

**Humber College Institute of
Technology & Advanced
Learning**

**2014/15 Greenhouse Gas
Emissions Inventory & Forecast**

FINAL REPORT



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March 30, 2015

EXECUTIVE SUMMARY

In 2015, the Humber College Institute of Technology & Advanced Learning (Humber College) retained Stantec Consulting Ltd. (Stantec) to complete an emission inventory for the 2014/15 reporting year as well as prepare a Greenhouse Gas (GHG) emissions forecast. The objective was to complete a comprehensive GHG inventory that could be meaningfully compared to a baseline, as well as compare against targets set out in the 5-Year Sustainability Plan. Humber College established the baseline year to be 2005/06 and completed the initial GHG inventory using utility data only.

Since the late 1990's, Humber College has undertaken a number of improvement initiatives that directly impact the performance of the Humber College facilities. Humber College's first action, the Energy Management Plan of 1998, resulted in a 20% decrease in energy use per square foot over the period of seven years (from 2005 to 2012). In 2014, an Energy and Water Conservation and Demand Management Plan (Energy Plan) was developed as a result of the more recent Ontario Regulation 397/11 under the Green Energy Act. The Energy Plan seeks to extend the gains made by Humber College while aligning tightly to one of Humber College's six values which is to "preserve our collective future by embracing the social, ecological and economic impact of our decisions". The Energy Plan documents a range of energy reduction and conservation activities such as lighting upgrades, chiller replacement and replacing boilers and generators with more efficient and cleaner natural gas burning equipment. Likewise, through the development of the 5-Year Sustainability Plan, students and faculty at Humber College are also becoming more engaged showing a strong commitment to sustainability and making this a priority at Humber College.

The following table presents the GHG emissions for 2005/06 and 2014/15 by emissions scope. Emissions are reported in tonnes of carbon dioxide equivalent (tCO₂e).

Table ES-1. GHG Emissions by Scope

Scope	2005/06 (tCO ₂ e)	2014/15 (tCO ₂ e)	Percent Change
Scope 1	5,952	5,522	-7.2%
Scope 2	7,102	3,392	-52.2%
Scope 3	13,252	14,578	10.0%
Total	26,306	23,492	-10.7%

Total emissions for 2014/15 are 23,492 t CO₂e and have decreased by 10.7% since 2005/06. Scope 1 and 2 Emissions are 5,521 tCO₂e and 3,392 tCO₂e and have decreased by 7.2% and 52.2% respectively. Scope 3 emissions, beyond the control of Humber College, are estimated to have increased by 10%. 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 number of students and

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staff) related to higher attendance at Humber College over the baseline year and with the quantification of waste emissions.

During this same reporting period, commuting emissions replaced facility emissions (combined natural gas and electricity) as the largest source of emissions under the GHG emission inventory. In part this was driven by a 60% increase in student enrollment - the number of full-time equivalent (FTE) students has increased from 32,589 to 52,026. Emissions from Scope 3 only marginally increase due to the limited number of parking spots available and due to the increased fuel efficiency of vehicles over the past 10 years. It is difficult to tell how much waste emissions have increased or decreased from the baseline year as this metric has only started to be tracked over the past 3 years. It can be noted, however, that waste diversion has increased to 54% in 2014 compared to 42% in 2013 thus resulting in lower GHG emissions.

In spite of the inclusion of these Scope 3 emissions, Humber College has been able to demonstrate a decrease in GHG emissions on a per student basis by 44.1% as noted in the Table below. This is attributed to the decrease in overall GHG emissions by 11.9% and the increase in FTE enrollment by 60% from 2005/06.

Table ES-2: 2005/06 and 2014/15 GHG Emissions by Emission Intensities

Parameter	2005/06	2014/15	Percent Change
Total Emissions (tCO ₂ e)	26,306	23,492	-10.7%
tCO ₂ e / FTE	0.81	0.45	-44.1%
tCO ₂ e / ft ²	0.006	0.004	-42.3%

Overall, future GHG emissions are expected to increase as these are driven by enrollment and the number of buildings Humber College owns and operates. If Humber College continues with its current pattern of development - a “business as usual” (BAU) scenario - Humber College can expect energy use and emissions to also increase with the addition of new buildings and as the student, staff and faculty populations grow. This growth will be tempered somewhat by natural and regulated efficiency improvements including building code improvements (Provincial jurisdiction) and vehicle fuel efficiency standards (Federal jurisdiction) as well as actions taken on by Humber College. It will be further tempered with the implementation of the Energy Consumption and Demand Management Plan, Scope 1 and 2 emissions can be reduced significantly as noted in Figure ES-1– most emission reductions will result from improving energy efficiency in the buildings. The remaining emissions are mainly Scope 3 emissions to which Humber College has significantly less influence over.

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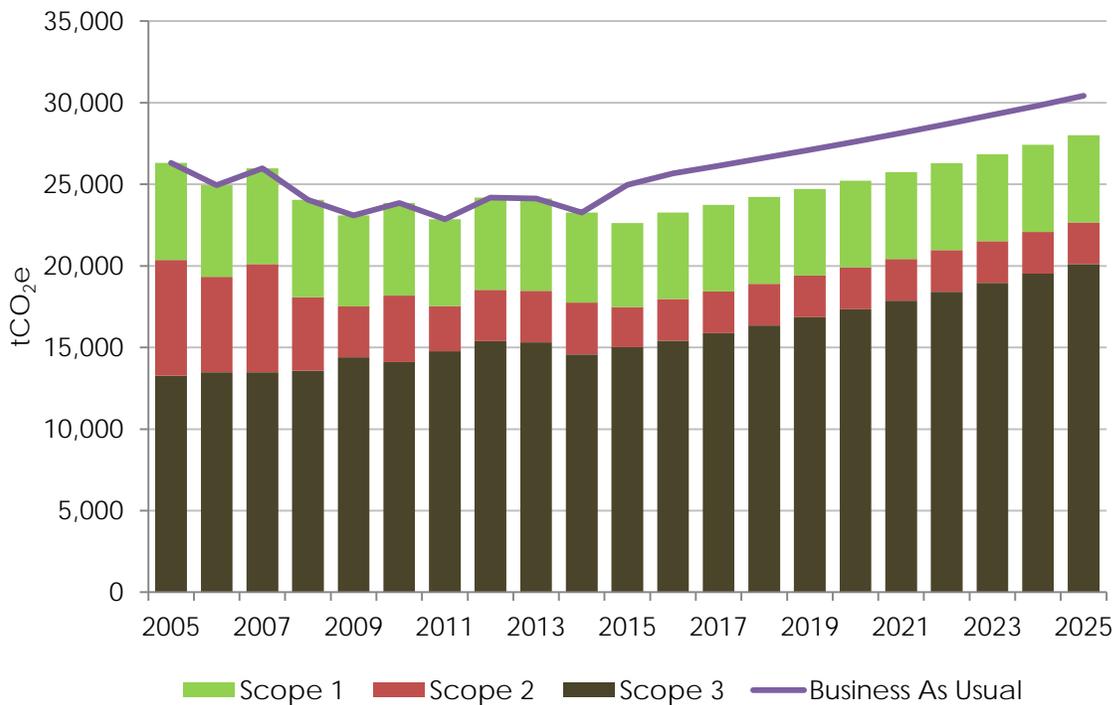


Figure ES-1. BAU Emissions vs Projected Emissions

With respect to GHG emissions, a key goal of the 5-Year Sustainability Plan is to reduce energy consumption by 40% and 50% (from the 2005/06 baseline) by the years 2018/19 and 2023/24, respectively. This goal aligns with the similar goals to reduce GHG emissions by 40% and 50% for the same milestone years.

Although energy use has decreased (approximately 18.4%) for all business units in the 2014/15 reporting year compared to the baseline year (Figure ES-2), with the addition of new buildings in 2015/16, it is anticipated that the aggressive energy reduction targets even with implemented measures will be difficult to achieve (Figure ES-3). This can change if more of the focus is on reducing natural gas usage as it has greater emissions and energy intensity than electricity.

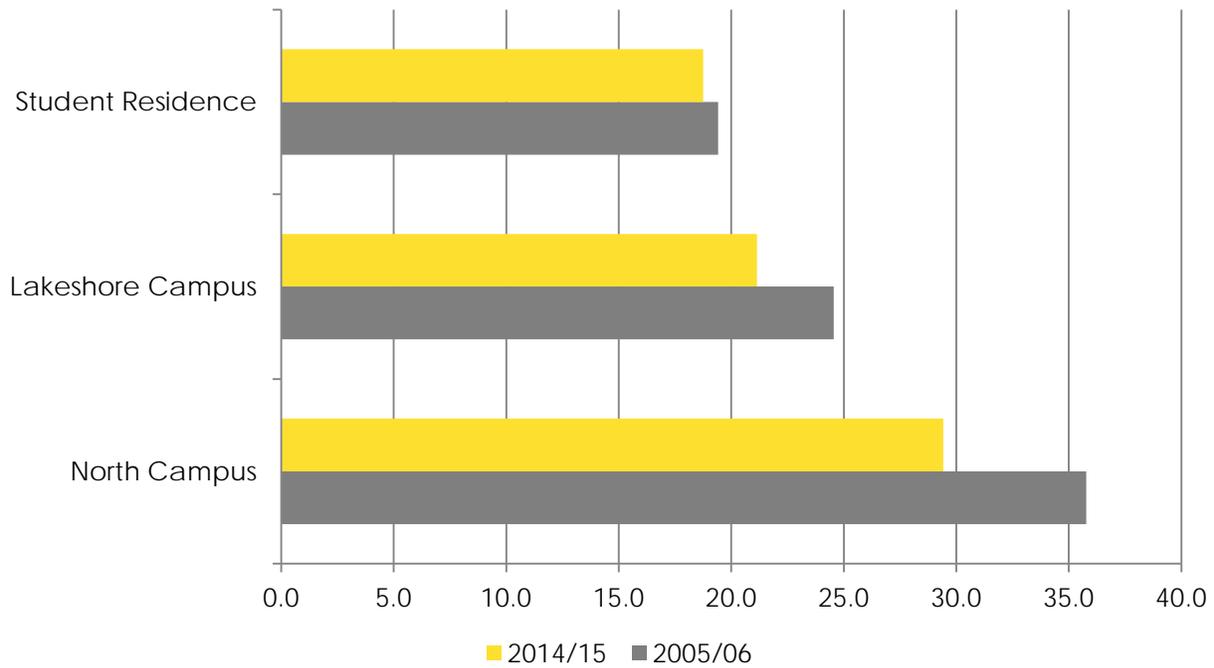


Figure ES-2. Current Energy Use by Business Unit

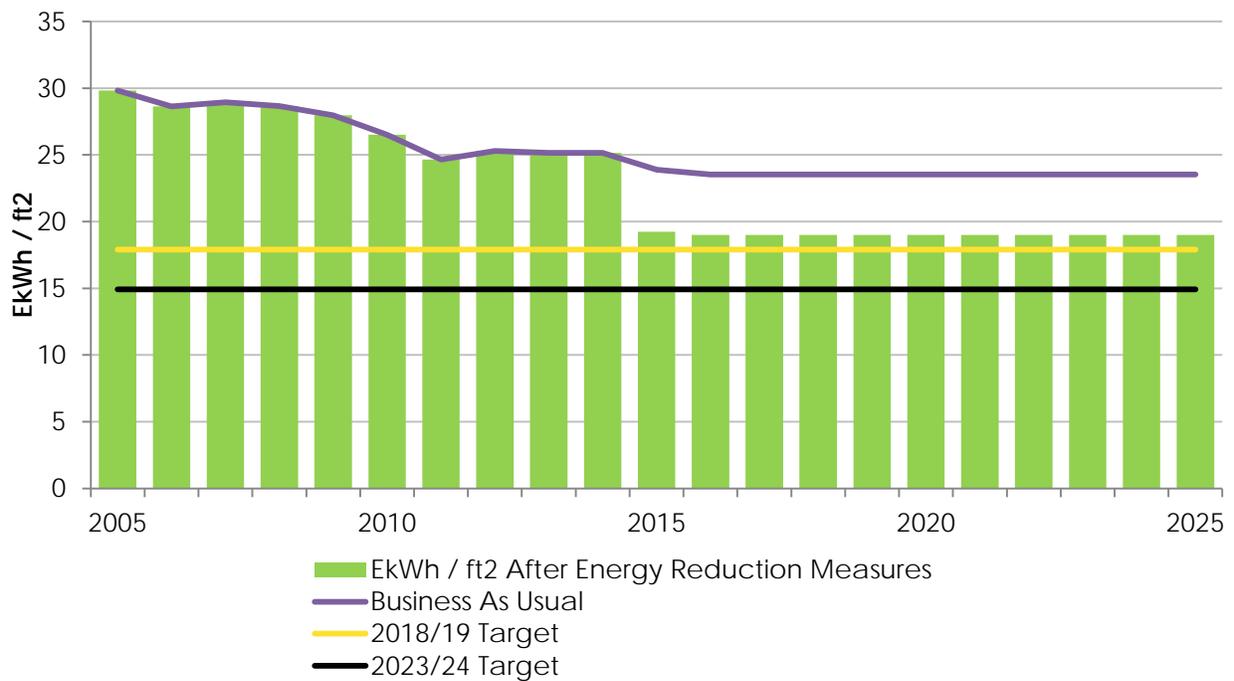


Figure ES-3. Projected Energy Use



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With respect to the GHG emissions target for Scope 1 and 2 Emissions, it is anticipated that the 2018/19 target of 40% will narrowly be achieved in the 2015/16 reporting year and maintained thereafter due to the fixed nature of the assets (i.e. buildings) (Figure ES-4). Note that the business as usual (BAU) scenario assumes that no energy/GHG reduction actions are implemented past the current reporting year. This allows readers to see what has and what is expected to be accomplished today versus what would happen if no further actions were undertaken.

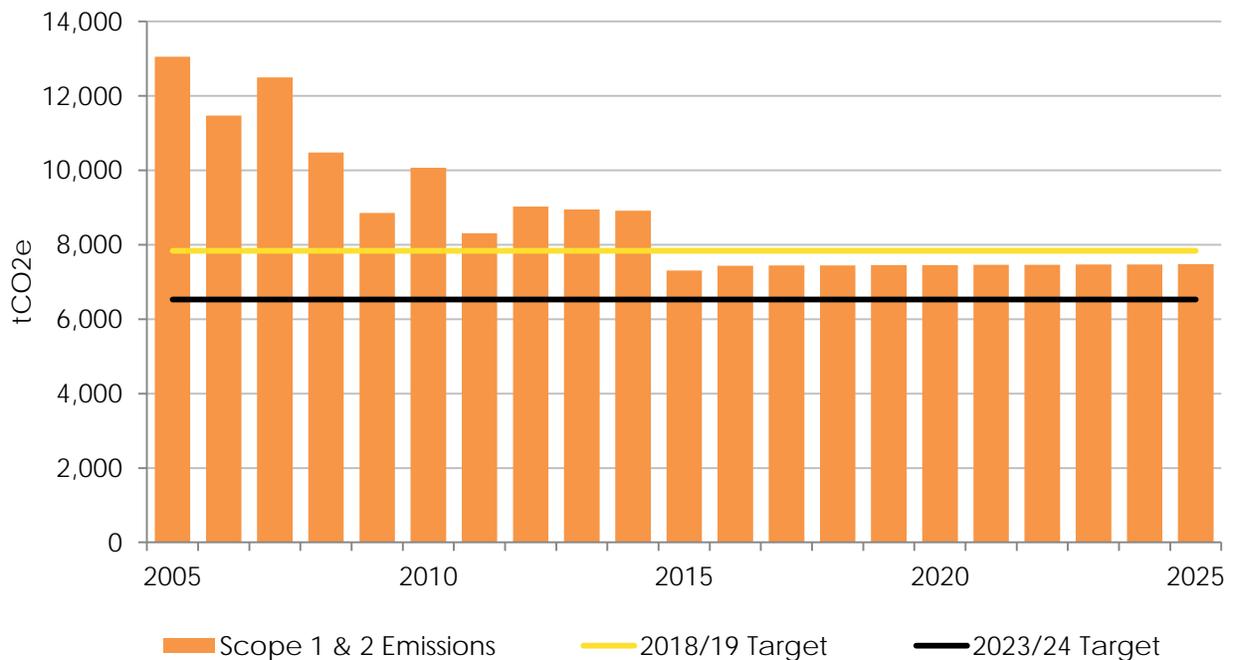


Figure ES-4. Projected Scope 1 and 2 Emissions

Humber College has taken important steps in developing a baseline emission inventory, developing sustainability initiatives and the 2014/15 GHG inventory provides a basis for assessing the success of the sustainability initiatives at Humber College. After the completion of each annual GHG inventory, Humber College 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 Emissions data - namely, commuter data and paper use. Humber College is encouraged to meet with stakeholders to reiterate the importance of accuracy, transparency and consistency in how activity data is collected. Particularly, an improvement to collecting postal code data and typical commuting behavior is an area where significant improvements could be made. Specifically, it would be beneficial to differentiate between permanent

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address and school year address as well as how often the student intends on commuting.

Further refinements could also be made if better paper use data was collected and the distance and type of travel that staff and faculty expense during a reporting period.

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ABBREVIATIONS

Abbreviation	Description
AASHE	The Association for the Advancement of Sustainability in Higher Education
ACCC	Association of Canadian Community Colleges
BAU	Business as usual
CEPA	<i>Canadian Environmental Protection Act</i>
CH ₄	Methane
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
EMP	Environmental Management Plan
FIT	Feed-in Tariff
FTE	Full Time Equivalent Students
GDP	Gross Domestic Product
GEA	<i>Green Energy Act</i>
GHG	Greenhouse Gas
GSF	Gross Square Footage
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
N ₂ O	Nitrous Oxide
NIR	National Inventory Report
PTE	Part Time Equivalent Students (1 PTE = 0.5 FTE)
STARS	Sustainability Tracking, Assessment & Rating System

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.¹

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.”² 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 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 Humber College emissions include:

¹ IPCC 5th Assessment Report (2013). <http://www.ipcc.ch/report/ar5/wg1/>

² 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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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.
- Currently, the government of Canada imposes 'Tier 2' emissions standards on vehicles, in line with similar legislation in the United States of America. This standard which has been in use since 2004 regulates the emissions of various air contaminants, including CO, NOx and particulate matter, from both light and heavy duty vehicles. In June of 2013, the government of Canada released notice of intent to develop regulations to further limit the emissions from vehicles by adopting newer 'Tier 3' standards. These standards are intended to come into effect in 2017 and will include more stringent emission standards as well as enact improvements to emissions testing procedures and fuel specifications. As a result, it is expected that pollutant emissions from vehicles will decrease by up to 80% compared to the current 'Tier 2' standards.

1.2.2 Provincial Initiatives

- In early 2013, the MOE posted, Greenhouse Gas Emissions Reductions in Ontario: A Discussion Paper on the Environmental Registry, to engage the public in the development of a greenhouse gas emissions reduction program. The program is expected to come into force in 2015, one year prior to the implementation of the federal greenhouse gas regulations.
- 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 Humber College) to develop and implement energy conservation programs and report on annual energy consumption and GHG emissions.

1.2.3 City Of Toronto Initiative

- The City of Toronto's GHG plan sets a goal of reducing CO₂ levels by 30% within their municipal operations by 2020, against a 1990 baseline. The City's Climate Change, Clean Air & Sustainable Energy Action Plan (2007) sets out a number of actions that will help to advance this goal focusing around policy, engagement and communication, adaption to smog and climate change, reducing emissions, and program development.

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1.3 LOCAL ACTION:

1.3.1 Humber College

Humber College has made sustainability a prominent part of its strategic plan. Humber College 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 Humber College reports under the Sustainability Tracking, Assessment & Rating System (STARS) every three years. In 2013, Humber College received a silver rating under the STARS program making them the first college in Ontario – and only the third in Canada – to get a silver rating.

In 2014, Humber College prepared its first 5-Year Sustainability Plan whose purpose is to outline specific sustainability related objectives for the college over the next 5 years. It provides a clear framework of ambitious, yet achievable, sustainability targets within operations, learning and engagement at the college. The plan provides direction, sets priorities, and seeks performance improvements on a number of focus areas, including:

1. Recycling and Waste Management
2. Sustainable Transportation
3. Energy and Climate Change
4. Green Buildings and Landscapes
5. Water Use
6. Procurement and Ethical Sourcing
7. Curriculum Integration
8. Outreach, Awareness and Communication
9. Investments

Many of the targets established in the 5-Year Sustainability Plan have been incorporated into the GHG inventory and forecast.

Since the late 1990's, Humber College has undertaken a number of improvement initiatives that directly impact the performance of the Humber College facilities. Humber College's first response, the Energy Management Plan of 1998, resulted in a 20% decrease in energy use per square foot over the period of seven years (from 2005 to 2012). In 2014, an Energy and Water Conservation and Demand Management Plan (Energy Plan) was developed as a result of the more recent Ontario Regulation 397/11 under the Green Energy Act. The Energy Plan seeks to extend the gains made by Humber College while aligning tightly to one of Humber College's six values which is to "preserve our collective future by embracing the social, ecological and economic impact of our decisions". The Energy Plan documents a range of energy reduction and

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conservation activities such as lighting upgrades, chiller replacement and replacing boilers and generators with more efficient and cleaner natural gas burning equipment.



2.0 PROJECT OBJECTIVE, METHODS & ASSUMPTIONS

2.1 OVERVIEW & OBJECTIVE

Humber College operates on two main campuses: North and Lakeshore both located within the City of Toronto. Humber College employs approximately 5,000 staff and faculty and has a current student body of approximately 52,018 full-time equivalent (FTE) students.

This project focused on quantifying Humber College's 2014/15 GHG emissions. This provided data that was compared to the 2005/06 GHG Inventory in order to track the effectiveness of implemented measures as well as provide a basis for estimating future emissions and applying GHG emission reduction objectives.

For Humber College, each reporting year begins in April and ends in March the following year. For the purposes of energy tracking and use, the three business units are tracked and reported on in aggregate: North Campus, Lakeshore Campus and Residences.

2.2 GHG EMISSION QUANTIFICATION METHODS

The Greenhouse Gas Emissions Protocol (GHG 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.

GHG emissions were quantified following the World Resources Institute *GHG Protocol: A Corporate Accounting and Reporting Standard, (Revised Edition)*. 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 Humber College's 2014/15 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 Global Warming Potential (GWP) which refers to ability of each GHG to trap heat in the atmosphere relative to carbon dioxide (CO₂) over a 100 year period.³

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

³ Environment Canada <http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=CAD07259-1>



Table 1. GHG Emissions and Scope

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

The 2014/15 GHG Inventory that Stantec has prepared for Humber 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 (Humber College) accounts for 100 percent of the GHG emissions from operations over which it, or one of its subsidiaries, has operational control.

The following section identifies data collected and assumptions applied for the 2014/15 GHG inventory.

2.3.1 Full Time & Part Time Students

As student enrollment numbers influence the Scope 3 emissions forecast, it was assumed that one (1) Part Time Equivalent Student (PTE) is equivalent to 0.5 Full Time Equivalent (FTE) student. All student data is converted into FTE equivalents. It is also assumed that all staff are full time.

2.3.2 Facility Operations (Electricity & Natural Gas)

Emissions resulting from energy consumption and from the stationary combustion of natural gas are calculated by utilizing the appropriate emission factor. The emission factors used to quantify the GHG emissions from the Environment Canada National Inventory Report (NIR). Currently, these emission factors are available from 1990-2012 and as such, the GHG data uses emission factors for 2012. The emission factor for natural gas is based on the properties of the fuel and generally do not fluctuate significantly from year to year.

Humber College was not able to provide full year activity data for electricity and natural gas consumption for the 2014/15 reporting year. Therefore, the 2013/14 data is applied as a proxy.

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2.3.3 Vehicles & Transportation

Data for the fleet vehicles and staff/faculty transportation were provided by Humber College, by fuel use, and cost of fuel, respectively. Staff and faculty work-related travel data is captured and reported through expense reports – no distances are reported. To get the estimate of kilometers (km) for the reporting year, a \$0.40 (CDN) / km rate was applied with a 15% uncertainty discount to factor out parking and other non-travel expenses. No staff/faculty travel data was available for 2005/06 and as such the 2014/15 data was applied and assumed to be a reasonable estimate since the amount of staff and faculty remain relatively consistent over the years. Fuel efficiency and emission factors were based on Canada's 2014 National Inventory Report (NIR).

Student and staff commuting data were based upon a commuter shed analysis completed for the 2014 fall semester. The GHG emissions are calculated using the estimated total distance travelled multiplied by a fuel use emission factor. To quantify GHG emissions for student and staff travel, a number of assumptions have to be made based upon the classification of the person travelling (FTE, PTE, or staff), the average distance travelled and the total number of available parking spots at each of the campuses. The underlying assumption of the GHG calculation is on the basis that there are a limited number of available parking spots available to the student/staff/faculty population, thus requiring a percentage of the population to take a different form of modal transportation (e.g. walk, bike, bus, carpool, etc.). Since the commuter shed analysis did not include the winter or summer semesters, an average travel distance of 26.4 km and 32.3km was applied to the summer and winter enrolment numbers for Humber Campus and the Lakeshore Campus, respectively. In addition to the above, the following assumptions were made:

- FTE travel: 2 Semesters x 14 Weeks / Semester x 3.5 Days Attendance / Week (x 2 trips);
- PTE travel: 2 Semesters x 14 Weeks / Semester x 1 Days Attendance / Week (x 2 trips);
- Summer FTE/PTE travel: 20% Occupancy Applied to Trips for FTE & PTE Summer Term;
- Staff travel: 48 Weeks x 5 Days Attendance / Week (x 2 trips). It is assumed that all staff are FTE based;
- 3,650 available parking spots at the North Campus;
- 850 available parking spots at the Lakeshore Campus;
- 10% uncertainty buffer (as some of the population may still drive and park off campus)

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It was also noted that the 2014 commuter analysis calculated more students than what appears to have registered. To accommodate, the commuter shed numbers were adjusted downward to match campus enrolment numbers provided by Humber College. Since no commuting data was available for the baseline reporting year, actual student FTE and PTE enrollment numbers were applied to the above assumptions using an average distance of 26.74 km for the Humber Campus and 32.32 km for the Lakeshore Campus. This is likely to be conservative estimate of baseline commuter emissions.

Under the GHG Protocol, these commutes are not considered college-activity and would be captured within Scope 3 of the respective GHG inventories.

2.3.4 Paper Consumption

Data for paper consumption was provided for the number of pages used for various paper sizes and properties. Envelope use for the reporting period was converted into 8.5 x 11 sheets of which 50% recycled content is assumed. Emissions were calculated based on overall paper weights, recycled content and emission factors from the British Columbia Best Practices for GHG Quantification and the Environmental Paper Network.

For the 2014/15 reporting years, there was fragmented paper use tracking for the Lakeshore Campus. To estimate paper use for the Lakeshore Campus, the North Campus paper use data was applied on a per FTE basis. These usage estimates were compared against the data available for Lakeshore to check for reasonableness of the estimates.

The same process was applied to the baseline year as no paper use tracking occurred at this time.

2.3.5 Waste & Recycling

Data for volumes of waste and recycling were provided directly by Humber College. Waste emissions were not applied to the baseline period as the tracking and diversion information was not being collected at the time. Waste emission factors were determined using the USEPA LandGem model⁴. 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 not included in the 2014/15 GHG emissions 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

⁴ 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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was conducted, the energy intensity of the material inputs, the destination and final use of recycle products, etc.). As such, recycling emissions were conservatively excluded from the 2014/15GHG inventory.



3.0 HUMBER COLLEGE'S GHG BASELINE (2005/06)

3.1 BASELINE EMISSIONS

The baseline GHG inventory was 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 Humber College or was estimated by applying industry, national, or regional averages for emissions and energy use (as described earlier).

A breakdown of the 2005/06 baseline GHG emissions by Scope is provided in Table 2 below.

Table 2. Baseline GHG Emissions

GHG Emissions Scope	Total Emissions (tCO ₂ e)
Scope 1	5,952
Scope 2	7,102
Scope 3	13,252
Total	26,306

The top 3 sources of emissions by activity in 2005/06 were:

- Electricity Consumption;
- Natural Gas Consumption; and
- Student and Faculty Commuting.

4.0 GHG EMISSIONS INVENTORY (2014/15)

4.1 REPORTING YEAR GHG EMISSIONS

The 2014/15 GHG emissions inventory was 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 Humber College or was estimated by applying industry, national, or regional averages for emissions and energy use.

A breakdown of the 2014/15 GHG emissions and activity data by Scope and Activity is included in Table 3.

For Scope 1, the emissions were mainly from natural gas consumption in buildings (97.7%). 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 (94.0% of Scope 3), followed by the emissions related to paper use (3.0% of Scope 3) and emissions from waste (3.0% of Scope 3).

Table 3. Summary of 2014/15 GHG Inventory by Scope and Activity Type

Activity Type	Measure / Units	Total Consumption	Emissions tCO ₂ e
Scope 1 Total			5,522
Building Natural Gas Use	Natural Gas (m ³)	2,853,835	5,395
Building Fuel Use	Diesel (L)	5,108	14
Fleet Fuel Use	Gasoline (L)	45,941	113
Building Refrigerant Use	Refrigerant (kg)	-	0
Scope 2 Total			3,392
Electricity Use	Electricity (kWh)	28,831,688	3,392
Scope 3 Total			14,578
Staff/Faculty Travel	Distance Travelled (km)	1,988,513	475
Paper Use	Cases of Paper (5000 Sheets / Case)	7,562	399
Waste Disposal	Waste to Landfill (tonnes)	919	443
Student/Staff Commuting	Distance Travelled (km)	55,472,867	13,260
Total 2014/15 GHG Emissions			23,492

5.0 DISCUSSION & ANALYSIS

5.1 CHANGES BETWEEN THE BASELINE AND THE 2014/15 REPORTING YEAR

Total emissions for 2014/15 are 23,492 t CO₂e and have decreased by 10.7% since 2005/06. Scope 1 and 2 Emissions are 5,521 tCO₂e and 3,392 tCO₂e and have decreased by 7.2% and 52.2% respectively. Scope 3 emissions, beyond the control of Humber College, are estimated to have increased by 10%. 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 number of students and staff) related to higher attendance at Humber College over the baseline year and with the quantification of waste emissions.

During this same reporting period, commuting emissions replaced facility emissions (combined natural gas and electricity) as the largest source of emissions under the GHG emission inventory. In part this was driven by a 60% increase in student enrollment - the number of full-time equivalent (FTE) students has increased from 32,589 to 52,026. Emissions from Scope 3 only marginally increase largely due to the increased fuel efficiency of vehicles over the past 10 years. It is difficult to tell how much waste emissions have increased or decreased from the baseline year as this metric has only started to be tracked over the past 3 years. It can be noted, however, that waste diversion has increased to 54% in 2014/15 compared to 42% in 2013/14 thus resulting in lower GHG emissions.

In spite of the inclusion of these Scope 3 emissions, Humber College has been able to demonstrate a decrease in GHG emissions on a per student basis by 44.1% as noted in the Figure below. This is attributed to the decrease in overall GHG emissions by 10.7% and the increase in FTE enrollment by 60% from 2005/06.

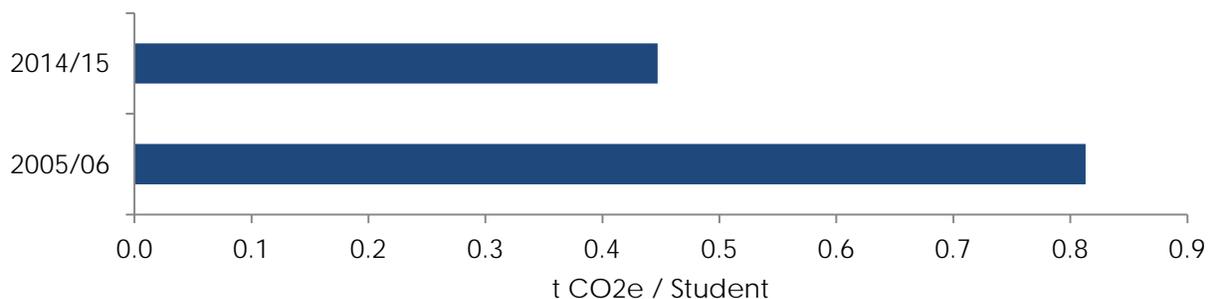


Figure 1. GHG Emission Intensity (tonnes CO₂e/student) for 2005/06 and 2014/15

A side-by-side comparison of activity data between 2005/06 and 2014/15 is provided in Table 4.

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Table 4. Comparison of 2005/06 and 2014/15 GHGs by Activity

Activity Type	Variable / Units	2005/06 Consumption	2014/15 Consumption	Percent Change
Scope 1				
Building Natural Gas Use	Natural Gas (m3)	3,094,125	2,853,835	-7.8%
Building Fuel Use	Diesel (L)	4,189	5,108	22.0%
Fleet Fuel Use	Gasoline (L)	37,672	45,941	22.0%
Building Refrigerant Use	Refrigerant (kg)	-	-	0.0%
Scope 2				
Electricity Use	Electricity (kWh)	28,409,571	30,835,487	8.5%
Scope 3				
Staff/Faculty Travel	Distance Travelled (km)	1,988,513	1,988,513	0.0%
Paper Use	Cases of Paper (5000 Sheets / Case)	4,737	7,562	59.6%
Waste	Waste to Landfill (tonnes)	-	919	0.0%
Student/Staff Commuting	Distance Travelled (km)	54,727,879	55,472,867	1.4%

With respect to the building natural gas and electricity use, it should be noted that Humber College's total square footage (ft²) has increased from 2,055,311ft², in the baseline year, to 2,432,306ft² in the reporting year – an increase of 18%. On a EkWh / ft² basis, overall energy usage has decreased 15.7% from the baseline year which is largely due to the actions and measures Humber College has implemented to reduce and conserve energy.

The comparison of GHG emissions by activity between 2005/06 and 2014/15 is provided in Table 5.

Table 5. Comparison of 2005/06 and 2014/15 GHGs

Activity Type	2005/06 GHG Emissions (tCO ₂ e)	2014/15 GHG Emissions (tCO ₂ e)	Percent Change
Scope 1 Emissions	5,952	5,522	-7.2%
Building Natural Gas Use	5,849	5,395	-7.8%
Building Fuel Use	12	14	21.8%
Fleet Fuel Use	91	113	24.2%
Building Refrigerant Use	0	0	0.0%

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Activity Type	2005/06 GHG Emissions (tCO ₂ e)	2014/15 GHG Emissions (tCO ₂ e)	Percent Change
Scope 2 Emissions	7,102	3,171	-55.3%
Electricity Use	7,102	3,392	-52.2%
Scope 3 Emissions	13,263	14,578	10.0%
Staff/Faculty Travel	456	475	4.3%
Paper Use	250	399	59.6%
Waste	0	443	0.0%
Student/Staff Commuting	12,546	13,260	5.7%
Total GHG Emissions	26,317	23,271	-10.7%

The contribution of emissions by source to Humber College’s emission inventory for 2005/06 and 2014/15 are graphically presented in Figure 2.

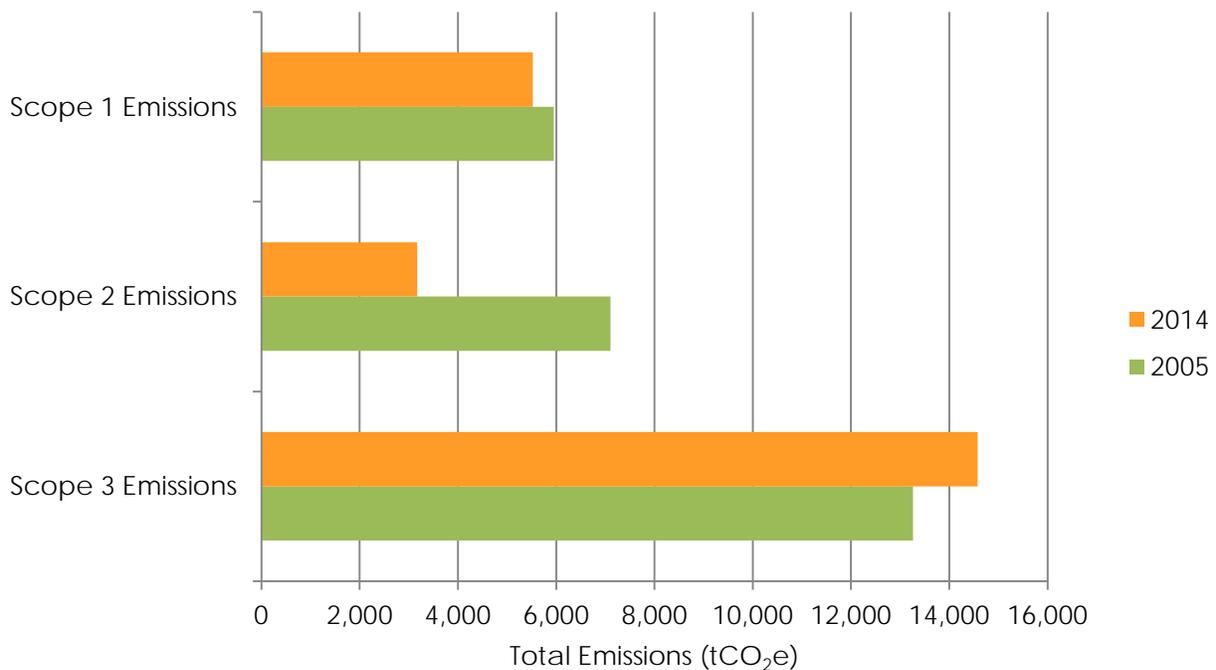


Figure 2. Contribution of Source of Overall Emission Inventory in 2005/06 and 2014/15

The largest contribution of GHG emissions are related to commuter activities, followed by the operation of the facilities at Humber College. Facility emissions combine to include emissions from natural gas combustion and electricity consumption. In 2014/15,



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there was a shift in GHG emissions by sector. Figure 3 shows the contribution of sectors to the overall emission inventory for 2005/06 and 2015/16.

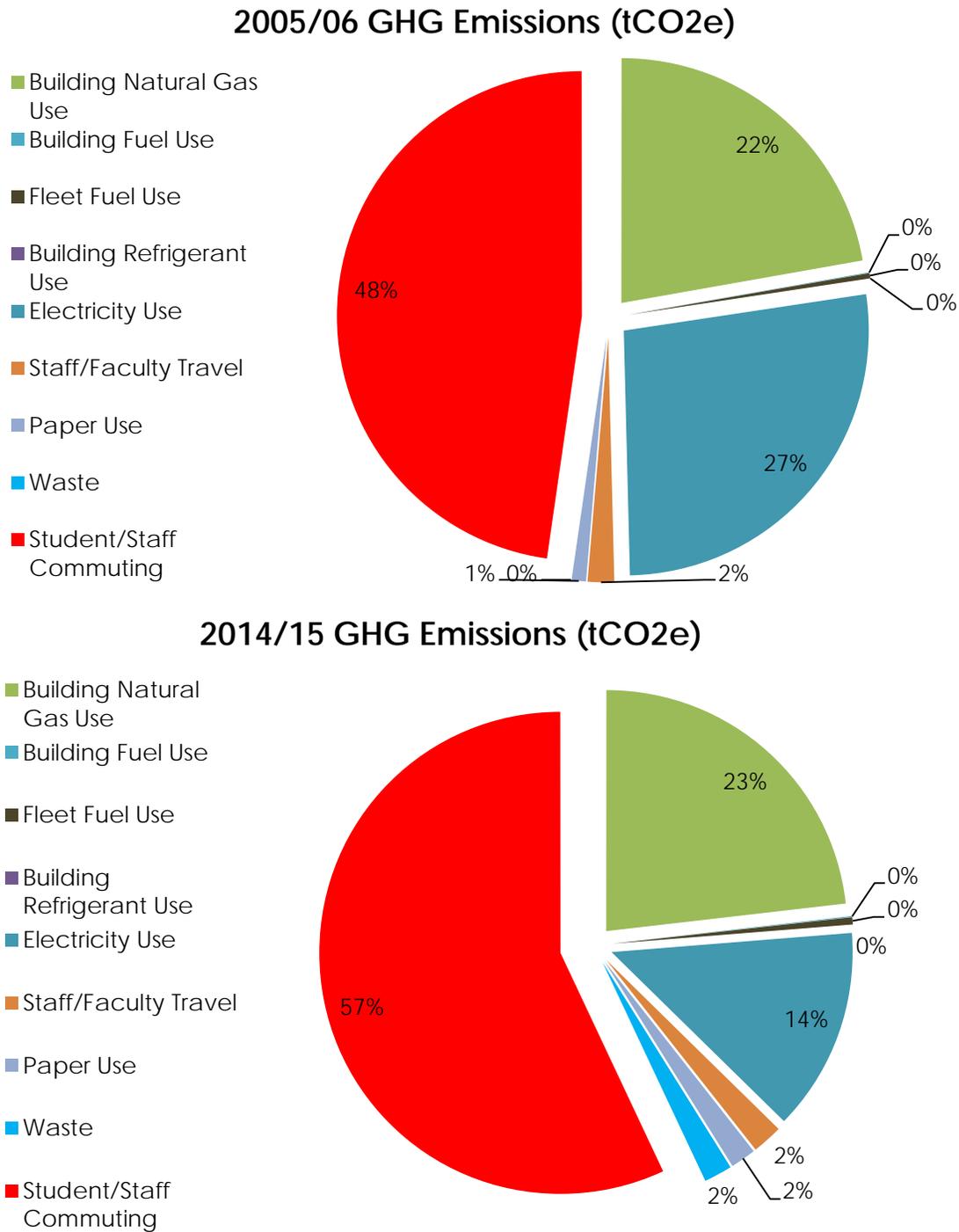


Figure 3. 2005/06 & 2014/15 GHG Emissions by Sector

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5.1.1 Commuter Travel

With a 60% increase in student enrollment at Humber College between 2005/06 and 2014/15 it is expected that there would be significant increase in GHG emissions (if not double) from commuting. However, as no data for student commuting was collected during the baseline year, only an estimate using the 2014 data could be determined which was based upon a fixed number of parking spots available at both of the campuses. Ultimately, the emissions only increased 5.7% between the reporting year and baseline. With the ability to collect postal codes and survey the student, staff and faculty populations, a more refined and representative factor could be developed.

A profile of commuter travel distances for 2014/15 is provided in Figure 4.

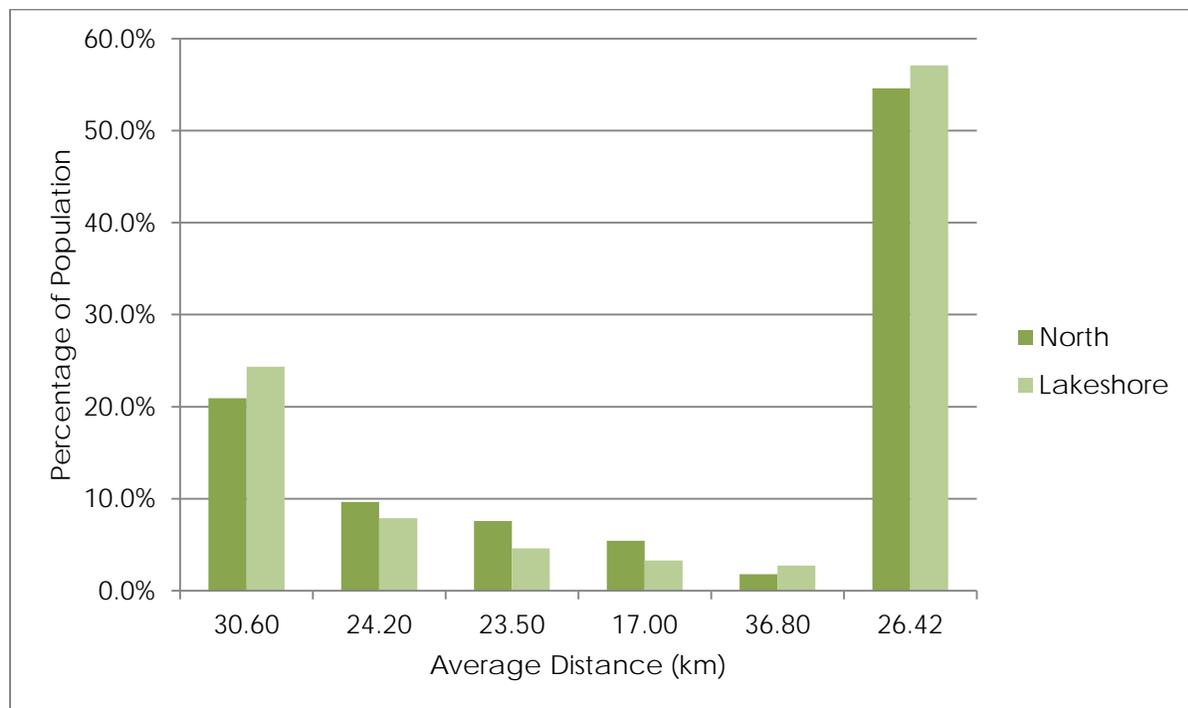


Figure 4. Commuter Profiles 2005/06 and 2014/15

5.1.2 Natural Gas

Natural gas consumption decreased by 22.1% between the baseline and the reporting year of which most, if not all of this decrease is associated with sustainability measures as the number of heating degree days was relatively the same (in 2014/15 there were 3,774.7 heating degree days versus 3,796.8 heating degree days in 2005/06). Table 6 provides comparative consumption of natural gas between the baseline year and the reporting year.

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5.1.3 Electricity

Humber College was able to reduce average electricity consumption by 8.3% between 2005/06 and 2014/15 during this same time the emission factors for electricity were decreased significantly over the same period. This is 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 6 provides comparative consumption of electricity between the baseline year and the reporting year by business unit.

Table 6. Comparison of 2005/06 and 2014/15 Energy Use by Business Unit

Activity Type	2005/06	2014/15	Percent Change
Energy Use	EkWh / ft²	EkWh / ft²	
Average	29.8	25.1	-15.7%
North Campus	35.8	29.4	-17.7%
Lakeshore Campus	24.6	21.1	-13.9%
Residence (Business Unit)	19.4	18.8	-3.4%
Electricity	kWh / ft²	kWh / ft²	
Average	13.8	12.7	-8.3%
North Campus	15.3	14.4	-5.7%
Lakeshore Campus	12.3	11.4	-7.3%
Residence (Business Unit)	11.4	9.5	-16.6%
Natural Gas	m³ of NG / ft²	m³ of NG / ft²	
Average	1.5	1.2	-22.1%
North Campus	1.9	1.4	-26.8%
Lakeshore Campus	1.2	0.9	-20.5%
Residence (Business Unit)	0.8	0.9	15.4%

The one key goal of the 5-Year Sustainability Plans is to reduce energy consumption by 40% and 50% (from the 2005/06 baseline) by the years 2018/19 and 2023/24, respectively. This goal aligns with the similar goals to reduce GHG emissions by 40% and 50% for the same milestone years.

Although total average energy use has decreased (approximately 15.7%), with the addition of new buildings in 2015/16, it is anticipated that the aggressive energy reduction targets even with implemented measures will be difficult to achieve (see Section 6.0). This can change if additional reduction measures, than those already planned, are implemented.

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5.1.4 Paper Consumption

Paper use has been estimated in the baseline using 2014/15 paper use / FTE as no data was collected for this during the baseline year. For the reporting period, an average 50% recycled content was applied.

5.1.5 Waste

It is difficult to tell how much waste emissions have increased or decreased from the baseline year as this metric has only recently started to be tracked over the past 3 years. It can be noted, however, that waste diversion has increased to 54% in 2014 compared to 42% in 2013 thus resulting in lower GHG emissions.

Humber College has a waste reduction target of 70% and will have to focus programs on diverting more waste in order to achieve this important goal.

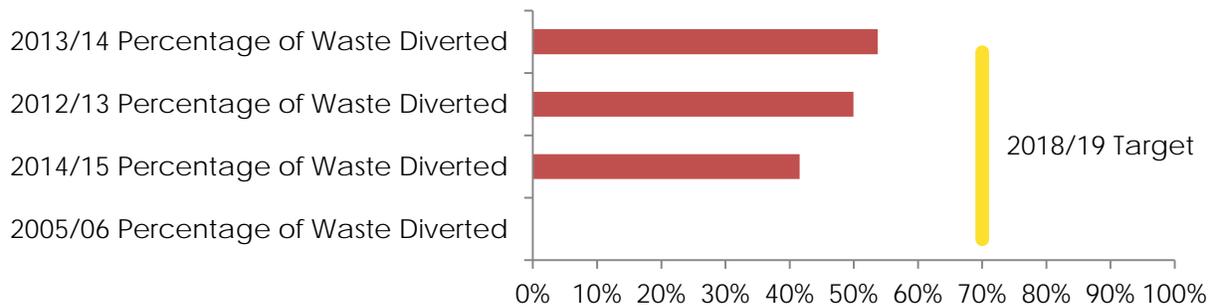


Figure 5. Waste Diversion Amount Achieved Compared to Target

6.0 GHG FORECAST

6.1 TARGETS

Humber College has committed to ensure that sustainability is reflected in the College's planning and decision making process which is defined in the 5-year Sustainability Plan. From the Sustainability 5 year plan, a number of key targets and goals were established. A number of these apply to the GHG inventory and forecast - these include:

- Reduce total energy use per square foot by 40% by 2018/19 compared to 2005/06; with a 50% reduction by 2023/24;
- Reduce Scope 1 and 2 GHG emissions intensity by 40% by 2018/19 compared to 2005/06; with a 50% reduction by 2023/24;
- Reduce total water use per student by 40% by 2018/19 compared to 2005/06;
- Increase waste diversion from 42% (2012/13) to 70% by 2018/19;
- All printing/copy paper purchases use 100% FSC certified and 100% Post-Consumer Waste (PCW) by 2018/2019; and
- Begin tracking Scope 3 Emissions.

The 5-year Sustainability Plan and Energy Consumption and Demand Management Plan provide a framework and an action plan to move towards achieving these target reductions. The development of a GHG inventory and forecast allows Humber College to assess progress against energy and GHG emission related targets.

6.2 BUSINESS-AS-USUAL (BAU) FORECAST

Energy consumption and GHG emissions are not static – they increase as the student population and as new buildings and fleets are added. In the future, they will continue to increase as Humber College grows. If Humber College continues with its current pattern of development - a "business as usual" (BAU) scenario – Humber College can expect energy use and emissions to also increase with the addition of new buildings and as the student, staff and faculty populations grow. This growth will be tempered somewhat by natural and regulated efficiency improvements including building code improvements (Provincial jurisdiction) and vehicle fuel efficiency standards (Federal jurisdiction) as well as actions taken on by Humber College.

The results of the BAU forecast indicate that energy consumption and GHG emissions will remain increase in proportion to student growth from now through to 2024/25, with energy use increasing only slightly (as see in Figure 6 and Figure 7).

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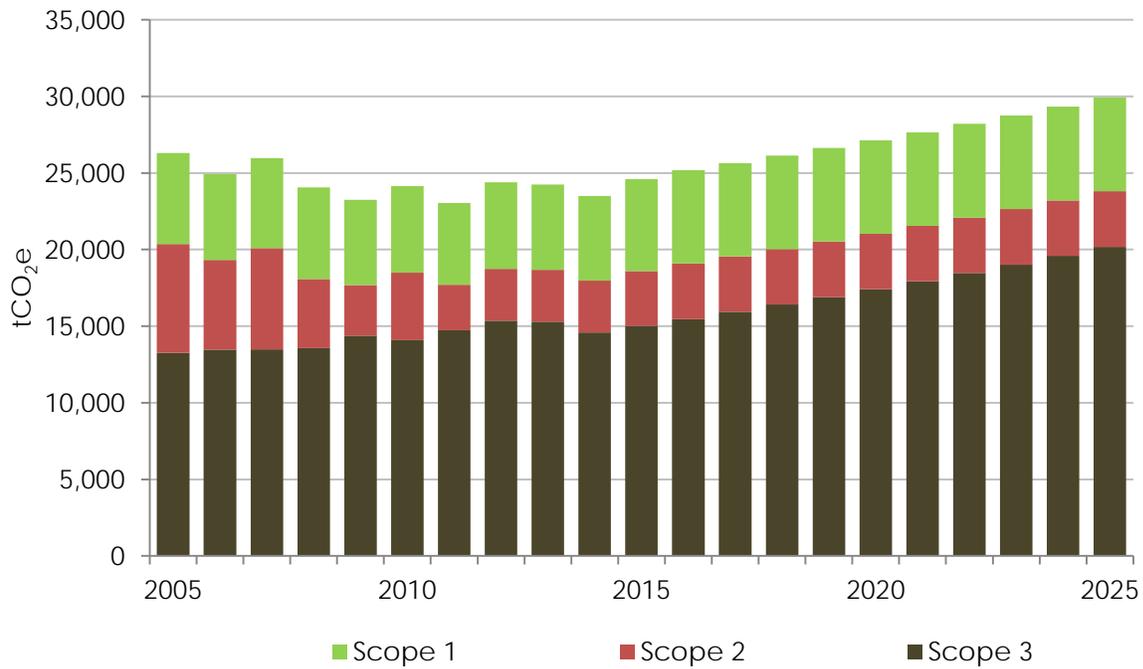


Figure 6. Business-as-usual (BAU) Forecast

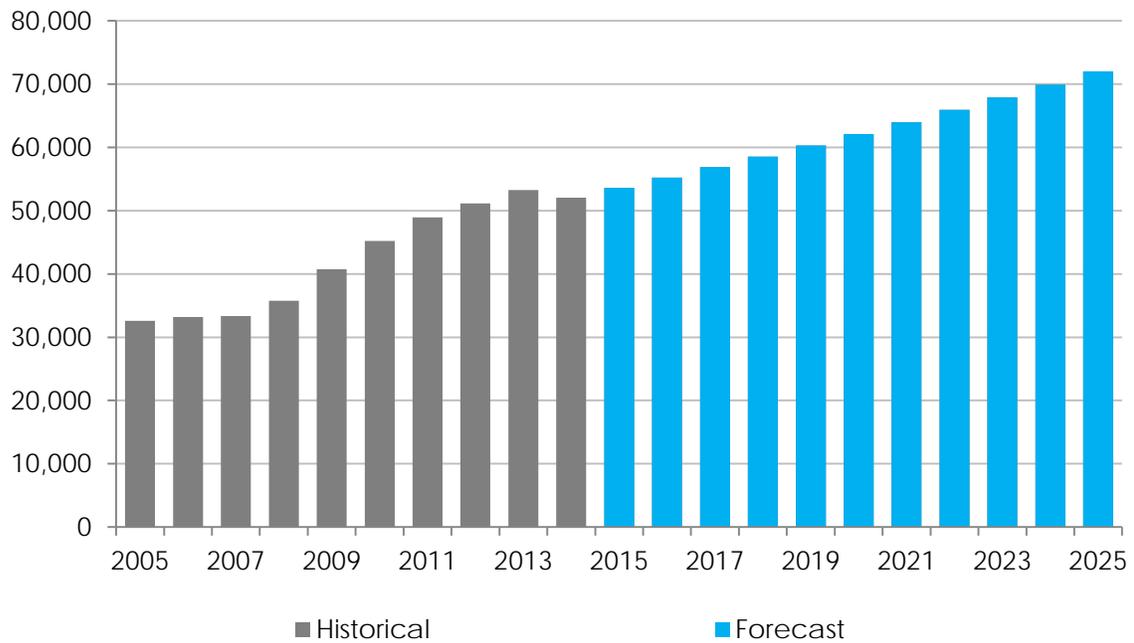


Figure 7. Student FTE Projected Growth

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The BAU forecast for energy use and GHG emissions per capita are shown in Figure 8 and Figure 9 respectively. Building energy usage largely increases with the addition and expansion of new buildings of which a number of additions are expected in the 2015/16 and the 2016/17 reporting year (Table 7). No other expansions are noted and thus energy use, without the implementation of any energy reduction measures, is expected to stabilize.

Table 7. Planned Building Additions by Year and Gross Square Footage (GSF)

Campus/Building	Commissioning Year	Area (GSF)
Lakeshore Campus		
Welcome Centre	2016	42,000
Athletics Centre	2016	12,000
Building G	2016	24,000
North Campus		
Building F Additions	2015	40,000
Humber LRC	2015	260,000

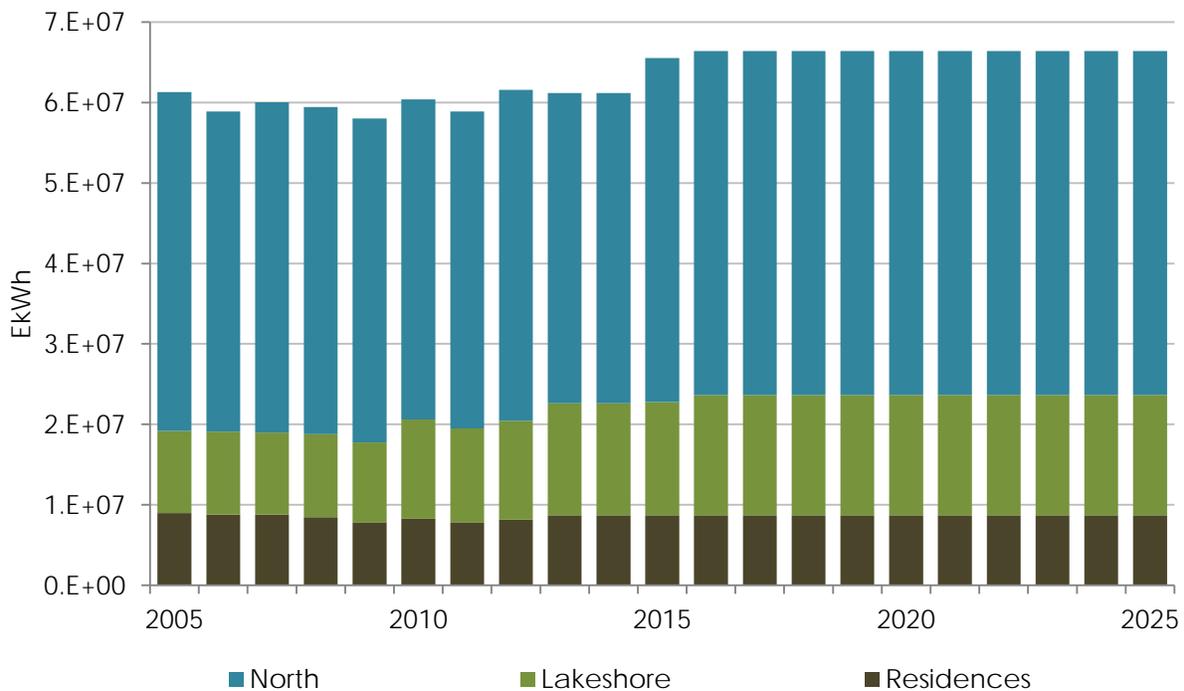


Figure 8. Projected Energy Use by Business Unit

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On the basis that building energy use is tied to building square footage, GHG emissions per capita are expected to stabilize and slightly decline over the next decade. However, if new buildings are added (not yet planned), this trend will reverse.

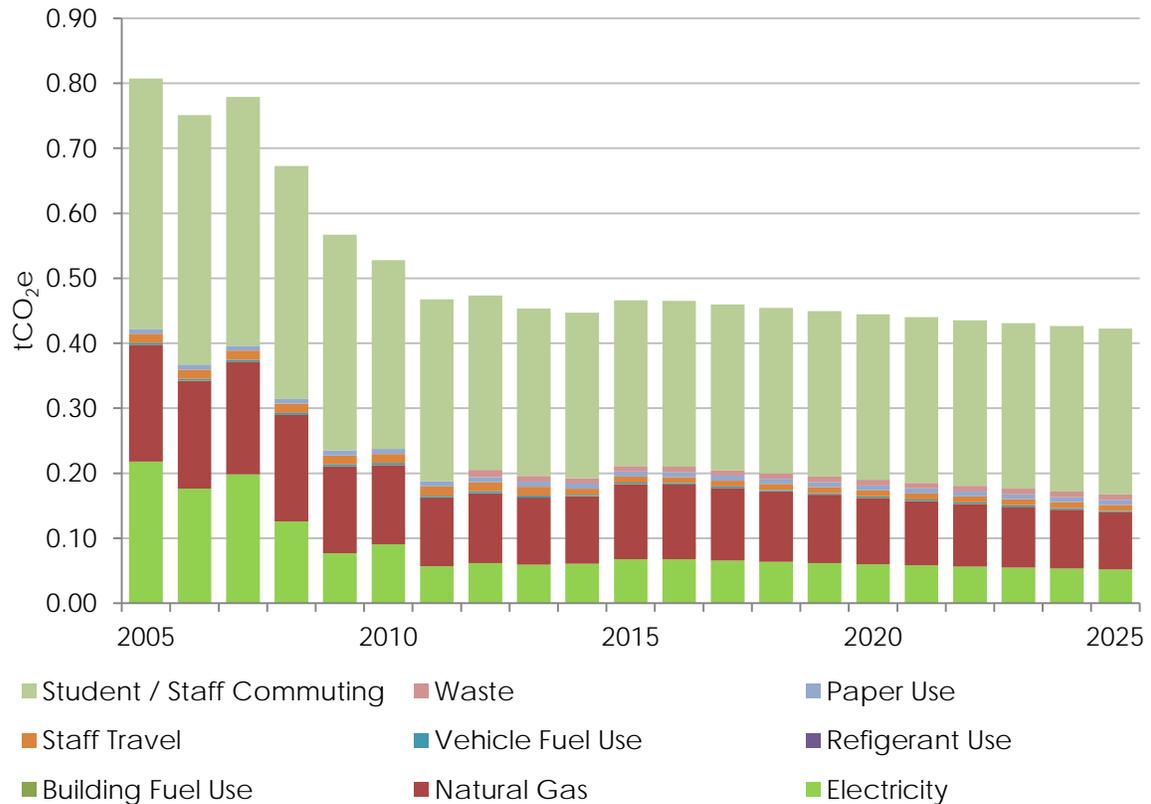


Figure 9. Projected GHG Emissions Per Capita Broken Out By Sector.

6.3 REDUCTION SCENARIO SUMMARY

A reduction scenario was developed as an alternate to the BAU scenario. Like the BAU scenario, it is driven by FTE population growth rate and by building additions. The reduction scenario accounts for the actions established in the Energy Consumption and Demand Management Plan. Altogether, this reduction scenario is estimated to achieve reductions in energy, electricity and GHG emissions (Figure 10).

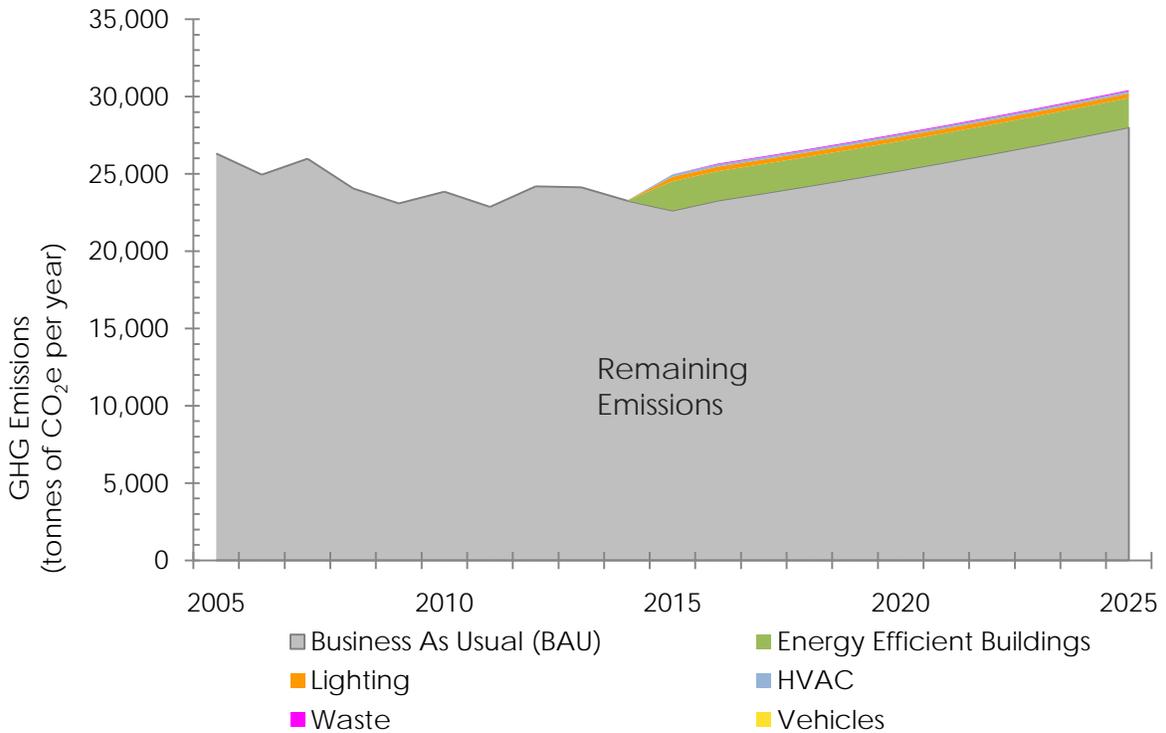


Figure 10. Humber College Greenhouse Gas (GHG) Emissions Reduction Forecast

In the BAU scenario, without the implementation of any reduction action, Humber College’s GHG emissions could exceed 30,000 tCO₂e. However, with the implementation of the Energy Consumption and Demand Management Plan, Scope 1 and 2 Emissions can be reduced significantly as noted in the above Figure – most emission reductions will result from improving energy efficiency in the buildings. The remaining emissions are mainly Scope 3 emissions to which Humber College has significantly less influence over.

An interesting observation is the difference between the changes in total and per capita values (Figure 11). While the total energy use and GHG emissions changes are relatively small, these occur while the population will grow by 34% (2014/16 to 2023/24). As a result the “per person” reductions are much more dramatic than the total reductions.

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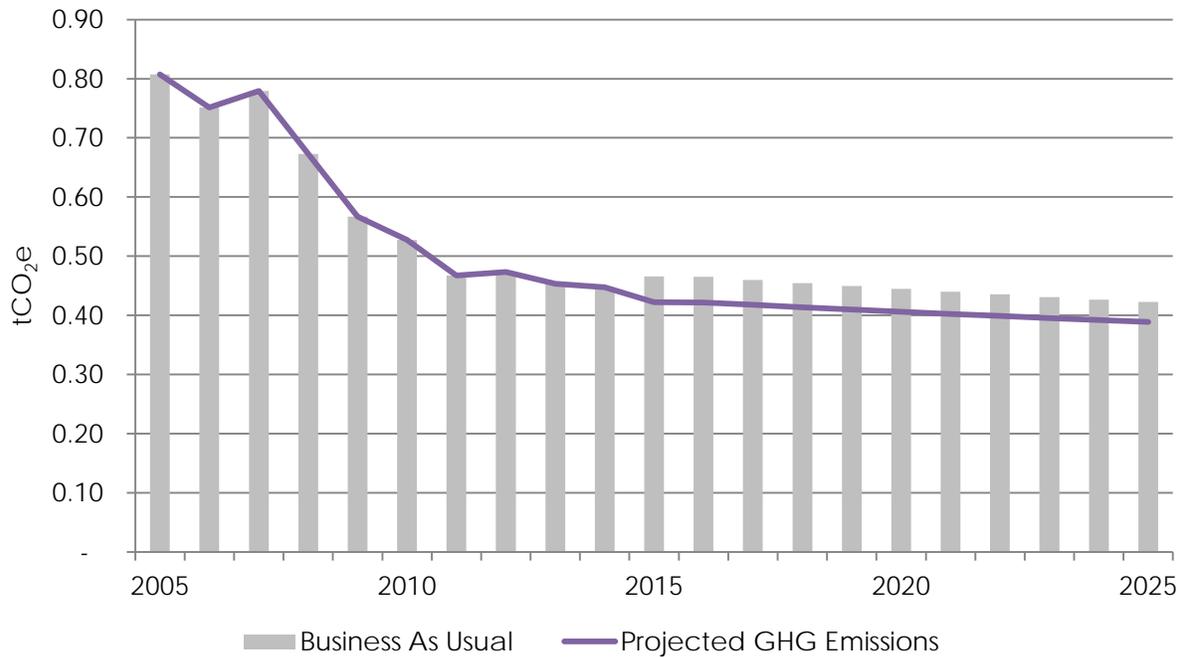


Figure 11. Business-as-usual (BAU) vs Reduction Scenario (Per Capita)

A summary of the impact that each reduction measure is expected to have is included in Table 8. Specific details on each action can be found in the Energy Consumption and Demand Management Plan.

Table 8. Reduction Scenario Actions

Action	Business Unit	Estimated Savings Per Year					
		Water (m ³)	EkWh	Electricity (%)	Natural Gas (%)	Vehicle Fuel Use (%)	Waste (%)
Enhanced Submetering	All Buildings			2%	2%		
Retro-Commissioning Program	All Buildings			10%	10%		
Building Envelope Performance Program	All Buildings			5%	5%		
Behavioral Energy Reduction Programs	All Buildings			2%	2%		
Automatic Voltage Regulation	All Buildings		310,000				
Install Water Efficient Toilets	All Buildings	18,000					
Install Water Efficient Urinals	All Buildings	11,000					

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Action	Business Unit	Estimated Savings Per Year					Waste (%)
		Water (m ³)	EkWh	Electricity (%)	Natural Gas (%)	Vehicle Fuel Use	
Upgrade Student Residence Showerheads	Residences	11,700					
Replace Water Cooled Equipment with DX Units	North	5,000					
Replace Water Cooled Equipment with DX Units	Lakeshore	5,000					
Lakeshore Campus Potlight Retrofit	Lakeshore		110,000				
North Campus Potlight Retrofit	North		225,000				
Carrier Drive Building Corridor Upgrade	All Buildings		-				
Washroom & Cove Lighting Redesign	All Buildings		60,000				
North Campus Stairwell Lighting Retrofit	North		110,000				
Parking Lot Retrofits (LED)	North		55,000				
Parking Lot Retrofits (LED)	Lakeshore		55,000				
Lighting Redesign - Classrooms and Labs	Lakeshore		1,000,000				
Lighting Redesign - Classrooms and Labs	North		1,000,000				
Smart Power Bars	North		12,500				
Smart Power Bars	Lakeshore		12,500				
Variable Air Retrofit - North L	North		600,000				
Variable Air Retrofit - North J	North		400,000				
Variable Air Retrofit - North K	North		400,000				
Kitchen Hood	Lakeshore		1,000				
Organics Diversion	All Buildings						10%
Efficient Fleet (E3)	Fleet Vehicles						2%



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6.4 ASSESSMENT AGAINST CURRENT SUSTAINABILITY TARGETS

The most important aspect around forecasting GHG emissions is that it allows Humber College to compare annual progress against the targets endorsed in the 5-year Sustainability Plan. The reduction scenario and the following figures illustrate that even with a number of energy and emission reduction measures, Humber College will fall short of meeting the targets endorsed in the 5-year Sustainability Plan. In light of this, the 5-year Sustainability Plan should be considered as a starting point for action. It is acknowledged that further action may be required in the future depending on whether technology changes or development activities occur faster or slower than anticipated.

With respect to the GHG emissions target for Scope 1 and 2 Emissions, it is anticipated that the 2018/19 target of 40% will narrowly be achieved in the 2015/16 reporting year and maintained thereafter due to the fixed nature of the assets (i.e. buildings) (Figure 13). Note that the business as usual (BAU) scenario assumes that no energy/GHG reduction actions are implemented past the current reporting year.

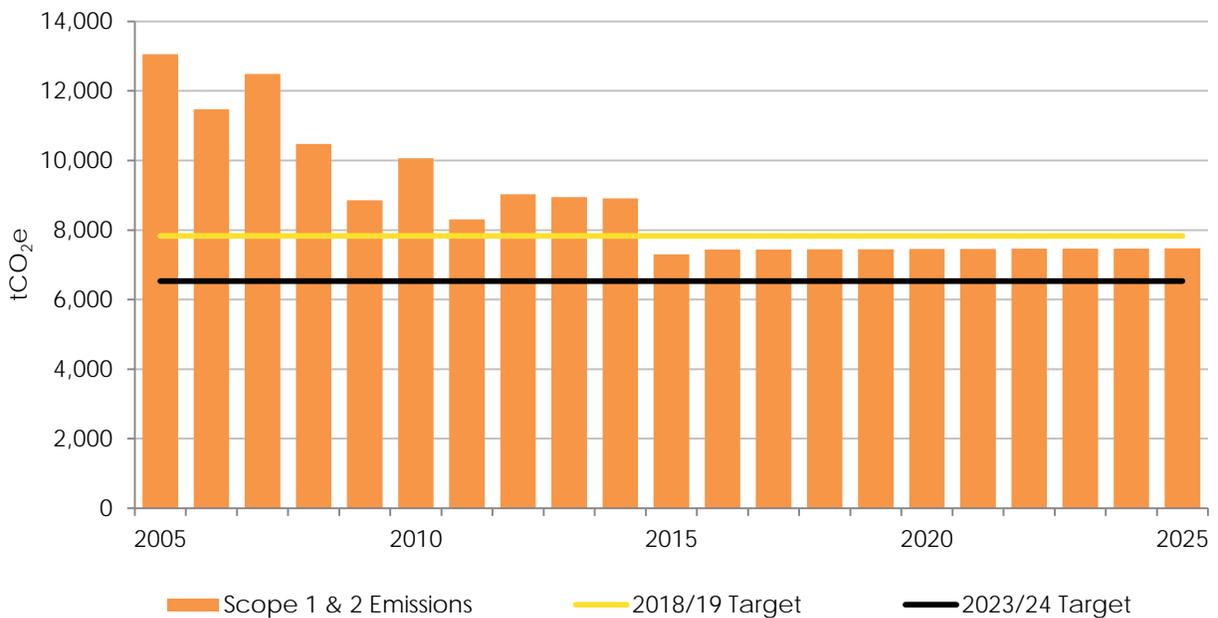


Figure 12. Projected Scope 1 and 2 Emissions vs Targets

Although energy use has decreased (approximately 18.4%) for all business units in the 2014/15 reporting year compared to the baseline year (see Figure on left), with the addition of new buildings in 2015/16, it is anticipated that the aggressive energy reduction targets even with implemented measures will be difficult to achieve (see Figure on the right). This can change if the more of the focus is on reducing natural gas usage as it has greater energy intensity than electricity.

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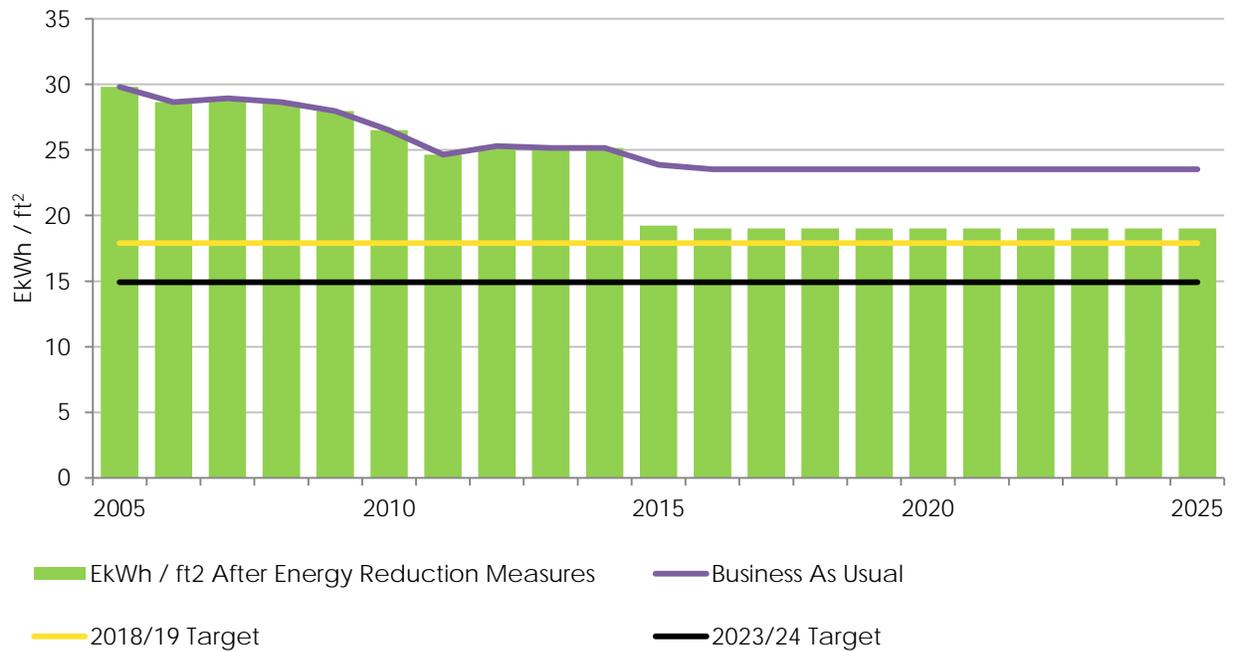


Figure 13. Projected Energy Use vs Targets

With the implementation of energy and water reduction measures, both GHG emissions and water use per student are anticipated to decrease whilst populations continue to rise as noted in the following projections. Current water use per FTE is below the 2018/19 target and will likely fall below the 2024/25 target in the 2015/16 reporting year (provided water savings programs are initiated)

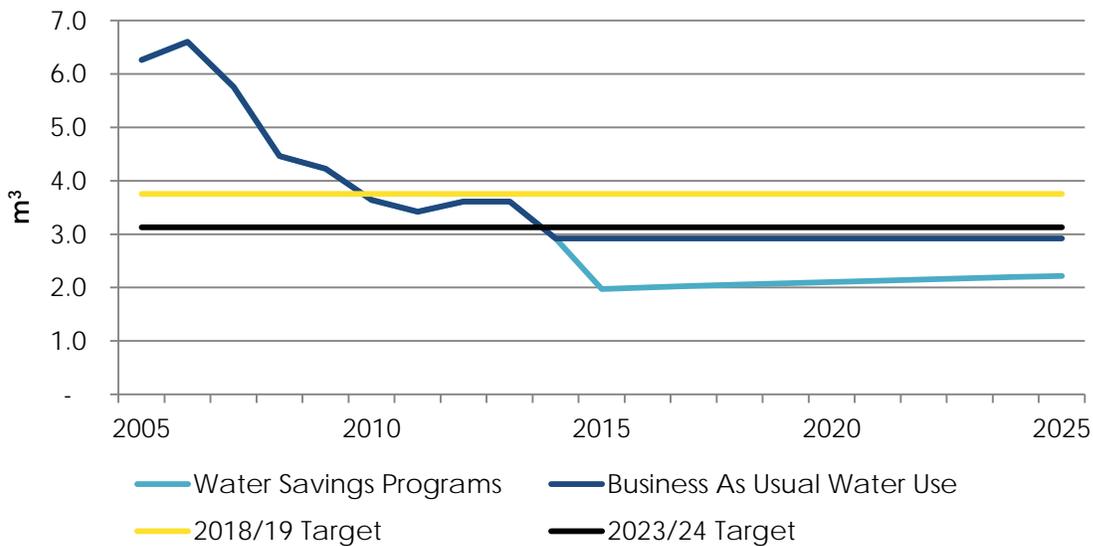


Figure 14. Projected Water Use vs Targets

7.0 GHG REDUCTION OPPORTUNITIES

7.1 PAST AND CURRENT INITIATIVES

Humber College has and plans to carry out a number of initiatives with the aim of reducing GHG emissions while expanding its buildings and facilities. These have been documented in Section 6.3 and are described in the Humber Energy and Water Conservation and Demand Management Plan.

7.2 FUTURE INITIATIVES

While many significant GHG reduction initiatives have taken place at Humber College, there are additional initiatives that could be carried out in order to maximize GHG emissions savings while aligning with the 5-Year Sustainability Plan, and the Humber Energy and Water Conservation and Demand Management Plan. The following recommendations are put forth for future consideration by Humber College. These should, of course, be assessed in terms of sustainability, social and economic indicators.

7.2.1 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.

7.2.2 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.

7.2.3 Upgrade Fleet

As the facility fleet ages and is due for replacement, Humber College could replace fossil-fuel based vehicles with hybrid-electric or fully electric vehicles depending upon the requirement and load of the vehicle.

7.2.4 Paper Recycled Content

At Humber College, approximately 50% 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 and would move Humber towards its

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goal of having all printing/copy paper purchases use 100% FSC certified and 100% Post-Consumer Waste (PCW) by 2018/2019.

7.2.5 Sustainability Outreach

Humber College 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 Humber College to reduce the future year's emission intensities further.

7.2.6 Internalize the Cost of Carbon

Humber 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,

8.0 IMPLEMENTATION AND MONITORING

8.1 PERFORMANCE MONITORING FRAMEWORK

Humber College has taken important steps in developing a baseline emission inventory, developing sustainability initiatives and the 2014/15 GHG inventory provides a basis for assessing the success of the sustainability initiatives at Humber College. After the completion of each annual GHG inventory, Humber College 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 Emissions data - namely, commuter data and paper use. Humber College is encouraged to meet with stakeholders to reiterate the importance of accuracy, transparency and consistency in how activity data is collected. Particularly, an improvement to collecting postal code data and typical commuting behavior is an 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 better paper use data was collected and the distance and type of travel that staff and faculty expense during a reporting period.

9.0 CONCLUSIONS

Humber College has made significant progress and achieved emission reductions between 2005/06 and the 2014/15 reporting year. An absolute decrease of 10.7% between the baseline and 2014/15 GHG emission inventory was accomplished as well as a 44.1% decrease on a FTE basis. The commitment to sustainability initiatives both by Humber College and its students is apparent. While Scope 3 emission, beyond the control of Humber, increased by 10%, this growth occurred at a much slower rate than the 60% increase in enrollment at Humber College. Humber College's leadership towards reducing energy use and GHG emissions from buildings is well noted, therefore, the key to future initiatives is student engagement and reducing Scope 3 emissions.

10.0 CLOSURE

Stantec has completed Humber College's 2014/15 greenhouse gas (GHG) emissions inventory using reasonably ascertainable information obtained from Humber College 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 Humber 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, "Humber College 2014/15 Greenhouse Gas Emissions Inventory" was produced by Daniel Hegg. It has been senior reviewed by Nicole Flanagan and Sana Talebi.

Respectfully Submitted,

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