33 kWh	0.22
Totals	14,377,964.47	603.87

Old Horizon Utilities Transfer Station Buiiding Records

Collapse All

Trackers by Node	Energy (KWh)	Emissions (tonnes CO_2e)
117 Market	10,807.81	0.45
117 Market Electricity	10,807.81 kWh	0.45
Totals	10,807.81	0.45

Stoney Creek Campus Records

Collapse All

Trackers by Node	Energy (KWh)	Emissions (tonnes CO_2e)
330 Leaside	105,118.53	4.41
330 Leaside Electricity	105,118.53 kWh	4.41
336 Leaside	355,614.03	14.94
336 Leaside Electricity	355,614.03 kWh	14.94
349 Leaside	9,311.68	0.39
349 Leaside Electricity	9,311.68 kWh	0.39
481 Barton	2,476,352.40	104.01
Stoney Creek Main Electricity	2,476,352.40 kWh	104.01
Totals	2,946,396.64	123.75

Totals for All Records

	Energy (KWh)	Emissions (tonnes CO_2e)
Totals	17,335,168.92	728.08

https://mowhawk.scope5.com/reports/1721/print 1/1