Carbon Footprint Analysis

University of Toronto, St. George Campus Greenhouse Gas Emissions Inventory Report May 1, 2008 – April 31, 2009

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1.0 Executive Summary

1.1 Background

This report summarizes the findings from an inventory of the anthropogenic greenhouse gas emissions for the University of Toronto (U of T), St. George campus of the fiscal year 2009. The purpose of completing the inventory is to clarify the sources of emissions and to guide short and long-term reduction policies and projects including energy retrofits, education and research.

Since the early seventies, The University of Toronto has been focused on sustainability. In fact, in 1977, the University dedicated a full time engineer to focus solely on energy conservation. Over the years numerous sustainability-driven initiatives have taken place on campus. These initiatives have included mechanical upgrades to energy efficient equipment, lighting improvements, water conservation projects as well as recycling programs. The University has made great strides in terms of using recycled products, reducing waste and even employing pesticide free landscaping techniques. Furthermore, renewable energy is generated on campus through various solar arrays. Today, the University continues to strive for excellence in terms of making the environment a priority and the Sustainability Office continues to develop innovative ideas to move the University towards carbon neutrality.

1.2 Scope and Methodology

This inventory utilizes the GHG Protocol to understand, quantify and manage greenhouse gas emissions. The GHG Protocol is an accounting framework, developed with the collaboration of the World Resources Institutes and the World Business Council for Sustainable Development. It divides emissions into three separate scopes.

As classified by the Intergovernmental Panel on Climate Change (IPCC), the emissions are reported in Metric Tonne Carbon Dioxide Equivalents ($mtCO_2e$), according to their Global Warming Potential (GWP) to provide the relative contribution of each gas to forcing climate change. The emissions are categorized, as per the GHG Protocol, and shown in Figure 1 on the following page.

To develop this report, a standardized greenhouse gas calculator (Campus Carbon Calculator version 6.4, Clean Air-Cool Planet, New Hampshire) was used to conduct the GHG inventory. The calculator allowed for easy entry and conversion of collected data to its carbon dioxide equivalent based on global warming potential.

The calculator uses standard methodologies codified by the GHG Protocol. These methodologies are currently the most accurate and widely accepted among policy makers. The calculator is an ACUPCC preferred tool.

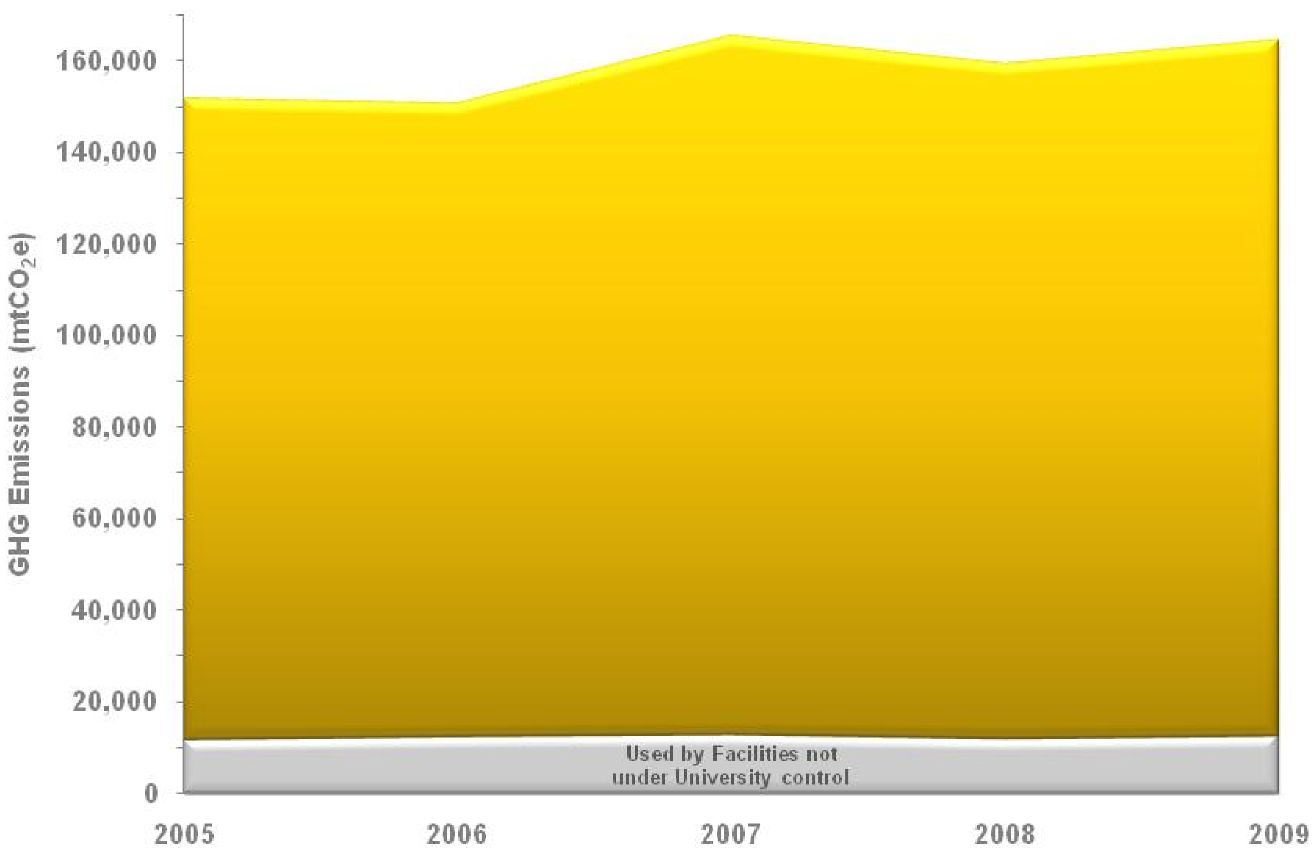
1.3 GHG Inventory

The inventory clearly demonstrates that the major sources of GHG emissions were Scope 1 and Scope 2 emissions. Scope 1 emissions account for 51% and Scope 2 accounts for 33%. Scope 1 emissions predominately included natural gas consumption. Scope 2 emissions included all purchased energy. Scope 3 emissions are all emissions not under the direct control of the University.

Below are the summarized findings:

- Total inventory for the fiscal year 2009 was 164,491 mtCO_2e
- The University sells steam and electricity to facilities not under their control; this accounts for approximately 15% of their scope 1 emissions
- On-campus stationary contributed the most at 50% of the total emissions
    - 16% from the cogeneration plant
    - 34% from other on campus stationary sources
- Electricity consumption accounts for 30% of the total inventory, and 90% of the Scope 2 emissions
- Commuting attributed for the largest section of Scope 3 emissions attributing to 14% of all emissions, and 87% of the Scope 3 emissions

Figure 1 – Total GHG Emissions: 5 Year Trend



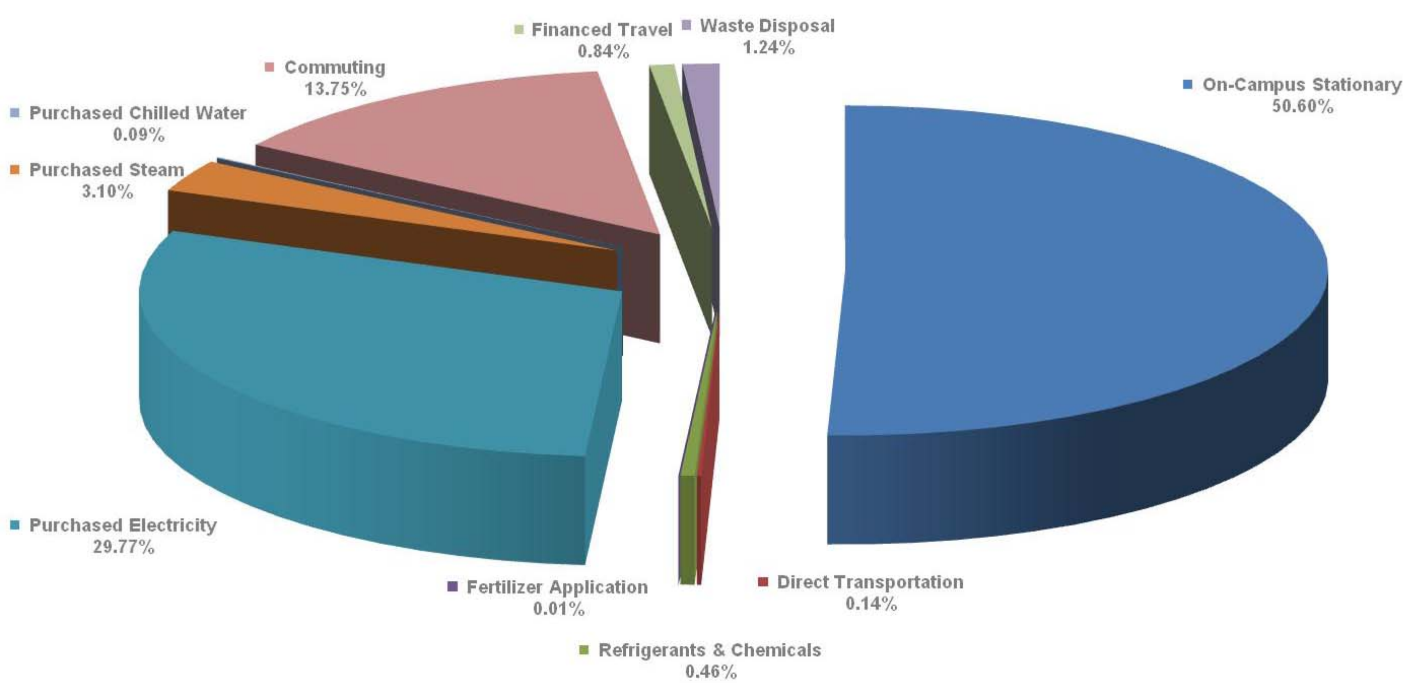
1.4 Steps to Climate Neutrality

Developing a GHG inventory is an ongoing process, and is the first step towards carbon footprint reduction. This inventory requires constant improvement in both the quality and accuracy of the data included, and expansion to include other activities within Scope 3.

The University should, and has, focused their emissions reduction projects on Scope 1 and 2 emissions. There are further reduction opportunities for the University if it decides to further improve energy efficiency of the campus.

To improve the identification of Scope 3 emissions, the University needs to improve their tracking and recording. Student surveys, purchasing and accounting policies are effective methods to aid in improvement. It is also helpful to implement green purchasing policies that monitor GHG emissions associated with purchases, and to track emissions beyond the boundary scope of this inventory.

Figure 2 – GHG Emissions by Activity



2.0 Background

2.1 Project Background

The purpose of completing this inventory is to clarify the sources of emissions and to guide short and long-term reduction policies and projects including energy retrofits, education and research. This report attempts to identify all anthropogenic GHG gas emissions.

2.2 College Background

Established in 1827, the University of Toronto is Canada's largest university, recognized as a global leader in research and teaching. U of T's distinguished faculty, institutional record of groundbreaking scholarship and wealth of innovative academic opportunities continually attract outstanding students and academics from around the world. The U of T is committed to providing an unparalleled learning experience through the close-knit learning communities made possible through its college system and academic divisions. Located in and around Toronto, one of the world's most diverse regions, the U of T's vibrant academic life is defined by a unique degree of cultural diversity in its learning community. The University is sustained environmentally by three green campuses, where renowned heritage buildings stand beside award-winning innovations in architectural design.

Since 1973 The University of Toronto has been focused on sustainability. Over the decades numerous sustainability-driven initiatives have taken place on campus. Today, the University through the Facilities & Services Department continues to strive for excellence in terms of making the environment a priority. In 2004 the University established the Sustainability Office which develops innovative ideas to move the University's students and academic community towards carbon neutrality.

2.3 Project Partners

The development of this report required both internal and external University resources. For transparency purposes, this section lists all partners who helped develop to this inventory.

University of Toronto's Facilities & Services Department

The University of Toronto's Facilities & Services Department worked with Honeywell to develop this report. They provided insight into the University's operation, and helped gather data associated with the carbon footprint. Additionally, they have the ability to influence the University to improve the ease and accuracy of the data collection, along with reducing the University's GHG emissions.

Honeywell

Honeywell operates four global divisions: Aerospace, Automation & Control Solutions, Transportation Systems, and Specialty Materials. Honeywell Building Solutions is a strategic business unit in the Automation & Control Solutions division. The Energy Solutions group operates under the umbrella of Honeywell Building Solutions, and aided in the development of this report.

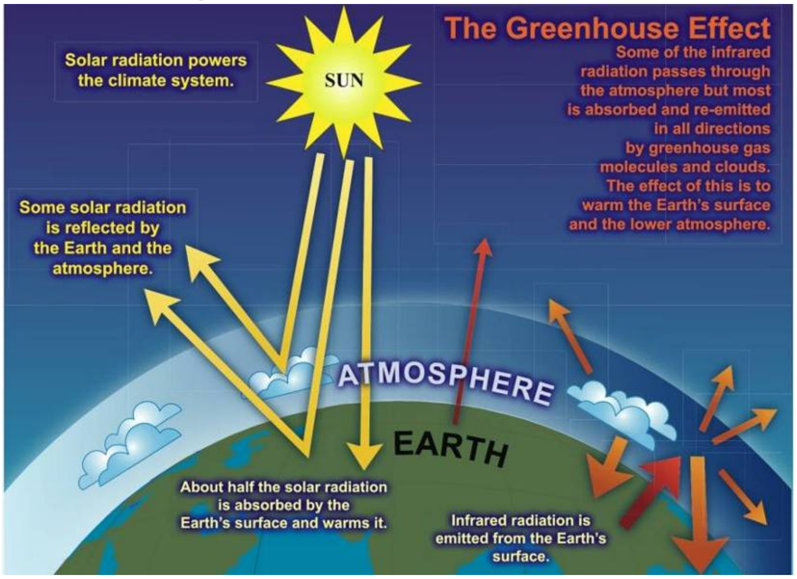
Clean Air Cool Planet

Clean Air-Cool Planet (CA-CP) is an action-oriented advocacy group that seeks to reduce the threat of global warming. CA-CP engages organizations and institutions in all sectors to take action leading to rapid cuts in greenhouse gas emissions. CA-CP produced a standardized greenhouse gas calculator (Campus Carbon Calculator version 6.4, Clean Air-Cool Planet, New Hampshire). This calculator was used in developing this report to determine the University of Toronto, St. George campus' GHG inventory or carbon footprint.

2.4 Climate Change Background

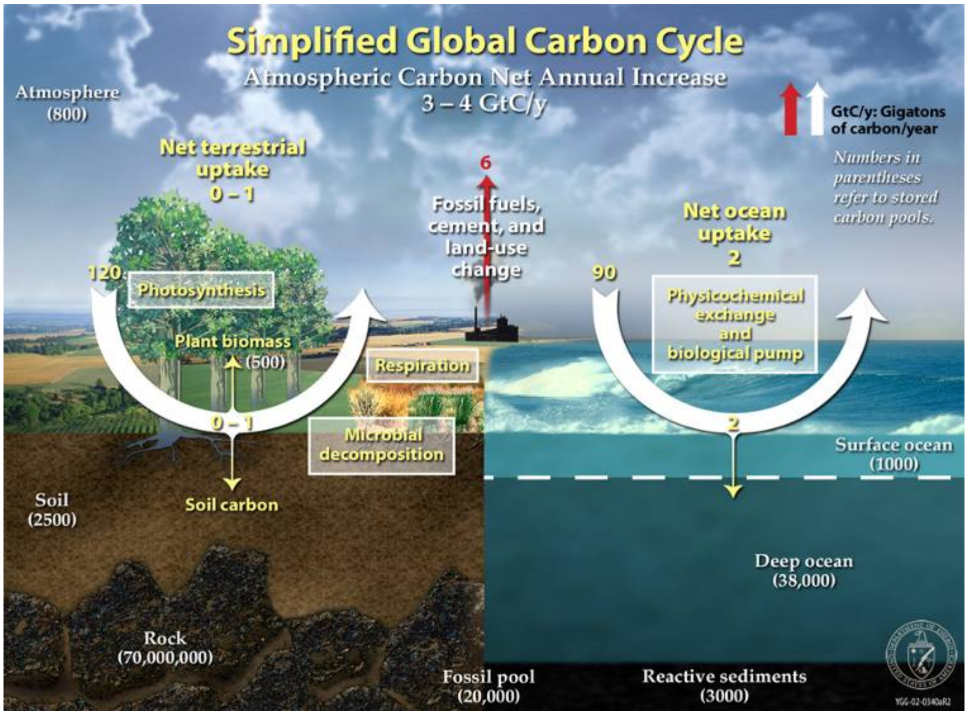
Climate change refers to fluctuations in the temperature, precipitation, wind, and other elements of the Earth's climate system. A variety of natural factors can influence these fluctuations including changes in orbital parameters, volcanic activity and solar irradiance. In addition, a change in the composition of the atmosphere can cause climate change. The planet is kept at a hospitable average temperature of 15.5ºC (60ºF) due to the insulating layer of greenhouse gases that encapsulate the surface. These gases absorb some of the sun's energy, and keep the enclosed surface warm. This phenomenon, known as the greenhouse effect, is a necessary component of the many systems needed to support life on Earth (Figure 3).

Figure 3 – Greenhouse Gas Effect



Naturally, carbon readily flows through the atmosphere, ocean, soil, and plants, also known as carbon sinks. Scientists commonly refer to this as the carbon cycle (Figure 4). Over millions of years, carbon originally found in plants transformed into fossil fuels, and then stored itself in sinks within the earth. Anthropogenic activities, specifically burning fossil fuels have moved the carbon stored below the earth into the atmosphere. Scientists refer to the addition of greenhouse gases into the atmosphere as climate change. Other greenhouse gases follow similar cycles, where their contribution to anthropogenic climate change occurs as humans move the gases from long-term sinks into the atmosphere.

Figure 4 – Carbon Cycle



Human activities have caused this movement between the long-term sinks, and have led to an "enhanced greenhouse effect," also known as global warming. Over the last 250 years, carbon dioxide concentrations have raised by almost 36%, with 50% of the increase occurring from 1770 to 1970, and the other 50% occurring in the last 35 years. Other GHG emissions have greatly increased; methane has more than doubled, and nitrous oxide has increased approximately 15%. In its fourth assessment report published in 2007, the IPCC concluded, "In light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last fifty years is likely to have been due to the increase in greenhouse gas concentrations." It is certain that human activities have significantly increased concentrations of greenhouse gases in the atmosphere and contributed to the enhanced greenhouse gas effect. While it is unclear exactly what the impacts of a changing climate will be, it is clear that there will be important ecological and human ramifications.

Table 1 below depicts the different types of GHGs and the significant increase from levels in 1750 (pre-industrialization).

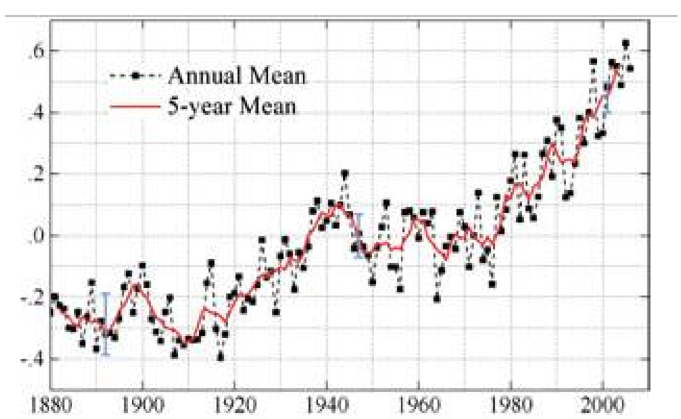
Table 1 – Greenhouse Gas Atmospheric Information

Greenhouse Gas Name	Alternative Name	Formula	1998 Level	Increase Since 1750
Carbon dioxide	Carbonic anhydride	CO_2	365ppm	87ppm
Carbon monoxide	Carbonic oxide	CO	11.1ppm	46ppb
Methane	Marsh gas	CH_4	1,745ppb	1,045ppb
Nitrous oxide	Laughing gas	N_2O	314ppb	44ppb
Tetrafluoromethane	Carbon tetrafluoride	CF_4	80ppt	40ppt
Hexafluoroethane	Perfluoroethane	C_2F_6	3 ppt	3ppt
Sulphur hexafluoride	Sulphur fluoride	SF_6	4.2ppt	4.2ppt
HFC-23	Trifluoromethane	CHF_3	14ppt	14ppt
HFC-134a	Tetrafluoroethane	$C_2H_2F_4$	7.5ppt	7.5ppt
HFC-152a	Difluoroethane	$C_2H_4F_2$	0.5ppt	0.5ppt

The IPCC also found that snow cover since the late 1960s has decreased by approximately 10%, and lakes and rivers in the Northern Hemisphere remain frozen for approximately two weeks less each year than they were in the late 1960s. Mountain glaciers in non-polar regions have also been in "noticeable retreat" in the 20th century, and the average global sea level has risen between 0.1 and 0.2 metres since 1900.

The global average surface temperature has increased over the twentieth century by approximately 0.74^{0}C. The World Meteorological Organization reported in December 1999 that the 1990s were, globally, the warmest decade since instrumental measurement started in the 1860s. Simply put, the world is getting warmer and temperatures are rising faster than ever.

Figure 5 – Global-Mean Surface Temperature Anomaly (ºC)



2.5 Definition of Greenhouse Gases

Greenhouse gases are gases in the Earth's atmosphere that absorb and emit radiation or heat. This process of trapping heat in the atmosphere is the main factor of the greenhouse effect. Common greenhouse gases in the atmosphere include water vapour, carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbons. CO_2 and $CH_{4,}$ contribute an average of 17%, and 6% to the greenhouse effect respectively while water vapour contributes 54%.

Each greenhouse gas traps the sun's energy to varying degrees; this is defined by IPCC as the global warming potential (GWP). By measuring and describing a greenhouse gas in terms of its global warming potential, it converts each greenhouse gas' impact into a similar unit. The standard unit of measurement is metric tonnes of carbon dioxide equivalents ($mtCO_2e$), which this report uses throughout to define GHG emissions by the University. This unit allows for a quick comparison of different gases relative to the effect they have on the greenhouse effect.

The Kyoto Protocol is an international protocol establishing legally binding commitments for the reduction of four greenhouse gases (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride), and two groups of gases (hydrofluorocarbons and perfluorocarbons). These gases are isolated from the rest because humans are able to control these emissions, and the impact that industrialization has on these gases. These six gases are included in this inventory.

Carbon Dioxide (CO_2) – Carbon is a continually cycling element that moves between the atmosphere, ocean, land biota, marine biota and mineral reserves. In the atmosphere, carbon exists primarily as carbon dioxide, which is a part of global biogeochemical cycling.

Methane (CH_4) – Anaerobic decomposition of organic matter in living systems primarily produces methane. For example, agriculture animals produce methane in their stomach while digesting food. As the animals produce manure it releases the methane into the atmosphere. In addition, the collection, processing, and combustion of fossil fuels produces methane.

Nitrous Oxide (N_2O) – The combustion of fossil fuels also produces nitrous oxide. It is also produced in some agriculture and industrial processes. The high atmospheric lifetime of N_2O and its global warming potential makes N_2O the second most important greenhouse gas next to CO_2.

Fluorocarbons – Hydrofluorocarbons, perfluorocarbons, and sulphur hexaflouride (HFC, PFC, SF_6 – Halocarbons) are primarily produced for industrial processes. HFCs were introduced as replacements for ozone-depleting substances, primarily as refrigerants. HFCs and SF_6 are used in aluminum smelting, electric power distribution and magnesium casting. These chemicals are powerful greenhouse gases, and have very long atmospheric lifetimes.

3.0 Scope and Methodology

3.1 GHG Protocol

The GHG Protocol is an internationally accepted accounting and reporting standard, developed with the collaboration of the World Resources Institutes (WRI) and the World Business Council for Sustainable Development (WBCSD). This inventory utilizes the GHG Protocol to understand, quantify, and manage greenhouse gas emissions. It is the standard reporting protocol recommended by the Canadian Government, and the CA-CP calculation tool follows other WRI GHG standards.

The GHG Protocol and the Canadian Government base their science on the United Nations Environment Program group. This group, known as the International Panel on Climate Change (IPCC), consists of the leading climate scientists. The GHG Protocol based all of its scientific information on reports developed by the IPCC.

Prior to conducting the University's inventory, the University clearly defined the operational and organizational boundaries. This report strictly follows the rules and guidelines that constitute these boundaries for relevance, completion, consistency and accuracy.

3.2 Organizational Boundaries

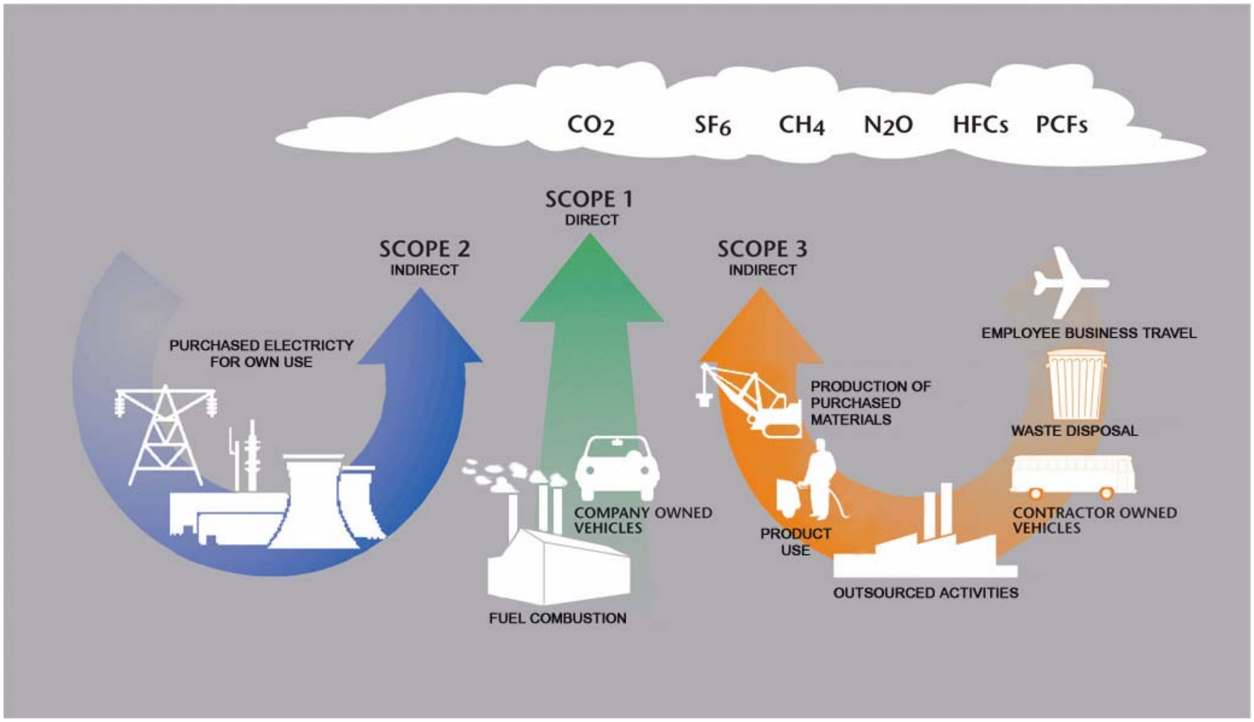
Organizational operations vary in their legal and organizational structures. The GHG Protocol stipulates numerous methods to best determine those boundaries. For transparency and consistency, this report sets specific organizational boundaries while determining the University of Toronto, St. George Campus' GHG inventory.

The report's organizational/spatial boundary includes only the St. George campus that represents a building floor area of 12,643,342 ft^2 (not including affiliated colleges). In accordance with the WRI's GHG Protocol, the inventory utilized the operational control approach to determine the organizational boundary. As such, this report only contains information for the St. George Campus. An inventory for the other two campuses, is planned for the future, but will be separate from this inventory. The inventory covered the University's fiscal year from May 2008 to April 2009.

3.3 Operational Boundaries

The GHG Protocol establishes a set of standards that enable organizations to define the operational boundaries for their GHG accounting and reporting endeavours. Identification of operational boundaries helps institutions to scope their sources of emissions providing accountability for the prevention of 'double counting'. The GHG protocol divides sources of emissions into three separate scopes (Figure 6).

Figure 6 – Overview of Emissions Sources' Scopes



Scope 1: Direct Emissions

The GHG Protocol defines Scope 1 emissions as all direct GHG emissions from sources under the University's control. Included is the generation of electricity, heat, or steam from fossil fuels. Within the University, this included stationary emissions (natural gas consumption), owned vehicle fleets (machinery and automotive vehicles), fugitive emissions (leakage from refrigerants in air conditioning equipment), and fertilizer application.

Scope 2: Indirect Emissions

Scope 2 emissions include all emissions associated with purchased electricity, heat or steam. For many organizations, Scope 2 emissions represent a large proportion of GHG emissions. Accounting for Scope 2 emissions allows organizations to assess the risks and opportunities associated with changing electricity provided. Scope 2 emissions for the University include purchased electricity, purchased steam and purchased chilled water.

Scope 3: All Other Indirect Emissions

Scope 3 includes all emissions from outsourced activities. Such emissions may have resulted from the activities of community members at the University, but occurred at sources owned and controlled by another organization (e.g. air travel, solid waste management, commuting activities). These are the most difficult emissions to track as organizations do not track all of the required information. For this inventory, the University of Toronto, St. George campus, included directly financed travel, faculty/staff/student commutes, and waste disposal within this scope. Table 2 summarizes sources of GHG emissions by scope and greenhouse gas type.

Table 2 – Sources of Emissions

Identification of Emissions Sources Scopes	Scope	GHG Emitted
On-site stationary sources	1	$C0_2$, N_20, CH_4
University fleet vehicle transportation	1	$C0_2$, N_20, CH_4
Refrigerant release	1	HFCs, HCFCs
Fertilizer Application	1	N_20
Purchased electricity	2	$C0_2$, N_20, CH_4
Purchased steam	2	$C0_2$, N_20, CH_4
Purchased chilled water	2	$C0_2$, N_20, CH_4
Directly financed travel	3	$C0_2$, N_20, CH_4
Faculty/staff/student commuting	3	$C0_2$, N_20, CH_4
Waste Disposal	3	-

3.4 Global Warming Potential

To develop a complete GHG emissions inventory, activity data (e.g., fuel consumed, kWh electricity purchased, air miles traveled) was multiplied by an emissions factor (e.g., kg CO_2/kWh, kg CH_4/kWh) to yield emissions for that activity by specific GHG type. This report converts each GHG into its carbon dioxide equivalent based on its global warming potential relative to CO_2 (Table 3). This shows all emissions in a common unit of measurement; namely mtCO_2e. For example, one metric tonne of methane is equal to the emissions from 23 metric tonnes of CO_2. This normalization allows everyone to compare each GHG type on its global warming potential. This report uses GWP factors from the IPCC's Third Assessment Report.

Table 3 – Global Warming Potential and Atmospheric Lifetime of Greenhouse Gases

Greenhouse Gases	Atmospheric Lifetime (Years)	Global Warming Potential - 100 Years (mtCO_2e)
Carbon dioxide (CO_2)	50-200	1
Methane (CH_4)	9-15	23
Nitrous Oxide (N_2O)	120	310
HFC 134A	15	1,300
HCFC 22	12	1,700
HCFC 404A	>48	3,260
Sulphur Hexafluoride (SF_6)	3,200	23,900

3.5 Clean Air Cool Planet Tool

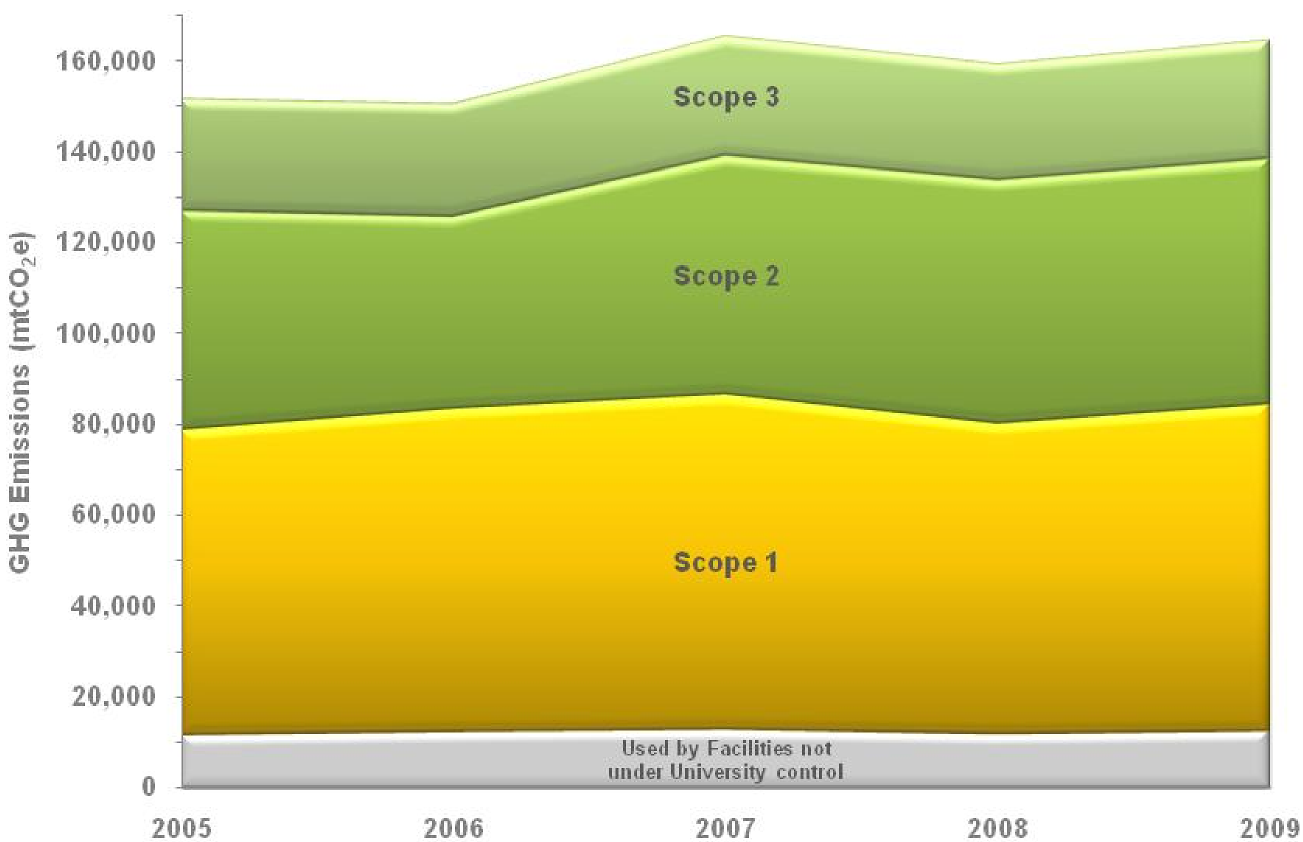
A GHG emissions inventory is an account of the amounts and sources of emissions of greenhouse gases attributable to the existence and operation of an institution. The GHG inventory is the foundation for an extended project of developing a long-term carbon management plan. Honeywell conducted the campus' GHG inventory using a standardized greenhouse gas calculator (Campus Carbon Calculator version 6.4, Clean Air-Cool Planet, New Hampshire). The calculator enabled easy entry and conversion of collected data to its carbon dioxide equivalent based on global warming potential. It adapted protocols established by the Intergovernmental Panel on Climate Change (IPCC) for national -level GHG accounting for use at an academic institution. The calculator is a Microsoft Excel workbook comprised of a series of spreadsheets that compute estimates of GHG emissions associated with campus activities (energy use, agriculture, refrigerants, solid waste management). Using the calculator, charts and graphs that illustrated changes and trends in emissions over time were produced. The following section is a brief description of the procedure used to acquire and calculate the data for all sources of GHG emissions.

4.0 GHG Inventory

4.1 Overview

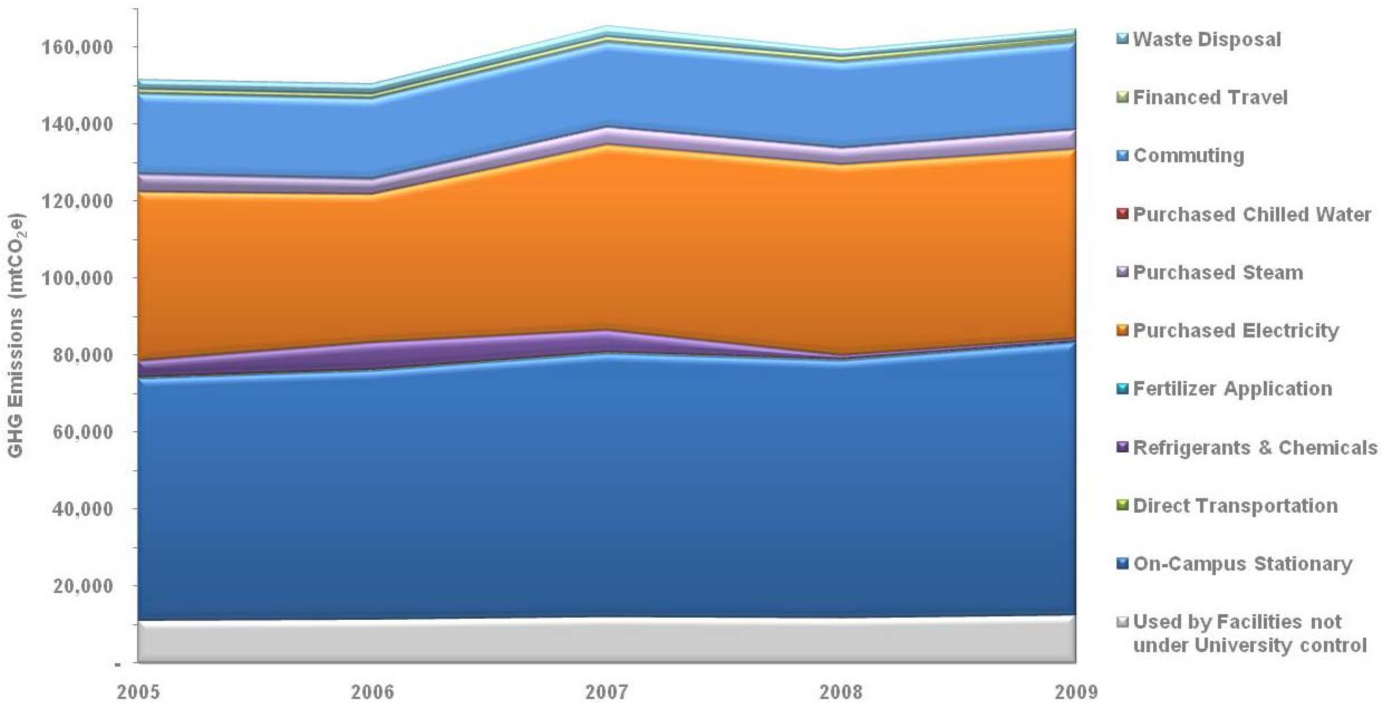
The University of Toronto, St. George Campus' GHG inventory clearly demonstrated that the major sources of emissions were Scope 1 and Scope 2 emissions. The University burns natural gas to generate steam and electricity that is sold to other buildings near their campus. These emissions are included in this GHG inventory; however, the University does not have control over how much energy these buildings use. The sold steam and electricity emissions account for 15% of their scope 1 emissions. The majority of Scope 1 and 2 emissions came from the on-campus stationary (natural gas space heating) and electricity consumption. Figure 7 depicts the emissions' scopes from 2005 to present.

Figure 7 - GHG Emission Trends



As shown in Figure 8, on-campus stationary emitted the most GHG compared to any other emission type.

Figure 8 – Trended Emissions Data by Activity



For the base year of May 2008 to April 2009, the University emitted 164,491 $mtCO_2e$. Scope 1 emissions account for 51% and Scope 2 accounts for 33%. Scope 1 emissions predominately included on-campus stationary. Scope 2 emissions included purchased electricity, steam and chilled water.

Accounting for 16% of total emissions, Scope 3 emissions include other indirect emissions that are a consequence of the University's activities, but are from sources neither owned nor controlled by the University of Toronto. This consists of faculty and staff commutes, student commutes, financed travel, and waste disposal. Figure 10 shows a detailed breakdown of emissions by activity.

Figure 9 - $mtCO_2e$ Emissions by Scope

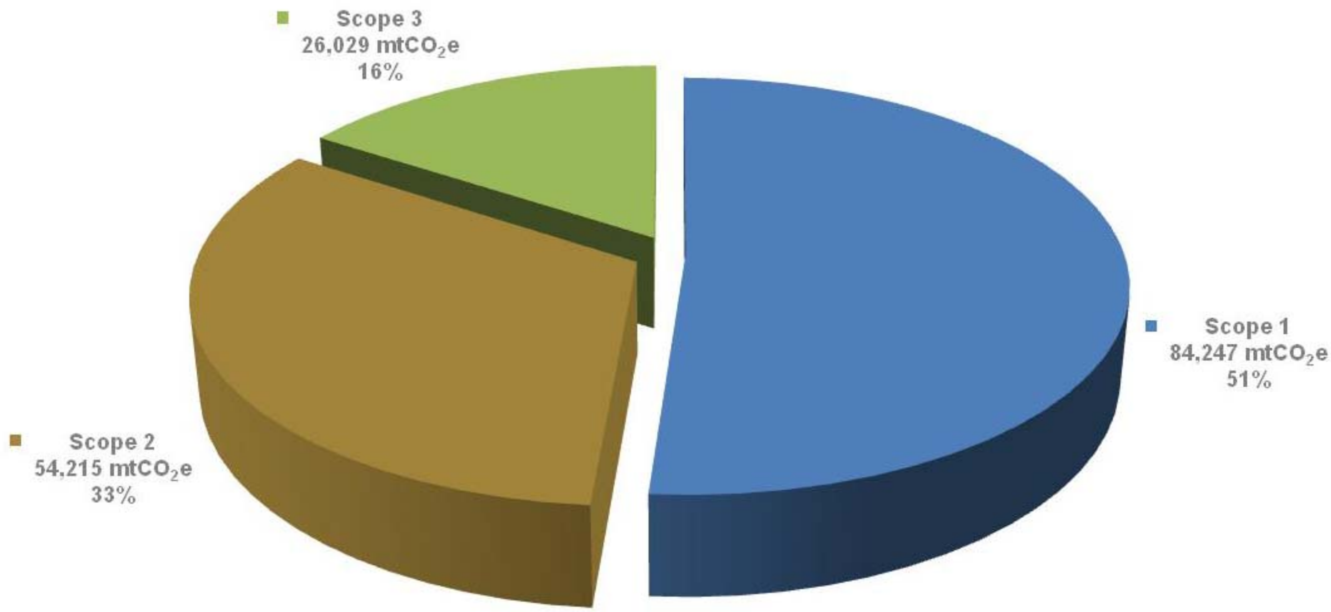
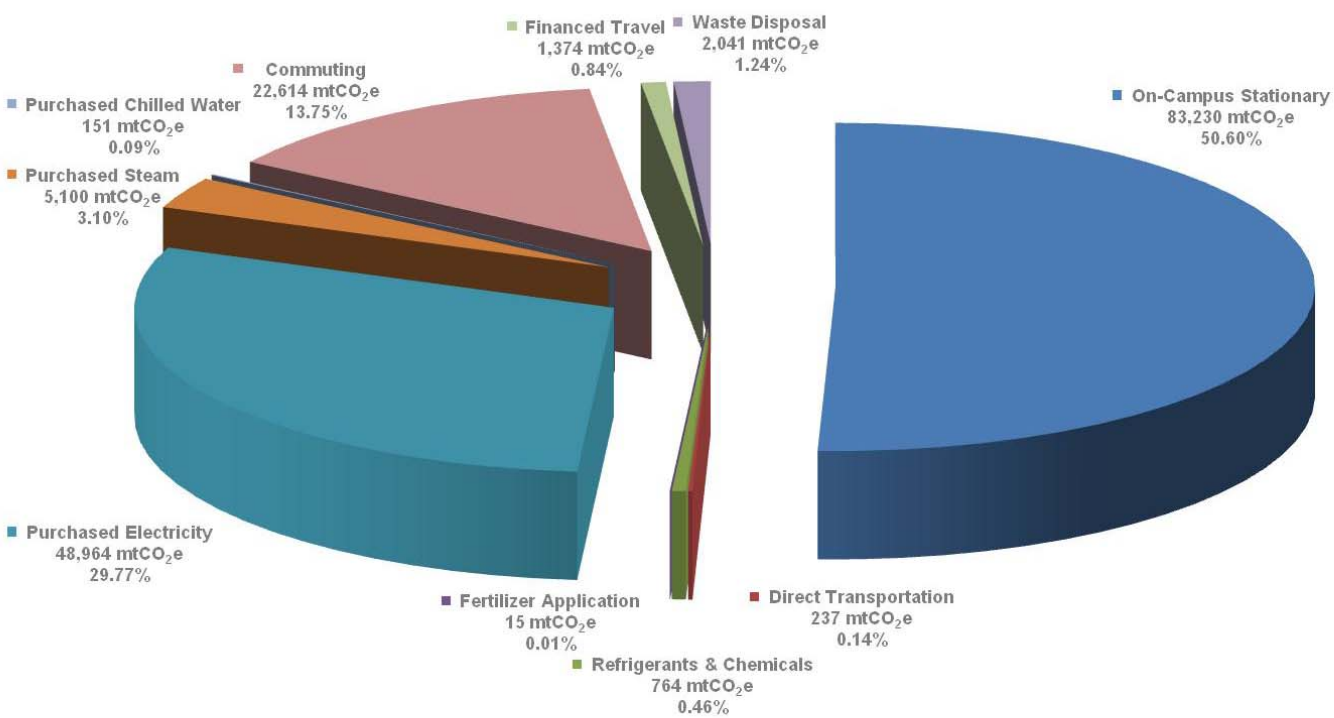


Figure 10 - $mtCO_2e$ Emissions by Activity



Of the six GHGs defined by the IPCC, carbon dioxide emissions account for the most significant portion of the University's GHG inventory. Table 4 provides a breakdown of emissions by activity, gas and scope.

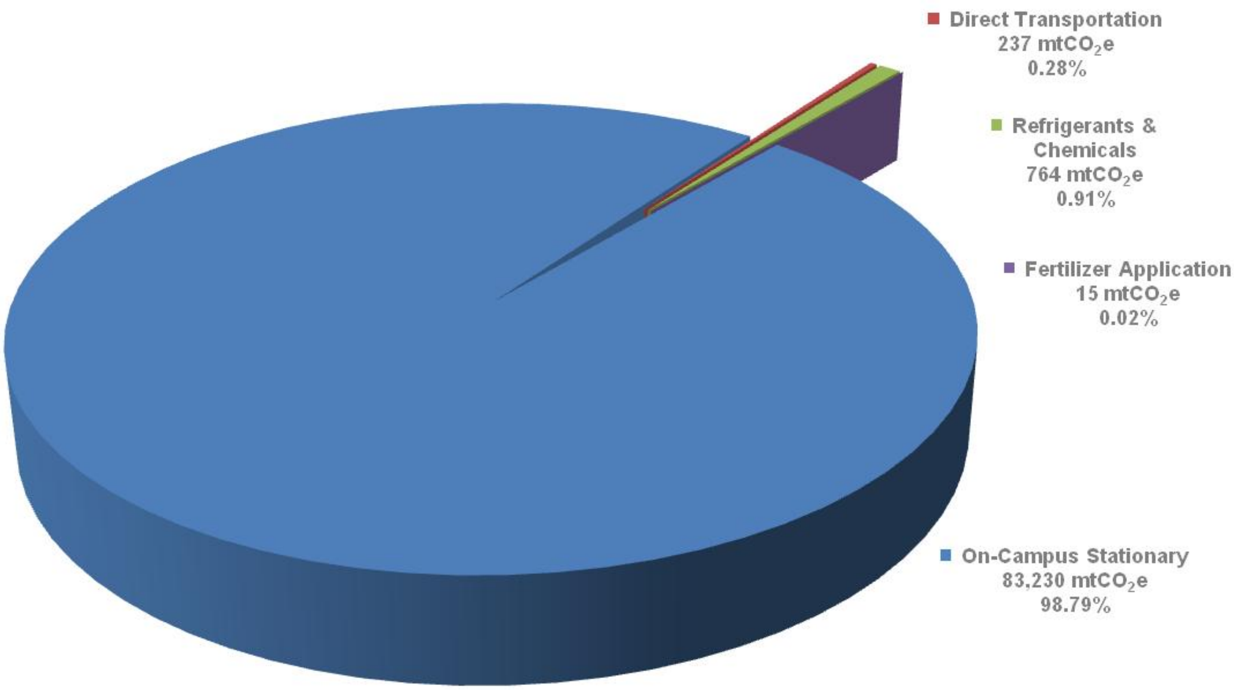
Table 4 – GHG Emissions by Activity and Source

Emission Source	Greenhouse Gases						
	CO_2 (kg)	CH_4 (kg)	N_2O (kg)	HFC (kg)	PFC (kg)	SF_6 (kg)	CO_2e (mt)
Co-gen Electricity	13,315,510	1,331	27	-	-	-	13,354
Co-gen Steam	13,314,955	1,331	27	-	-	-	13,353
Other on-campus stationary	56,355,720	5,700	122	-	-	-	56,523
Direct transportation	231,560	44	15	-	-	-	237
Refrigerants & chemicals	-	-	-	515	-	-	764
Fertilizer application	-	-	51	-	-	-	15
Scope 1 – Total	83,217,745	8,407	242	515	-	-	84,247
Purchased electricity	48,731,344	602	739	-	-	-	48,964
Purchased steam	5,085,473	508	10	-	-	-	5,100
Purchased chilled water	150,440	2	2				151
Scope 2 – Total	53,967,256	1,113	751	-	-	-	54,215
Faculty / Staff commuting	8,301,167	1,419	500	-	-	-	7,549
Student commuting	18,541,346	2,145	813	-	-	-	15,065
Financed air travel	1,255,711	12	14	-	-	-	1,260
Other financed travel	110,758	22	8	-	-	-	114
Waste Disposal	-	-	-	-	-	-	2,041
Scope 3 – Total	23,587,584	3,014	1,117	-	-	-	26,029
All scopes	**160,772,585**	**12,533**	**2,110**	**515**	**-**	**-**	**164,491**

4.2 Scope 1 Direct Emissions

Over 98% of the University of Toronto's Scope 1 emissions come from the burning of natural gas (Figure 11). The University operates a large natural gas fired heating plant and an electricity generating plant fired from natural gas. These systems generate steam and electricity for both the UofT campus, and other facilities not under the University's control. Scope 1 emissions emitted 51% of the University's GHG Inventory.

Figure 11 – Scope 1 Emissions (mtCO_2e)



On Site Stationary

On site stationary fuel source emissions include the natural gas fired cogeneration plant, natural gas fired central utility plant, distillate oil, and natural gas used in other buildings. To calculate these emissions, the Facilities & Services Department at the University of Toronto provided the natural gas consumption data. This fuel combustion is responsible for 98.79% of the Scope 1 emissions, equivalent to 83,230 mtCO_2e of emissions.

Fleet Vehicle Transportation

Fleet vehicle transportation emissions include emissions from any vehicles owned by the University. These vehicles include grounds equipment, facilities service vehicles, security vehicles and any other University owned vehicles. To calculate these emissions, the Facilities & Services Department at the University of Toronto provided annual fuel use, measured in litres. The fleet consumed 94,058 litres of gasoline, 5,766 litres of diesel, and 4,941 litres of natural gas generating 0.28% of Scope 1 emissions. Fleet vehicle transportation accounted for 237 $mtCO_2e$ of emissions.

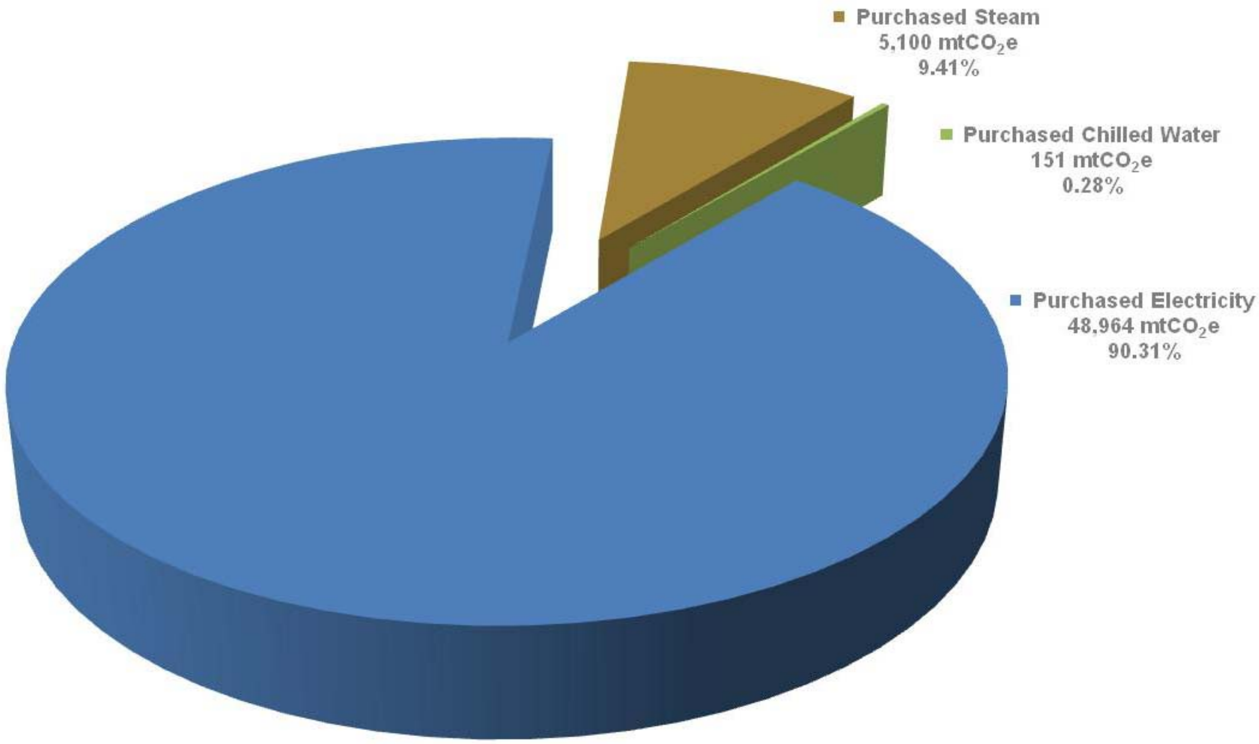
Refrigerant

Also referred to as fugitive emissions, this category considers a chemical used in the University refrigeration equipment. These chemicals primarily include chlorofluorocarbons (CFC) perfluorocarbons (PFC), hydrofluocarbons (HFC) and SF6. These chemicals are strong greenhouse gases as they have a high GWP. The Facilities & Services Department provided this data based on the amount of refrigerant that service technicians added to their systems in the base year. These emissions only accounted for 779 $mtCO_2e$, and 0.91% of the Scope 1 emissions.

4.3 Scope 2 Indirect Emissions

The University's Scope 2 emissions were from purchased electricity, steam, and chilled water. Electricity accounted for the majority of these emissions, as the electricity powers their buildings (Figure 12). Combined they accounted for 33% of the total GHG emissions.

Figure 12 – Scope 2 Emissions (mtCO_2e)



Purchased Electricity

The University purchased electricity for Scope 2 emissions from the Toronto Hydro Corporation and Ontario Power Generation. Purchased electricity data was available for fiscal year (FY) 2009 and provided by the Facilities & Services Department. All of the information is from electric utility invoices. The University redistributes some of the electricity purchased from the utility to other buildings. Although these buildings are outside of their control, the emissions are included in this inventory. Honeywell then entered the annual data into the Campus Carbon Calculator, and the Calculator converted the data to GHG emissions using the Ontario distribution of electricity production from 2007. Purchased electricity accounted for 29% of the total emissions.

Purchased Steam

The University purchased steam for Scope 2 emissions from Enwave Energy Corporation. The Facilities & Services Department provided the steam use data in MMBTU. Honeywell entered the annual data into the Calculator, which assumes a central plant efficiency of 81.7% to convert the MMBTU of steam to MMBTU of natural gas. From natural gas to steam, the calculator uses the standard factor. Purchased steam accounted for 3.10% of the total emissions.

Purchased Chilled Water

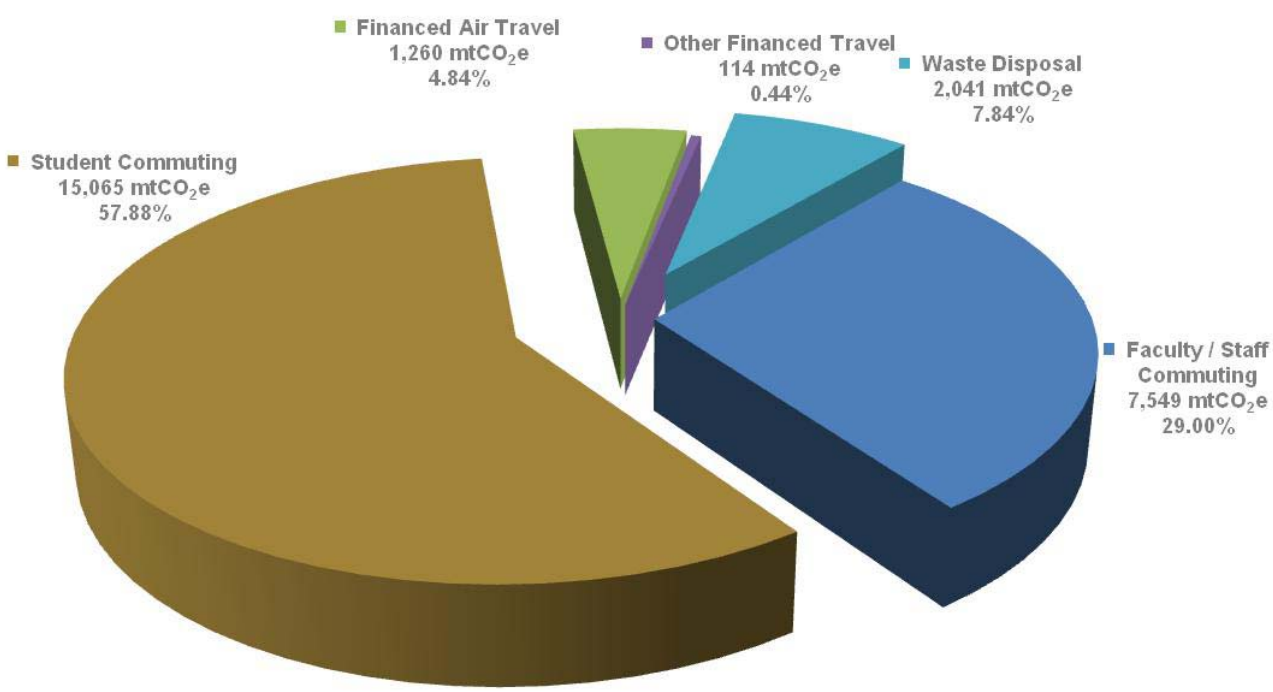
The University purchased chilled water for Scope 2 emissions from ROM. The ROM generates their chilled water through an electric chiller. To calculate the GHG emissions from the chilled water purchased, Honeywell entered the data provided form the Facilities & Services Department, measured in MMBTU into the Campus Carbon Calculator. The Calculator assumes a standard plant COP of 3.5 efficient to convert the MMBTU into electricity. The Calculator then used the Ontario distribution of electricity production from 2007 to convert kWh to mtCO_2e. Purchased chilled water accounted for 0.09% of the total emissions.

4.4 Scope 3 Indirect Emissions

Scope 3 emissions are from sources that the University does not own or operate, but has some type of control over. This includes commuting, outsourced transportation, study abroad air travel, solid waste and paper use. While the GHG Protocol considers Scope 3 emissions optional, the University took the broadest perspective possible and chose to include these emissions.

Over 86% of the Scope 3 emissions resulted from commuting habits of students, staff and faculty. Although students had the highest percentage of the emissions, staff/faculty was higher on a per capita basis.

Figure 13 – Scope 3 Emissions (mtCO_2e)



Faculty/Staff/Student Commuting

A large student, staff and faculty population travels to and from the University of Toronto's St. George campus each day. For data on commuting habits, this report used data provided by the Transportation Tomorrow Survey (TTS). The Ministry of Transportation, eighteen municipal governments, GO Transit, and the TTC joined forces to conduct a comprehensive survey of travel patterns called the TTS. The TTS is an important travel survey, conducted in partnership with municipalities in central Ontario, and the Province of Ontario. This survey has been conducted every five years for the past 20 years, to keep up with changing transportation needs. Every five years, the TTS completes a survey. The last study, completed in 2006, includes the daily inbound and outbound school and work trips of students, staff and faculty. The survey indicated that a cumulative distance of more than 157 million kilometres was travelled each year.

The calculator breaks down University commuting by community member (student, faculty and staff) and by mode of transportation (personally owned vehicle, bus, rail and commuter rail). This report assumed that students travel to and from campus 160 days/year while staff and faculty are on campus 222.5 days/year.

The TTS does not distinguish between the different types of public transit travel. As such, the TTS did not separate bus and light rail (streetcars) travel data. This report assumed that Faculty/Staff/Students travelled equally on buses and light rail. Staff and faculty numbers were not available for FY 2009 so this report used FY 2008 data. Tables 5 through 7 highlight the commuting assumptions made for this report.

Table 5 – Student Commuting Assumptions

Students Transportation Type	% Travel	Total # of Students	Trips / Week	Weeks / Year	Miles / Trip
Students – personal vehicle	8%	4,317	10	32	10
Students – car pool / “drop offs”	4%	2,158	10	32	10
Students – bus	30%	16,187	10	32	4
Students – light rail	30%	16,187	10	32	4
Students – commuter rail	6%	3,237	10	32	19
Students – walk/bike/on campus	22%	11,871	10	32	-

Table 6 – Staff Commuting Assumptions

Staff Transportation Type	% Travel	Total # of Staff	Trips / Week	Weeks / Year	Miles / Trip
Staff – personal vehicle	33%	3,099	10	44.5	8
Staff – car pool / “drop offs”	7%	657	10	44.5	8
Staff – bus	18%	1,691	10	44.5	3
Staff – light rail	18%	1,691	10	44.5	3
Staff – commuter rail	4%	376	10	44.5	19
Staff – walk/bike	20%	1,878	10	44.5	-

Table 7– Faculty Commuting Assumptions

Faculty Transportation Type	% Travel	Total # of Faculty	Trips / Week	Weeks / Year	Miles / Trip
Faculty – personal vehicle	33%	803	10	44.5	8
Faculty – car pool / “drop offs”	7%	170	10	44.5	8
Faculty – bus	18%	438	10	44.5	3
Faculty – light rail	18%	438	10	44.5	3
Faculty – commuter rail	4%	97	10	44.5	19
Faculty – walk/bike	20%	487	10	44.5	-

For the base year staff, faculty and student commuting significantly contributed to the GHG inventory. On a per capita basis, staff and faculty have a higher carbon footprint as they tend to drive more personal vehicles. Staff and faculty drove over 24 million kilometres per year commuting to work daily, and students drove over 27 million kilometres per year commuting to school. Commuting emissions yielded 22,614 $mtCO_2e$ for the base year. This attributed to over 86% of the Scope 3 emissions and 14% of all emissions.

Directly Financed Air Travel

This category includes air travel paid for by the University. Air travel GHG emissions associated with flights taken by University faculty and staff for business reasons and by the athletic teams and student programs was evaluated.

The University was able to provide the annual amount spent on air-travel for all three campuses. To covert the dollars spent into distance flown, the Calculator assumes that average flight costs amount to $0.25/km. In addition, to allocate the proper amount to St. George Campus, this report allocated miles based on the population percentage of faculty and staff.

Based on a population of 11,825 staff and faculty, the total estimated travel distance in FY 2009 is 2,612,397 kilometres, yielding 1,260 $mtCO_2e$. These emissions account for 5% of Scope 3 GHG emissions and 0.77% of total GHG emissions.

Other Financed Travel

This category includes travel paid for by the University that uses vehicles owned by someone other than the University, excluding airfare. This category includes personal car travel for business purposes (mileage). Similar to financed air travel, it was difficult to gather adequate information.

The University was able to provide the annual amount spent for annual travel reimbursement across the three campuses. To convert the annual amount spent, the calculator divided the University’s stated average reimbursement for travel, based on kilometres travelled. To allocate the proper amount to St. George Campus, this report allocated miles based on the population percentage of faculty and staff.

Based on a population of 11,825 staff and faculty, the total estimated travel distance in FY 2009 is 452,444 kilometres, yielding 114 $mtCO_2e$. These emissions account for 0.4% of Scope 3 GHG emissions and 0.07% of total GHG emissions.

Waste Disposal

The University provided total $mtCO_2e$ associated with waste disposal (Table 10). The University calculated the emissions based on 2007 landfill emission factors, and weight of waste disposed. Numbers were not available for FY 2009 so this report used FY 2008 data. These emissions account for 8% of Scope 3 GHG emissions and 1% of total GHG emissions.

Table 8 – 2007-2008 Waste Disposal Data

	$mtCO_2e/t$ disposed		Tonnes disposed			% of total weight	$mtCO_2e$
Waste Stream	recycled	landfilled	recycled	landfilled	total		
Total Waste	-	-	3,547.5	2,095.9	5,643.4	100%	-
Mixed Paper	1.51	0.92	924.9	-	924.9	16.4%	1,397
Cardboard	1.3275	1.7	319.4	-	319.4	5.7%	424
Organics	0	0.91	-	-	0.0	0.0%	0
Mixed Containers	0.86	0.03	256.5	-	256.5	4.5%	221
Landfilled garbage	n/a	0.45	0.0	-	0.0	0.0%	0
Total			**1,500.7**	**0.0**		**26.6%**	**2,041**

5.0 Steps to Climate Neutrality

5.1 Overview GHG Inventory

Now that the GHG inventory is complete, the University will be able to:

- Recognize how the Campus Carbon Calculator will aid in the creation of a Climate Action Plan
- Identify essential elements of the completed GHG inventory
- Identify strategic audiences and the key messages that the inventory offers them
- Identify engagement mechanisms and timetables
- Recognize the educational possibilities and the impact that these make

Steps to Climate Neutrality

The University of Toronto has established an inventory of emissions and set an appropriate boundary; the next key question surrounds the strategy on how to become carbon neutral. Forum for the Future developed the Carbon Management Hierarchy (Figures 14 and 15). World leaders in climate change such as Interface Flooring and Ben and Jerry's use this hierarchy. Beyond this hierarchy, these companies have taken a more "cradle to grave" approach to reducing carbon in their processes.

This hierarchy prioritizes the avoidance of emissions, their reduction through energy efficiency and replacement of high carbon energy sources with low or zero carbon alternatives as the preferred means for the University to address their contribution to climate change. This hierarchy places carbon offsetting at the bottom of the hierarchy because it directly reduces the University's emissions. However, offsetting is a necessary tool for an organization to achieve carbon neutrality.

Figure 14 – Carbon Management Hierarchy

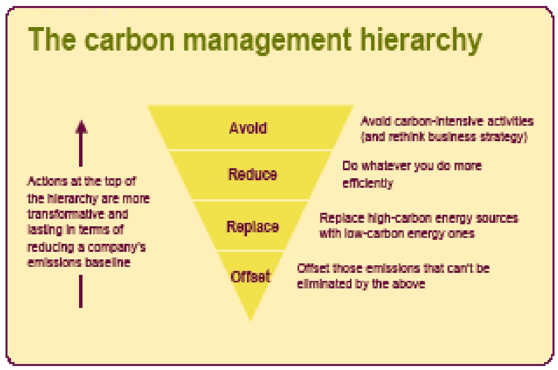
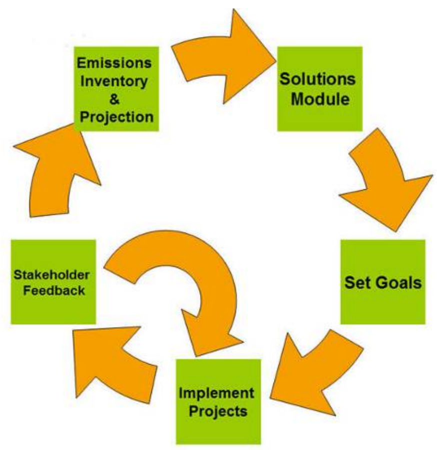


Figure 15 – Carbon Management



In following this hierarchy, the University is continually looking for energy efficient upgrades, the top three sections of the pyramid shown in Figure 14. Here are some of the energy efficient initiatives that the University has implemented over the last five years.

- Replaced incandescent bulbs across all three campuses with more efficient compact fluorescent bulbs
- Installed vending machine controls at the St. George and Scarborough campuses
- Communication and Awareness Program named "Rewire" for campus residences. The program aims to empower students, staff and faculty to reduce their own energy consumption through small behaviour changes with a high environmental impact
- Installed heat recovery in the cogeneration plant to preheat combustion air
- Installed heat recovery on the boiler's 'blow-down'
- Replaced old inefficient T-12 lights with new T-8 lights and occupancy sensors (38,000 fixtures and 86,000 lamps)
- Installed 17 new energy efficient chillers

In addition to the above synopsis, please refer to Appendix 1 for a comprehensive explanation of the University's sustainability initiatives. Since 1973, the university has demonstrated their commitment to the environment with an approximate aversion of 709,684 $mtCO_2e$ (this does not include the impact of the cogeneration plant installed in 1993).

5.2 GHG Inventory

Developing a GHG inventory is an ongoing process. This inventory is the first step towards accurately determining University of Toronto, St George Campus' GHG inventory. Federal regulations require the St. George Campus to report their GHG Scope 1 emissions every year starting with the 2009 calendar year. These requirements start provincially for the 2010 calendar year.

Scope 1 and 2 emissions represent over 84% of the total GHG inventory. Within this report, data was accurately tracked and accounted. Beyond Scope 1 and Scope 2 emissions, future reports will have the advantage of being able to expand on the information provided within this report as it identifies areas and methods to improve on the reporting of emissions.

Scope 3 emissions allow for the most room for improvement within this inventory. Within Scope 3, the University can improve the quality of gathering emissions data for subsequent reports by more accurately tracking the emissions and by including emissions beyond the boundaries of this inventory.

A better tracking system for commuting would improve the accuracy and sensitivity of the inventory to yearly and monthly commuting levels and would help to develop transportation related mitigation strategies that would lead to more cost effective GHG emissions reductions. To improve the quality of the commuting factors, the university should consider increasing the frequency of their commuter surveys. Moreover, the University could more accurately determine emissions associated with financed travel by improving their tracking of these emissions. The University could initiate numerous tracking devices for both air travel and other travel. For example, travel could be booked through one travel agency to track distances travelled. In addition, the University could change their reporting structure so that everyone reports their mileage.

5.3 Mitigation Strategy

The University of Toronto should focus their reductions efforts on its major sources of GHG emissions. These emissions include natural gas consumption, electricity consumption and daily commuting. Together, these sources accounted for most of the emissions. These operations offer the largest potential for mitigation efforts. While there will be many ideas proposed by the Climate Action Plan Work Group to achieve carbon neutrality, some important strategies currently occurring and/or being reviewed include:

- Continue energy efficiency improvements, focus on longer payback, start considering the costs of carbon
- Evaluate programs to reduce the consumption of buildings that purchase steam from U of T
- Scope 3 emission reductions require further analysis
- Develop a Carbon Mitigation Action Plan

Appendix 1

1. Introduction

Honeywell was asked by the University to illustrate the impact of these initiatives on their energy consumption and GHG emission levels. Since 1973 the University has implemented many initiatives around energy efficiency. The following sections are compiled based on data provided by the University. Honeywell did not validate the results or the intent of the initiatives.

2. Energy Initiatives

In the past years the University has completed many energy improvement projects; so many, that it is impractical to list them all. Below are highlights of the university's efforts over the last 35 years.

- 1974, steam trap replacement monitoring program starts.
- 1977, established a full time professional engineer exclusively for energy conservation.
- 1979, Central Control Monitoring System installed.
- 1991, replaced incandescent bulbs across all three campuses with more efficient compact fluorescent bulbs.
- 1993, co-generation system installed.
- 1994, replaced 1200 exit light fixtures with more efficient LED technology.
- 1995, Phase 1 lighting retrofit, T12 to T8 lighting (83,000 fixtures and 175,000 lamps).
- 1997-98, installed variable speed drives on over 100 motors
- 2000, flue heat recovery system installed at Central Steam Plant
- 2004, Sustainability Office established
- 2007-08, Replaced 17 chillers with high efficiency
- 2008, Installed heat recovery systems on the boiler's blow-down, and in the co-generation plant to preheat combustion air.
- 2009, Phase 2 lighting retrofit, remaining T12 to T8 lighting (38,000 fixtures and 86,000 lamps).

3. Utility Data

To demonstrate the impact of the energy initiatives on energy consumption, the University has provided Honeywell the data from 1973 – 2008 for the following items.

- Utility consumptions
  - Electricity
  - Thermal (includes natural gas, fuel oil #2, and purchased steam)
- Savings expected from initiatives
- Square footage

Table 1 on the following page shows the utility consumption data and then normalizes it to the area in which the energy is consumed (ekWh/ft^2).

Table 2 shows the expected savings from the University's conservation initiatives, as provided by the university. Honeywell has not provided any measurement and verification to validate these savings.

By summing the values of Tables 1 and 2, one can model what the annual energy consumption would have been. The results are shown in Table 3 on the following pages.

The following tables and graphs show the consumption trends for each utility along with the associated mtCO_2e.

Table 1 – Actual Energy Usage (includes conservation initiatives)

Year	Ft^2	Electricity (GJ)	Thermal (GJ)	$ekWh/ft^2$
1973/74	8,018,737	557,924	1,252,148	62.70
1974/75	8,040,000	540,000	1,230,832	61.18
1975/76	8,066,736	532,368	1,119,353	56.88
1976/77	8,066,736	506,228	1,130,202	56.35
1977/78	8,031,737	490,716	1,092,187	54.75
1978/79	8,103,735	474,833	1,082,648	53.39
1979/80	8,316,728	480,308	1,075,608	51.97
1980/81	8,251,730	479,207	1,019,593	50.45
1981/82	8,457,925	493,531	1,025,602	49.89
1982/83	8,594,605	487,832	904,342	45.00
1983/84	8,527,116	501,707	957,363	47.53
1984/85	8,592,184	495,594	948,845	46.70
1985/86	8,514,759	503,849	942,426	47.18
1986/87	8,476,267	508,421	881,327	45.54
1987/88	8,467,613	523,598	917,838	47.29
1988/89	8,467,613	510,505	939,560	47.57
1989/90	8,798,495	528,394	975,188	47.47
1990/91	8,833,370	576,562	938,631	47.65
1991/92	8,927,533	606,812	929,981	47.82
1992/93	8,975,024	579,431	1,014,356	49.33
1993/94	8,963,861	602,989	1,019,679	50.28
1994/95	9,092,318	604,714	912,292	46.35
1995/96	9,188,504	591,275	1,089,333	50.81
1996/97	9,206,674	607,936	1,063,020	50.42
1997/98	9,206,211	612,529	1,071,446	50.81
1998/99	9,120,562	626,101	972,152	48.68
1999/00	9,120,831	626,926	1,058,803	51.34
2000/01	9,011,664	637,153	1,155,063	55.24
2001/02	9,681,061	719,172	1,132,445	53.13
2002/03	10,186,900	732,992	1,231,334	53.56
2003/04	10,426,601	753,595	1,171,305	51.28

Year	Ft^2	Electricity (GJ)	Thermal (GJ)	$ekWh/ft^2$
2004/05	10,585,003	791,568	1,091,106	49.41
2005/06	11,227,522	827,809	1,194,412	50.03
2006/07	11,534,972	842,512	1,310,741	51.85
2007/08	11,639,382	881,550	1,360,245	53.50

Table 2 – Expected Savings from Conservation Initiatives

Year	Electricity (GJ)	Thermal (GJ)	Total (GJ)
1973/74	-	-	-
1974/75	19,404	24,636	44,040
1975/76	28,896	140,290	169,186
1976/77	55,036	129,440	184,476
1977/78	68,113	161,991	230,104
1978/79	89,006	182,773	271,779
1979/80	98,349	223,072	321,421
1980/81	94,929	268,937	363,866
1981/82	94,951	295,126	390,077
1982/83	110,160	437,729	547,889
1983/84	91,589	374,169	465,758
1984/85	102,229	392,848	495,077
1985/86	88,588	387,177	475,765
1986/87	81,337	442,265	523,602
1987/88	65,558	404,402	469,960
1988/89	78,651	382,680	461,331
1989/90	83,784	398,721	482,505
1990/91	38,043	440,724	478,767
1991/92	14,344	464,077	478,421
1992/93	45,030	387,118	432,148
1993/94	20,695	380,052	400,747
1994/95	27,908	507,498	535,406
1995/96	48,039	345,477	393,516
1996/97	32,643	374,627	407,270
1997/98	28,017	366,129	394,146
1998/99	8,486	452,048	460,534
1999/00	7,680	365,440	373,120
2000/01	-	252,133	241,990
2001/02	-	379,279	333,692
2002/03	-	359,378	335,166
2003/04	-	456,838	428,701
2004/05	-	561,771	506,682
2005/06	-	558,796	512,171

Year	Electricity (GJ)	Thermal (GJ)	Total (GJ)
2006/07	-	490,476	450,540
2007/08	-	457,276	385,566

Table 3 – Energy Use (excluding conservation initiatives)

Year	Electricity (GJ)	Thermal* (GJ)	Total (GJ)
1973/74	557,924	1,252,148	1,810,072
1974/75	559,404	1,255,468	1,814,872
1975/76	561,264	1,259,643	1,820,907
1976/77	561,264	1,259,643	1,820,907
1977/78	558,829	1,254,178	1,813,007
1978/79	563,839	1,265,420	1,829,259
1979/80	578,657	1,298,680	1,877,337
1980/81	574,136	1,288,530	1,862,666
1981/82	588,482	1,320,728	1,909,210
1982/83	597,992	1,342,071	1,940,064
1983/84	593,296	1,331,532	1,924,828
1984/85	597,823	1,341,693	1,939,516
1985/86	592,437	1,329,603	1,922,040
1986/87	589,758	1,323,592	1,913,350
1987/88	589,156	1,322,241	1,911,397
1988/89	589,156	1,322,241	1,911,397
1989/90	612,178	1,373,909	1,986,087
1990/91	614,605	1,379,355	1,993,960
1991/92	621,156	1,394,059	2,015,215
1992/93	624,461	1,401,474	2,025,935
1993/94	623,684	1,399,731	2,023,416
1994/95	632,622	1,419,790	2,052,412
1995/96	639,314	1,434,810	2,074,124
1996/97	640,579	1,437,647	2,078,226
1997/98	640,546	1,437,575	2,078,121
1998/99	634,587	1,424,201	2,058,788
1999/00	634,606	1,424,243	2,058,848
2000/01	627,010	1,407,196	2,034,206
2001/02	673,585	1,511,724	2,185,309
2002/03	708,780	1,590,712	2,299,493
2003/04	725,458	1,628,142	2,353,601
2004/05	736,479	1,652,877	2,389,356
2005/06	781,184	1,753,208	2,534,393
2006/07	802,576	1,801,217	2,603,793
2007/08	809,840	1,817,521	2,627,361

Table 4 – GHG Emissions (includes conservation initiatives)

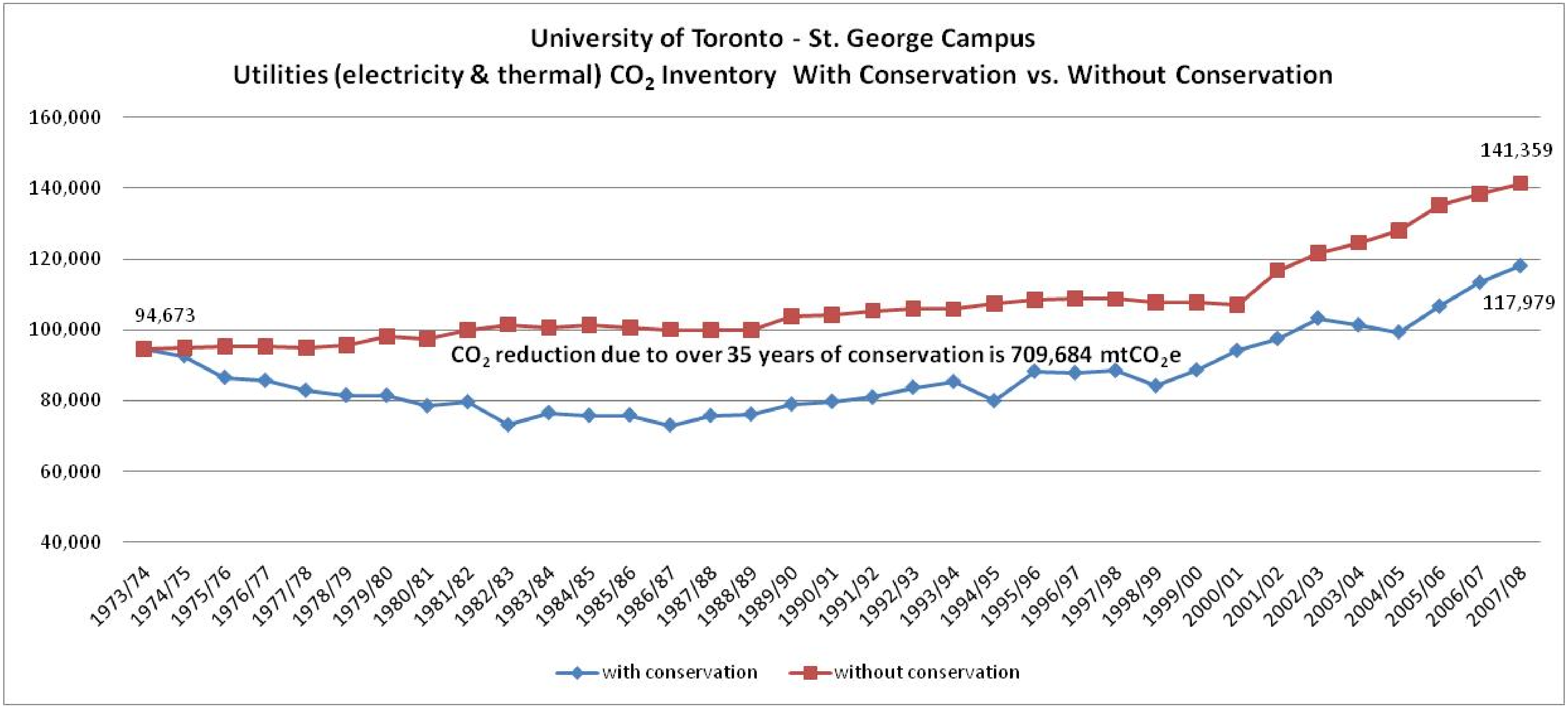
Year	Electricity ($mtCO_2e$)	Thermal ($mtCO_2e$)	Total ($mtCO_2e$)
1973/74	30,651	64,021	94,673
1974/75	29,667	62,931	92,598
1975/76	29,247	57,232	86,479
1976/77	27,811	57,786	85,598
1977/78	26,959	55,843	82,802
1978/79	26,086	55,355	81,441
1979/80	26,387	54,995	81,382
1980/81	26,327	52,131	78,458
1981/82	27,114	52,438	79,552
1982/83	26,801	46,238	73,039
1983/84	27,563	48,949	76,512
1984/85	27,227	48,514	75,741
1985/86	27,681	48,185	75,866
1986/87	27,932	45,062	72,993
1987/88	28,766	46,928	75,694
1988/89	28,046	48,039	76,085
1989/90	29,029	49,861	78,890
1990/91	31,675	47,991	79,667
1991/92	33,337	47,549	80,886
1992/93	31,833	51,863	83,696
1993/94	33,127	52,135	85,263
1994/95	33,222	46,645	79,867
1995/96	32,484	55,697	88,180
1996/97	33,399	54,351	87,750
1997/98	33,651	54,782	88,434
1998/99	34,397	49,705	84,102
1999/00	34,442	54,136	88,578
2000/01	35,004	59,057	94,062
2001/02	39,510	57,901	97,411
2002/03	40,269	62,957	103,226
2003/04	41,401	59,888	101,289
2004/05	43,487	55,787	99,275
2005/06	45,478	61,069	106,548
2006/07	46,286	67,017	113,303
2007/08	48,431	69,548	117,979

Table 5 – GHG Emissions (excludes conservation initiatives)

Year	Electricity ($mtCO_2e$)	Thermal ($mtCO_2e$)	Total ($mtCO_2e$)
1973/74	30,651	64,021	94,673
1974/75	30,733	64,191	94,924
1975/76	30,835	64,405	95,239
1976/77	30,835	64,405	95,239
1977/78	30,701	64,125	94,826
1978/79	30,976	64,700	95,676
1979/80	31,790	66,400	98,191
1980/81	31,542	65,882	97,424
1981/82	32,330	67,528	99,858
1982/83	32,853	68,619	101,472
1983/84	32,595	68,080	100,675
1984/85	32,843	68,600	101,443
1985/86	32,547	67,982	100,529
1986/87	32,400	67,674	100,075
1987/88	32,367	67,605	99,972
1988/89	32,367	67,605	99,972
1989/90	33,632	70,247	103,879
1990/91	33,765	70,525	104,291
1991/92	34,125	71,277	105,402
1992/93	34,307	71,656	105,963
1993/94	34,264	71,567	105,831
1994/95	34,755	72,593	107,348
1995/96	35,123	73,361	108,484
1996/97	35,192	73,506	108,698
1997/98	35,190	73,502	108,693
1998/99	34,863	72,818	107,681
1999/00	34,864	72,820	107,685
2000/01	35,004	71,949	106,953
2001/02	39,510	77,293	116,803
2002/03	40,269	81,332	121,601
2003/04	41,401	83,246	124,647
2004/05	43,487	84,510	127,998
2005/06	45,478	89,640	135,119
2006/07	46,286	92,095	138,381
2007/08	48,431	92,928	141,359

Table 6 – GHG Emissions avoided

Year	Electricity ($mtCO_2e$)	Thermal ($mtCO_2e$)	Total ($mtCO_2e$)
1973/74	-	-	-
1974/75	1,260	1,066	2,326
1975/76	7,173	1,587	8,760
1976/77	6,618	3,024	9,642
1977/78	8,282	3,742	12,024
1978/79	9,345	4,890	14,235
1979/80	11,405	5,403	16,809
1980/81	13,751	5,215	18,966
1981/82	15,090	5,216	20,306
1982/83	22,381	6,052	28,433
1983/84	19,131	5,032	24,163
1984/85	20,086	5,616	25,702
1985/86	19,796	4,867	24,663
1986/87	22,613	4,469	27,081
1987/88	20,677	3,602	24,278
1988/89	19,566	4,321	23,887
1989/90	20,386	4,603	24,989
1990/91	22,534	2,090	24,624
1991/92	23,728	788	24,516
1992/93	19,793	2,474	22,267
1993/94	19,432	1,137	20,569
1994/95	25,948	1,533	27,481
1995/96	17,664	2,639	20,303
1996/97	19,154	1,793	20,948
1997/98	18,720	1,539	20,259
1998/99	23,113	466	23,579
1999/00	18,685	422	19,107
2000/01	12,891	-	12,891
2001/02	19,392	-	19,392
2002/03	18,375	-	18,375
2003/04	23,358	-	23,358
2004/05	28,723	-	28,723
2005/06	28,571	-	28,571
2006/07	25,078	-	25,078
2007/08	23,380	-	23,380
Total GHG emissions avoided since 1973			**709,684**


University of Toronto - St. George Campus
Utilities (electricity & thermal) CO_2 Inventory With Conservation vs. Without Conservation
160,000
140,000
120,000
100,000
80,000
60,000
40,000
94,673
141,359
117,979
CO_2 reduction due to over 35 years of conservation is 709,684 $mtCO_2e$
1973/74
1974/75
1975/76
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
1987/88
1988/89
1989/90
1990/91
1991/92
1992/93
1993/94
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
with conservation
without conservation