The Corporation of the City of Kingston Energy Consumption and Greenhouse Gas Inventory Update (2011)

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EXECUTIVE SUMMARY

Background and Methodology

An energy consumption and Greenhouse Gas (GHG) emission inventory is presented for the Corporation of the City of Kingston for the years 2000 (baseline) and 2006 to 2011.

The methodology adopted for this inventory aligns with the FCM/ICLEI guidance document and the inventory is defined by the operational control of the corporation's organizational boundary. Changes in methodology from the most recent inventory are identified to allow for consistency. Modifications in methodologies and emission factors are applied to historical data sets to enable the inventories from 2000 and 2006 to 2009 to be restated. This enables consistency and allows for a meaningful comparison from year to year. Energy consumption, GHG emissions data and cost data is provided for 2000 and 2006 to 2011.

Analyses are provided for the emission sources (electricity, natural gas, heating oil, diesel, propane and waste) and energy sectors (buildings, vehicle fleet, streetlights, waste water, water and waste). Energy consumption, GHG emission and energy expenditure comparisons are made between 2011 and the base year (2000). The variations in energy consumption, GHG emissions and expenditure between 2000 and 2011 are reviewed on a sector and energy source basis.

Within each of the sectors detailed analysis are provided to gain insight into the energy consumption, GHG emission and expenditure cost data over time. Buildings that have realized a greater than 20% increase in electricity and natural gas consumption between 2010 and 2011 as well as the ten (10) buildings with the greatest energy intensity (GJ/ft^2) for 2011 are identified. A discussion of the impact of weather on the building sector energy consumption (GJ) and energy consumption intensity is provided (GJ/ft^2) and data limitations are detailed. The fleet sector is subdivided into corporate fleet and transit. Indicators based on kilometers travelled for energy consumption, GHG emissions and cost are presented. Waste water and water treatment plants are analyzed individually and cost and GHG emission indicators based on volume of water treated are provided.

Recommendations are provided to improve subsequent inventories and to assist the corporation in reducing its energy consumption, GHG emissions and costs.

2011: Corporate Emission Source and Sector Overview

The City of Kingston corporate GHG emissions are derived from the following emission sources: electricity, natural gas, fuel oil, diesel, gasoline, propane and waste. The corporate energy sectors include: buildings, water, waste water, fleet, streetlights and waste. Table 1 provides the contribution of each of the emission sources to consumption, GHG emissions and cost for 2011. Table 2 provides the contribution from each of the sectors to consumption, GHG emissions and cost for 2011.

Table 1: 2011: Energy Consumption, Emission and Cost Details by Emission Source

Emission Source	Consumption		GHG Emissions		Cost	
	GJ	% of Total Sources	tonnes	% of Total Sources	Million $	% of Total Sources
Electricity	218,480	46%	9,103	36%	$7.01	58%
Natural Gas	125,077	26%	6,360	25%	$1.29	11%
Diesel	111,044	23%	7,837	31%	$2.91	24%
Propane	1,064	0.2%	64	0.3%	$0.04	0.3%
Heating Oil	1,916	0.4%	139	1%	$0.03	0.3%
Gasoline	20,847	4%	1,419	6%	$0.73	6%
Waste	n/a	n/a	368	1%	n/a	n/a
Total	478,428	100%	25,290	100%	$12.01	100%

Table 2: 2011: Energy Consumption, Emissions and Cost Details by Energy Sector

Sector	Consumption		GHG Emissions		Cost	
	GJ	% of Total Sources	tonnes	% of Total Sources	Million $	% of Total Sources
Buildings	205,696	43%	9,649	38%	$4.01	33%
Vehicle Fleet	131,891	28%	9,257	37%	$3.64	30%
Streetlights	34,588	7%	1,441	6%	$1.21	10%
Waste Water	68,860	14%	3,002	12%	$1.95	16%
Water	37,392	8%	1,574	6%	$1.20	10%
Waste	n/a	n/a	368	1%	n/a	n/a
Total	478,428	100%	25,290	100%	$12.01	100%

Table 1 and 2 indicate that in 2011 the corporation of the City of Kingston consumed 478,428 GJ of energy, released 25,290 tonnes of GHG emissions and spent $12 Million on energy. Electricity is the dominant emission source accounting for 46% of the total energy consumption, 36% of the total GHG emissions and 58% of the total cost. The building sector is dominant sector responsible for 43% of the total energy consumption, 38% of the total GHG emissions and 33% of the total energy costs.

Corporate Energy Consumption

Figure 1 provides the total City of Kingston corporate energy consumption (expressed as Gigajoules - GJ) from all sources (electricity, natural gas, heating fuel, gasoline, diesel and propane) for the base year 2000 and 2006 to 2011. Since 2000, the energy consumption has increased by approximately 12%.

Figure 1: Energy Consumption (GJ) from 2000 and 2006 to 2011

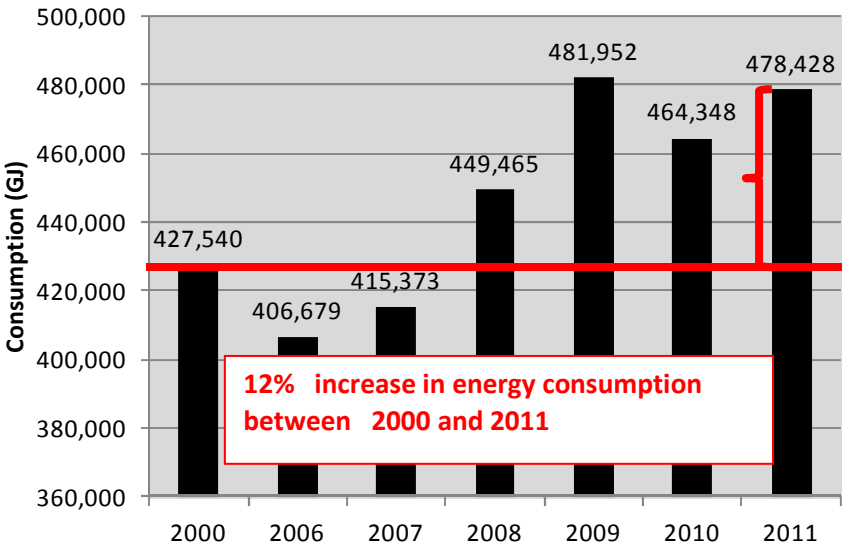


Figure 2 illustrates the difference in consumption by energy source between 2000 and 2011 and Figure 3 illustrates the difference in energy consumption by sector between 2000 and 2011. While the building sector and the electricity energy source are dominant, Figure 2 illustrates that the gain in energy consumption is due primarily to the increased consumption of diesel and natural gas and Figure 3 illustrates that the consumption gains are primarily in the fleet and wastewater sectors.

Figure 2: Energy Consumption difference between 2000 and 2011 by Energy Source

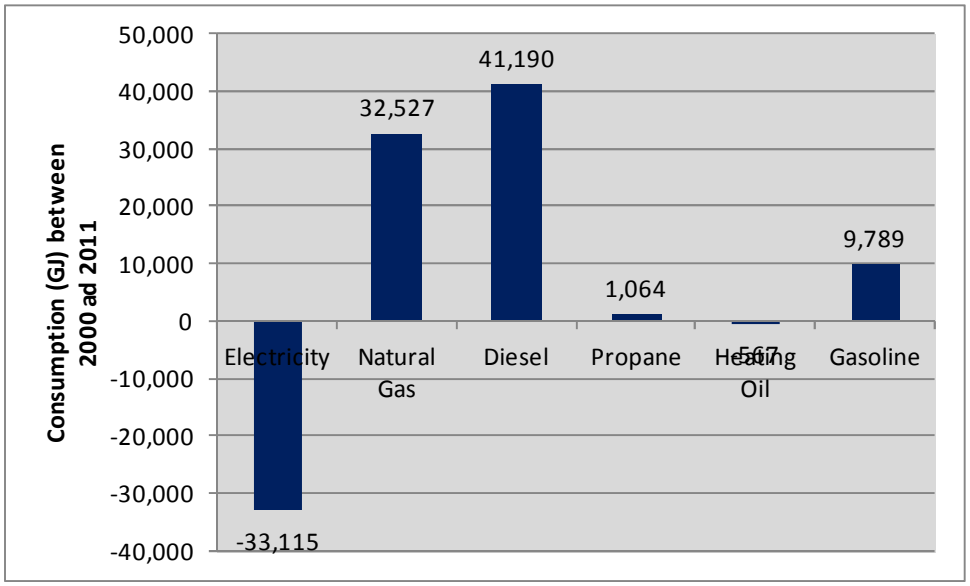
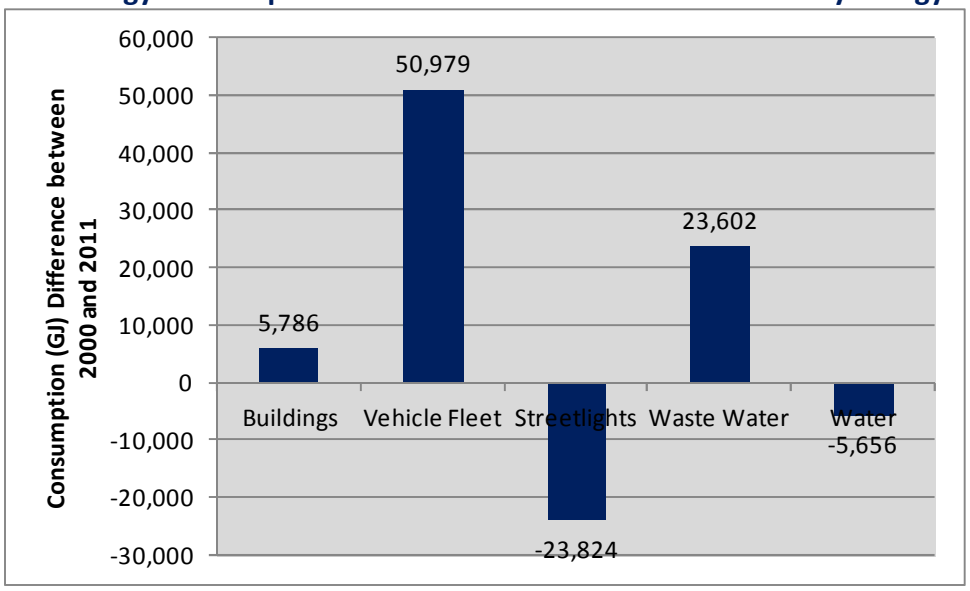


Figure 3: Energy Consumption difference between 2000 and 2011 by Energy Sector



Corporate Greenhouse Gas Emissions

Figure 4 provides the total City of Kingston corporate GHG emissions (tonnes) from all sources (electricity, natural gas, heating fuel, gasoline, diesel and propane) for the base year 2000 and 2006 to 2011. Although the total corporate energy consumption has increased by 12% between 2000 and 2011, the corporate release of GHG emissions has decreased by 22% over this same period.

Figure 4: Tonnes of GHG Emissions (2000 and 2006 to 2011)

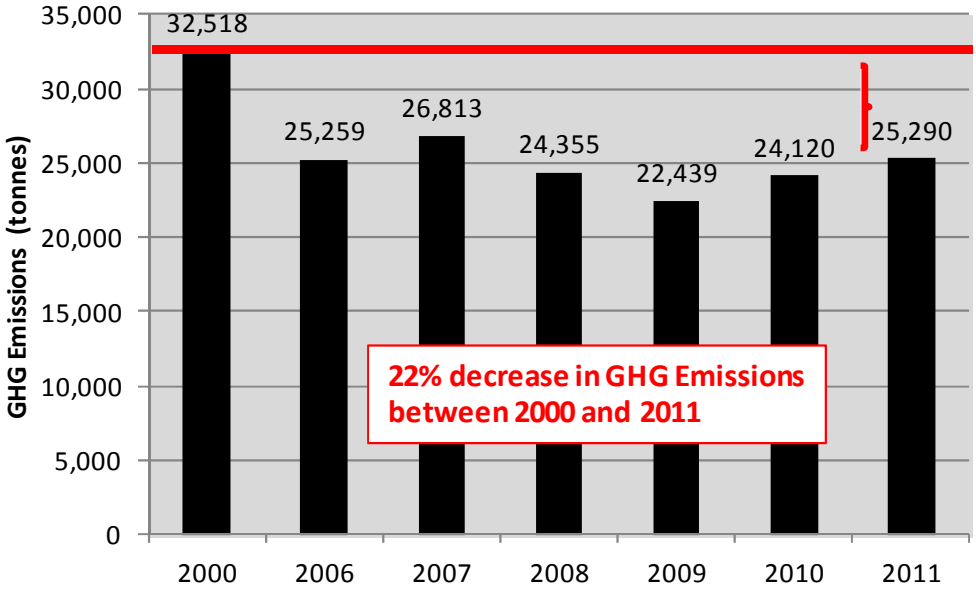


Figure 5 illustrates the difference in GHG emissions release by energy source between 2000 and 2011 and Figure 6 illustrates the difference in GHG emission release by sector between 2000 and 2011. While the building sector and the electricity energy source are the dominant contributors to GHG emissions, Figure 5 illustrates that the reduction in the release of GHG emissions is due to a significant reduction in emissions from electricity and Figure 6 illustrates that the GHG emission reduction are most significant in the building and streetlighting sectors. Electricity is the most significant energy source within the building sector and the only energy source within the streetlighting sector. While electricity energy consumption did experience a reduction over this time due to conservation and energy switching, the most significant reason for this reduction in GHG emissions between 2000 and 2011 is due to the 52% reduction in the Ontario electricity emission factor over this time.

Figure 5: GHG Emission difference between 2000 and 2011 by Energy Source

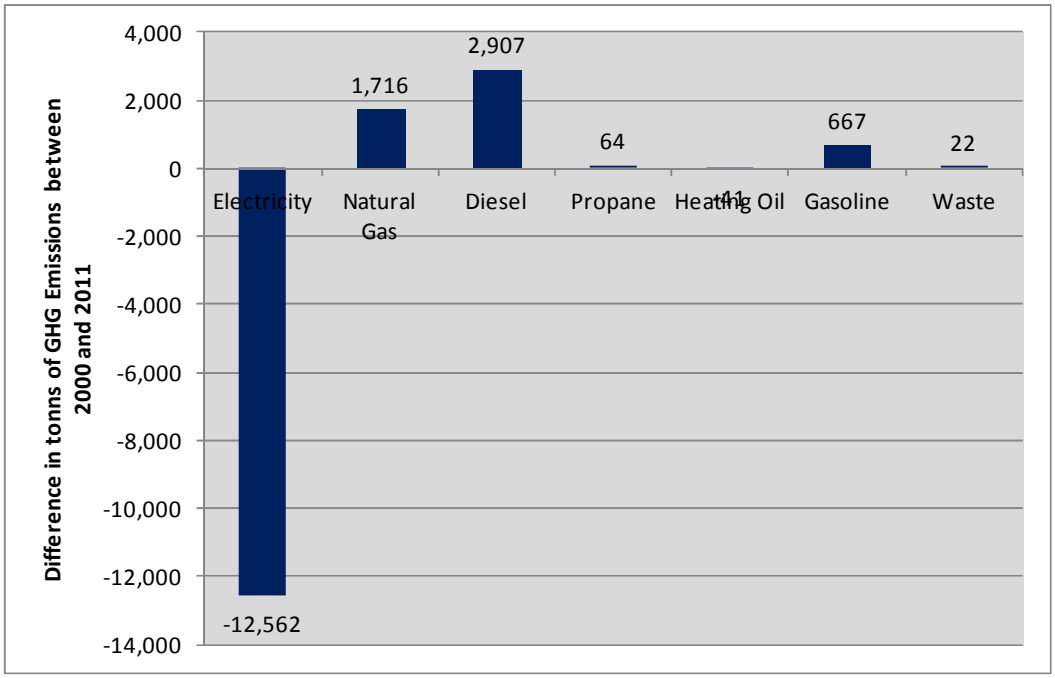
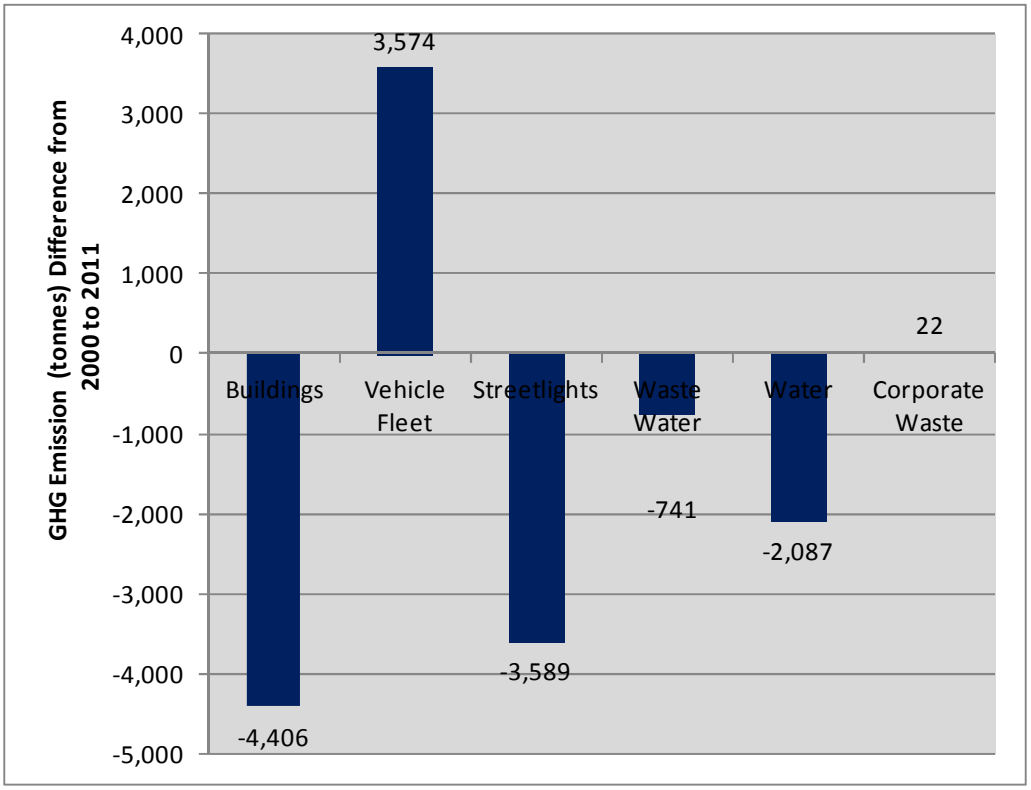


Figure 6: GHG Emission difference between 2000 and 2011 by Energy Sector



Corporate Energy Expenditures

Figure 7 indicates that the Corporation of the City of Kingston has increased its spending on energy by 51% from $7.93 Million in 2000 to $12.01 Million 2011.

Figure 7: Total Corporate Energy Expenditure (2000, and 2006 to 2011)

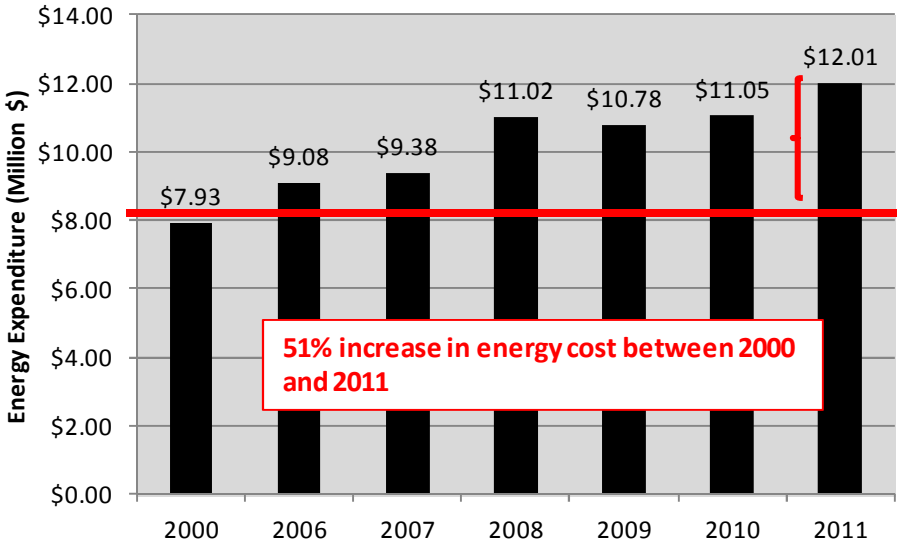


Figure 8 illustrates the difference in energy expenditure by energy source between 2000 and 2011 and Figure 9 illustrates the difference in energy expenditure by sector between 2000 and 2011. The energy cost for all energy sources has increased between 2000 and 2011. Most significant are diesel ($1.69 Million), electricity ($1.22 Million) and natural gas ($0.61 Million). Energy costs across all sectors have increased between 2000 and 2011, with the exception of streetlighting. The most notable increase is in the fleet sector ($2.2 Million) which is diesel dominant, followed by buildings ($1.19 Million) and waste water ($0.90 Million) which are both electricity dominant. The reduction in cost within the streetlighting sector between 2000 and 2011 is reflective of the decrease in energy consumption achieved through retrofits.

Figure 8: Energy Expenditure difference between 2000 and 2011 by Energy Source

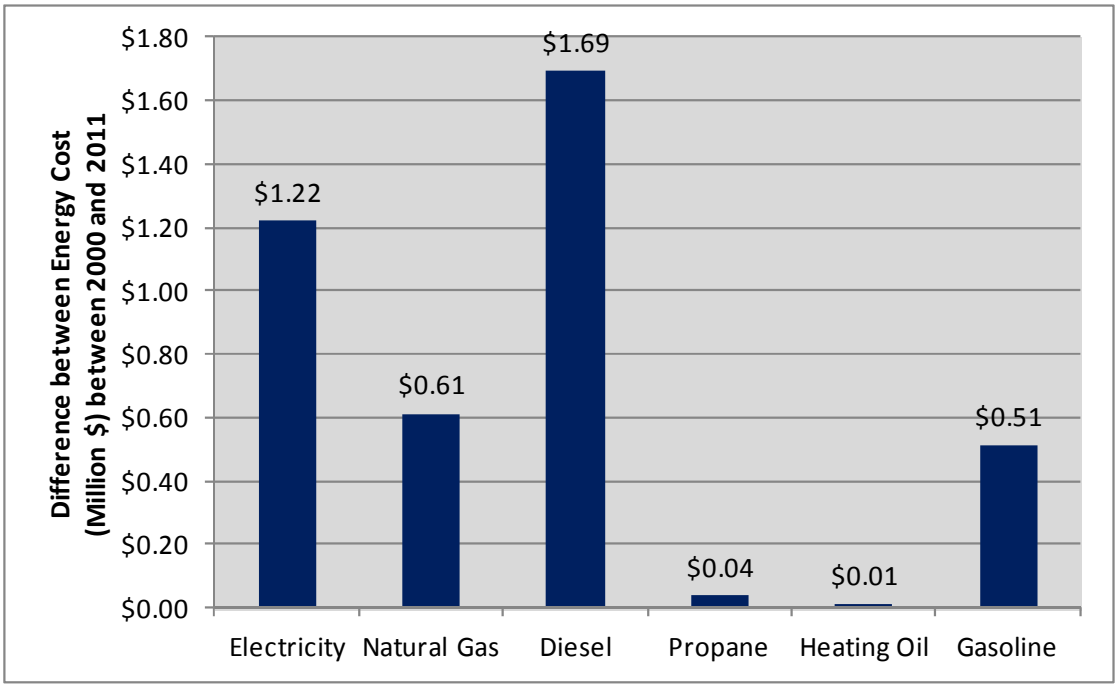
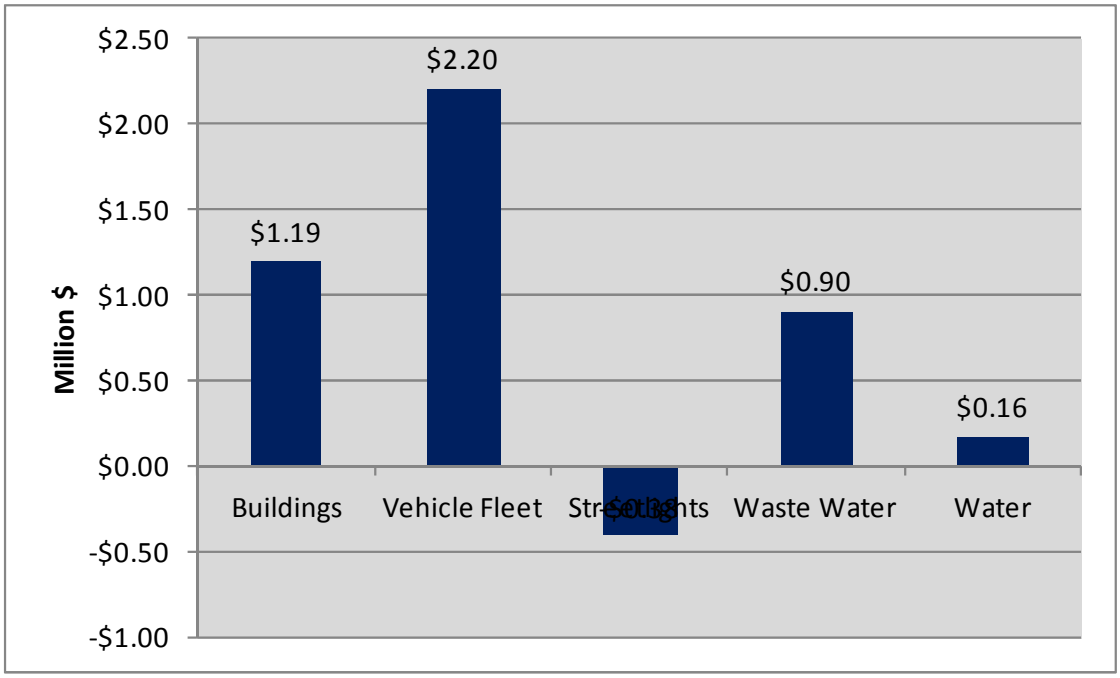


Figure 9: Energy Expenditure difference between 2000 and 2011 by Energy Sector



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1.0 INTRODUCTION

This document presents the City of Kingston Corporate energy consumption and GHG emission inventory for the years 2000 (baseline) and 2006 to 2011. This current inventory builds on past inventories and provides modifications to reflect changes in data accuracy and sources. Past inventories include a 2000 baseline completed by ICLEI Energy Services in 2003 as well as a (2006 to 2009) inventory completed by TriEdge & Associates in collaboration with PE International in 2011.

A review of the protocol and boundary applied to this inventory is discussed and the inventory methodology is detailed. Changes in methodology from the most recent inventory are identified to allow for consistency. Modifications in methodologies and emission factors are applied to historical data sets to enable the inventories from 2000 and 2009 to be restated. This enables consistency and allows for a meaningful comparison from year to year. Data sets were collected for the years 2010 and 2011. Energy consumption, GHG emission and cost data is provided for 2000 and 2006 to 2011. Analyses are provided for the emission sources (electricity, natural gas, heating oil, diesel, propane and waste) and energy sectors (buildings, vehicle fleet, streetlights, waste water, water and waste).

Objectives

The objectives of the City of Kingston Corporate Energy Consumption and GHG inventory Update (2011) are:

- To apply the new emission factors from the most recent Environment Canada National Inventory Report: *(1990 to 2010) GHG Sources and Sinks in Canada.*
- To assist in meeting the requirements of Ontario Regulation 397/11;
- To provide the foundation for a corporate energy plan (Corporate GHG reduction plan);
- To provide a foundation for corporate climate change mitigation;
- To determine the relationship between energy consumption, GHG emissions and cost over time;
- To determine at a sector level (buildings, street lighting, water treatment, waste water treatment, fleet and waste) energy consumption, GHG emissions and energy costs;
- To determine at the energy source level (natural gas, electricity, fuel oil (heating oil), propane, diesel and gasoline) the distribution of energy consumption, GHG emissions and energy costs.

2.0 INVENTORY PROTOCOL, BOUNDARY & SCOPE

The GHG inventory protocol, boundary and scope applied in the 2006 to 2009 Corporate GHG inventory have been applied to the 2011 Corporate GHG inventory update.

Protocol

As in the previous inventory, the current City of Kingston Corporate GHG inventory applies the ICLEI protocol for corporate reporting. .

Boundary

As in the case of the previous inventory, the 2011 Kingston Corporate GHG inventory update has adopted operational control to determine its organizational boundary.

Scope

City of Kingston Corporate GHG emissions are into the following three (3) scopes.

Scope 1: Direct Emissions

Direct emissions are emissions from sources within the City of Kingston's geopolitical boundary.

1. Stationary Combustion: Combustion that produces electricity, steam heat or power using equipment in a fixed location.
2. Mobile Combustion: Combustion of fuels associated with transportation.
3. Process Emissions: Emissions from physical or chemical processing other than fuel combustion.
4. Fugitive Emissions: Emissions that are not physically controlled but result from intentional or unintentional releases.

Scope 2: Indirect Emissions

Scope 2 is a specific category of indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating or cooling. These emissions result from activities that take place within the organizational boundary but that occur at sources owned or controlled by another entity (i.e. electricity power plant).

Scope 3: Other Indirect Emissions

Scope 3 includes all other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the organization (i.e. employee commuting and business travel, outsourced activities, waste disposal).

Table 1 categorizes the emission sources from the City of Kingston's Corporate GHG Inventory into these respective scopes.

Table 1: Summary of Emission Sources and Scopes

Corporate GHG Emission Scopes
Scope 1: Direct Emissions
Natural Gas
Diesel
Gasoline
Propane
Heating Oil
Scope 2: Indirect Emissions
Electricity
Scope 3: Other Indirect Emissions
Waste

3.0 DATA SOURCES AND METHODOLOGY

The Corporate GHG Inventory Update (2011), includes new data provided for the years 2010 and 2011, as well as restated data for the years 2000 and 2006 to 2009 to reflect more accurate data sets, updated emission factors and modified methodologies.

The Corporate GHG Inventory is subdivided into the following six (6) sectors:

- Buildings,
- Fleet Vehicles (including corporate fleet and transit),
- Water treatment and distribution,
- Waste Water treatment and distribution,
- Streetlights (including traffic lights) and
- Waste.

The City of Kingston Corporate GHG inventory is based on the following five (5) principles for the accounting and reporting of GHG emissions common to the WRI/WBCSD GHG Protocol, ISO 14064 GHG Accounting Standards and the IEAP were applied:

- **Relevance**: The GHG inventory shall appropriately reflect the GHG emissions of the community within is geopolitical boundary.
- **Completeness:** All GHG emissions sources and activities within the chosen inventory boundary shall be accounted for. Any specific exclusion will be disclosed.
- **Consistency:** Consistent methodologies to allow for meaningful comparisons of emissions over time shall be used. Any changes to the data, inventory boundary, methods, or any relevant factors in the time series, shall be disclosed.
- **Transparency:** All relevant issues shall be addressed in a factual and coherent manner to provide a clear audit trail, should auditing be required. Any relevant assumptions shall be disclosed and include appropriate reference to the accounting calculation methodologies and data sources used, which may include the relevant Protocol and any relevant supplements.
- **Accuracy**: The quantification of GHG emissions should not be systematically over or under the actual emissions. Accuracy should be sufficient to enable intended users to make decisions with reasonable assurance as to the integrity of the reported information.

3.1 Emission Factors

GHG emissions are reported as equivalent tonnes of Carbon Dioxide (eCO2 (t)). To estimate GHG emissions the quantity of the emission source (electricity, natural gas, heating oil, propane, gasoline and diesel) is multiplied by the emission factor for that emission source. The emission factors are derived from the most recent Environment Canada National Inventory Report (1990 to 2010).

Emission factors for natural gas, fuel oil (heating oil), diesel (motor) and gasoline (motor) have remained unchanged. For these emission sources the same emission factors have been in place since the baseline inventory in 2000.

Electricity is the only emission source that has an emission factor that changes over time. The electricity emission factor is a function of the Ontario electricity energy mix and as the Province approaches its target of phasing out coal-fired plants the emission factor for electricity is impacted. In addition, each time the Environment Canada National Inventory Report is published the historical electricity emission factor is restated to reflect improved methodologies. The Ontario electricity emission factors presented within the National Inventory Report (NIR) – Environment Canada (1990-2008) was applied to the 2006 to 2009 corporate inventory. The Ontario electricity emission factors presented within the most recent National Inventory Report – Environment Canada (1990 to 2010) was applied to the 2011 Corporate GHG Inventory Update. The most recent NIR not only provided revised emission factors for 2009 but also restated historical Ontario electricity emission factors. Therefore, to ensure meaningful year to year comparisons, the emission factors applied to the City of Kingston Community GHG Inventory for the years 2000 and 2006 to 2009 had to be restated. The Ontario emission factor for 2010 was applied to 2011. Table 2 provides a comparison of the Ontario electricity emission factor applied in the 2006 to 2009 inventory and the current inventory update (2010 and 2011).

Table 2: Comparison of Ontario Electricity GHG Emission from NIR Reports

Year	Emission Factor NIR (1990-2008): Ontario kg CO2/kwh	Emission Factor NIR (1990-2010): Ontario kg CO2/kwh	Difference between NIR-2008 and NIR - 2010	Difference between 2000 based on NIR (1990 -2010)
2000	0.28	0.31	10.7%	N/A
2006	0.18	0.21	16.7%	-32.3%
2007	0.2	0.24	20.0%	-22.6%
2008	0.17	0.17	0.0%	-45.2%
2009	0.17	0.12	-29.4%	-61.3%
2010		0.15		-51.6%
2011*		0.15		-51.6%

Table 2 indicates that Ontario electricity emission factors reported by Environment Canada varied significantly between the NIR (1990 to 2008) and NIR (1990 to 2010). The changes in historical emission factors are due to improved methodologies in emission factor estimates. It

is anticipated that each year a NIR update is provided these historical emission factors will be restated. The year to year decrease in the Ontario electricity emission factors is due to improvements in the Ontario electricity energy mix. Between 2000 and 2011, the Ontario electricity emission factor decreased by 51.6%. It is likely that in the next update of the NIR the historical electricity emission factors may be restated. This will require that the Kingston Corporate electricity GHG emission estimates to be recalculated.

3.2 Emission Sources: Data Sources, Methodology and Quality Overview

Table 3 provides a summary of the data sources, method of obtaining the data and the data quality represented by each of the emission sources for 2010 and 2011.

Table 3: Summary of Data Source, Method and Data Quality (2010 and 2011)

BUILDING SECTOR		
Data Source	**Method/Comments**	**Data Quality**
Energy Source: Electricity		
mcw data set	Annual consumption (kWh) and cost data provided by mcw. Data collected by mcw from individual bills from Utilities Kingston and Hydro One.	Cost: High Consumption: High
Utilities Kinston	City staff collected meter readings from bills for the beginning of the year and the end of year to determine the annual consumption. To determine cost, an average $/kWh was determined from the mcw data set and was applied to the Utilities Kingston consumption data.	Cost: Low to Med Consumption: High
Hydro One	For non-mcw buildings, the monthly consumption and cost data was collected from electronic spreadsheets. TriEdge compiled the monthly cost and consumption data into annual summaries.	Cost: High Consumption: High
Estimates based on past data	For facilities where there was no data available a consumption estimate was made based on past data. The mcw average $/kWh was applied to determine the cost.	Cost: Low to Med Consumption: Low to Med
Estimates based on like Buidings	For buildings where there was no data available, the consumption per square foot from a like building was applied to the square footage of the building to determine consumption. The mcw average $/kWh was applied to the estimated consumption data to determine cost.	Cost: Low Consumption: Low
Energy Source: Natural Gas		
mcw data set	Annual consumption (m3) and cost data provided by mcw. Data collected by mcw from individual bills from Utilities Kingston and Union Energy.	Cost: High Consumption: High
Utilities Kinston	City staff collected meter readings from bills for the beginning of the year and the end of year to determine the annual consumption. To determine cost, an average $/m3 was determined from the mcw data set and was applied to the Utilities Kingston consumption data.	Cost: Low to Med Consumption: High
Union Energy	TriEdge accessed the City of Kingston weblink to the union energy bills which contained consumption and cost data. The system only houses data for two years. Therefore, there was a complete data set for the year 2010 but there was only a partial year of data for 2010. Therefore, the consumption data for 2011 and 2012 was used to estimate the missing months for 2010. The average unit cost data for 2010 was applied to the estimated consumption data.	2011 Cost: High 2011 Consumption: High

BUILDING SECTOR continued		
Data Source	**Method/Comments**	**Data Quality**
Energy Source: Fuel Oil (Heating Oil)		
Supplier Bills	Consumption and cost data was derived from monthly bills from supplier and was compiled by either TriEdge or City staff.	Cost: High Consumption: High
Estimates based on past data	Estimates of consumpition was based on previous years and the cost data was determined from an average of the $/liter for the year.	Cost: Low to Med Consumption: Low to Med
Energy Source: Propane		
Supplier Bills	Consumption and cost data was derived from monthly bills from supplier and was compiled by TriEdge.	Cost: High Consumption: High
WATER FACILITIES SECTOR		
Energy Source: Electricity		
Utilty Kingston Compilation	Utilities Kingston provided a consumption and cost summary spreadsheet for water treatment and distribution facilities that are serviced by both Hydro One and Utilities Kingston.	Cost: High Consumption: High
Energy Source: Natural Gas		
Utilty Kingston Compilation	Utilities Kingston provided a consumption and cost summary spreadsheet for water treatment and distribution facilities that are serviced by Utilities Kingston.	Cost: High Consumption: High
WASTE WATER FACILITIES SECTOR		
Energy Source: Electricity		
Utilty Kingston Compilation	Utilities Kingston provided a consumption and cost summary spreadsheet for water treatment and distribution facilities that are serviced by both Hydro One and Utilities Kingston.	Cost: High Consumption: High
Energy Source: Natural Gas		
Utilty Kingston Compilation	Utilities Kingston provided a consumption and cost summary spreadsheet for water treatment and distribution facilities that are serviced by Utilities Kingston.	Cost: High Consumption: High

FLEET SECTOR		
Data Source	**Method/Comments**	**Data Quality**
Energy Source: Diesel		
City: Waste Management	The City waste management provided the diesel consumption data for BFI (outsourced for recycling pickup). The cost data was derived from the MTO fuel index which provides fuel pricing on a monthly basis.	Cost: Med to High Consumption: High
City: Transportation	The City Transportation Services provided a compilation of diesel consumption and cost for both corporate fleet and transit.	Cost: High Consumption: High
Energy Source: Gasoline		
City: Transportation	The City Transportation Services provided a compilation of gasoline consumption and cost for both corporate fleet and transit.	Cost: High Consumption: High
STREETLIGHTS SECTOR		
Energy Source: Electricity		
Utilities Kingston	Utilities Kingston provided both cost and consumption data for streetlights and traffic lights.	Cost: High Consumption: High
Hydro One	Hydro One was only able to provid cost data. Therefore the $/kWh derived from the Utilities Kingston data was applied to the Hydro One data to determine the consumption.	Cost: High Consumption: Med.
WASTE SECTOR		
ICLEI factor	The City of Kingston does not track the waste produced by corporate operations. Therefore a factor was applied to estimate the amount of waste produced on a per employee basis.	Cost: na Consumption: Low

Data Quality Legend:

- High: Bottom-up activity level data from established and reliable data collection systems.
- Medium: A mix of bottom-up activity level data from established and reliable or ad hoc data collection systems with some assumptions about activity levels.
- Low: Based mainly on assumptions about activity levels.

3.2.1 Building Sector – Data Details and Methodology

Modified List of Facilities and Updated Facility Areas:

During the 2011 Corporate GHG Inventory Update there were several key methodology changes from previous years including: revised list of buildings and improved building area data. In 2011, the list of buildings to be included within the inventory was revisited and modified. Small facilities where there was little available data (therefore increasing the inaccuracy of the data set) and facilities that were not under the operational control of the City of Kingston were removed. The previous years inventories (including the base year 2000) were modified to reflect this adjustment in facilities. The City of Kingston has recently updated its building asset list with verified facility areas. This is a significant improvement in the data accuracy since a portion of the building consumption was based on consumption per square foot estimates. The list of buildings (name, address and area) is provided in Table 4. The list of facilities that were removed from the inventory is provided in Appendix A.

Collection of Facility Energy Consumption:

The building sector includes the following energy sources: electricity, natural gas, heating oil and propane. Electricity and natural gas are the dominant energy sources, heating oil and propane contribue very marginally (<2%) to the overall buiding emissions.

During the 2010 and 2011 inventory, it was possible to source actual electricity and natural gas consumption data for most of the facilities. The mcw data set provided cost and consumption data derived from invoices. Consumption data was not available for the British Whig building for 2011 and 2010 and had to be estimated from the 2006 and 2009 data sets. For faciltiies serviced by Utilities Kingston an average $/kWh for electricity and $/m3 for natural gas derived from the mcw data set was applied to consumption data to determine cost. For facilities serviced by Hydro One the electricity cost and consumption data was summarized from HydroOne spreadsheets. For facilities serviced by Union Gas complete natura gas cost and consumption data was provided for 2011 from the weblink but since Union Gas only posts invoices for a 2 year period only a portion of the 2010 data was available. Therefore estimates were made based based on available data sets to cover the missing periods.

The 2006 to 2009, the total electricity data is less accurate than that for 2010 and 2011 because estimates of consumption had to be determined for buildings not included in the mcw data set where no data was available. Average consumption data (2010 and 2011) was used to estimate consumption for these facilities. The average $/kWh for electricity and $/m3 for natural gas from the mcw data set for that year was applied to the consumption estimates to determine cost.

The baseline 2000 data set was modified to reflect the modified building list to ensure meaningful comparisons. Where data was lacking (approximately 24% of the facilities) consumption estimates were made based on the subsequent years of data and the 2000 average unit costs.

Table 4: Corporate Facilities within the GHG Inventory

Building #	Facility	Address	Floor Area (ft^2)
1	Centre 70	3 Days Road	29,185
2	Cataraqui CC	1030 Sunnyside Road	95,000
3	Kingston Utilities Building / City Administration	1211 John Counter Blvd.	31,984
4	City Hall	216 Ontario Street	47,451
5	Court House	1 & 5 Court Street	26,109
6	Portsmouth Olympic Harbour	53 Young Street	64,441
7	Airport ATB (Terminal)	1114 Len Birchall Way	14,640
8	Depot-610	610 Montreal St.	1,725
9	KFPL - Central Library	130 Johnson St.	60,030
10	KFPL - Isabel Turner Branch	935 Gardiners Rd.	32,427
11	Pittsburgh Public Library	80 Gore Rd	6,700
12	Kingscourt Library	115 Kirkpatrick St.	3,352
13	Bus Depot (Transit Centre)	1181 John Counter Blvd.	28,324
14	Airport Garage	1095 LenBirchall Way	5,490
15			
16	Recycling Centre	2709 Creekfrod Road.	78,964
17	Parks & Rec Storage Garage	2711 Creekford Road	10,860
18	Bruce Parking Garage	266 Bagot St.	32,291
19	Hanson Parking Garage	109 Brock St.	115,173
20	Chown Parking Garage	197 Brock Street	159,550
21	Fire Station #1	1648 Joyceville Rd.	12,196
22	Fire Station #2	3505 Brewers Mills Rd.	2,888
23	Fire Station #3	211 Gore Rd.	8,866
24	Fire Station #4	271 Brock St.	24,765
25	Fire Station #5	170 Railway St.	7,848
26	Fire Station #6	262 Palace Rd.	4,899
27	Fire Station #7	905 Woodbine Road	19,892
28	Fire Station #8	1485 Unity Rd.	8,115
29	Fire Station #9	2835 Hwy 38	6,595
30	Fire Station #10	127 Days Rd.	4,904
31	Artillery Park	76 Ordanance Rd.	26,125
32	MacLachlan Woodworking	Hwy 2 @ Grasscreek Pk	1,219
33	Belle Park Fairways	731 Montreal St.	3,935
34			
35	Meadowcrest	Kingston Mills Rd.	2,893
36			
37	Rideaucrest Facility	175 Rideau St.	113,848
38	Oakwood Daycare	33 Compton St.	6,564
39	Emergency Ctr.-500 O'Connor	500 O'Conner Dr.	15,663
40	K-Rock Centre	1 Barrack Street	166,250
41	Wally Elmer Centre	106 Daly St.	22,634

Table 4 Corporate Facilities within the GHG Inventory continued

Building #	Facility	Address	Floor Area (f^{t2})
42	Memorial Centre	303 York St.	61,500
43	INVISTA Centre	1350 Gardiners Rd.	180,000
44	Police Headquarters	705 Division St.	121,440
45	Grand Theatre	218 Princess St.	28,000
46	362 Montreal Street	362 Montreal St.	37,011
	Cooks Brothers Arena	692 Bagot St.	26,630
	Harold Harvey Arena	42 Church St.	23,300
	Market Square Rink (Outdoor)		
	Lake Ontario Park - Facility	920 King St. West	14,259
	Pump House Steam Museum	23 Ontario St.	7,500
	Airport Hangar #4	1040 LenBirchhall Way	42,500
	Airport Hangar #5	1060 LenBirchhall Way	42,500
	Midland Avenue (former admin.)	1425 Midland Avenue	20,380
	623 King Street	623 King St.	2,000
	Madoma	1805 Hwy 2 East	4,528
	Calvin Park Library	88 Wright St.	6,000
	J.K. Tett Complex	370 King St. West	39,784
	British Whig Building	310 King St. East	28,200
	City Greenhouse Building	99 Norman Rogers Drive	8,222
	City Works Garage Building	701 Division Street	32,678
	Equipment Depot - Forestry Garage	1643 Kingston Rd. 15	8,640
	Former County of Frontenac Works Ga	546 Gardiners Rd.	6,095
	Kingston Police Storage	717 Division St.	4,800
	Rodden Park Barn	111 Norman Rogers Drive	8,826
	Rodden Park House	87 and 89 Norman Rogers D	3,336
	KARC	196 Lappans Lane	28,811
	Former Police Headquaters	11 Queen Street	51,000

3.2.2 Waste and Waste Water Sector – Data Details and Methodology

Natural gas and electricity cost and consumption data for the water and wastewater plants and distribution systems was provided by Utilities Kinston. The data set was verified to ensure consistency across the years. Data for the water and wastewater plants was reviewed, inaccuracies noted and revised data was provided by Utility Kingston.

3.2.3 Fleet Sector – Data Details and Methodology

The Fleet Sector includes corporate fleet, transit fleet and outsourced BFI reycling vehicles. The collection of data for the fleet sector is limited to within the municipality of Kingston (i.e. transit servicing Loyalist Township is not included). The City of Kingston transportation services provides diesel and gasoline consumption and cost data for corporate fleet and transit (including biodiesel). The City of Kingston waste services provides the consumption of fuel by the outsourced BFI trucks that provide recycling services to the city. Cost data for the fuel consumed by the BFI recycling trucks is derived from the Ministry of Energy price index website. Since transit was not included in the 2000 inventory, transit fuel consumption for 2006 was applied to 2000.

3.2.4 Streetlight Sector – Data Details and Methodology

The streetlight Sector includes street lights and traffic lights within the municipality. The lights within the core are serviced by Utilities Kingston and those outside of the core are serviced by Hydro One. In previous inventories, the only data available was the total cost of electricity. Estimates had to be made on the average $/kWh to determine consumption. In the 2011 inventory, data for both cost and consumption was provided for the Utilities Kingston data set for 2006 to 2011. This enabled an actual $/kWh to be determined. This unit cost was applied to determine the consumption for both the Hydro One and the Utilities Kingston data. Relationships from this data was used to restate the 2000 data set to enable a more meaningful comparison.

3.2.5 Streetlight Sector – Data Details and Methodology

Waste makes up <1% of the total corporate GHG emissions. The City of Kingston does not track the collection (tonnage) of recyclables, compost and material sent to landfill. Therefore, an estimate is made based on tonnage of waste generated per employee and tonnes of GHG emissions produced per tonne of waste generated.

4.0 SECTOR ANALYSIS

Sectors for the Kingston Corporate GHG inventory include:

- Buildings,
- Water Treatment and Distribution,
- Waste Water Treatment and Distribution,
- Fleet (including Transit),
- Streetlights (including Traffic Lights), and
- Waste.

This section provides an overview of the total corporate energy consumption, GHG emissions and energy cost by sector. A detailed review of the consumption, GHG emissions and costs associated with each of the sectors is provided.

4.1 OVERVIEW

This section provides an overview of the total corporate energy consumption, GHG emissions and energy cost by sector.

4.1.1 Sector Energy Consumption (GJ) Overview by Sector

This section provides an overview of the corporate energy consumption by sector. To be able to compare the sectors, the energy consumption (i.e. m3 natural gas, kWh electricity, liters of fuel etc.) has been converted to Gigajoules (GJ). Figure 1 provides the energy consumption (GJ) by sector for 2011 and Figure 2 provides a comparison of the energy consumption (GJ) for 2000 and 2006 to 2011 by sector.

What is a Gigajoule (GJ)?
A Gigajoule is a measure of energy. One gigajoule of electricity energy is equivalent to keeping a 60-watt bulb continuously lit for six months.[1]

[1] http://oee.nrcan.gc.ca/commercial/technical-info/tools/8397

Figure 1: 2011 Corporate Energy Consumption (GJ) by Sector
Total: 478,428 GJ

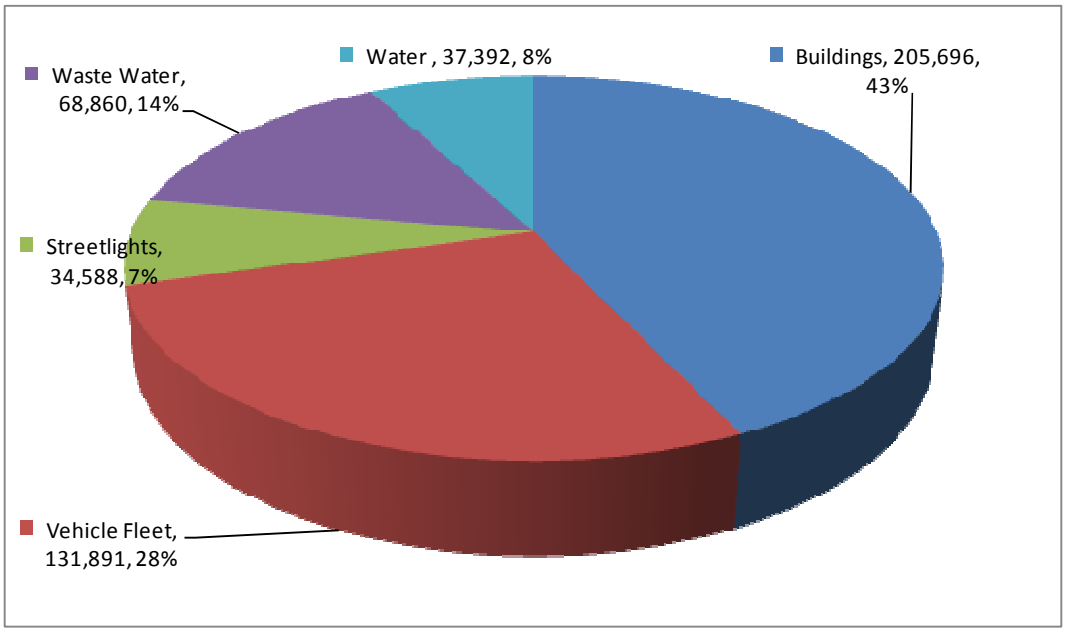
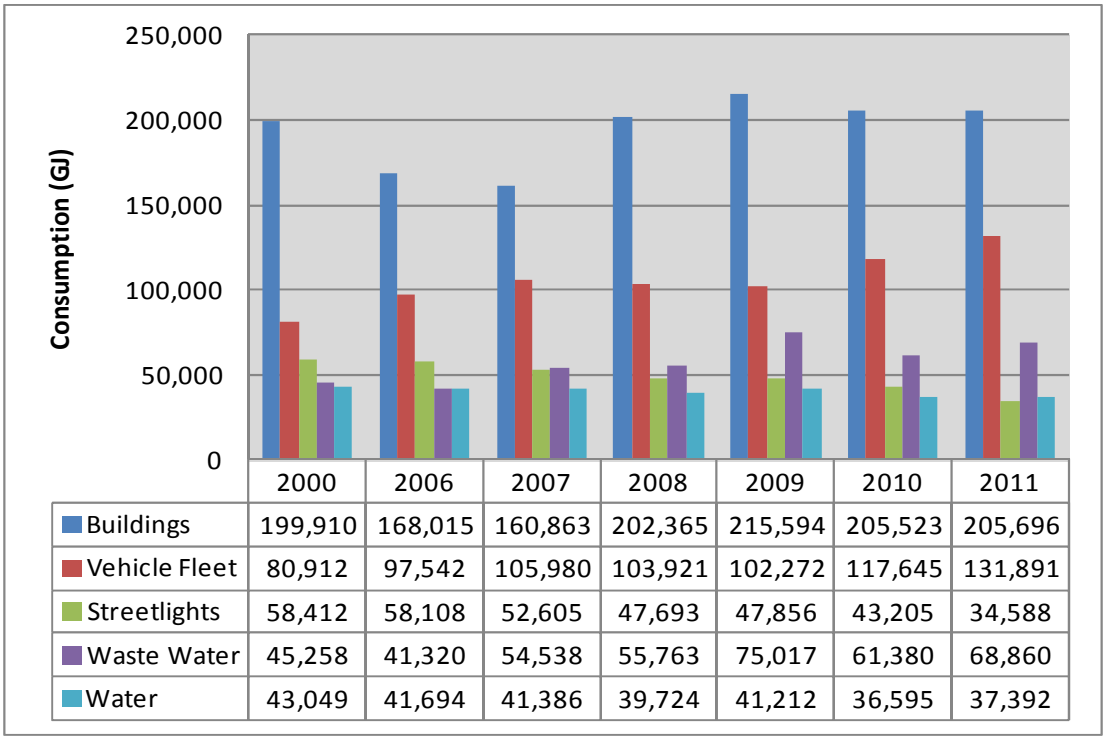


Figure 2: Annual Energy Consumption (GJ) by Sector (2000 and 2006 to 2011)



	2000	2006	2007	2008	2009	2010	2011
Buildings	199,910	168,015	160,863	202,365	215,594	205,523	205,696
Vehicle Fleet	80,912	97,542	105,980	103,921	102,272	117,645	131,891
Streetlights	58,412	58,108	52,605	47,693	47,856	43,205	34,588
Waste Water	45,258	41,320	54,538	55,763	75,017	61,380	68,860
Water	43,049	41,694	41,386	39,724	41,212	36,595	37,392

Year	2000	2006	2007	2008	2009	2010	2011
Total GJ	427,540	406,679	415,373	449,465	481,952	464,348	478,428
% Difference from 2000	n/a	-4.9%	-2.8%	5.1%	12.7%	8.6%	11.9%

The corporate energy consumption increased by approximately 12% (50,887 GJ) between 2000 and 2011. Consumption increases were realized in the building (3%, 5,786 GJ), fleet (63%, 50,979 GJ) and wastewater (52%, 23,602 GJ) sectors and decreases were captured in the streetlights (-41%, -23,824 GJ)) and water sectors (-13%, 5,656)). Figure 3 illustrates the difference in energy consumption (GJ) between 2000 and 2011 for each of the sectors. Vehicle fleet experienced the greatest increase and streetlights realized the greatest reduction.

Figure 3: The Difference in Energy Consumption (GJ) by Sector between 2000 and 2011

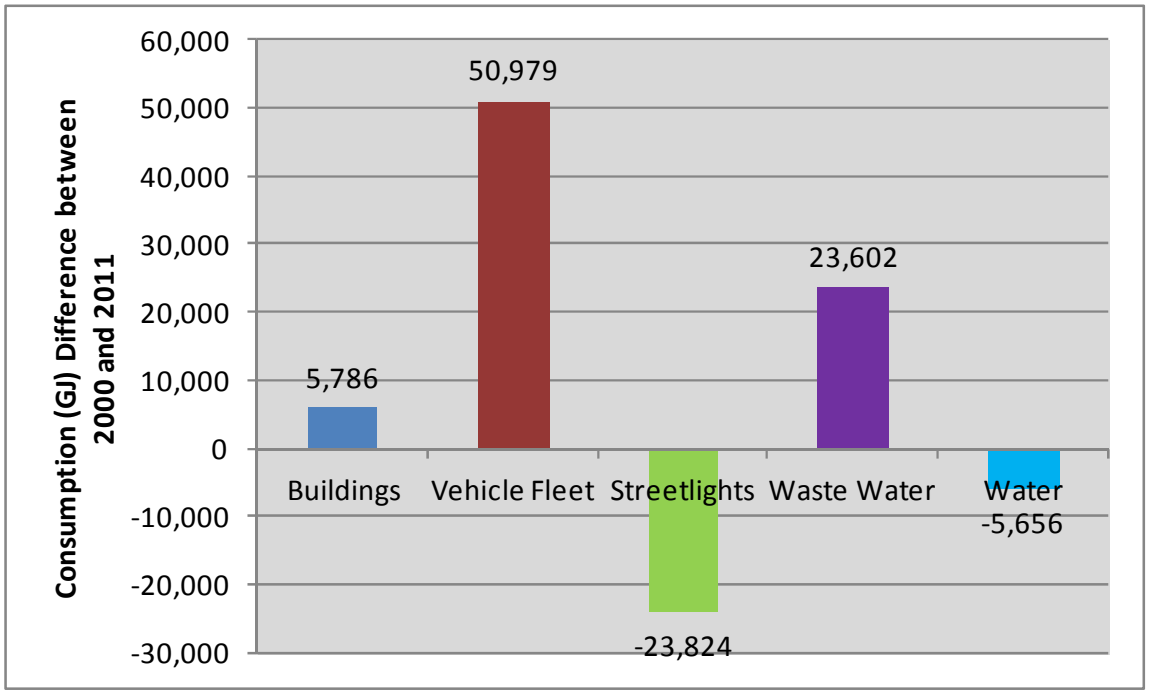
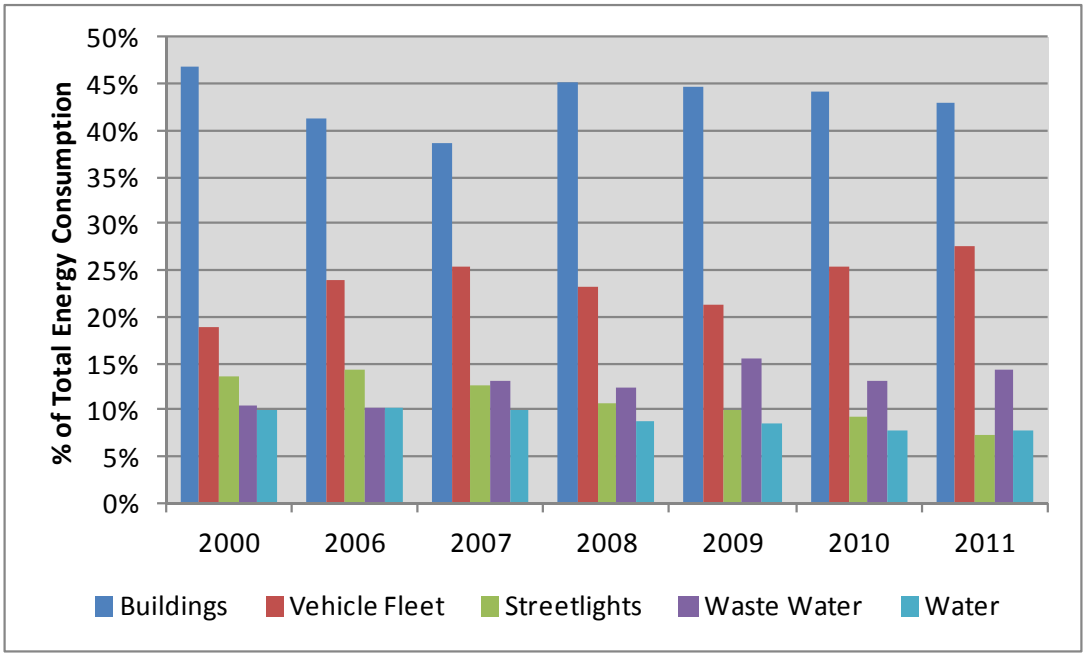


Figure 4 illustrates the difference in the percentage of the total energy consumption (GJ) by sector for the years 2000 and 2006 to 2011. The building sector is consistently the dominant sector for the percentage of total energy consumption decreasing by 4% from 2000 to 2011. Fleet consistently ranks second for the percentage of the total energy consumption but had the greatest increase (9%) between 2000 and 2011. Streetlights had the most significant reduction in the percentage of total energy consumption of -6% from 2000 to 2011. The total consumption contribution from waste water increased by 4% and decreased by 2% for water between 2000 and 2011.

Figure 4: Percentage of Total Energy Consumption (GJ) by Sector (2000 and 2006 to 2011)



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4.1.2 Sector GHG Emission Overview

This section provides an overview of the corporate GHG emissions by sector. Figure 5 provides the GHG Emissions by sector for 2011. In 2011, the City of Kingston Corporation generated 25,290 tonnes of GHG emissions.

Figure 5: 2011 GHG Emissions by Sector
(Total: 25,290 tonnes of GHG Emissions)

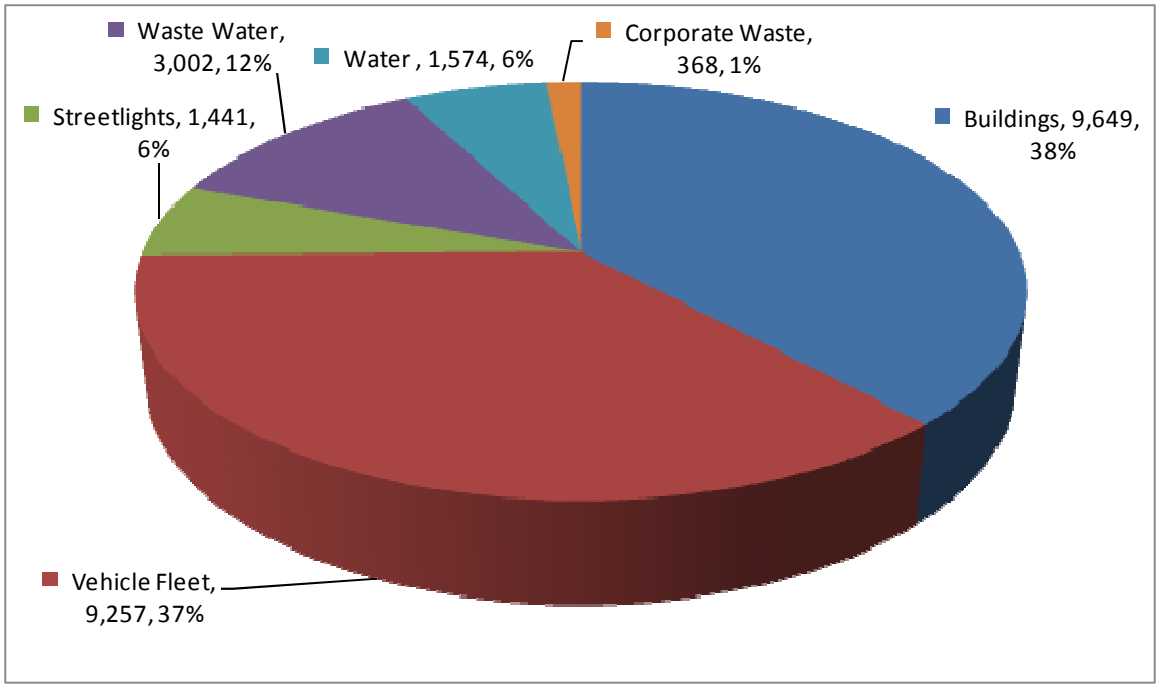
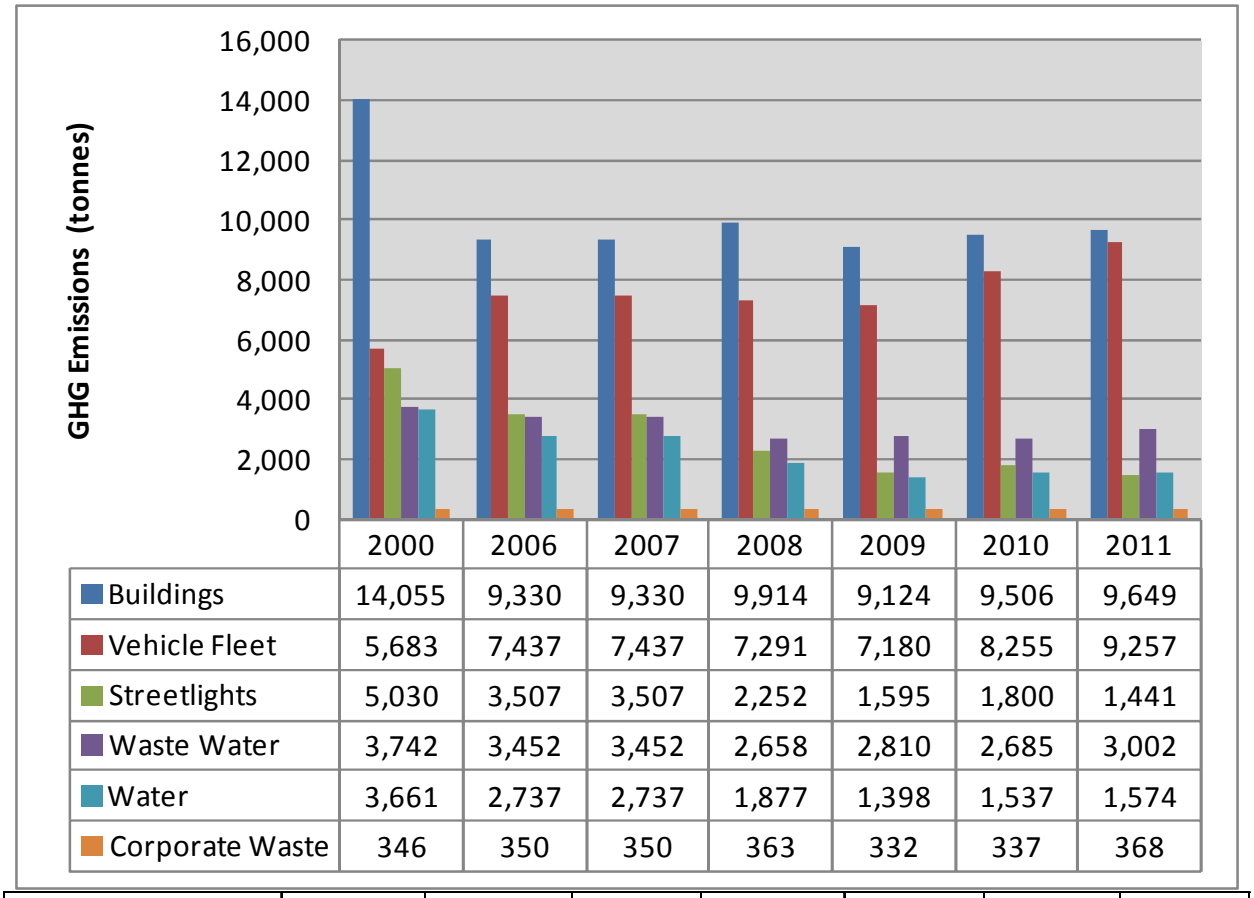


Figure 6 provides a comparison of the distribution of Corporate GHG emissions for 2000 and 2006 to 2011 by sector.

Figure 6: Total GHG Emissions by Sector (2000 and 2006 to 2011)



	2000	2006	2007	2008	2009	2010	2011
Buildings	14,055	9,330	9,330	9,914	9,124	9,506	9,649
Vehicle Fleet	5,683	7,437	7,437	7,291	7,180	8,255	9,257
Streetlights	5,030	3,507	3,507	2,252	1,595	1,800	1,441
Waste Water	3,742	3,452	3,452	2,658	2,810	2,685	3,002
Water	3,661	2,737	2,737	1,877	1,398	1,537	1,574
Corporate Waste	346	350	350	363	332	337	368

Year	2000	2006	2007	2008	2009	2010	2011
Total Emmissions (tonnes)	32,518	25,259	26,813	24,355	22,439	24,120	25,290
% Difference from 2000	n/a	-22%	-18%	-25%	-31%	-26%	-22%

Figure 7 illustrates the difference in GHG emissions (tonnes) between 2000 and 2011. Buildings (-4,406 tonnes), Streetlights (-3,589 tonnes), water (-2,087 tonnes) and wastewater (-741 tonnes) contributed to the reduction of GHG emissions, while fleet experienced an increase (3,574 tonnes) in GHG emissions.

Figure 7: The Difference in GHG Emissions by Sector between 2000 and 2011

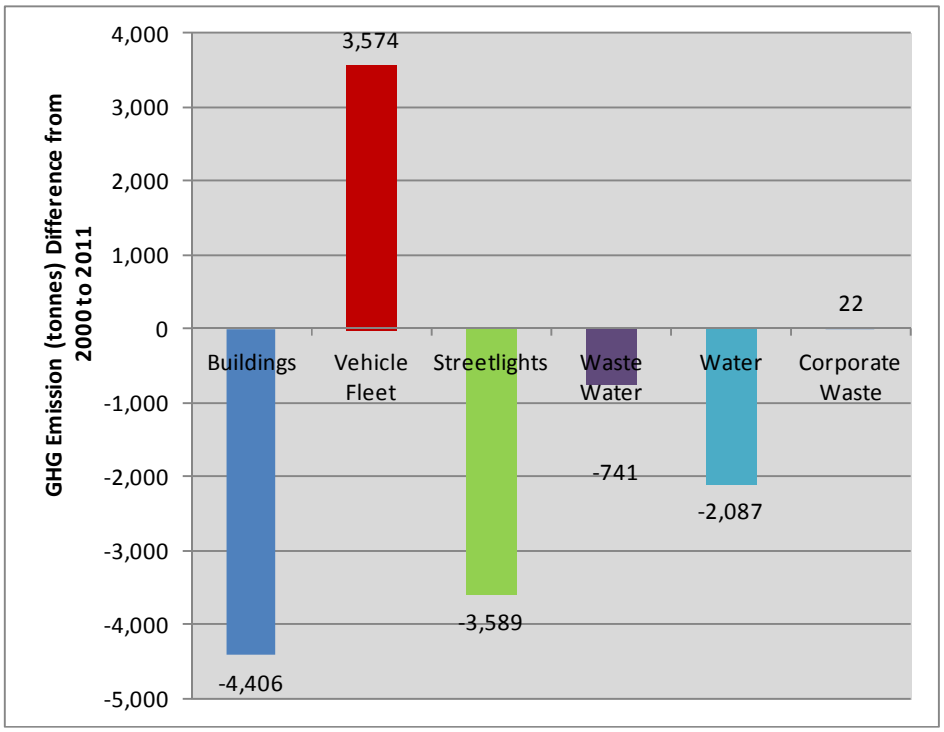
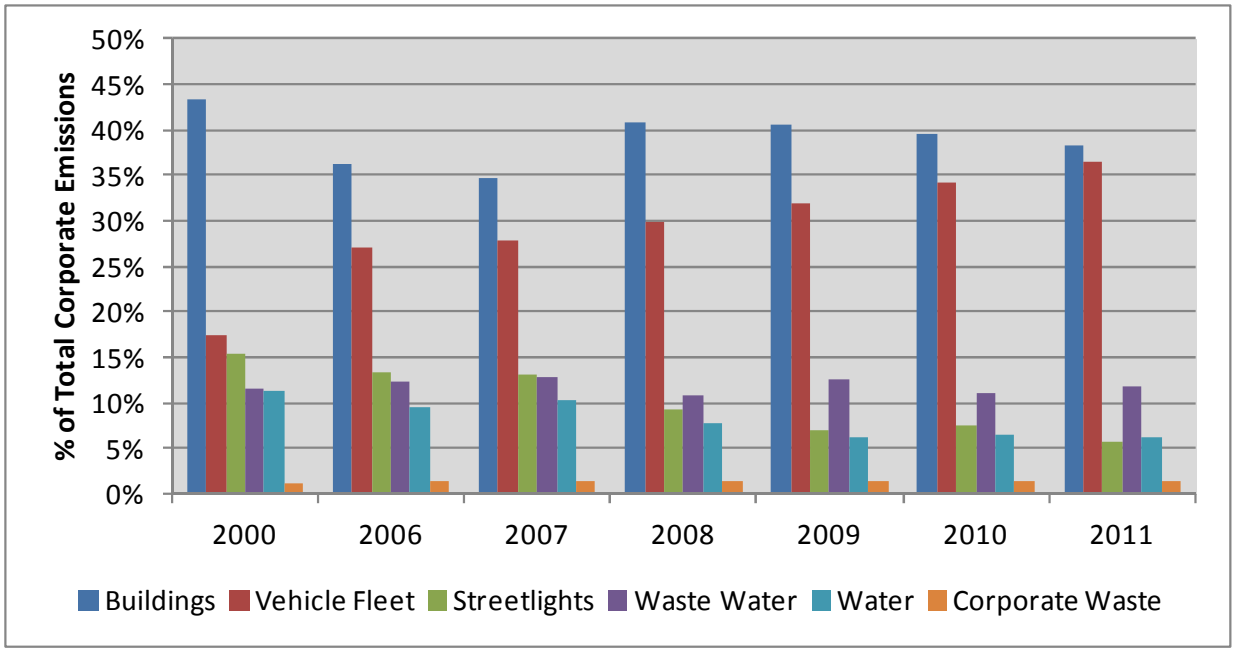


Figure 8 illustrates the percentage of the total corporate GHG emissions represented by each of the sectors for the years 2000 and 2006 to 2011.

Figure 8: Percentage of Total Corporate GHG Emissions by Sector (2000 and 2006 to 2011)

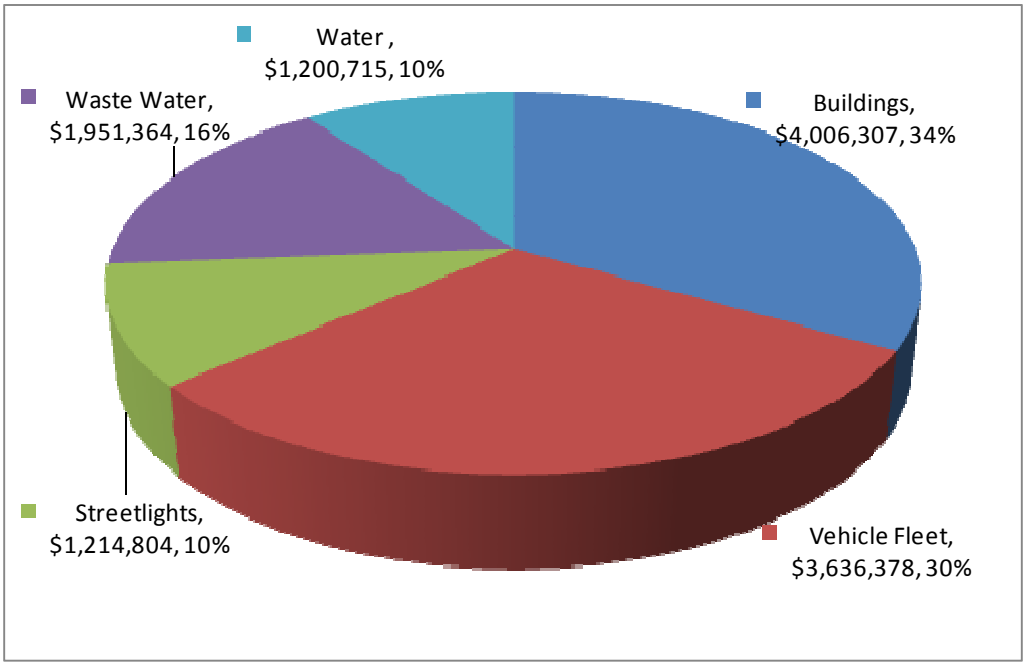


While buildings consistently represent the highest proportion of GHG emissions in comparison to the corporate total, their contribution has decreased by 5% from 2000 to 2011. Similarly, water and streetlights realized a reduction in their overall contribution to corporate emissions. Fleet is the only sector to realize an increase with a rise of 19% in its contribution to the total corporate emissions.

4.1.3 Energy Cost Overview by Sector

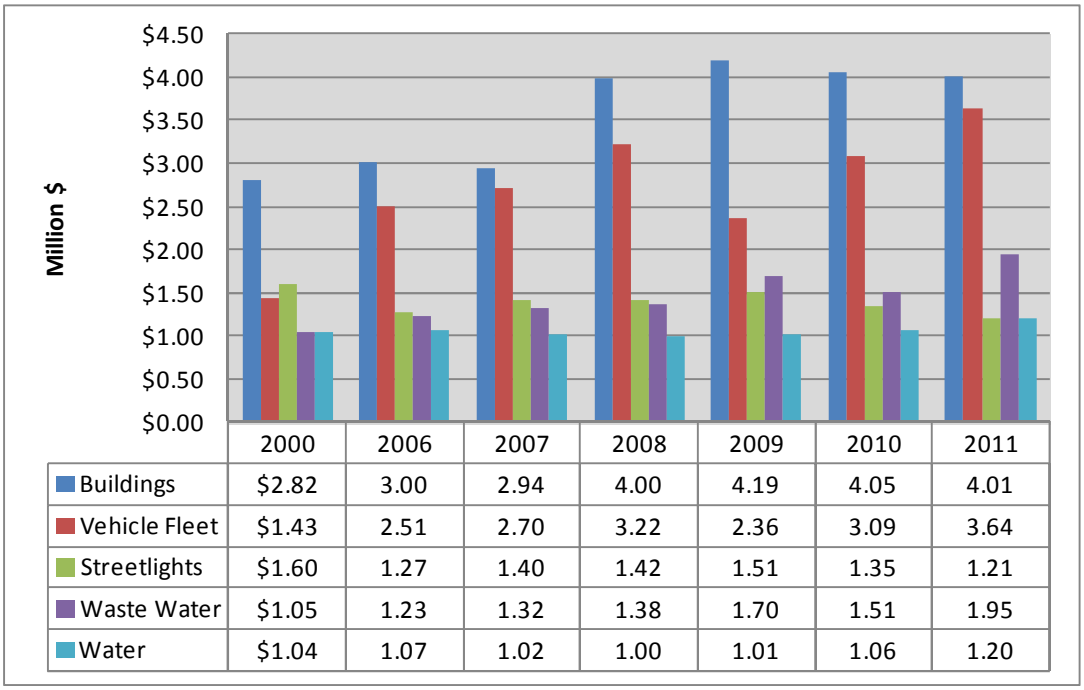
This section provides an overview of the corporate energy cost by sector. Figure 9 illustrates the cost of energy by sector for 2011.

Figure 9: 2011 Corporate Energy Cost by Sector (Total: $12,009,569)



In 2011, the corporation spent $12,009,569 on energy. Buildings, fleet, water and wastewater had comparable contributions of 34%, 30% and 26% respectively followed by streetlights with 10%. Figure 10 provides a comparison of the corporate distribution of energy costs 2000 and 2006 to 2011 by sector.

Figure 10: Corporate Energy Cost by Sector (2000, and 2006 to 2011)



	2000	2006	2007	2008	2009	2010	2011
Buildings	$2.82	3.00	2.94	4.00	4.19	4.05	4.01
Vehicle Fleet	$1.43	2.51	2.70	3.22	2.36	3.09	3.64
Streetlights	$1.60	1.27	1.40	1.42	1.51	1.35	1.21
Waste Water	$1.05	1.23	1.32	1.38	1.70	1.51	1.95
Water	$1.04	1.07	1.02	1.00	1.01	1.06	1.20

Year	2000	2006	2007	2008	2009	2010	2011
Total Million$	$7.93	$9.08	$9.38	$11.02	$10.78	$11.05	$12.01
% Difference from 2000	n/a	15%	18%	39%	36%	39%	51%

The cost of corporate energy has increased by approximately 51% between 2000 and 2011. Figure 11 illustrates the difference in the energy cost by sectors between 2000 and 2011. All sectors with the exception of streetlights experienced an increase in energy cost. The most significant increase was the fleet sector ($2.21 Million), followed by buildings ($1.19 Million,), waste water ($0.90 Million) and water ($0.16 Million). Figure 12 provides a summary of the percentage energy cost by sector for 2000 and 2006 to 2011. Buildings, streetlights and water realized a contribution reduction to the total corporate energy cost of -2%, -10% and -3% respectively between 2000 and 2011. In contrast, fleet experienced a significant increase in its contribution to the total corporate energy cost (12%) between 2000 and 2011.

Figure 11: Difference in Corporate Sector Energy Costs between 2000 and 2011

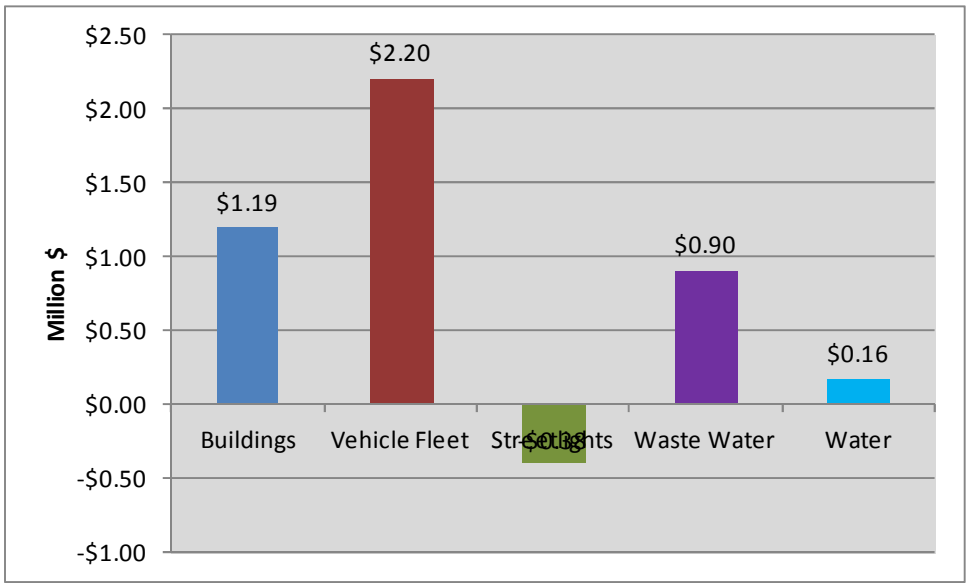
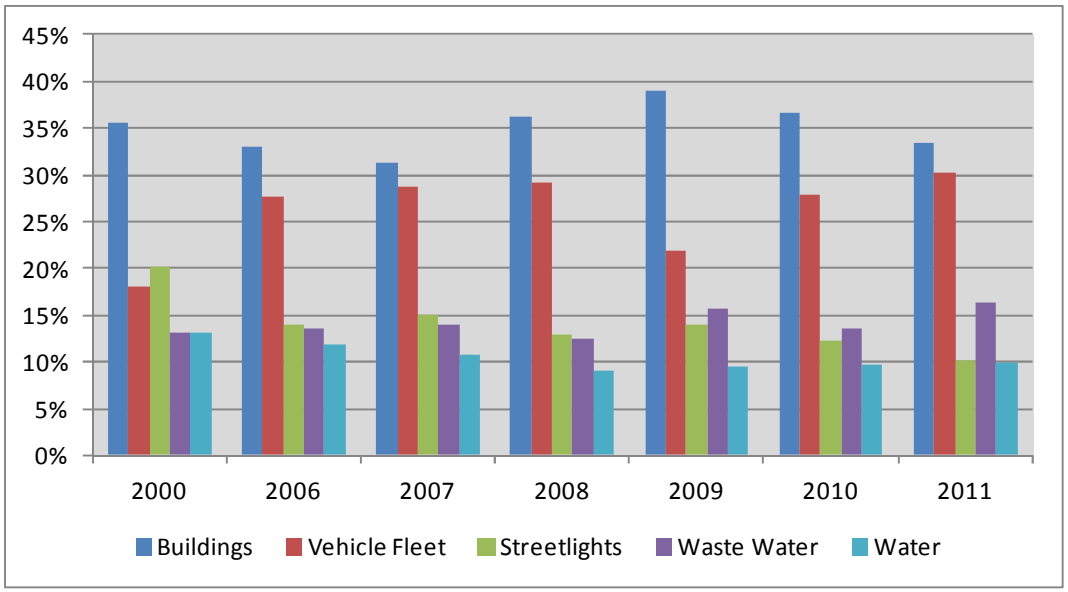


Figure 12: Percentage of Total Energy Cost by Sector (2000 and 2006 to 2011)



4.2 BUILDING SECTOR

4.2.1 Current Status of the Corporate Building Sector

The Corporate Building sector has the following energy sources: electricity, natural gas, propane and heating oil. Electricity and natural gas are the dominant energy sources with propane and heating oil providing a marginal contribution. In 2011, the corporate building sector consumed 205,696 GJ of energy at a cost of approximately $4,006,307 and emitted 9,649 tonnes of GHG emissions.

Table 5 provides a summary of the top ten energy consumers in 2011. This list of ten buildings is responsible for 68% of the total building energy consumption and 67% of the total building energy cost and emissions.

Table 5: 2011: Corporate Buildings: Top Ten Energy Consumers

Rank	Building	Consumption (GJ)	Cost ($)	Emissions (tonnes)
1	**INVISTA Centre**	32,506	$666,969	1,480
2	**Rideaucrest Facility**	22,670	$448,505	1,045
3	**K-Rock Centre**	15,135	$324,064	681
4	**Memorial Centre**	13,468	$193,263	645
5	**Police Headquarters**	12,219	$280,289	548
6	**Bus Depot (Transit Centre)**	10,310	$141,209	499
7	**Artillery Park**	8,809	$133,674	420
8	**Kingston Utilities Building / City Administration**	8,468	$165,778	385
9	**Cataraqui Community Centre**	8,438	$195,723	379
10	**Portsmouth Olympic Harbour**	7,355	$146,179	336
Total Top Ten Buildings:		139,378	$2,695,653	6,418
Total Buildings:		205,696	$4,006,307	9,649
% of Total:		68%	67%	67%

To enable buildings that have made both positive and negative progress related to energy consumption to be identified, buildings were analyzed to reveal buildings with a greater than twenty percent difference in electricity and natural gas consumption between 2010 and 2011 were identified.

Table 6 provides a summary of corporate buildings that had a greater than 20% difference in electricity consumption between 2010 and 2011. Buildings that experienced a significant increase over this time include: Belle Park Fairways (83%), Oakwood Daycare (209%), Cooks Brother Arena (77%), City Greenhouse Building (24%), Rodden Park Barn (45%) and Rodden Park House (43%). Buildings that experience energy consumption reduction during this time include: Court House, Hanson and Chown Parking Garages, Emergency Centre, Harold Harvey Arena (modified use from arena to theatre), Lake Ontario Park Facility, Steam House Museum and City Works Garage.

Table 6: Buildings with a > 20% Difference in Electricity Consumption between 2010 and 2011

Building	Data Source	2011 (kWh)	2010 (kWh)	Difference (kwh)	% Difference
Court House	mcw data	227,521	305,578	-78,057	-26%
Hanson Parking Garage	mcw data	117,798	161,293	-43,495	-27%
Chown Parking Garage	mcw data	230,299	304,842	-74,543	-24%
Belle Park Fairways	UK data - collected by City	219,119	119,929	**99,190**	**83%**
Oakwood Daycare	UK data - collected by City	282,508	91,340	**191,168**	**209%**
Emergency Ctr.-500 O'Con	mcw data	237,984	317,454	-79,470	-25%
Cooks Brothers Arena	UK data - collected by City	103,439	58,589	**44,850**	**77%**
Harold Harvey Arena	UK data - collected by City	102,711	245,217	-142,506	-58%
Lake Ontario Park - Facility	UK data - collected by City	25,862	46,094	-20,232	-44%
Pump House Steam Museum	UK data - collected by City	24,860	43,319	-18,459	-43%
City Greenhouse Building	UK data - collected by City	18,718	15,114	**3,604**	**24%**
City Works Garage Building	UK data - collected by City	**246,613**	341,760	-95,147	-28%
Rodden Park Barn	UK data - collected by City	**24,567**	16,937	**7,630**	**45%**
Rodden Park House	UK data - collected by City	**1,356**	948	**408**	**43%**

Table 7 provides a summary of corporate buildings that had a greater than 20% difference in natural gas consumption between 2010 and 2011. Buildings that experienced a significant increase over this time include: Kingston Utilities Building (32%), Portsmouth Olympic Harbour (19%), Central Library (21%), Pittsburgh Library (27%), Memorial Centre (61%), 623 King St. (22%), and KARC (20%). Buildings that had a reduction of greater than 20% use of natural gas between 2010 and 2011 include: Fire Station #4, Emergency Centre, Harold Harvey Arena (repurposed to a theatre) and Kingston Police Storage.

Table 7: Buildings with a > 20% Difference in Natural Gas Consumption (2010 to 2011)

Building	Data Source	2011 (m3)	2010 (m3)	Difference (m3)	% Difference
Kingston Utilities Building / City Administration	mcw data	**101,041**	76,808	**24,233**	**32%**
Portsmouth Olympic Harbour	UK data - collected by City	**92,871**	77,798	**15,073**	**19%**
KFPL - Central Library	UK data - collected by City	**43,593**	36,023	**7,570**	**21%**
Pittsburgh Public Library	Union Gas accounts	**6,608**	5,209	**1,399**	**27%**
Fire Station #4	UK data - collected by City	**26,322**	32,933	**-6,611**	**-20%**
Emergency Ctr.-500 O'Connor	mcw data	**31,720**	40,683	**-8,963**	**-22%**
Memorial Centre	UK data - collected by City	**260,079**	162,030	**98,049**	**61%**
Harold Harvey Arena	UK data - collected by City	**11,057**	14,110	**-3,053**	**-22%**
623 King Street	UK data - collected by City	**5,163**	4,226	**937**	**22%**
Kingston Police Storage	UK data - collected by City	**3,026**	4,167	**-1,141**	**-27%**
KARC	UK data - collected by City	**61,814**	51,483	**10,331**	**20%**

Table 8 ranks the top ten buildings based on energy intensity. Interestingly, the Bust Depot (Transit Centre) and Artillery Park are the top two (2) facilities for energy intensity and they are both currently undergoing renovations.

Table 8: 2011 Top Ten Building by Energy Intensity

Rank	Building	Energy Intensity (GJ/ft2)
1	Bus Depot (Transit Centre)	0.364
2	Artillery Park	0.337
3	Kingston Utilities Building / City Administration	0.265
4	Belle Park Fairways	0.240
5	Memorial Centre	0.219
6	Rideaucrest Facility	0.199
7	Airport ATB (Terminal)	0.181
8	Calvin Park Library	0.163
9	Emergency Ctr.-500 O'Connor	0.160
10	Oakwood Daycare	0.155

4.2.1 Building Sector Overview

Table 9 summarizes the building sector energy consumption (GJ), GHG emissions and cost for 2000 and 2006 to 2011.

Table 9: Building: Consumption, Cost and Emissions 2000 and 2006 to 2011

Year	2000	2006	2007	2008	2009	2010	2011
Energy Consumption (GJ)							
Electricity	110,459	82,490	73,924	94,840	102,919	99,828	95,077
Natural Gas	86,967	83,699	84,765	105,349	110,560	103,420	107,638
Propane	0	538	667	614	607	607	1,064
Heating Oil	2,484	1,287	1,507	1,561	1,508	1,668	1,916
Total Building GJ:	**199,910**	**168,015**	**160,863**	**202,365**	**215,594**	**205,523**	**205,696**
% of Total Sectors:	**47%**	**41%**	**39%**	**45%**	**45%**	**44%**	**43%**
GJ/ft2:	**0.122**	**0.101**	**0.098**	**0.097**	**0.103**	**0.098**	**0.099**
Energy Cost ($)							
Electricity	$2,158,389	$1,933,919	$2,052,400	$2,641,323	$2,925,260	$3,008,407	$2,851,581
Natural Gas	$636,491	$1,035,564	$844,635	$1,306,303	$1,217,732	$986,844	$1,088,352
Propane	$0	$15,462	$19,345	$19,042	$20,717	$20,717	$36,334
Heating Oil	$20,178	$19,846	$23,708	$29,571	$28,771	$31,371	$30,040
Total Building Cost:	**$2,815,058**	**$3,004,791**	**$2,940,088**	**$3,996,240**	**$4,192,480**	**$4,047,339**	**$4,006,307**
% of Total Sectors:	**35%**	**33%**	**31%**	**36%**	**39%**	**37%**	**33%**
Cost/ft2	**$1.72**	**$1.80**	**$1.79**	**$1.91**	**$2.01**	**$1.94**	**$1.94**
Greenhouse Gas Emissions (tonnes)							
Electricity	9,512	4,812	4,928	4,479	3,431	4,160	3,962
Natural Gas	4,363	4,199	4,253	5,286	5,547	5,189	5,485
Propane	0	32	40	37	36	36	64
Heating Oil	180	93	109	113	109	121	139
Total Building Emissions:	**14,055**	**9,137**	**9,330**	**9,914**	**9,124**	**9,506**	**9,649**
% of Total Sectors:	**43%**	**36%**	**35%**	**41%**	**41%**	**39%**	**38%**
tonnes/100 ft2:	**0.856**	**0.547**	**0.569**	**0.474**	**0.436**	**0.455**	**0.466**

Year	2000	2006	2007	2008	2009	2010	2011
Energy Consumption (GJ)							
Electricity	110,459	82,490	73,924	94,840	102,919	99,828	95,077
Natural Gas	86,967	83,699	84,765	105,349	110,560	103,420	107,638
Propane	0	538	667	614	607	607	1,064
Heating Oil	2,484	1,287	1,507	1,561	1,508	1,668	1,916
Total Building GJ:	**199,910**	**168,015**	**160,863**	**202,365**	**215,594**	**205,523**	**205,696**
% of Total Sectors:	**47%**	**41%**	**39%**	**45%**	**45%**	**44%**	**43%**
GJ/ft2:	**0.122**	**0.101**	**0.098**	**0.097**	**0.103**	**0.098**	**0.099**
Energy Cost ($)							
Electricity	$2,158,389	$1,933,919	$2,052,400	$2,641,323	$2,925,260	$3,008,407	$2,851,581
Natural Gas	$636,491	$1,035,564	$844,635	$1,306,303	$1,217,732	$986,844	$1,088,352
Propane	$0	$15,462	$19,345	$19,042	$20,717	$20,717	$36,334
Heating Oil	$20,178	$19,846	$23,708	$29,571	$28,771	$31,371	$30,040
Total Building Cost:	**$2,815,058**	**$3,004,791**	**$2,940,088**	**$3,996,240**	**$4,192,480**	**$4,047,339**	**$4,006,307**
% of Total Sectors:	**35%**	**33%**	**31%**	**36%**	**39%**	**37%**	**33%**
Cost/ft2	**$1.72**	**$1.80**	**$1.79**	**$1.91**	**$2.01**	**$1.94**	**$1.94**
Greenhouse Gas Emissions (tonnes)							
Electricity	9,512	4,812	4,928	4,479	3,431	4,160	3,962
Natural Gas	4,363	4,199	4,253	5,286	5,547	5,189	5,485
Propane	0	32	40	37	36	36	64
Heating Oil	180	93	109	113	109	121	139
Total Building Emissions:	**14,055**	**9,137**	**9,330**	**9,914**	**9,124**	**9,506**	**9,649**
% of Total Sectors:	**41%**	**32%**	**32%**	**38%**	**37%**	**36%**	**35%**
tonnes/100 ft2:	**0.856**	**0.547**	**0.569**	**0.474**	**0.436**	**0.455**	**0.466**

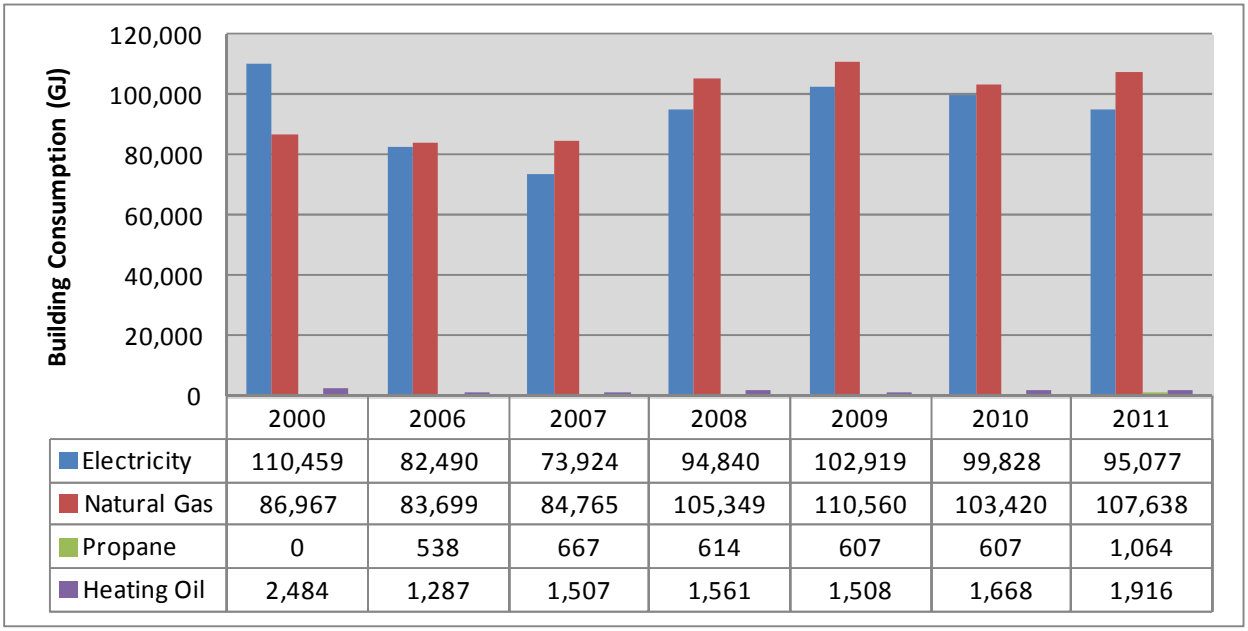
The building sector is responsible for the most energy consumption of all the sectors. While the corporate building energy consumption (GJ) increased by 3% (5,786 GJ) from 2000 to 2011, its energy cost increased by 42% ($1,191,250) and its emissions decreased by 31% (-4,406 tonnes). The corporate building proportion of the total corporate energy consumption, energy cost and GHG emissions reduced from 2000 to 2011 by 4%, 2% and 6% respectively.

The corporate building sector has reduced its energy intensity (GJ/ft^2) by 18% between 2000 and 2011. This indicates that the corporate building sector is becoming more efficient. In spite of the reduction in energy intensity (GJ/ft2) between 2000 and 2011, the energy cost per ft^2 has increased by 13%. The tonnes of GHG emissions per 100 ft^2 have reduced by 46% between 2000 and 2011 and by 15% between 2006 and 2011.

4.2.2 Building Sector Energy Consumption (GJ) by Emission Source

Figure 13 provides a summary of the building sector energy consumption (GJ) from 2000 and 2006 to 2011.

Figure 13: Building Sector: Annual Consumption (GJ) by Energy Source



	2000	2006	2007	2008	2009	2010	2011
Electricity	110,459	82,490	73,924	94,840	102,919	99,828	95,077
Natural Gas	86,967	83,699	84,765	105,349	110,560	103,420	107,638
Propane	0	538	667	614	607	607	1,064
Heating Oil	2,484	1,287	1,507	1,561	1,508	1,668	1,916

Year	2000	2006	2007	2008	2009	2010	2011
Total GJ	199,910	168,015	160,863	202,365	215,594	205,523	205,696
% Difference from 2000	n/a	-16.0%	-19.5%	1.2%	7.8%	2.8%	2.9%

The building sector consistently contributes the most to the total corporate energy consumption. Since 2000, the building energy consumption has increased by 3%. During this period, the consumption of electricity decreased by 14% (-15,382 GJ) and the consumption of natural gas increased by 24% (20,671 GJ).

To understand the variations in energy consumption for the building sector, we need to identify changes to the building portfolio over time. Figure 14 illustrates the relationship between energy consumption and total corporate building area. The energy consumption and the total corporate building area are essentially coincident. Table 10 provides the energy consumption, total corporate building area, energy intensity (GJ/ft^2) and the addition and removal of buildings over time. Based on this data, while the energy consumption has increased by 3% from 2000 to 2011, the total corporate area has increased by 26%. The energy intensity of the corporate building portfolio has reduced by 19% from 2000 to 2011 (from 0.122 GJ/ft^2 to 0.099 GJ/ft^2).

Figure 14: Relationship between Energy Consumption and Area

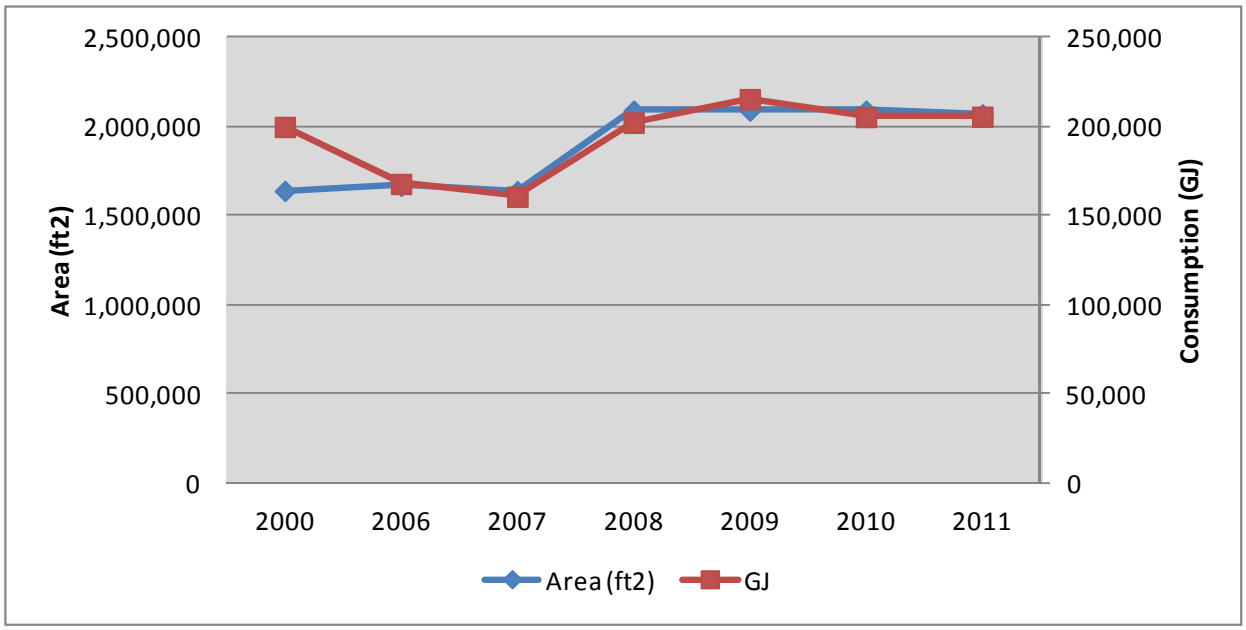


Table 10: Energy Consumption and Area Changes (2000 and 2006 to 2011)

Year	2000	2006	2007	2008	2009	2010	2011
Area (ft2)	1,641,045	1,669,245	1,641,245	2,090,735	2,090,735	2,090,735	2,070,355
GJ	199,910	168,015	160,863	202,365	215,594	205,523	205,696
GJ/ft2	0.122	0.101	0.098	0.097	0.103	0.098	0.099
Addition		British Whig Building		Grand Theatre KROCK INVISTA new Police HQ			
Removal			Grand Theatre renovation	old Police HQ			Midland Ave.

4.2.2.2 Impact of Weather on the Building Sector Energy Consumption

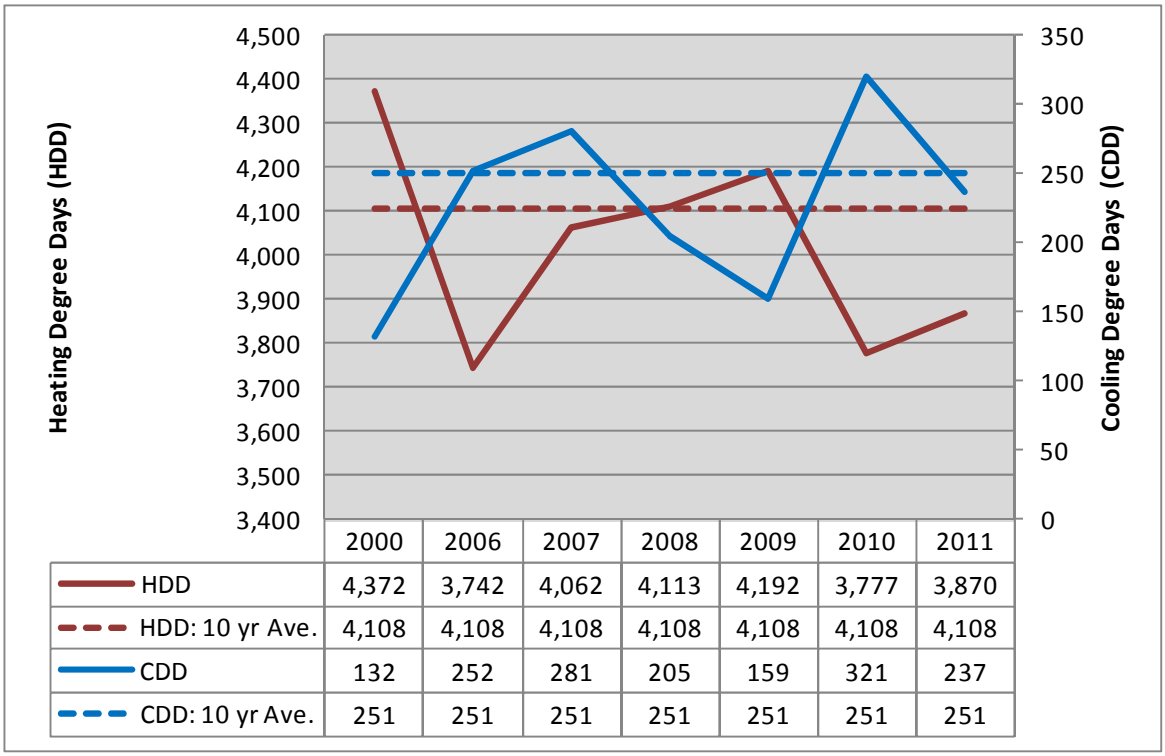
Weather influences the amount of energy that is consumed to heat and cool buildings. It is assumed that in a cold winter more natural gas energy will be consumed for heating and that during a hot summer more electricity will be consumed for cooling. Therefore, if we want to try to determine the corporation's progress related to reducing its energy consumption it is necessary to take into account the influence of heating and cooling variability by normalizing the building energy consumption. Natural gas, propane and heating oil are normalized for heating and electricity is normalized for cooling.

An overview of heating and cooling degree days is provided. The impact of heating degree days on the consumption of natural gas and the impact of cooling degree days on the consumption of electricity is outlined. There are significant limitations in the data set which lead to inaccuracies. These data limitations are provided. The impact of weather on the estimated total building energy consumption and energy consumption intensity is presented. It is estimated that the true building energy consumption (GJ) and energy consumption intensity (GJ/ft^2) is within the range of the actual and normalized data point boundaries.

Heating and Cooling Degree Days

Heating Degree Day (HDD) is a measure of the energy needed to heat a building and Cooling Degree Day (CDD) is a measure of the energy needed to cool a building. The number of degrees that a day's average temperature is below 18 degrees Celsius is the number of HDD for that day. For example, if the average temperature for a day was 10 degrees Celsius then the HDD for that day would be 8 degrees Celsius. Similarly, the number of degrees that a day's average temperature is above 18 degrees Celsius is the number of cooling degree days. Figure 15 provides a summary of the annual HDD and CDD from 2000 and 2006 to 2011 as well as the 10 year averages for HDD and CDD.

Figure 15: Annual HDD and CDD (2000 and 2006 to 2011) and 10 Year Averages



	2000	2006	2007	2008	2009	2010	2011
HDD	4,372	3,742	4,062	4,113	4,192	3,777	3,870
HDD: 10 yr Ave.	4,108	4,108	4,108	4,108	4,108	4,108	4,108
CDD	132	252	281	205	159	321	237
CDD: 10 yr Ave.	251	251	251	251	251	251	251

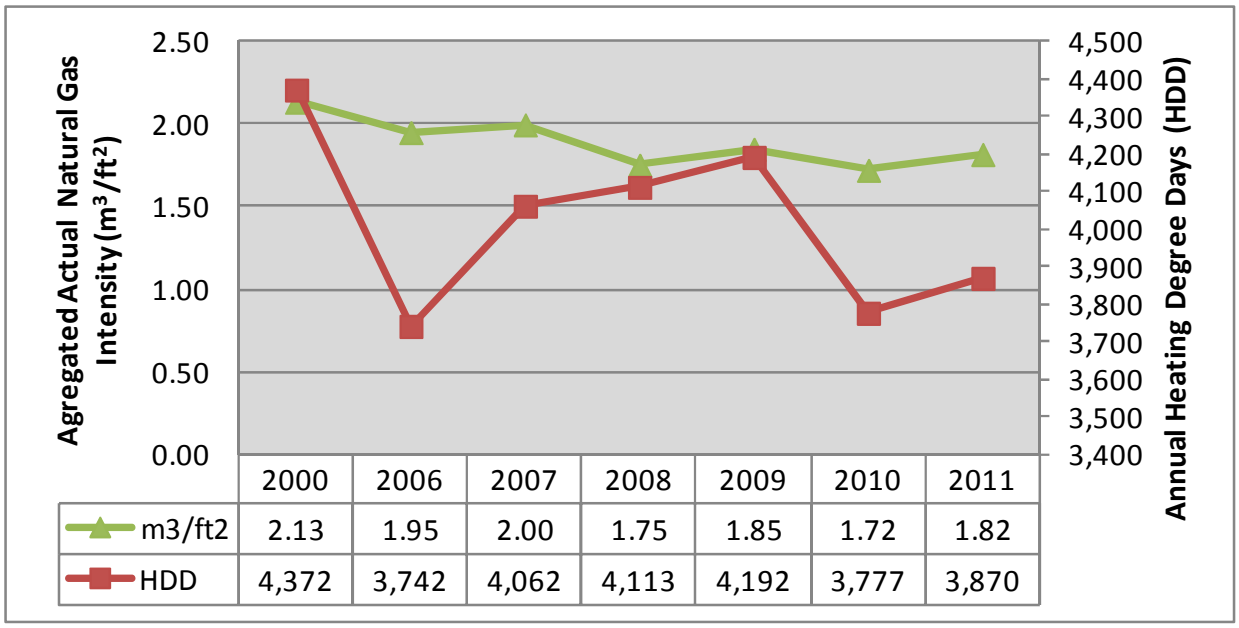
Based on this data we can see that the year 2000 (baseline) had the lowest number of CDD and the highest number of HDD in comparison to 2006 to 2011. This means that since 2000 more energy has had to be used in the summer to cool our buildings and less energy has had to be used in the winter to heat our buildings. By the dramatic drop in HDD in 2006 we see that it was an exceptional warm winter. Similarly, we see that in 2009 the summer was relatively cool (comparable to 2000). In 2011, the Kingston community experienced an 11.5% decrease in HDD and a 79% increase in CDD in comparison to the baseline year of 2000. The dashed lines represent the 10 year average for CDD (blue: 251 CDD) and HDD (red: 4,108).

The Impact of Weather on the Consumption of Natural Gas in the Building Sector

Generally, natural gas is used to heat buildings and therefore there is an expected relationship between the annual consumption of natural gas and the annual number of HDD. Since the City of Kingston corporate building portfolio changes over time it is necessary to determine the aggregated natural gas intensity (m^3/ft^2) to allow for a meaningful comparison of consumption from year to year. This is the total natural gas consumed by corporate buildings divided by the total area of corporate buildings that consumed natural gas. Figure 16 provides a summary of the actual annual natural gas intensity plotted against HDD. In general, we see a relationship between a decrease/increase in the natural gas intensity and a decrease/increase in the HDD. In 2008, however, the natural gas intensity decreases while the HDD increases. Between 2007

and 2008, the following buildings were added to the corporate portfolio: KROCK Centre, INVISTA, new Police Headquarters and the newly renovated Grand Theater. We anticipate that these facilities had greater energy intensity efficiency, therefore causing a decrease in the overall corporate natural gas intensity while the HDD increased.

Figure 16: Annual Natural Gas Intensity and HDD

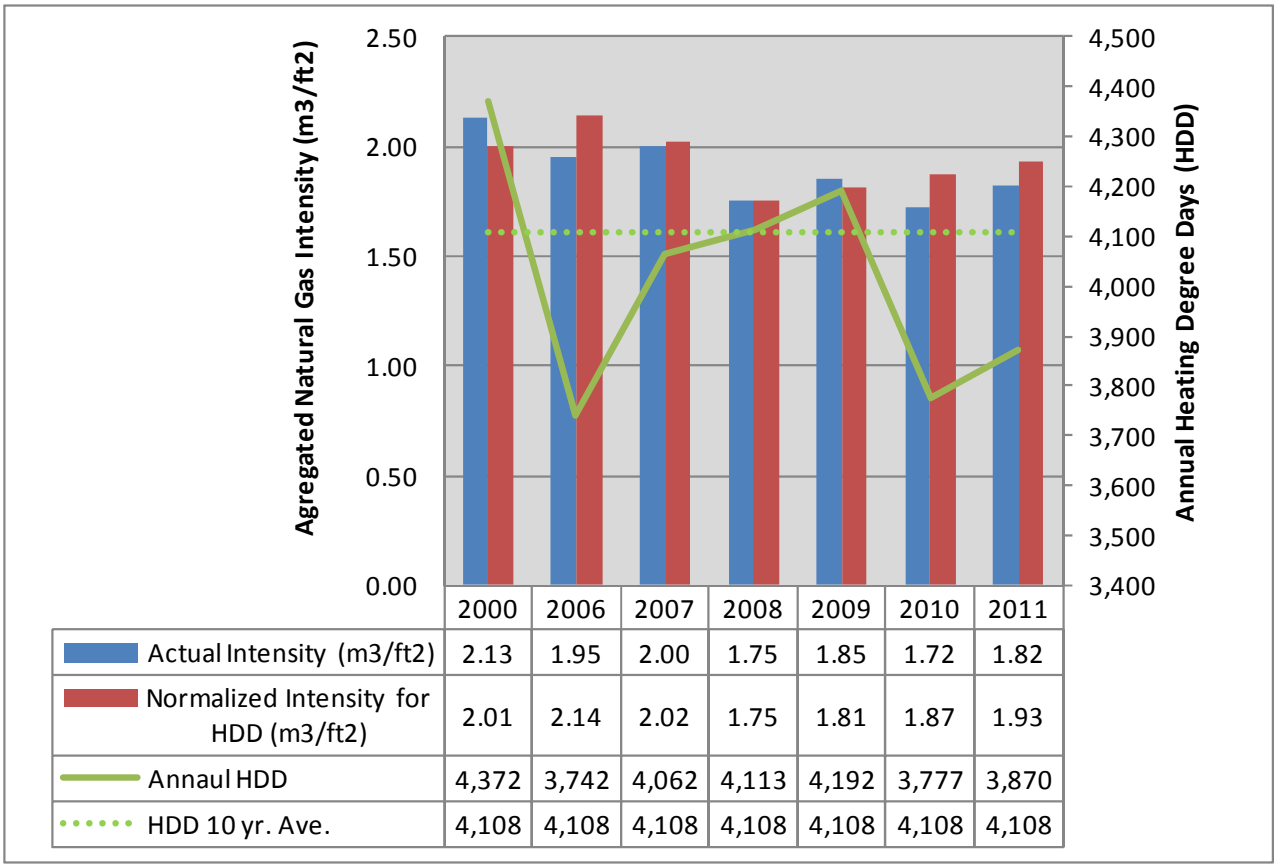


	2000	2006	2007	2008	2009	2010	2011
m3/ft2	2.13	1.95	2.00	1.75	1.85	1.72	1.82
HDD	4,372	3,742	4,062	4,113	4,192	3,777	3,870

Normalization of Natural Gas Intensity due to HDD

When we compare natural gas consumption intensity data from year to year we understand that some years are cooler than others (therefore increasing the natural gas needed for heating). In order to take away the impact of weather (changes in HDD) we normalize the natural gas intensity data. This is done by taking the natural gas intensity and dividing it by its annual HDD and then multiplying it by the 10 year HDD average. Figure 17 illustrates the Actual and Normalized Natural Gas Intensity as well as the annual HDD and the HDD 10 year average.

Figure 17: Actual and Normalized Natural Gas Intensity (m^3/ft^2)



	2000	2006	2007	2008	2009	2010	2011
Actual Intensity (m3/ft2)	2.13	1.95	2.00	1.75	1.85	1.72	1.82
Normalized Intensity for HDD (m3/ft2)	2.01	2.14	2.02	1.75	1.81	1.87	1.93
Annaul HDD	4,372	3,742	4,062	4,113	4,192	3,777	3,870
HDD 10 yr. Ave.	4,108	4,108	4,108	4,108	4,108	4,108	4,108

Year	2000	2006	2011	% Difference between 2011 & 2000	% Difference between 2011 and 2006
Actual ($m3/ft^2$)	2.13	1.95	1.82	-15%	-7%
Normalized ($m3/ft^2$)	2.01	2.14	1.93	-4%	-10%

This data indicates that while the actual intensity decreased by 15% between 2000 and 2011 the normalized intensity only decreased by 4% during the same period. Based on a comparison between 2006 and 2011, we see that the actual intensity decreased by 7% while the normalized intensity decreased by 10%. **Based, on the data limitations and the crude level of weather normalization analysis, it is estimated that the true percentage difference in natural gas intensity ($m3/ft^2$) between 2000 and 2011 ranged from a reduction of 4% to a reduction of 15%.** The normalized natural gas intensity decreased significantly in 2008 when new and renovated facilities where added to the corporate portfolio (KROCK Centre, INVISA, new Police Headquarters and newly renovated Grand Theater). Since 2008, the normalized natural gas intensity since then has been creeping up. With weather already taken into account the increase since 2008 is due to other factors (i.e. decrease in efficiency and conservation).

The Ability to Predict Natural Gas Intensity Based on HDD

In order to determine if it was possible to predict the annual natural gas intensity based on annual HDD a series of regressions were completed. Only seven (7) data points are available. Unfortunately, the relationship between HDD and natural gas intensity is weak (Correlation: 0.518 and R^2: 0.269). It is therefore not possible to determine a predictive relationship. This implies that there are other significant factors at play, outside of HDD, that influence the natural gas intensity. Some of these factors that could influence changes in natural gas intensity could include: retrofits, decreased efficiency, changes in conservation behaviours and operational practices, changes in hours of operation, changes in building use.

The Impact of Weather on the Consumption of Electricity in the Building Sector

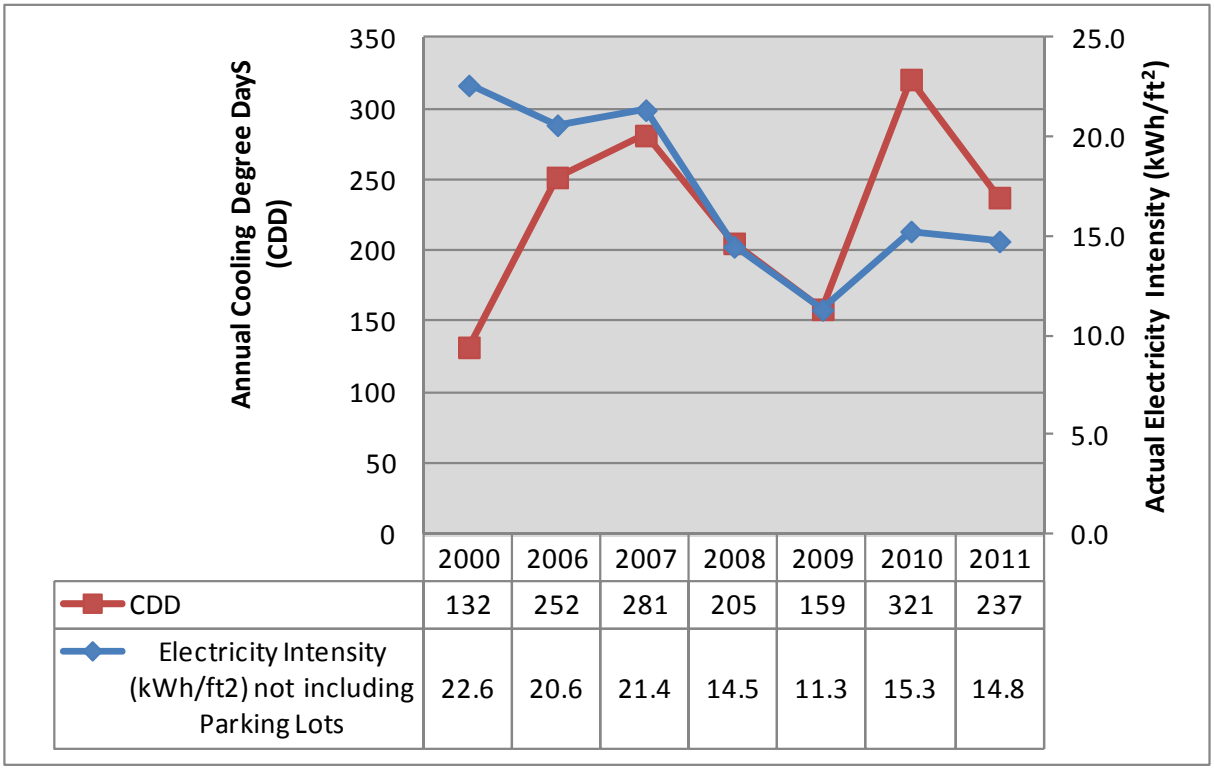
Data Set Limitations

The data set used to develop the City of Kingston Corporate Inventory provides the total electricity consumption of facilities on an annual basis. There is no division provided for the amount of the electricity that is used for lighting, heating and cooling. The aggregated nature of this data set becomes problematic when we want to massage the data to adjust for weather. Generally, electricity is used to cool buildings and natural gas is used to heat buildings. This is however a generalization and there may be some buildings that are heated with electricity or where electric heaters are used in the winter to supplement natural gas heating. Without this refinement of electricity energy use, errors are introduced when we try to normalize the electricity consumption for weather. Base-load building electricity use for non-weather related activities including plug-load and the lighting base-load are not known.

Relationship between Electricity Intensity (kWh/ft^2) and CDD

To attempt to look at the annual electricity intensity for cooling the parking electricity consumption and square footage was removed since we know that this load is due to lighting. There are other electricity base-loads that need to be accounted for including lighting and plug loads. Since we do not have the base-load data error is introduced into our estimates.

Figure 18: Annual Electricity Intensity (kWh/ft2) not Including Parking Lots and CDD



	2000	2006	2007	2008	2009	2010	2011
CDD	132	252	281	205	159	321	237
Electricity Intensity (kWh/ft2) not including Parking Lots	22.6	20.6	21.4	14.5	11.3	15.3	14.8

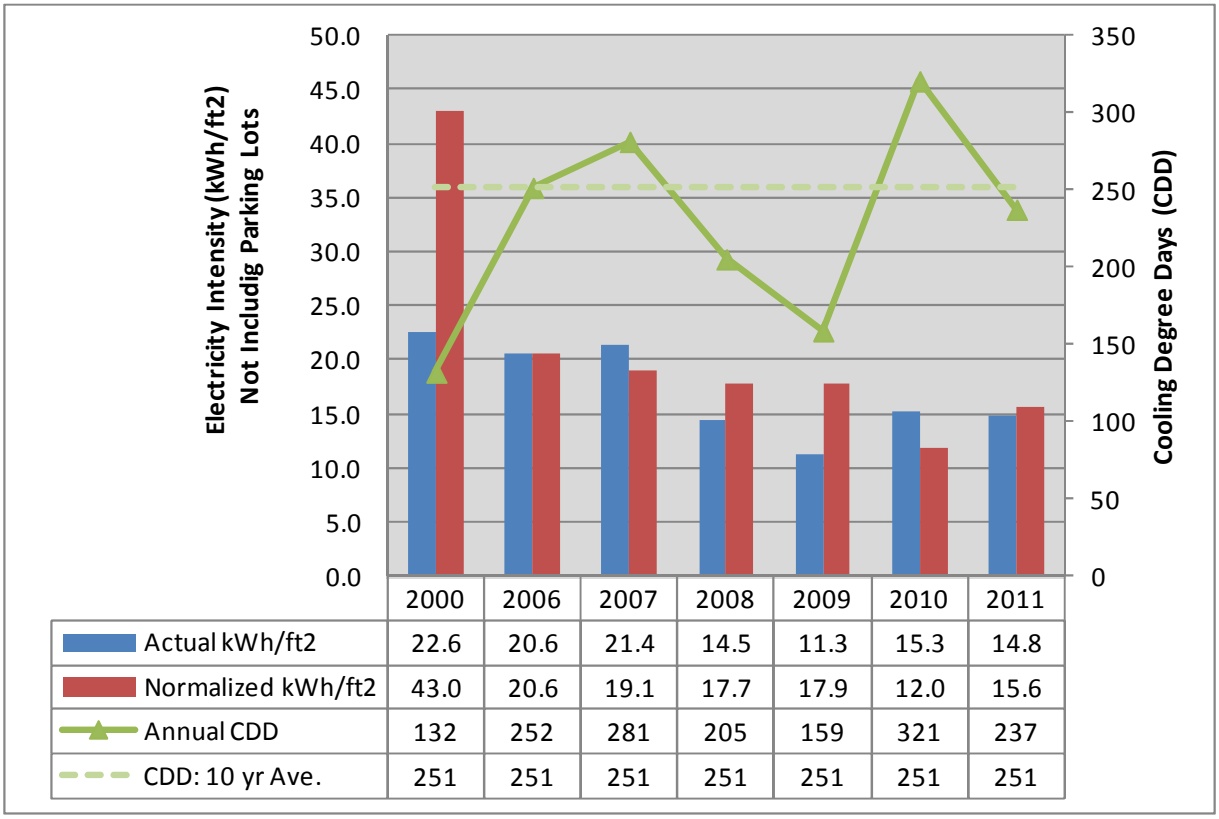
Based on this plot it is evident that the 2000 data point is not consistent with the other data points. Not including the 2000 data point allows a correlation of approximately 0.59 between kWh/ft^2 and CDD.

Normalization of Electricity Intensity due to CDD

When we compare electricity intensity data from year to year we understand that some years are warmer than others (therefore requiring more electricity energy for cooling) and that this is likely to have an impact on the electricity intensity. In order to take away the impact of weather (changes in CDD) we normalize the electricity intensity data. This is done by taking the electricity intensity and dividing it by its annual CDD and then multiplying it by the 10 year CDD average. Figure 19 compares the Actual and Normalized Electricity Intensity as well as the annual CDD and the CDD 10 year average. Again, there are data limitations. Since the data provided is aggregated as annual data, it is not possible to remove the lighting base load, plug load and any electricity load that is used for heating. Therefore, error is introduced into the normalization of electricity intensity for cooling.

Figure 19 illustrates the actual electricity intensity and the normalized electricity intensity taking into account CDD and provides a comparison between the actual and the normalized electricity intensity.

Figure 19: Actual and Normalized CDD Electricity Intensity (kWh/ft^2)



Year	2000	2006	2011	% Difference between 2011 & 2000	% Difference between 2011 and 2006
Actual (kWh/ft^2)	22.6	20.6	14.8	-35%	-28%
Normalized (kWh/ft^2)	43	20.6	15.6	-64%	-24%

Figure 19 indicates the impact of normalizing the electricity intensity for CDD. A comparison between the actual and the normalized intensity between 2000 and 2011 indicates a 35% reduction for the actual intensity and a 64% reduction for the normalized reduction. A comparison between 2006 and 2011 indicates 28% reduction for the actual intensity and a 24% reduction for the normalized intensity. **Based, on the data limitations and the crude level of weather normalization analysis, it is estimated that the true percentage difference in electricity intensity (kWh/ft^2) between 2000 and 2011 ranged from a reduction of 35% to a reduction of 64%.**

The Ability to Predict Electricity Intensity (kWh/ft2) based on CDD

In order to determine if it was possible to predict the annual electricity intensity based on annual CDD a series of regressions were completed. A greater correlation was noted by eliminating the 2000 data point. Therefore, only six (6) data points are available.

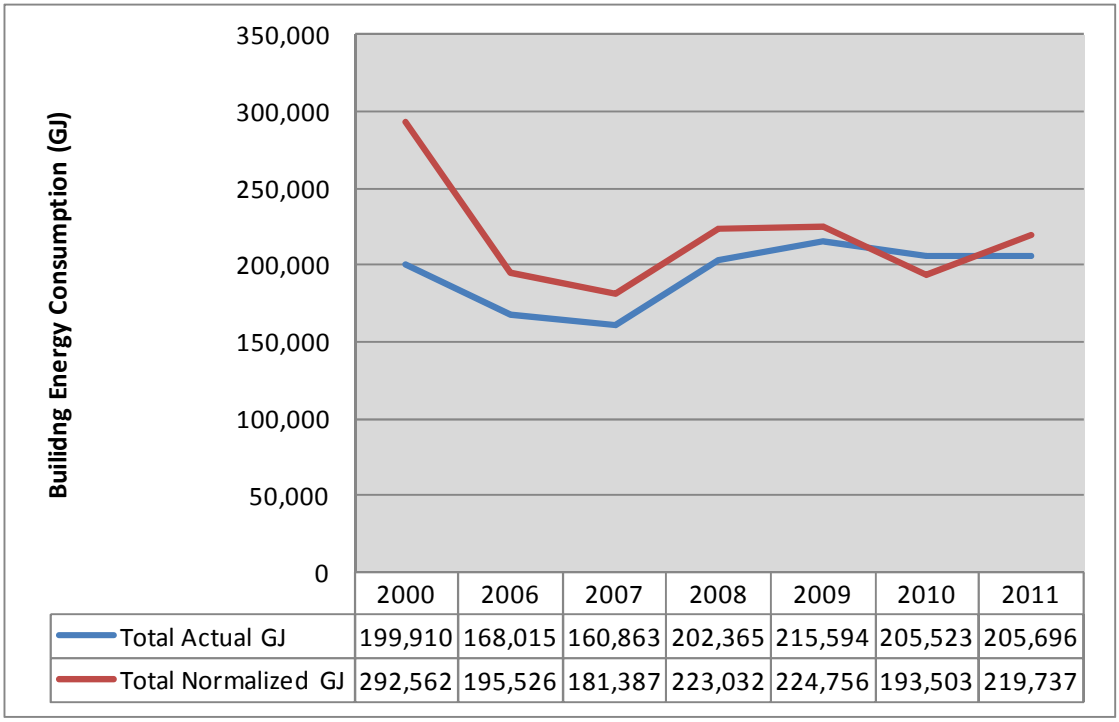
Unfortunately, the relationship between CDD and natural gas intensity is weak (Correlation: 0.59 and R^2: 0.34). It is therefore not possible to determine a predictive relationship. This implies that there are other significant factors at play, outside of CDD, that influence the electricity intensity. Some of these factors that could influence changes in electricity intensity could include: retrofits, increased efficiency, improvements in conservation behaviours and operational practices, changes in hours of operation, changes in building use.

Estimated Weather Impacts on Total Building Energy Consumption (GJ) and Energy Intensity (GJ/ft^2)

In order to look at the total estimated impact of weather on building energy consumption we need to convert the energy consumption from the various sources (natural gas, electricity, propane and heating oil into common units – Giga Joules (GJ). Natural gas consumption was normalized for HDD. While much smaller contributors, propane and heating oil w were also normalized for HDD. Electricity was normalized for CDD. There are data limitations due to accuracy of the data set as well as the inability to isolate the electricity non-weather related load (i.e. plug load and lighting load).

Figure 20 compares the total building energy consumption for both the actual data set and the normalized data set. With the exception of 2010, the normalized data set is consistently higher than the actual data set.

Figure 20: Comparison of Actual and Normalized Total Building Energy Consumption



	2000	2006	2007	2008	2009	2010	2011
Total Actual GJ	199,910	168,015	160,863	202,365	215,594	205,523	205,696
Total Normalized GJ	292,562	195,526	181,387	223,032	224,756	193,503	219,737

Table 11 provides a breakdown of the actual and normalized building energy consumption by energy source.

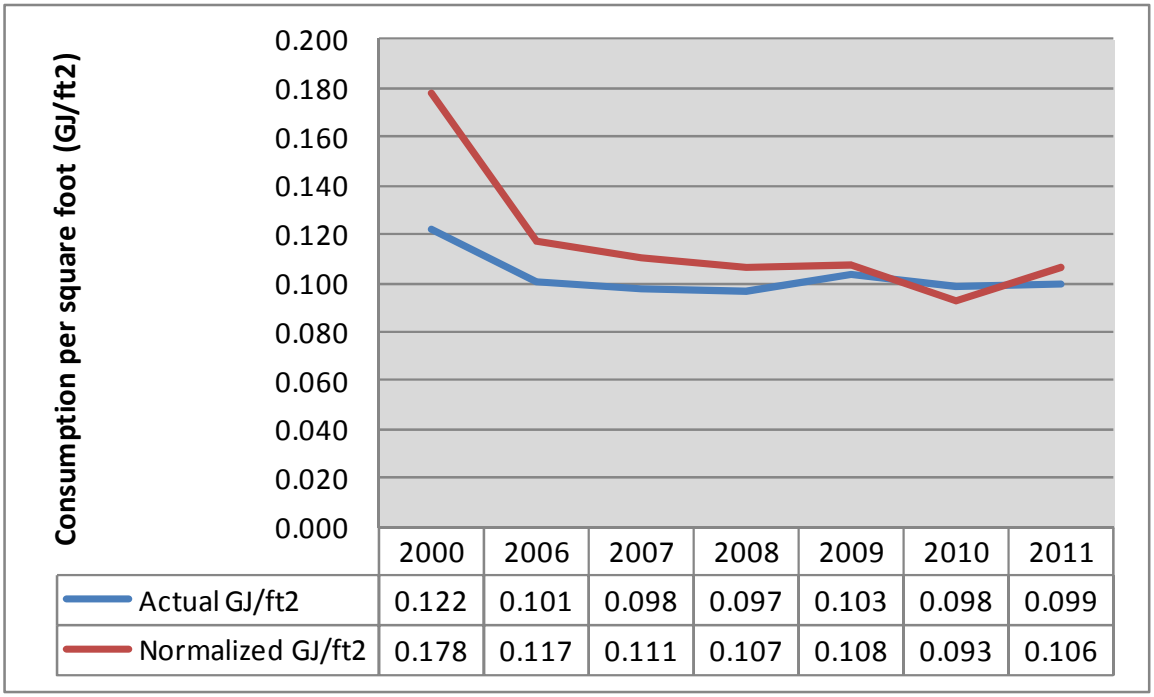
Table 11: Comparison of the Actual and Normalized Building Energy Consumption

Year	Natural Gas		Electricity		Propane		Heating Oil		Total	
	Actual Total GJ	Normalized GJ	Actual Total GJ	Normalized GJ	Actual Total GJ	Normalized GJ	Actual Total GJ	Normalized GJ	Actual GJ	Normalized GJ
2000	86,967	81,766	110,459	208,463	0	0	2,484	2,334	199,910	292,562
2006	83,699	91,884	82,490	101,722	538	506	1,287	1,413	168,015	195,526
2007	84,765	85,763	73,924	93,368	667	732	1,507	1,524	160,863	181,387
2008	105,349	105,233	94,840	115,618	614	621	1,561	1,559	202,365	223,032
2009	110,560	108,344	102,919	114,328	607	606	1,508	1,478	215,594	224,756
2010	103,420	112,485	99,828	78,610	607	594	1,668	1,814	205,523	193,503
2011	107,638	116,039	95,077	100,506	1,064	1,157	1,916	2,034	205,696	219,737
Diff from 2000:	24%	42%	-14%	-52%	n/a	n/a	-23%	-13%	3%	-25%
Diff from 2006:	29%	26%	15%	-1%	98%	129%	49%	44%	22%	12%

Based on this data set, we cans see that if we consider only the actual data, it would appear that the building energy consumption increased by 3% between 2000 and 2011. If, however, we consider the impact of weather, and consider the normalized data set we see that the normalized energy consumption actually decreased by 25% from 2000 to 2011. This large difference is due the significant difference between the annual CDD in 2000 (132) and the CDD 10 year average (251) which impacts the electricity consumption. If we look at the difference between 2011 and 2006 building energy consumption data set, we see that that actual data set would indicate that the building energy consumption has increased by 22% where as the normalized data set indicates that the building energy consumption increased by 12%. Overall based on the **Based, on the data limitations and the crude level of weather normalization analysis, it is estimated that the true percentage difference in energy consumption between 2000 and 2011 ranges from between an increase of 3% and a decrease of 25%.**

Figure 21 compares the actual and normalized building energy consumption intensity (GJ/ft^2) for 2000 and 2006 to 2011.

Figure 21: Comparison of Actual and Normalized Energy Consumption Intensity (GJ/ft^2)



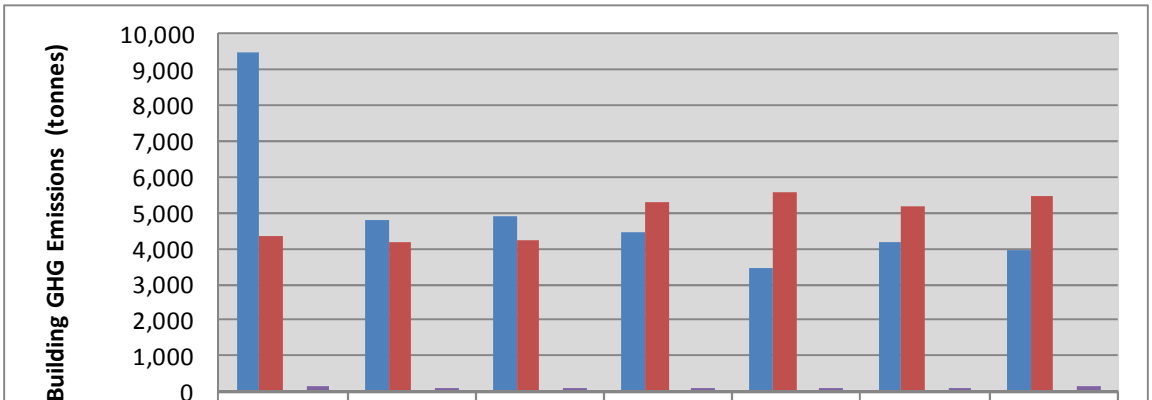
Year	2000	2006	2011	% Difference between 2011 & 2000	% Difference between 2011 and 2006
Actual (GJ/ft^2)	0.122	0.101	0.099	-18%	-17%
Normalized (GJ/ft^2)	0.178	0.117	0.106	-40%	-34%

Based on this data we see that between 2000 and 2011 the actual building energy consumption intensity decreased by 18% (from 0.122 GJ/ft^2 to 0.099 GJ/ft^2) while the normalized building energy consumption intensity decreased by 40% (from 0.178 GJ/ft^2 to 0.106 GJ/ft^2). If we compare the 2000 to 2006 data set, we see that the actual building energy consumption intensity decreased by 1% (from 0.101 GJ/ft^2 to 0.099 GJ/ft^2) while the normalized building energy consumption decreased by 9% (from 0.117 GJ/ft^2 to 0.106 GJ/ft^2). **Based, on the data limitations and the crude level of weather normalization analysis, it is estimated that the true percentage difference in energy consumption intensity (GJ/ft^2) between 2000 and 2011 ranges from between a decrease of 18% and a decrease of 40%. Overall, this gives confidence to the statement that consumption intensity of the building sector is decreasing with time.**

4.2.3 Building GHG Emissions by Emission Source

Figure 22 illustrates the building GHG emissions (tonnes) by emission source for 2000 and 2006 to 2011.

Figure 22: Building: GHG Emissions (tonnes) by Source (2000 and 2006 to 2011)



	2000	2006	2007	2008	2009	2010	2011
Electricity	9,512	4,812	4,928	4,479	3,431	4,160	3,962
Natural Gas	4,363	4,199	4,253	5,286	5,547	5,189	5,485
Propane	0	32	40	37	36	36	64
Heating Oil	180	93	109	113	109	121	139

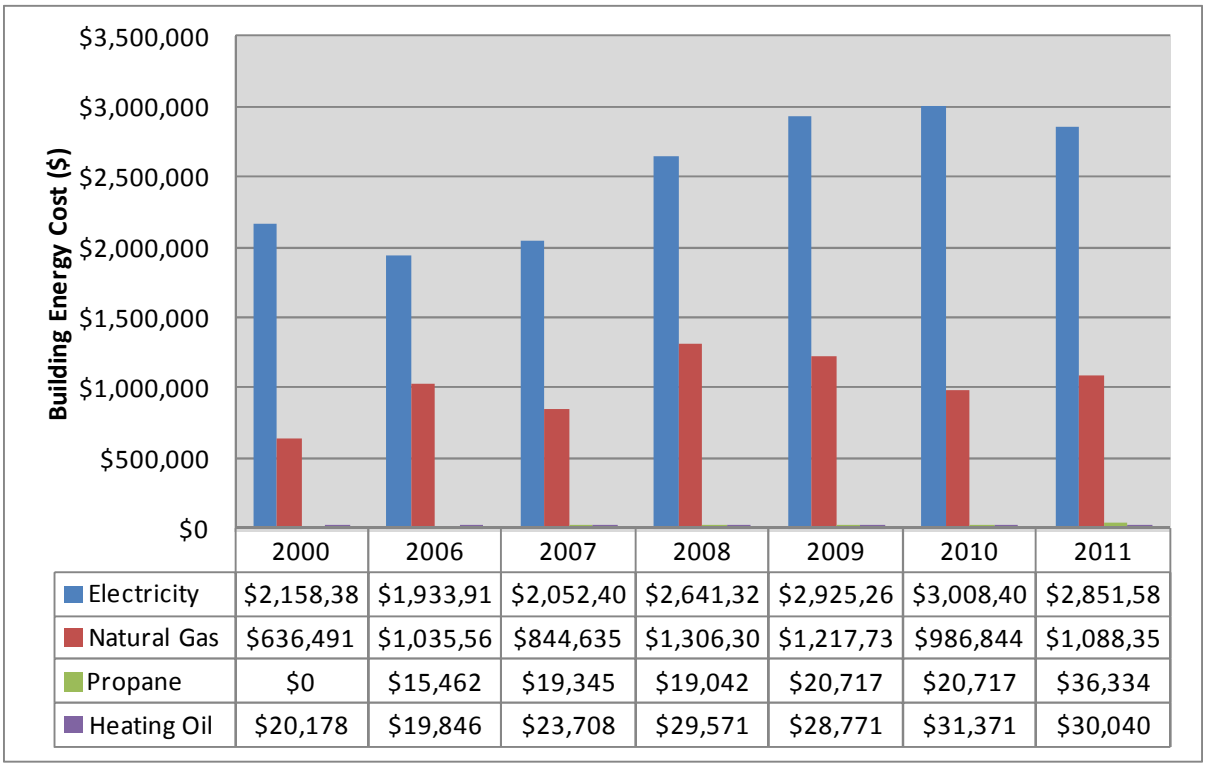
Year	2000	2006	2007	2008	2009	2010	2011
GHG Emissions (tonnes)	14,055	9,137	9,330	9,914	9,124	9,506	9,649
% Difference from 2000	n/a	-35.0%	-33.6%	-29.5%	-35.1%	-32.4%	-31.3%

While the building energy consumption (GJ) increased by 3%, the tonnes of GHG emissions has decreased 31% between 2000 and 2011. During this time the GHG emissions from electricity decreased by 58% and the GHG emissions for natural gas increased by 26%. This GHG reduction in electricity is largely due to the 52% reduction in the Ontario electricity emission factor. The GHG emission increase in natural gas is due to a corresponding increase in natural gas consumption.

4.2.4 Building Energy Cost by Emission Source

Figure 23 provides the corporate building energy cost by emission source for 2000 and 2006 to 2011.

Figure 23: Building Energy Cost by Source (2000 and 2006 to 2011)



	2000	2006	2007	2008	2009	2010	2011
Electricity	$2,158,38	$1,933,91	$2,052,40	$2,641,32	$2,925,26	$3,008,40	$2,851,58
Natural Gas	$636,491	$1,035,56	$844,635	$1,306,30	$1,217,73	$986,844	$1,088,35
Propane	$0	$15,462	$19,345	$19,042	$20,717	$20,717	$36,334
Heating Oil	$20,178	$19,846	$23,708	$29,571	$28,771	$31,371	$30,040

Year	2000	2006	2007	2008	2009	2010	2011
Energy Cost ($)	$2,815,058	$3,004,791	$2,940,088	$3,996,240	$4,192,480	$4,047,339	$4,006,307
% Difference from 2000	n/a	6.7%	4.4%	42.0%	48.9%	43.8%	42.3%

In spite of a consumption reduction of 3%, the corporate building energy cost has increased by 42% ($1.2 Million) from 2006 to 2011. Electricity and natural gas are responsible for 58% ($0.69 Million) and 38% ($0.45 Million) of this increase respectively.

4.3 WATER SECTOR

This section provides an overview of the total water sector (water treatment and distribution) and provides a more detailed summary of the two (2) water treatment plants. The water sector overview provides a summary of the energy consumption, cost and GHG emissions for 2000 and 2006 to 2011. A comparison is made between the 2011 and the 2000 baseline data. The Water Plant overview provides the energy consumption, cost, GHG emissions, volume of water treated and indicator data for the 80 Sunny Acres Road Water Plant (Point Pleasant) and the 300 King Street Water Plant (Central).

4.3.1 WATER Sector Overview

Table 12 summarizes the water sector energy consumption (GJ), GHG emissions and cost for 2000 and 2006 to 2011.

Table 12: Water Sector: Consumption, Cost and Emissions 2000 and 2006 to 2011

Year	2000	2006	2007	2008	2009	2010	2011
Energy Consumption (GJ)							
Electricity	41,778	39,964	40,028	38,127	39,746	35,109	35,530
Natural Gas	1,271	1,730	1,358	1,596	1,466	1,486	1,863
Total GJ:	**43,049**	**41,694**	**41,386**	**39,724**	**41,212**	**36,595**	**37,392**
% of Total Sectors:	**10%**	**10%**	**10%**	**9%**	**9%**	**8%**	**8%**
Energy Cost ($)							
Electricity	$1,021,003	$1,046,706	$998,730	$977,229	$988,640	$1,044,957	$1,180,980
Natural Gas	$15,010	$26,879	$19,065	$26,567	$25,539	$19,451	$19,735
Total Building Cost:	**$1,036,013**	**$1,073,585**	**$1,017,795**	**$1,003,796**	**$1,014,179**	**$1,064,408**	**$1,200,715**
% of Total Sectors:	**13%**	**12%**	**11%**	**9%**	**9%**	**10%**	**10%**
Greenhouse Gas Emissions (tonnes)							
Electricity	3,598	2,331	2,669	1,797	1,325	1,463	1,480
Natural Gas	64	87	68	80	74	75	93
Total GHG Emissions:	**3,661**	**2,418**	**2,737**	**1,877**	**1,398**	**1,537**	**1,574**
% of Total Sectors:	**11%**	**9%**	**9%**	**7%**	**6%**	**6%**	**6%**

Between 2000 and 2011, water sector's energy consumption (GJ), energy cost and GHG emissions decreased by 13%, increased by 16% and decreased by 57% respectively. This reduction in energy consumption is due to a decreased consumption of electricity. The increase in energy cost is largely due to the increase in per unit electricity costs. The significant reduction in GHG emissions is due to the 52% decrease in the Ontario electricity emission factor between 2000 and 2011.

Figures 24,25 and 26 graphically shows the water sector's energy consumption (GJ), GHG emissions and energy cost from 2000 and 2006 to 2011 by energy source.

Figure 24: Water Sector Energy Consumption (GJ) by Emission Source (2000 and 2006 to 2011)

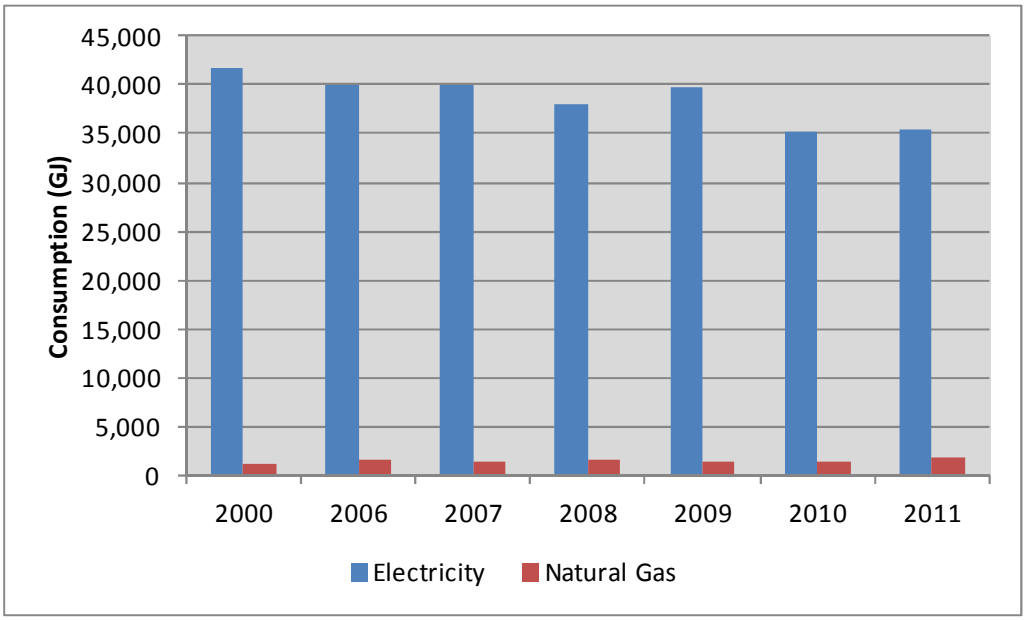


Figure 25: Water Sector GHG Emissions (tonnes) by Emission Source (2000 and 2006 to 2011)

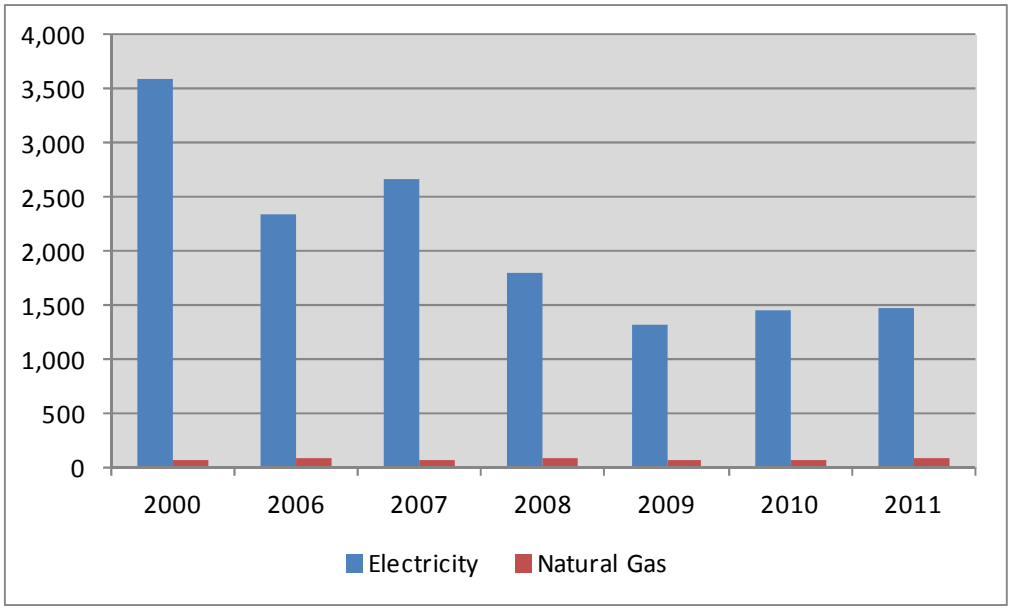
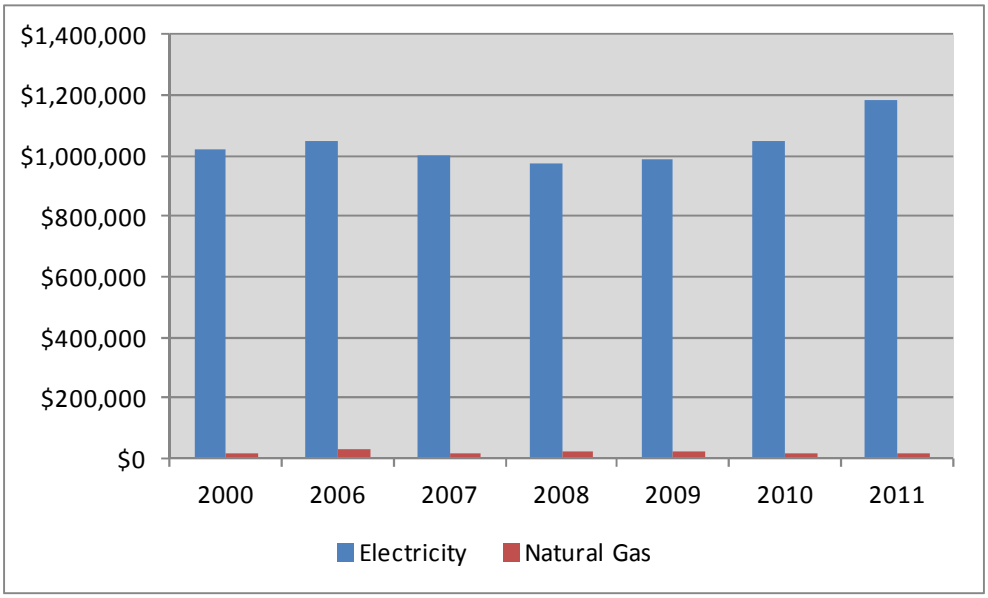


Figure 26: Water Sector Energy Cost by Source (2000 and 2006 to 2011)



4.3.2 WATER Plants Overview

The City of Kingston provides treated water to its residents via two (2) water treatment plants located at 80 Sunny Acres Road (Point Pleasant) and 300 King St. (Central Plant). In 2011, the total volume of water treated was 25,110,267 m^3. The Sunny Acre Plant treated 29% of this volume and the 300 King St. Plant treated 71% of this volume. A summary of the energy consumption, GHG emissions, cost and indicators are presented for these plants for 2006 to 2011.

Table 13 provides a summary of the energy consumption, GHG emission, cost and indicators for the Sunny Acres Road water treatment plant. The Sunny Acres Road plant only has electricity as its energy source. In 2011, this plant consumed 10,751 GJ of energy at a cost of $318,121 and emitted 448 tonnes of GHG emissions. Its energy consumption (kWh and GJ) has remained relatively stable from 2006 to 2011. The GHG emissions have reduced by 26% and the energy cost has increased by 40% over this period. The GHG emission is due to a 32% reduction in the Ontario electricity emission factor between 2006 and 2011. While the volume of water treated has remained relatively consistent over time, the cost of treatment ($ per 1000 m^3) has increased by 48% and the GHG emissions per 1000 m^3 of water treated has reduced by 22%.

Table 13: 80 Sunny Acres Road: Energy Consumption, GHG Emissions, Cost and Indicators

Year	Electricity				Volume Treated	Cost per 1000 m^3 treated	GHG emissions per 1000 m^3 treated
	kwh	Consumption (GJ)	GHG Emissions (tonnes)	Cost	m^3 x 1000	$ per 1000 m^3	tonnes per 1000 m^3
2011	2,986,363	10,751	448	318,121	7,256	$43.843	0.062
2010	2,911,237	10,480	437	275,460	7,193	$38.294	0.061
2009	3,007,348	10,826	361	255,130	7,555	$33.769	0.048
2008	2,821,263	10,157	480	282,190	7,928	$35.592	0.060
2007	2,985,894	10,749	717	274,048	7,514	$36.470	0.095
2006	2,880,859	10,371	605	226,689	7,675	$29.535	0.079
% Difference 2011 to 2006	4%	4%	-26%	40%	-5%	48%	-22%

Table 14 provides a summary of the energy consumption, GHG emission and cost for the King Street water treatment plant and Table 15 provides a summary of the indicators for this facility. In 2011 the King Street plant consumed 20,735 GJ of energy at a cost of $0.64 Million and released 878 tonnes of GHG emissions. Energy consumption and the release of GHG emissions reduced by 12% and 36% respectively from 2006 and 2011.

Table 14: 300 King St. Plant: Energy Consumption, GHG Emissions and Cost (2006 to 2011)

Year	Electricity				Natural Gas				Total		
	kWh	(GJ)	GHG Emissions (tonnes)	Cost ($)	m3	(GJ)	GHG Emissions (tonnes)	Cost ($)	(GJ)	GHG Emissions (tonnes)	Cost ($)
2011	5,288,791	19,040	793	$621,209	44,980	1,695	85	$16,276	20,735	878	$637,485
2010	5,248,734	18,895	787	$551,452	33,725	1,271	64	$15,010	20,167	851	$566,462
2009	6,280,985	22,612	754	$531,367	33,522	1,263	63	$21,333	23,875	817	$552,700
2008	6,037,021	21,733	1,026	$494,959	37,969	1,431	72	$23,076	23,164	1,098	$518,035
2007	6,065,585	21,836	1,456	$478,108	32,358	1,220	61	$16,023	23,056	1,517	$494,131
2006	6,129,741	22,067	1,287	$492,625	42,694	1,609	81	$24,265	23,676	1,368	$516,890
% Difference 2011 to 2006	-14%	-14%	-38%	26%	5%	5%	5%	-33%	-12%	-36%	23%

Table 15 provides a summary of the King Street plant indicator data for 2006 to 2011. In 2011, the King Street plant treated 17,854,323 m^3 of waste water at a cost of $35.7 per 1000 m^3 and emitted 0.05 tonnes of GHG emissions for every 1000m^3 of waste water treated. Between 2006 and 2011, the volume of waste water treated decreased by 9%. During this same time the

cost per 1000 m3 treated has increased by 36% and the tonnes of GHG emissions decreased by 29%. This reduction is due to the decrease in the Ontario electricity emission factor between 2006 and 2011.

Table 15: 300 King St. (Central Plant) – Indicators

Year	Volume Treated	Cost per 1000 m^3 Treated	GHG Emissions per 1000 m^3 Treated
	m3 x 1000	**$ per 1000 m3**	**tonnes per 1000 m3**
2011	17,854	$35.705	0.049
2010	18,004	$31.464	0.047
2009	19,983	$27.658	0.041
2008	19,345	$26.778	0.057
2007	19,466	$25.385	0.078
2006	19,693	$26.247	0.069
% Difference 2011 to 2006	-9%	36%	-29%

4.4 WASTE WATER SECTOR

This section provides an overview of the total waste water sector (waste water treatment and distribution) and provides a more detailed summary of the two (2) waste water treatment plants. The water sector overview provides a summary of the energy consumption, cost and GHG emissions for 2000 and 2006 to 2011. A comparison is made between the 2011 and the 2000 baseline data. The Waste Water Plant overview provides the energy consumption, cost, GHG emissions, volume of waste water treated and indicator data for the Ravensview waste water treatment plant and the Front Street waste water treatment plant.

4.4.1 WASTE WATER Sector Overview

Table 16 summarizes the waste water sector energy consumption (GJ), GHG emissions and cost for 2000 and 2006 to 2011. In 2011, the waste water sector consumed 68,860 GJ of energy at a cost of $1.95 Million and emitted 3,002 tonnes of GHG emissions. While the waste water sector includes both electricity and natural gas, electricity is the dominant energy source.

Table 16: Waste Water Sector: Consumption, Cost and Emissions 2000 and 2006 to 2011

Year	2000	2006	2007	2008	2009	2010	2011
Energy Consumption (GJ)							
Electricity	40,946	36,693	43,418	47,498	58,660	46,402	53,284
Natural Gas	4,312	4,627	11,120	8,264	16,357	14,978	15,576
Total Building GJ:	**45,258**	**41,320**	**54,538**	**55,763**	**75,017**	**61,380**	**68,860**
% of Total Sectors:	**11%**	**10%**	**13%**	**12%**	**16%**	**13%**	**14%**
Energy Cost ($)							
Electricity	$1,014,480	$1,158,154	$1,162,080	$1,270,231	$1,493,192	$1,387,043	$1,764,536
Natural Gas	$32,642	$70,022	$153,826	$107,388	$207,471	$119,591	$186,828
Total Cost:	**$1,047,122**	**$1,228,176**	**$1,315,907**	**$1,377,619**	**$1,700,663**	**$1,506,634**	**$1,951,364**
% of Total Sectors:	**13%**	**14%**	**14%**	**13%**	**16%**	**14%**	**16%**
Greenhouse Gas Emissions (tonnes)							
Electricity	3,526	2,895	2,895	2,243	1,955	1,933	2,220
Natural Gas	216	232	558	415	855	751	781
Total Emissions:	**3,742**	**3,127**	**3,452**	**2,658**	**2,810**	**2,685**	**3,002**
% of Total Sectors:	**12%**	**12%**	**13%**	**11%**	**13%**	**11%**	**12%**

Between 2000 and 2011, the waste water sector experienced an increase in energy consumption and energy cost of 52% (23,602 GJ) and 23% ($0.9 Million) respectively and a 20% (741 tonnes) reduction in the release of GHG emissions. The reduction in GHG emissions while the energy consumption increased is due to the 52% decrease in the Ontario electricity emission factor between 2000 and 2011.

Figures 27, 28 and 29 graphically shows the water sector's energy consumption (GJ), GHG emissions and energy cost from 2000 and 2006 to 2011 by energy source.

Figure 27: Waste Water Sector Energy Consumption (GJ) by Emission Source (2000 and 2006 to 2011)

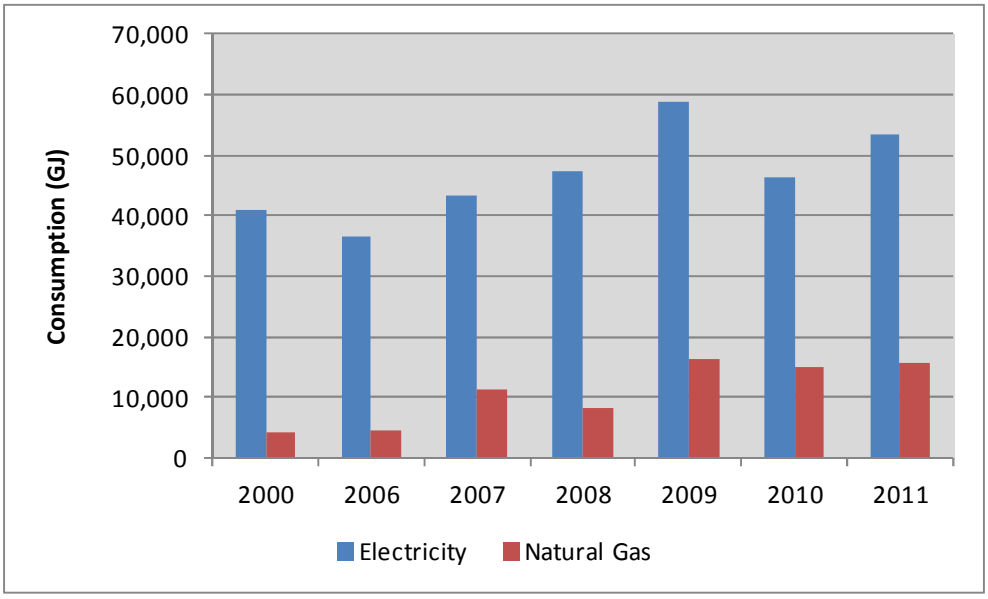


Figure 28: Waste Water Sector GHG Emissions (tonnes) by Emission Source (2000 and 2006 to 2011)

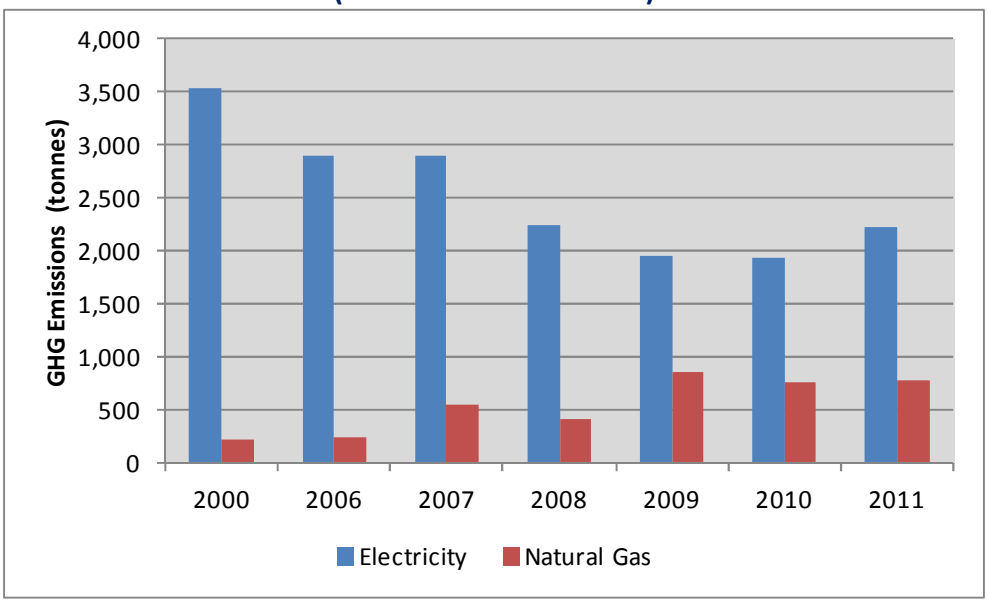
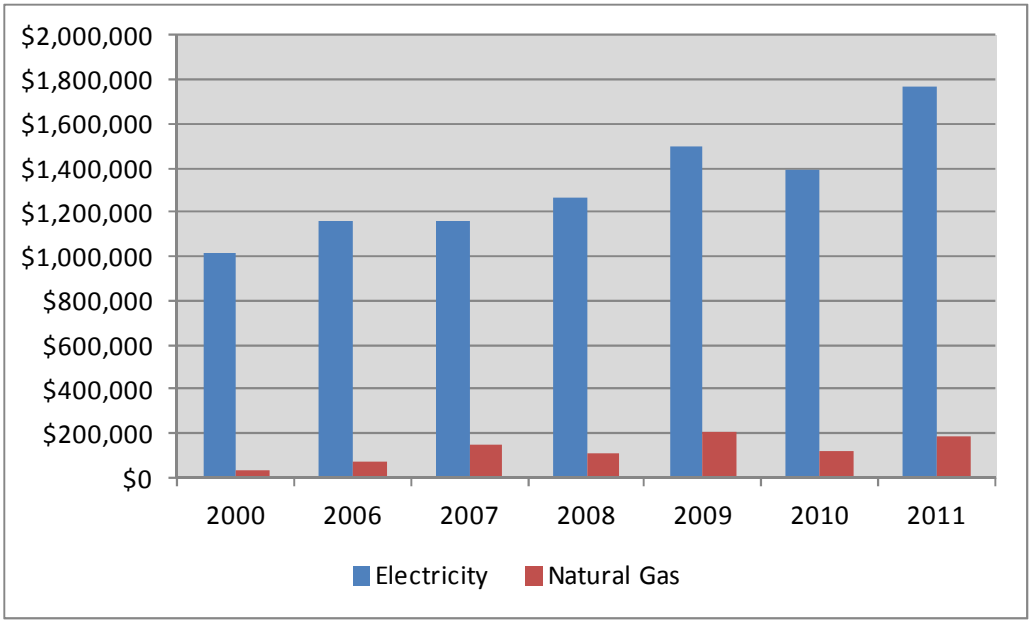


Figure 29: Waste Water Sector Energy Cost by Source (2000 and 2006 to 2011)



4.4.2 WASTE WATER Plants Overview

This section provides an overview of the two (2) waste water treatment plants. The energy consumption, cost, GHG emissions, volume of waste water treated and indicator data for the Ravensview waste water treatment plant and the Front Street waste water treatment plant is presented. In 2011, the two plants treated approximately 33,370,419 m^3 of waste water. The Ravensview plant accounted for 68% of this volume and the Front Street plant accounted for the remaining 32%.

Table 17 provides the energy consumption, GHG emissions and cost data for the Ravensview waste water treatment plant from 2006 to 2011. In 2011, the Ravensview plant consumed 26,619 GJ of energy at a cost of $0.66 Million and emitted 1,172 tonnes of GHG emissions. While the plant consumes both electricity and natural gas, electricity is the dominant energy source. Between 2000 and 2006, the Ravensview plant underwent a massive upgrade introducing secondary treatment to the facility. This significant change in operations is observed in the consumption data. Between 2006 and 2011, the energy consumption, cost and GHG emissions increased by 99%, 92% and 58% respectively.

Table 17: Ravensview: Energy Consumption, GHG Emissions and Cost (2006 to 2011)

Year	Electricity				Natural Gas				Total		
	kWh	(GJ)	GHG Emissions (tonnes)	Cost ($)	m3	(GJ)	GHG Emissions (tonnes)	Cost ($)	(GJ)	GHG Emissions (tonnes)	Cost ($)
2011	5,331,676	19,194	800	$576,629	196,992	7,425	373	$87,616	26,619	1,172	$664,245
2010	4,138,964	14,900	621	$407,194	132,829	5,006	251	$49,434	19,907	872	$456,628
2009	5,947,018	21,409	714	$523,671	433,990	16,357	821	$207,471	37,766	1,534	$731,142
2008	2,104,125	7,575	358	$198,113	219,267	8,264	415	$107,388	15,839	772	$305,500
2007	2,203,790	7,934	529	$249,028	295,045	11,120	558	$153,826	19,054	1,087	$402,855
2006	2,428,000	8,741	510	$276,792	122,770	4,627	232	$70,022	13,368	742	$346,814
% Difference 2011 to 2006	120%	120%	57%	108%	60%	60%	60%	25%	99%	58%	92%

Table 18 provides a summary of the Ravensview indicator data for 2006 to 2011. In 2011, the Ravensview plant treated 22,845,475 m^3 of waste water at a cost of $29 per 1000 m^3 and emitted 0.05 tonnes of GHG emissions for every 1000 m^3 of waste water treated. Between 2006 and 2011, the volume of waste water treated decreased by 15%. Waste water operations estimate that this reduction was realized as the result of improvements to the waste water distribution lines resulting in less infiltration. During this same time the cost per 1000 m^3 treated has increased by 125%. A marked increase in the cost treatment of wastewater at this facility is noted in 2009 as the plant upgrades were brought online, thereby increasing the energy consumption.

Table 18: Ravensview Waste Water Plant Indicators (2006 to 2011)

Year	Volume Treated	Cost per 1000 m3 treated	GHG emissions per 1000 m3 treated
	m3 x 1000	$ per 1000 m3	tonnes per 1000 m3
2011	22,845	$29.076	0.051
2010	20,309	$22.484	0.043
2009	24,596	$29.726	0.062
2008	26,293	$11.619	0.029
2007	23,689	$17.006	0.046
2006	26,797	$12.942	0.028
% Difference 2011 to 2006	-15%	125%	85%

Table 19 provides the energy consumption, GHG emissions and cost data for the Front Street waste water treatment plant from 2006 to 2011. In 2011, the Front Street plant consumed 20,925 GJ of energy at a cost of $0.47 Million and emitted 935 tonnes of GHG emissions. While the plant consumes both electricity and natural gas, electricity is the dominant energy source. Between 2006 and 2011, the energy consumption, cost and GHG emissions increased by 100%, 46% and 57% respectively. It is noted that consumption essentially doubled between 2006 and 2007.

Table 19: Front Street Plant: Energy Consumption, GHG Emissions and Cost (2006 to 2011)

Year	Electricity				Natural Gas				Total		
	kWh	(GJ)	GHG Emissions (tonnes)	Cost ($)	m3	(GJ)	GHG Emissions (tonnes)	Cost ($)	(GJ)	GHG Emissions (tonnes)	Cost ($)
2011	3,755,164	13,519	563	$407,244	196,510	7,406	372	$58,968	20,925	935	$466,212
2010	3,740,962	13,467	561	$357,821	225,518	8,500	426	$54,783	21,967	988	$412,604
2009	4,194,398	15,100	503	$354,774	191,071	7,201	361	$90,969	22,301	865	$445,743
2008	4,154,920	14,958	706	$406,590	115,181	4,341	218	$56,411	19,299	924	$463,001
2007	4,307,587	15,507	1,034	$406,590	168,494	6,351	319	$87,847	21,858	1,352	$494,437
2006	2,358,305	8,490	495	$288,219	52,916	1,994	100	$30,167	10,484	595	$318,386
% Difference 2011 to 2006	59%	59%	14%	41%	271%	271%	271%	95%	100%	57%	46%

Table 20 provides a summary of the Front Street plant indicator data for 2006 to 2011. In 2011, the Front Street plant treated 10,524,944 m^3 of waste water at a cost of $29 per 1000 m^3 and emitted 0.089 tonnes of GHG emissions for every 1000 m^3 of waste water treated. Between 2006 and 2011, the volume of waste water treated increased by 3%, the cost of water treatment per 1000 m^3 increased by 43% and the GHG emission released per 1000 m^3 increased by 53%. A significant and sustained increase in consumption of electricity that occurred between 2006 and 2007 is largely responsible.

Table 20: Front Street Waste Water Plant Indicators (2006 to 2011)

Year	Volume Treated	Cost per 1000 m^3 treated	GHG emissions per 1000 m^3 treated
	m3 x 1000	$ per 1000 m3	tonnes per 1000 m3
2011	10,525	$44.296	0.089
2010	9,567	$43.126	0.103
2009	9,911	$44.976	0.087
2008	10,276	$45.058	0.090
2007	9,120	$54.216	0.148
2006	10,244	$31.081	0.058
% Difference 2011 to 2006	3%	43%	53%

4.5 FLEET SECTOR

This section provides an overview of the corporate fleet sector. The fleet sector includes corporate fleet and Kingston transit (serving the City of Kingston municipality). The data set from 2006 to 2011 includes fuel consumption from the outsourcing of recycling pick-up within the Kingston municipality by BFI. The emission sources that make up the fleet sector are gasoline and diesel. Within the fleet sector overview a summary of the total fleet energy consumption, cost and GHG emissions for 2000 and 2006 to 2011 is presented. A comparison is made between the 2011 and the 2000 baseline data. More detailed sections (5.5.2 and 5.5.3) present detailed consumption, cost, emission data and indicators for both the corporate fleet as well as the transit operations.

4.5.1 FLEET Sector Overview

In 2011, the fleet sector consumed 131,891 GJ of energy at a cost of $3.64 Million and emitted 9,257 tonnes of GHG emissions. In 2011, the fleet sector accounted for 28%, 30% and 34% of the total corporate energy consumption, cost and GHG emissions respectively. In general, diesel accounts for approximately 85% of the total energy consumption and gasoline makes up the remaining 15%.

Table 21 provides a summary of the consumption, GHG emission and energy costs for 2000 and 2006 to 2011. As detailed in the methodology section, the 2000 data set did not include transit operations. Therefore, it was estimated that the 2000 transit fuel consumption was consistent with the 2006 fuel consumption. Since 2000 the fleet energy consumption and tonnes of GHG emissions emitted both increased by 63 %(50,979 GJ and 3,574 tonnes), while the fleet energy cost increased by 154% ($1.69 Million). The fleet sector's contribution to the total corporate energy consumption, GHG emissions and cost has increased significantly from 2000 to 2011.

Table 21: Fleet: Energy Consumption, GHG Emissions and Cost (2000, 2006 to 2011)

Year	2000	2006	2007	2008	2009	2010	2011
Consumption (GJ)							
Gasoline	11,058	16,958	17,454	17,403	15,380	19,477	20,847
Diesel	69,854	80,584	88,526	86,519	86,892	98,168	111,044
Total GJ	**80,912**	**97,542**	**105,980**	**103,921**	**102,272**	**117,645**	**131,891**
% of Total Sectors	**19%**	**24%**	**26%**	**23%**	**21%**	**25%**	**28%**
Cost ($)							
Gasoline	$220,772	$490,340	$480,092	$540,149	$372,052	$547,103	$731,377
Diesel	$1,213,596	$2,017,138	$2,220,710	$2,681,084	$1,989,040	$2,537,943	$2,905,001
Total Cost (Million $)	**$1.43**	**$2.51**	**$2.70**	**$3.22**	**$2.36**	**$3.09**	**$3.64**
% of Total Sectors	**18%**	**28%**	**29%**	**29%**	**22%**	**28%**	**30%**
GHG Emissions (tonnes)							
Gasoline	753	1,155	1,188	1,185	1,047	1,326	1,419
Diesel	4,930	5,688	6,248	6,106	6,133	6,929	7,837
Total GHG Emissions (tonnes)	**5,683**	**6,842**	**7,437**	**7,291**	**7,180**	**8,255**	**9,257**
% of Total Sectors	**17%**	**27%**	**28%**	**30%**	**32%**	**34%**	**37%**

Figures 30, 31 and 32 illustrates that the water sector's energy consumption (GJ), GHG emissions and energy cost from 2000 and 2006 to 2011 by energy source.

Figure 30: Fleet Sector Energy Consumption (GJ) by Emission Source (2000 and 2006 to 2011)

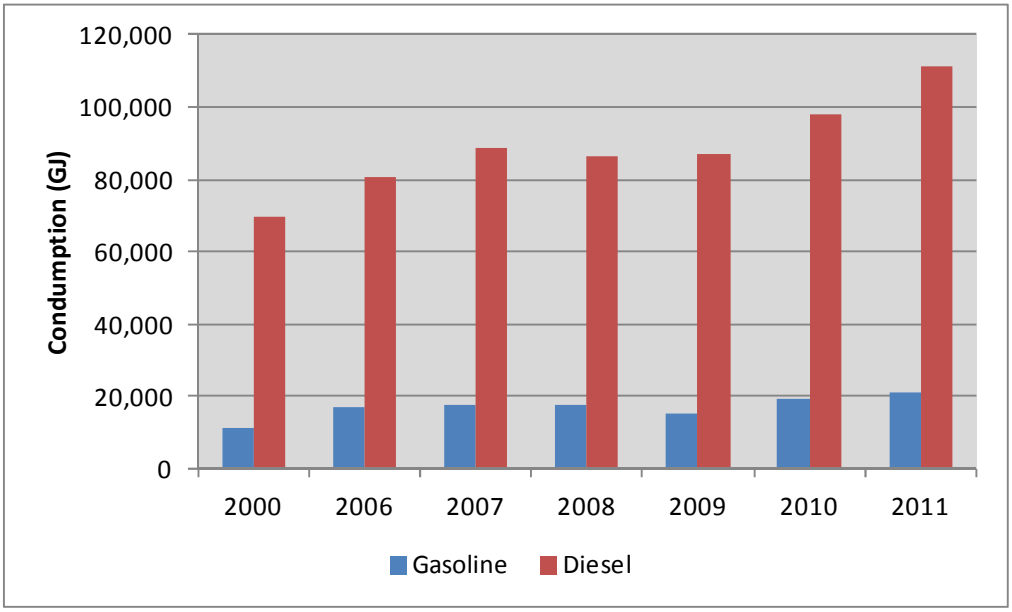


Figure 31: Fleet Sector GHG Emissions (tonnes) by Emission Source (2000 and 2006 to 2011)

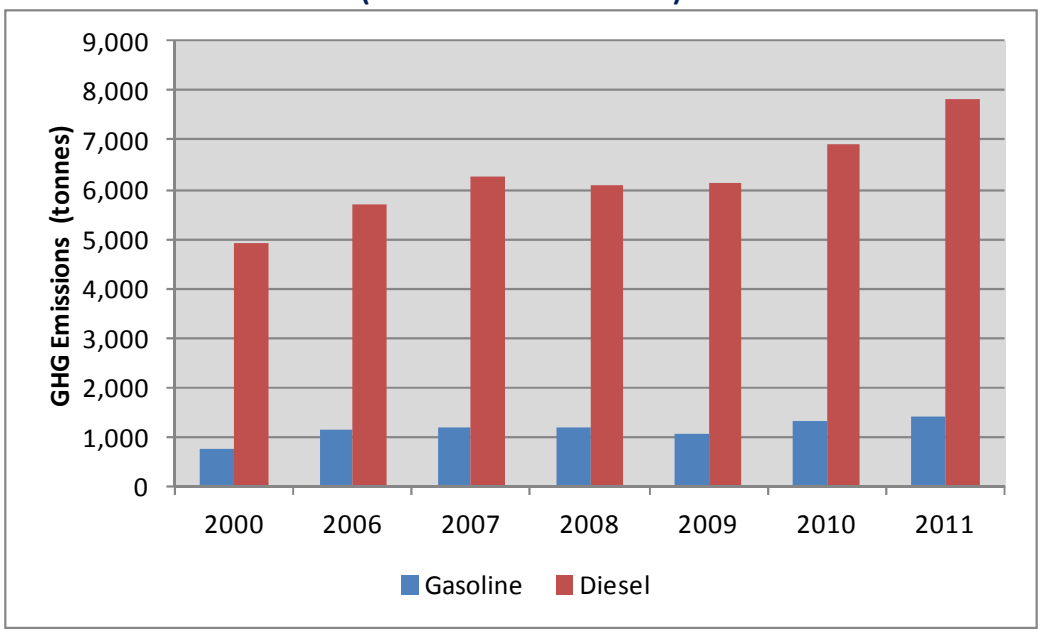
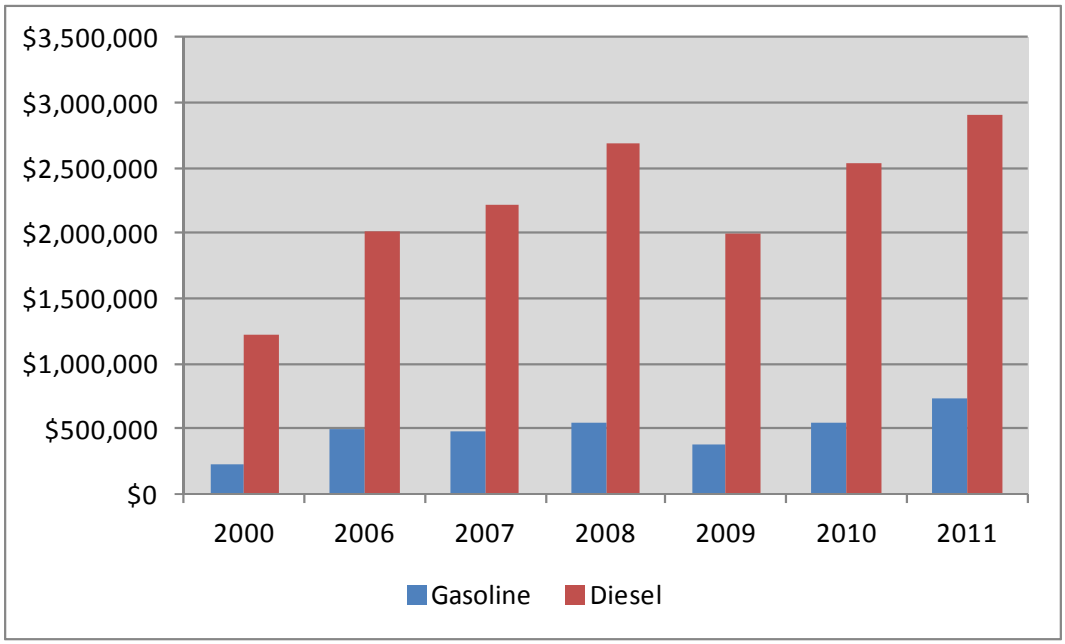


Figure 32: Fleet Sector Energy Cost by Source (2000 and 2006 to 2011)



4.5.2 FLEET: Transit Overview

In 2011, the Kingston Transit operated 44 buses, travelled 3.4 Million kilometers, cost $1.86 Million in fuel and emitted 5,345 tonnes of GHG emissions. Table 22 presents the energy consumption, cost, GHG emissions, number of buses and indicators for 2006 to 2011. Over this time the consumption per 1000 kilometers remained relatively consistent ranging from a low of 18GJ/1000 km to a high of 22 GJ/1000km. This indicates that the fuel efficiency is slightly reduced in 2011. The GHG emissions per km follow a parallel trend. While there have been variations over the years the fuel cost per 1000 kilometers ($/1000 km) has also remained relatively consistent between 2000 and 2011.

Table 22: Transit: Consumption, GHG Emissions, Cost and Indicators (2006 to 2011)

Transit	2006	2007	2008	2009	2010	2011	Difference
Number of Buses	37	37	38	41	44	44	19%
Transit kilometers travelled	2,578,460	2,921,787	2,904,480	3,396,465	3,238,220	3,399,740	32%
km per bus	69,688	78,967	76,434	82,841	73,596	77,267	11%
Total Consumption (GJ)	52,993	55,954	53,184	60,235	67,788	75,764	43%
Consumption (GJ) per bus	1,432	1,512	1,400	1,469	1,541	1,722	20%
Cosumption (GJ) per 1000 km	**21**	**19**	**18**	**18**	**21**	**22**	**8%**
Total Cost ($)	1,397,071	1,472,723	1,732,780	1,437,539	1,550,613	1,862,698	33%
Fuel Cost per Bus	$37,759	$39,803	$45,599	$35,062	$35,241	$42,334	12%
Fuel Cost per km travelled	**$0.54**	**$0.50**	**$0.60**	**$0.42**	**$0.48**	**$0.55**	**1%**
GHG Emissions (tonnes)	3,739	3,948	3,752	4,250	4,783	5,345	43%
GHG Emissions (tonnes) per Bus	101	107	99	104	109	121	20%
GHG Emissions (tonnes) per 1000 km	**1.45**	**1.35**	**1.29**	**1.25**	**1.48**	**1.57**	**8%**

4.5.3 FLEET: Corporate Fleet Overview

In 2011, the Kingston Transit operated 376 vehicles, travelled 4.4 Million kilometers, cost $1.63 Million in fuel and emitted 3,536 tonnes of GHG emissions. Table 23 presents the energy consumption, cost, GHG emissions, number of vehicles and indicators for 2006 to 2011. Over this time the consumption per 1000 kilometers and the tonnes GHG emissions decreased by 30% indicating an increase in overall vehicle energy efficiency. Although the total fuel cost increased by 63% between 2006 and 2011, the fuel cost per km travelled decreased by 10%.

Table 23: Corporate Fleet: Consumption, GHG Emissions, Cost and Indicators (2006 to 2011)

Corporate Fleet	2006	2007	2008	2009	2010	2011	Difference
Number of Vehicles	255	254	295	256	312	376	47%
City Fleet kilometers traveled	2,424,765	2,365,009	3,661,053	2,318,616	3,249,140	4,395,709	81%
km per vehicle	9,509	9,311	12,410	9,057	10,414	11,691	23%
Total Consumption (GJ)	39,871	45,372	46,370	37,654	44,779	50,801	27%
Consumption (GJ) per Vehicle	156	179	157	147	144	135	-14%
Cosumption (GJ) per 1000 km	**16**	**19**	**13**	**16**	**14**	**12**	**-30%**
Fuel Cost ($)	$1,005,235	$1,121,442	$1,362,619	$834,734	$1,160,764	$1,634,948	63%
Fuel Cost per Vehicle	$3,942	$4,415	$4,619	$3,261	$3,720	$4,348	10%
Fuel Cost per km travelled	**$0.41**	**$0.47**	**$0.37**	**$0.36**	**$0.36**	**$0.37**	**-10%**
GHG Emissions (tonnes)	2,773	3,160	3,231	2,621	3,114	3,536	27%
GHG Emissions (tonnes) per Vehicle	11	12	11	10	10	9	-14%
GHG Emissions (tonnes) per 1000 km	**1.14**	**1.34**	**0.88**	**1.13**	**0.96**	**0.80**	**-30%**

4.6 STREETLIGHT SECTOR

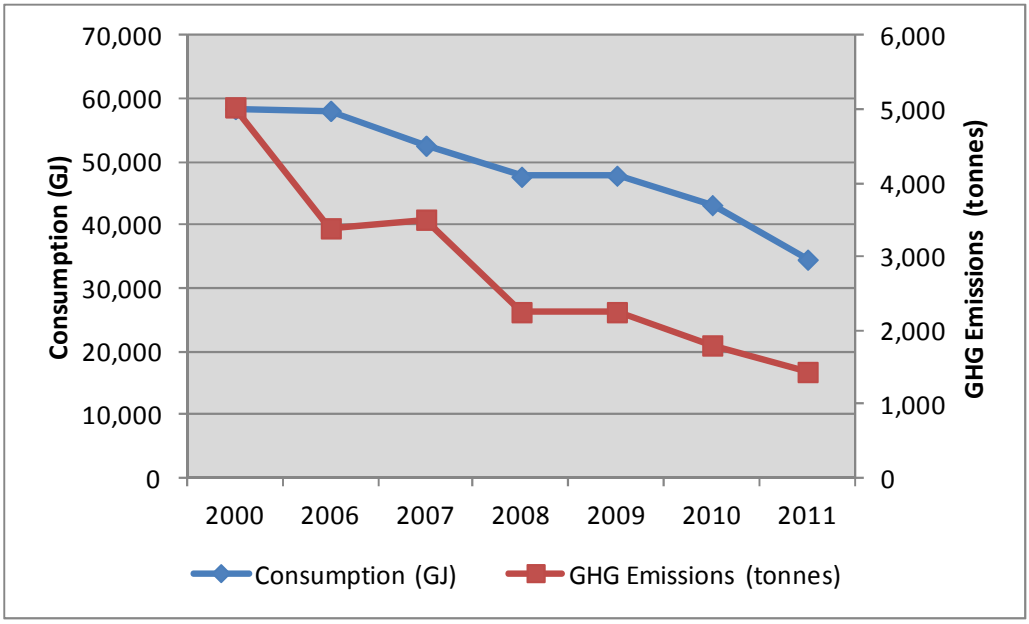
This section provides an overview of the streetlight sector which includes traffic lights. Table 24 summarizes the streetlight energy consumption (GJ), GHG emissions and cost for 2000 and 2006 to 2011. In 2011, the streetlight sector consumed 9.6 Million kWh (34,588 GJ) of energy at a cost of $1.2 Million and emitted of 1,441 tonnes of GHG emissions. Between 2000 and 2011, the consumption of energy (electricity) by the streetlight sector decreased by 41%. This reduction in consumption is credited to a streetlight and traffic light retrofit program. This 41% reduction in consumption translated into a 24% reduction in energy costs. A 71% reduction in the emission of GHG emissions was realized between 2000 and 2011 due in part to the reduction in consumption as well as the reduced Ontario electricity emission factor.

Table 24: Streetlight Sector: Consumption, Cost and Emissions 2000 and 2006 to 2011

Year	2000	2006	2007	2008	2009	2010	2011
Energy Consumption (kWh)							
Electricity	16,225,498	16,141,193	14,612,614	13,247,974	13,293,459	12,001,518	9,607,812
Energy Consumption (GJ)							
Electricity	58,412	58,108	52,605	47,693	47,856	43,205	34,588
% of Total Sectors:	**14%**	**14%**	**13%**	**11%**	**10%**	**9%**	**7%**
Energy Cost ($)							
Electricity	$1,599,131	$1,270,961	$1,402,011	$1,417,357	$1,508,641	$1,349,387	$1,214,804
% of Total Sectors:	**20%**	**14%**	**15%**	**13%**	**14%**	**12%**	**10%**
Greenhouse Gas Emissions (tonnes)							
Electricity	5,030	3,390	3,507	2,252	2,252	1,800	1,441
% of Total Sectors:	**15%**	**13%**	**13%**	**9%**	**7%**	**7%**	**6%**

Figure 33 illustrates the streetlight energy consumption (GJ) and GHG Emissions for 2000 and 2006 to 2011.

Figure 33: Streetlight Sector: Consumption and GHG Emissions (2000 and 2006 to 2011)



4.7 WASTE SECTOR

While the waste sector contributes very marginally (1%) to the total corporate GHG Emission inventory, it is a key component of overall corporate sustainability. There are economic, social and environmental merits to the diversion of waste from landfill that is not captured in a GHG inventory. The City of Kingston does not track the collection (tonnage) of recyclables, compost and material sent to landfill. Therefore, as discussed in Section 3, an estimate is made based on tonnage of waste generated per employee and tonnes of GHG emissions produced per tonne of waste generated. In 2011, it is estimated that the corporation sent 764 tonnes of waste to landfill and generated 368 tonnes of GHG emissions. Table 25 provides a summary of number of corporate employees, tonnage of waste sent to landfill and the release of GHG emissions from 2006 to 2011.

Table 25: Waste Sector - Tonnes of GHG Emissions (2006 to 2011)

Year	2006	2007	2008	2009	2010	2011
Number of Employees	1,157	1,171	1,214	1,110	1,127	1,232
Tonnage of waste to landfill	717	726	753	688	699	764
GHG Emissions (tonnes)	346	350	363	332	337	368
% of Total Sectior Emissions	1%	1%	1%	1%	1%	1%

5.0 EMISSION SOURCE ANALYSIS

Emission sources for the Kingston Community greenhouse gas inventory include:

- Electricity,
- Natural gas,
- Fuel oil (Heating Oil),
- Diesel (motor),
- Gasoline (motor),
- Propane and
- Waste.

This section provides an overview of the total corporate energy consumption, GHG emissions and energy cost by emission source and a detailed review of the consumption, GHG emissions and cost associated with the following key emission sources: electricity, natural gas, diesel and gasoline. Propane, heating oil and waste contribute very marginally (<2%) to the overall energy consumption, cost and GHG emissions.

5.1 OVERVIEW

This section provides an overview of the total corporate energy consumption, GHG emissions and energy cost by emission source.

5.1.1 Energy Consumption (GJ) Overview by Emission Source

This section provides an overview of the corporate energy consumption. To be able to compare the various types of emission sources the energy consumption (i.e. m3 natural gas, kWh electricity, liters of fuel etc.) has been converted to Giga Joules (GJ). A breakdown of the 2011 corporate energy consumption by sector is presented.

Figure 34 provides the corporate energy consumption (GJ) by source for 2011. In 2011, the Corporation of the City of Kingston consumed 478,428 GJ of energy. Electricity represents the greatest energy source with 46% of the total corporate total followed by natural gas (26%), diesel (23%), gasoline (4%), heating oil (1%) and propane (<1%).

Figure 34: 2011 Corporate Energy Consumption (GJ) by Source (Total: 478,428 GJ)

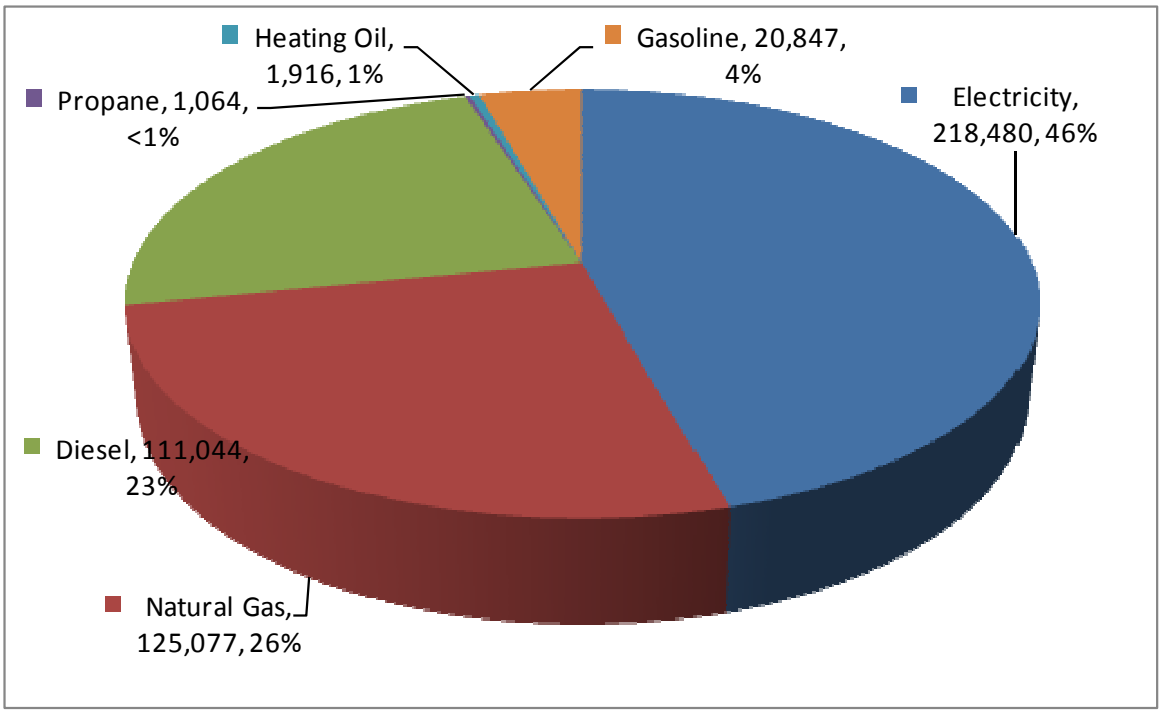
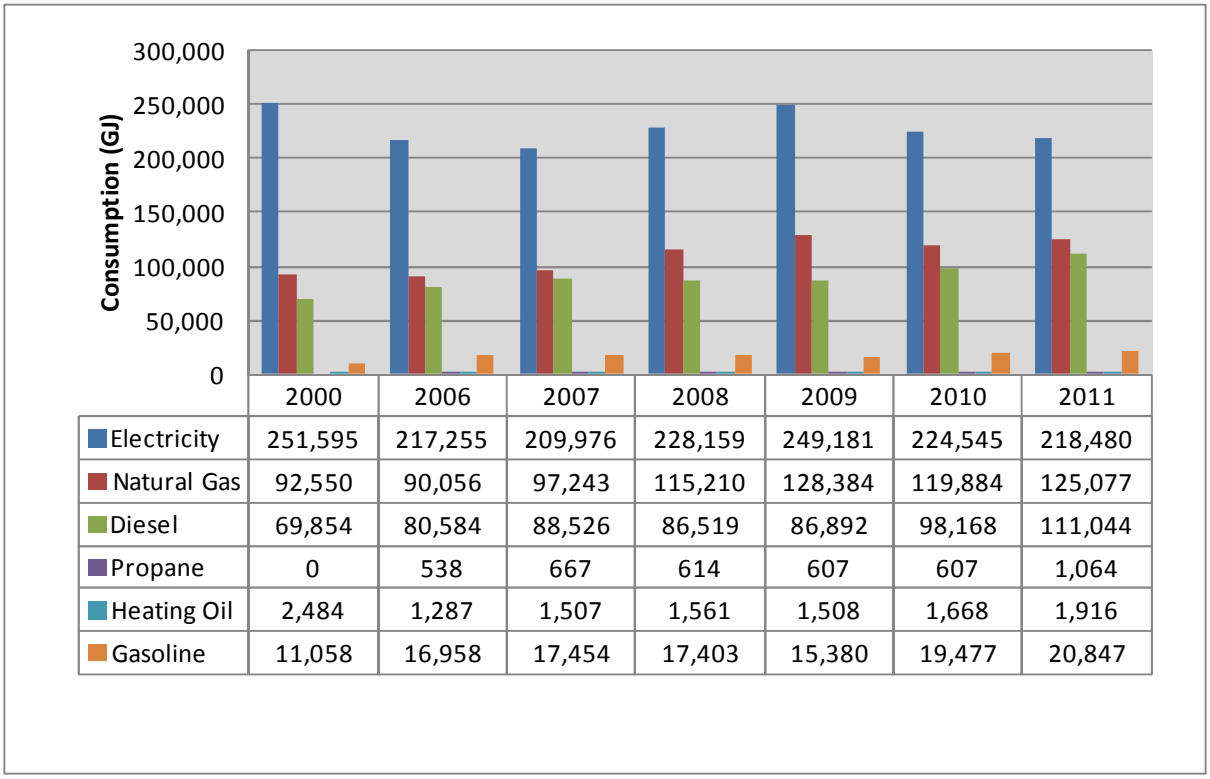


Figure 35 provides the corporate energy consumption (GJ) by emission source for the years 2000 and 2006 to 2011.

Figure 35: Corporate Energy Consumption (GJ) by Emission Source (2000, 2006 to 2011)



	2000	2006	2007	2008	2009	2010	2011
Electricity	251,595	217,255	209,976	228,159	249,181	224,545	218,480
Natural Gas	92,550	90,056	97,243	115,210	128,384	119,884	125,077
Diesel	69,854	80,584	88,526	86,519	86,892	98,168	111,044
Propane	0	538	667	614	607	607	1,064
Heating Oil	2,484	1,287	1,507	1,561	1,508	1,668	1,916
Gasoline	11,058	16,958	17,454	17,403	15,380	19,477	20,847

Year	**2000**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Total GJ	427,540	406,679	415,373	449,465	481,952	464,348	478,428
% Difference fron	n/a	-5%	-3%	5%	13%	9%	12%

The corporate energy consumption has increased by 12% between 2000 and 2011. During this period the consumption of electricity has decreased by 13% (-33,115 GJ) while the consumption of natural gas, diesel, and gasoline has increased by 35% (32,527 GJ), 59% (41,190 GJ) and 89% (9,789 GJ) respectively. This difference in energy consumption (GJ) by emission source between 2000 and 2011 is illustrated in Figure 36.

Figure 36: The Difference in Consumption (GJ) by Emission Source between 2000 and 2011

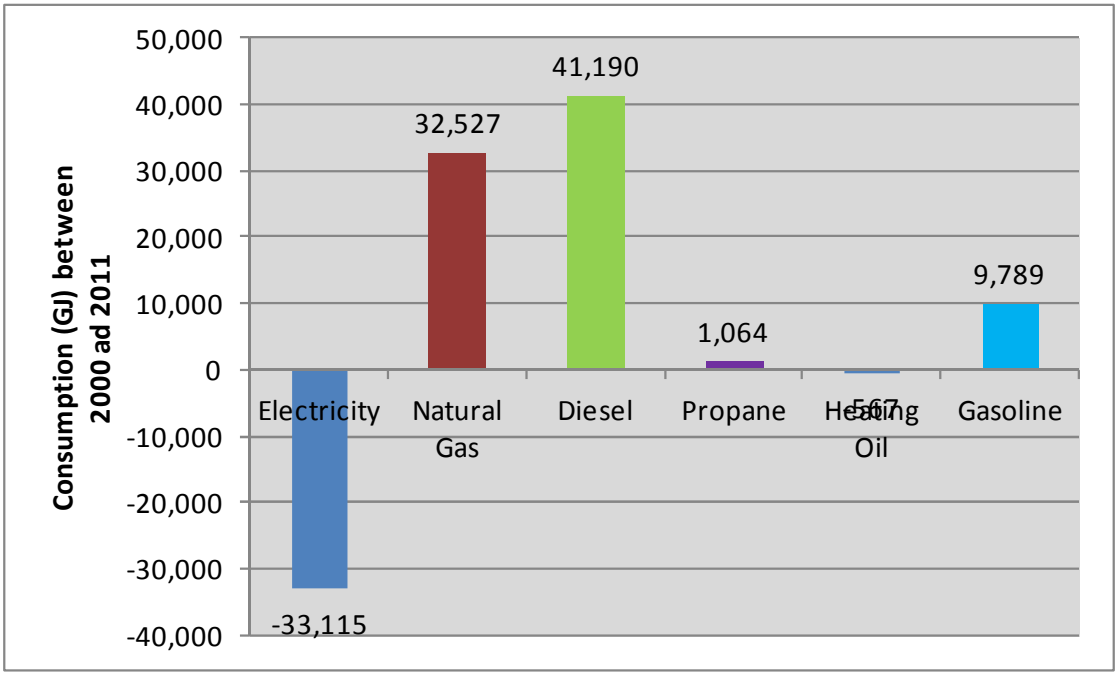


Figure 37 illustrates the percentage of the total energy consumption (GJ) by emission source for the years 2000 and 2006 to 2011.

Figure 37: Percentage of Corporate Consumption (GJ) by Source (2000 and 2006 to 2011)

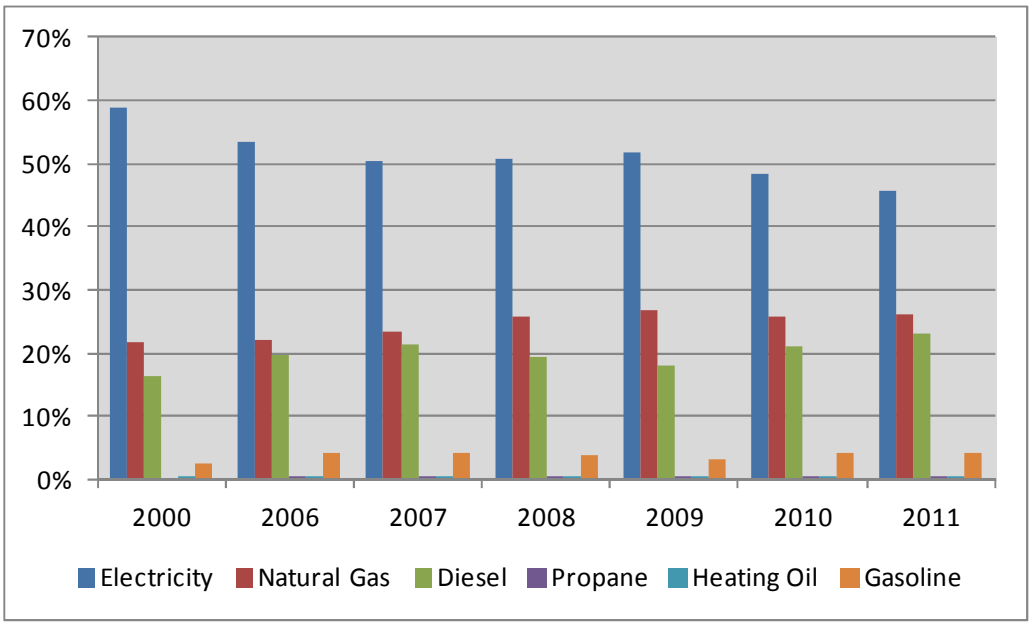


Figure 37, indicates that while electricity is consistently the major contributor to the total corporate energy consumption its percentage contribution has decreased by 13% between

2000 and 2011. The proportion of the total represented by natural gas, diesel and gasoline has increased by 4%, 7% and 2% respectively.

5.1.2 GHG Emissions Overview by Emission Source

This section provides and overview of the corporate GHG emissions by emission source. Figure 38 provides a summary of the total corporate GHG emissions generated by emission source for 2011. In 2011, the Corporation of the City of Kingston released 25,290 tonnes of GHG Emissions. Electricity represents the greatest energy source with 36% of the total corporate total followed by diesel (31%), natural gas (25%), gasoline (6%), heating oil (1%), waste (1%) and propane (<1%).

Figure 38: 2011 Corporate Greenhouse Gas Emissions by Source (Total: 25,290 tonnes of GHG Emissions)

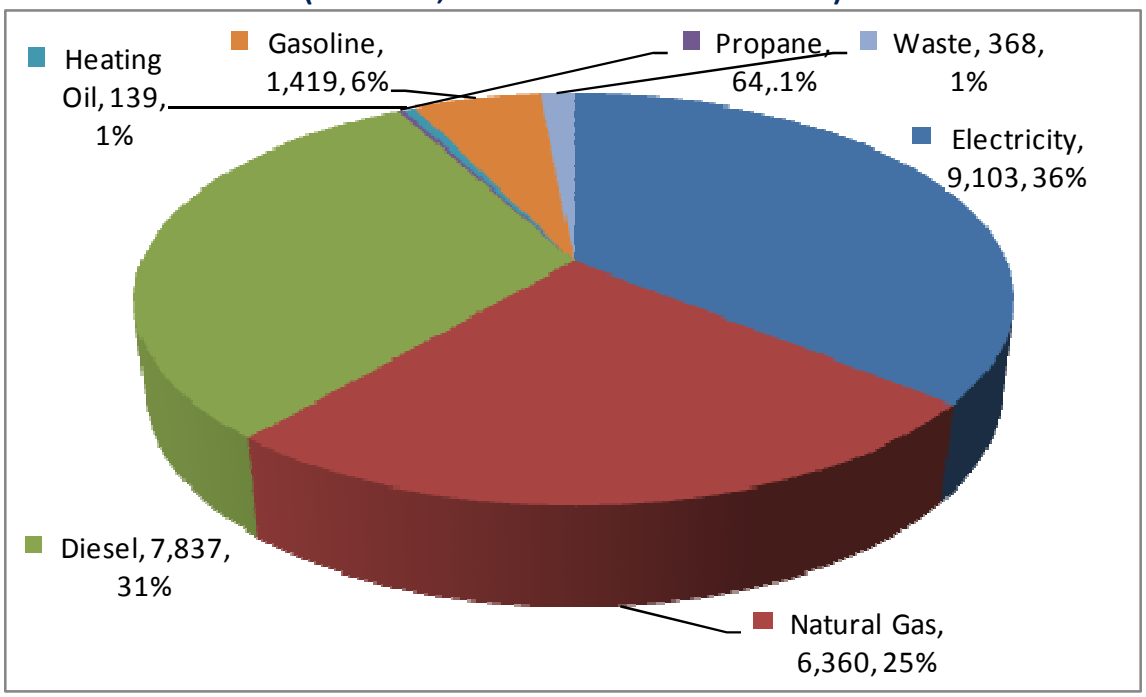
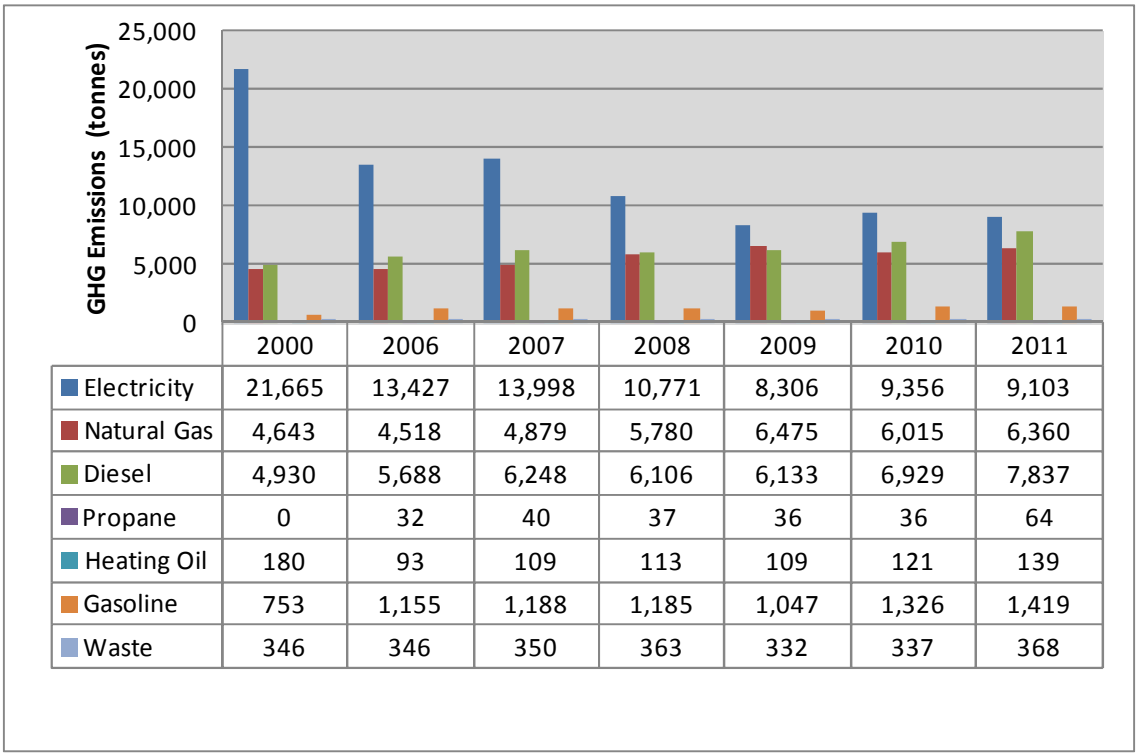


Figure 39 provides a summary of the total corporate GHG emissions generated by emission source for the baseline year (2000) and the years 2006 to 2011. The corporate energy GHG emissions decreased by 22% (-7,227 tonnes) between 2000 and 2011. During this period the emissions from electricity decreased by 58% (-12,562 tonnes) largely due to the 52% reduction in the Ontario electricity emission factor. As illustrated in Figure 40, the emissions from natural gas, diesel and gasoline increased by 37% (1.716 tonnes), 59% (2,907 tonnes) and 89% (667 tonnes) respectively.

Figure 41 illustrates the percentage of the total GHG emissions represented by each of the emissions sources for the years 2000 and 2006 to 2011. The contribution of electricity to the total corporate GHG emissions decreased by 31% between 2000 and 2011. During this time the proportion for natural gas, diesel and gasoline increased by 11%, 16% and 6% respectively.

Figure 39: Total Corporate GHG Emissions by Emission Source (2000 and 2006 to 2011)



	2000	2006	2007	2008	2009	2010	2011
Electricity	21,665	13,427	13,998	10,771	8,306	9,356	9,103
Natural Gas	4,643	4,518	4,879	5,780	6,475	6,015	6,360
Diesel	4,930	5,688	6,248	6,106	6,133	6,929	7,837
Propane	0	32	40	37	36	36	64
Heating Oil	180	93	109	113	109	121	139
Gasoline	753	1,155	1,188	1,185	1,047	1,326	1,419
Waste	346	346	350	363	332	337	368

Year	2000	2006	2007	2008	2009	2010	2011
GHG Emissions (tonnes)	32,518	25,259	26,813	24,355	22,439	24,120	25,290
% Difference from 2000	n/a	-22%	-18%	-25%	-31%	-26%	-22%

Figure 40: The Difference in the GHG Emissions Released by Source between 2000 and 2011

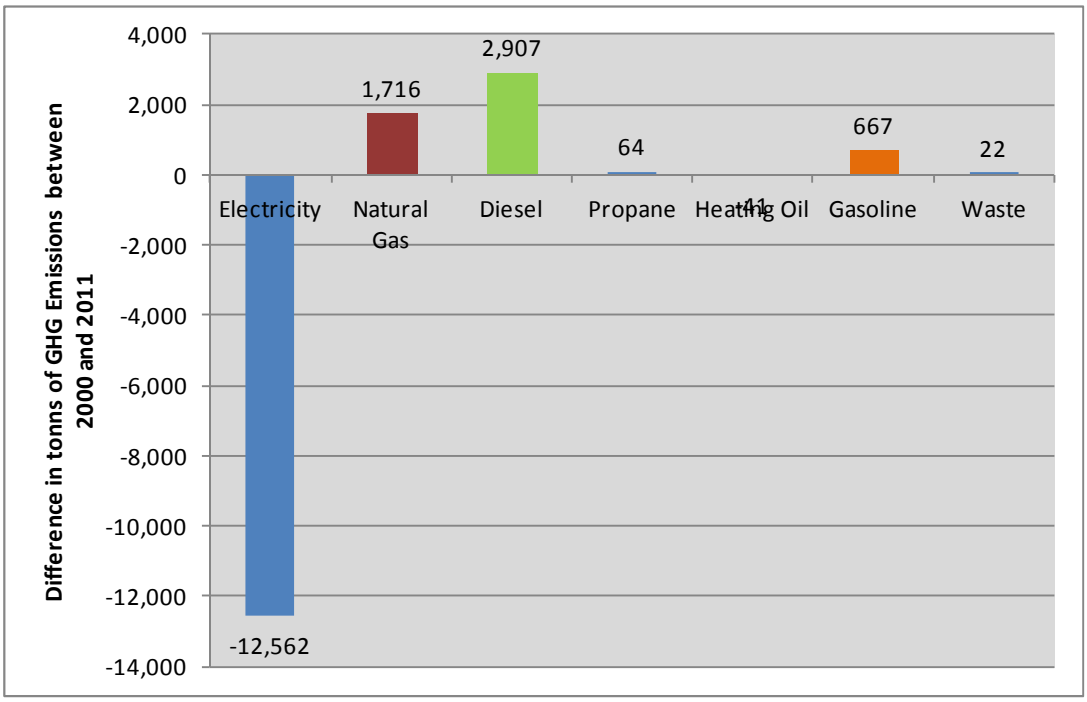
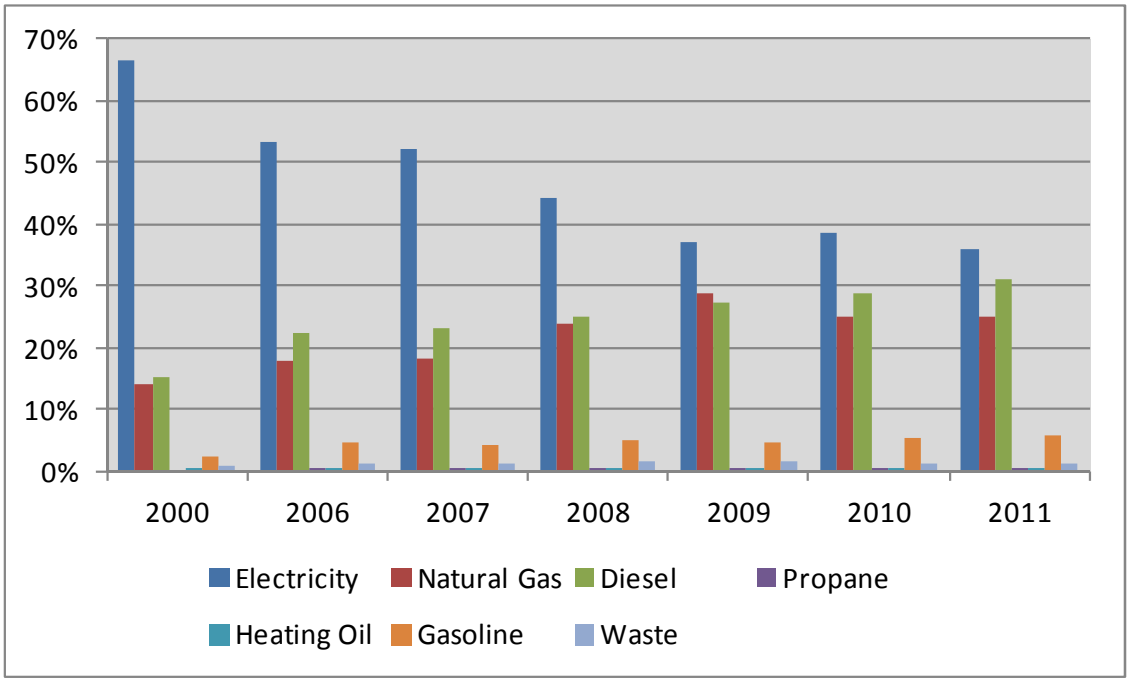


Figure 41: Percentage of Corporate GHG Emissions Released by Source (2000 and 2006 to 2011)



5.1.3 Energy Cost Overview by Emission Source

This section provides an overview of the corporate energy cost by emission source. Figure 42 provides a summary of the cost of energy by emission source for the year 2011. In 2011, the Corporation of the City of Kingston spent $12,009,569 on energy. Electricity represents the greatest energy cost with 59% of the total corporate total followed by diesel (24%), natural gas (11%), gasoline (6%), heating oil (<1%) and propane (<1%).

Figure 42: 2011 Corporate Energy Cost by Emission Source (Total Cost: $12,009,569)

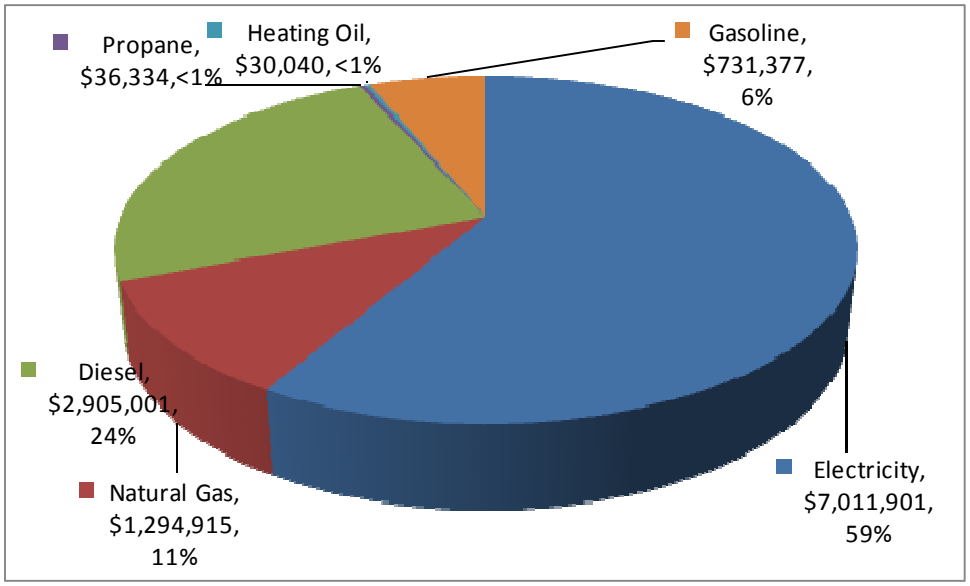
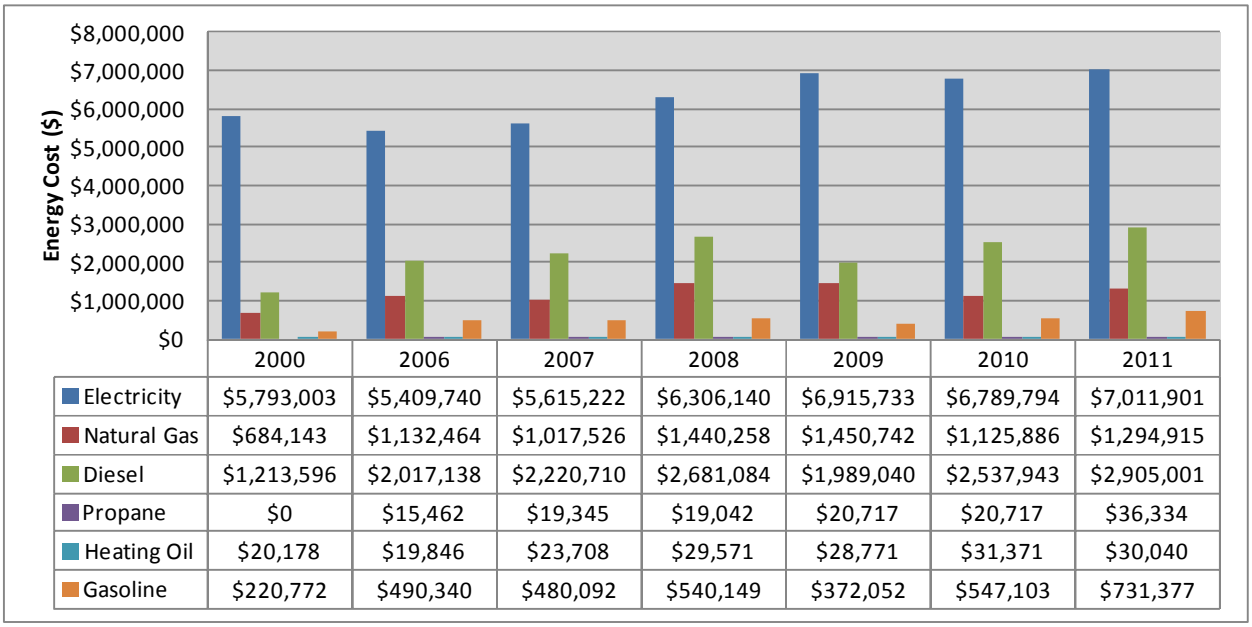


Figure 43 provides a summary of the corporate energy cost by emission source for the years 2000 and 2006 to 2011. The corporate energy cost increased by 51% ($4.08 Million) between 2000 and 2011. During this period the cost from electricity increased by 21 % ($1.22 Million). As illustrated in Figure 44, electricity, natural gas, diesel and gasoline energy costs increased by $1.2 Million, $0.61 Million, $1.69 Million and $0.51 Million respectively.

Figure 45 illustrates the percentage of the total corporate energy costs represented by each of the emissions sources for the years 2000 and 2006 to 2011. The contribution of electricity to the total corporate GHG emissions decreased by 15% between 2000 and 2011. During this time the proportion for natural gas, diesel and gasoline increased by 2%, 9% and 6% respectively.

Figure 43: Corporate Energy Cost by Emission Source (2000 and 2006 to 2011)



	2000	2006	2007	2008	2009	2010	2011
Electricity	$5,793,003	$5,409,740	$5,615,222	$6,306,140	$6,915,733	$6,789,794	$7,011,901
Natural Gas	$684,143	$1,132,464	$1,017,526	$1,440,258	$1,450,742	$1,125,886	$1,294,915
Diesel	$1,213,596	$2,017,138	$2,220,710	$2,681,084	$1,989,040	$2,537,943	$2,905,001
Propane	$0	$15,462	$19,345	$19,042	$20,717	$20,717	$36,334
Heating Oil	$20,178	$19,846	$23,708	$29,571	$28,771	$31,371	$30,040
Gasoline	$220,772	$490,340	$480,092	$540,149	$372,052	$547,103	$731,377

Year	2000	2006	2007	2008	2009	2010	2011
Total Cost ($)	$7,931,691	$9,084,991	$9,376,603	$11,016,244	$10,777,054	$11,052,814	$12,009,569
% Difference from 2000	n/a	15%	18%	39%	36%	39%	51%

Figure 44: Corporate Energy Cost by Emission Source (2000 and 2006 to 2011)

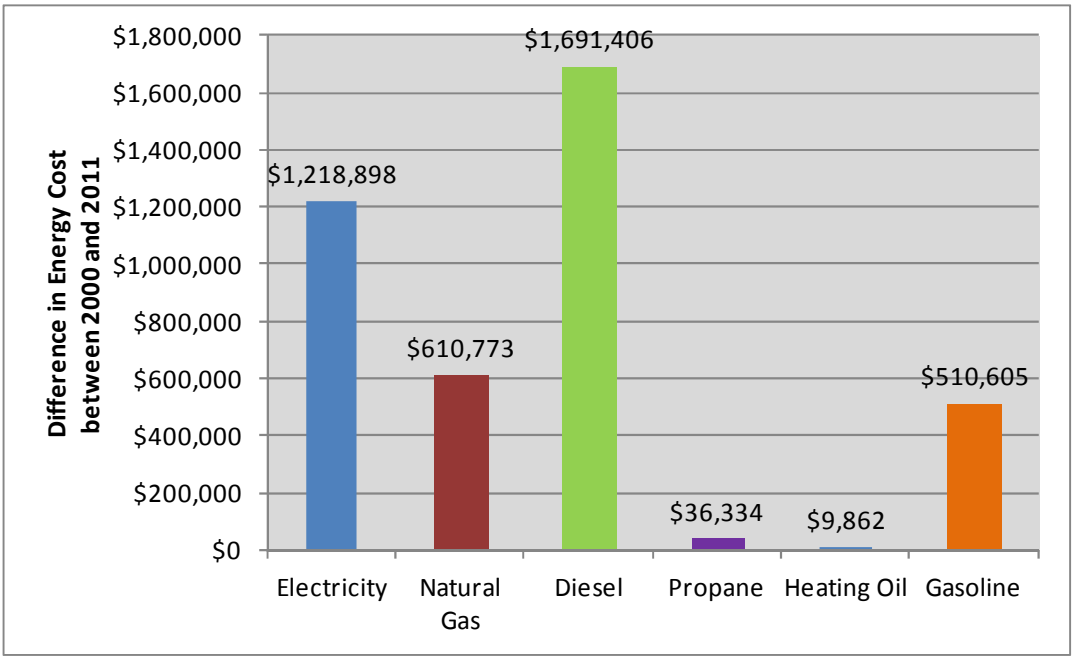
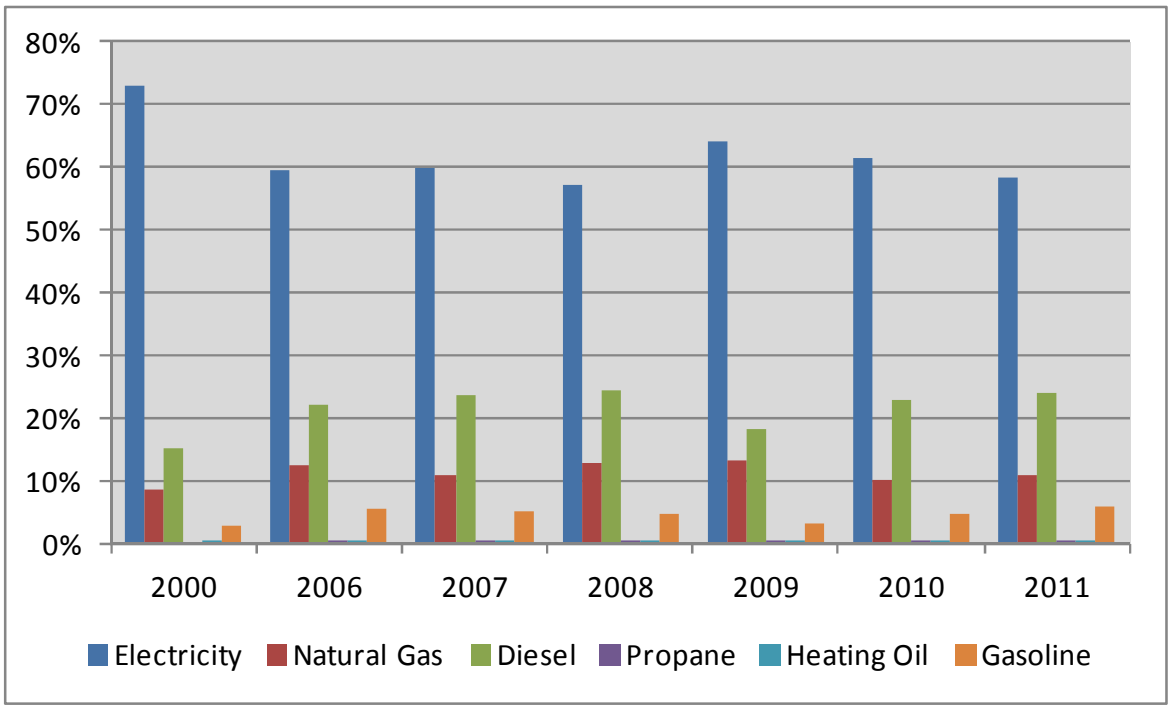


Figure 45: Percentage of Cost by Emission Source (2000 and 2006 to 2011)



5.2 ELECTRICITY

Electricity is the major energy source for the following sectors: buildings, water, waste water and streetlights. This section provides an overview of the Ontario electricity emission factor changes and discusses its impact on GHG emissions.

Table 26 provides a summary of the electricity consumption, emissions and cost for 2000 and 2006 to 2011.

Table 26: Electricity: Consumption, Emissions and Expenditure (2000 and 2006 to 2011)

Year	2000	2006	2007	2008	2009	2010	2011
Electricity: Consumption (GJ)							
Buildings	110,459	82,490	73,924	94,840	102,919	99,828	95,077
Water	41,778	39,964	40,028	38,127	39,746	35,109	35,530
Waste Water	40,946	36,693	43,418	47,498	58,660	46,402	53,284
Streetlights	58,412	58,108	52,605	47,693	47,856	43,205	34,588
Total GJ:	**251,595**	**217,255**	**209,976**	**228,159**	**249,181**	**224,545**	**218,480**
% of Total Sources	**59%**	**53%**	**51%**	**51%**	**52%**	**48%**	**46%**
Electricity: Energy Cost (Million$)							
Buildings	$2.16	$1.93	$2.05	$2.64	$2.93	$3.01	$2.85
Water	$1.02	$1.05	$1.00	$0.98	$0.99	$1.04	$1.18
Waste Water	$1.01	$1.16	$1.16	$1.27	$1.49	$1.39	$1.76
Streetlights	$1.60	$1.27	$1.40	$1.42	$1.51	$1.35	$1.21
Total Cost:	**$5.79**	**$5.41**	**$5.62**	**$6.31**	**$6.92**	**$6.79**	**$7.01**
% of Total Sources	**73%**	**60%**	**60%**	**57%**	**64%**	**61%**	**58%**
Cost/GJ:	**$23.03**	**$24.90**	**$26.74**	**$27.64**	**$27.75**	**$30.24**	**$32.09**
Electricity: Greenhouse Gas Emissions (tonnes)							
Buildings	9,512	4,812	4,928	4,479	3,431	4,160	3,962
Water	3,598	2,331	2,669	1,797	1,325	1,463	1,480
Waste Water	3,526	2,895	2,895	2,243	1,955	1,933	2,220
Streetlights	5,030	3,390	3,507	2,252	2,252	1,800	1,441
Total Emissions	**21,665**	**13,427**	**13,998**	**10,771**	**8,963**	**9,356**	**9,103**
% of Total Sources	**67%**	**53%**	**52%**	**44%**	**39%**	**39%**	**36%**

Key findings from this data set comparison are as follows:

- While the total annual electricity consumption did not vary significantly from 2000 to 2011, the electricity proportion of the total corporate energy consumption decreased from 59% in 2000 to 46% in 2011.
- Between 2000 and 2006, the electricity consumption decreased for the building, water and streetlight sector. The waste water sector was the only sector that realized a gain in electricity consumption over this time.

- While the total electricity energy cost increased by $1.87 Million between 2000 and 2011, the electricity proportion of the total corporate energy cost decreased from 73% to 58%.
- The cost per GJ increased by 39% from $23 in 2000 to $32 in 2011.
- Between 2000 and 2011, the building, water and waste water sectors all realized an increase in annual electricity energy costs. The streetlight sector is the only sector that realized a reduction in its annual electricity energy cost over this period.
- The total corporate emissions from electricity decreased by 58% (-12,562 tonnes) and the electricity proportion of the total corporate GHG emissions decreased by 31% 9from 61% to 36%) between 2000 and 2011. The electricity emission factor (based on the Ontario energy mix) which decreased by 52% between 2000 and 2011 is responsible for much of this reduction.

5.3 NATURAL GAS

Natural gas is an energy source for the following corporate sectors: buildings, water, and waste water. This section provides an overview of the natural gas emission factor and a summary of the consumption, GHG emission and cost by sector. Table 27 summarizes the natural gas consumption, cost and GHG emission data for 2000 and 2006 to 2011.

Table 27: Natural Gas: Consumption, Expenditure and Emissions for 2000 and 2006 to 2011

Year	2000	2006	2007	2008	2009	2010	2011
Natural Gas: Consumption (GJ)							
Buildings	86,967	83,699	84,765	105,349	110,560	103,420	107,638
Water	1,271	1,730	1,358	1,596	1,466	1,486	1,863
Waste Water	4,312	4,627	11,120	8,264	16,357	14,978	15,576
Total GJ:	**92,550**	**90,056**	**97,243**	**115,210**	**128,384**	**119,884**	**125,077**
% of Total Sectors:	**22%**	**22%**	**23%**	**26%**	**27%**	**26%**	**26%**
Natural Gas: Energy Cost ($)							
Buildings	$636,491	$1,035,564	$844,635	$1,306,303	$1,217,732	$986,844	$1,088,352
Water	$15,010	$26,879	$19,065	$26,567	$25,539	$19,451	$19,735
Waste Water	$32,642	$70,022	$153,826	$107,388	$207,471	$119,591	$186,828
Total Cost:	**$684,143**	**$1,132,464**	**$1,017,526**	**$1,440,258**	**$1,450,742**	**$1,125,886**	**$1,294,915**
% of Total Sectors:	**9%**	**12%**	**11%**	**13%**	**13%**	**10%**	**11%**
Cost/GJ:	**$7.39**	**$12.58**	**$10.46**	**$12.50**	**$11.30**	**$9.39**	**$10.35**
Natural Gas: Greenhouse Gas Emissions (tonnes)							
Buildings	4,363	4,199	4,253	5,286	5,547	5,189	5,485
Water	64	87	68	80	74	75	93
Waste Water	216	232	558	415	855	751	781
Total Emissions	**4,643**	**4,518**	**4,879**	**5,780**	**6,475**	**6,015**	**6,360**
% of Total Sectors:	**14%**	**18%**	**18%**	**24%**	**29%**	**25%**	**25%**

Key findings from this data set are as follows:

- Between 2000 and 2011, the natural gas consumption, cost and GHG emissions have all increased for each of the sectors.
- The proportion of the total corporate energy consumption, cost and GHG emissions represented by natural gas have increased between 2000 and 2011.
- The total natural gas energy consumption, cost and GHG emissions have increased by 35% (32,527 GJ), 89% ($0.61 Million) and 37% (1,716 tonnes) respectively between 2000 and 2011.
- The natural gas cost per GJ has increased by 40% from $7.39 in 2000 to $10.35 in 2011.
- The proportion of the total corporate GHG emissions represented by natural gas has increased from 14% in 2000 to 25% in 2011. This is due to a significant increase in natural gas consumption within the building and waste water sectors.

5.4 GASOLINE

Gasoline is consumed by the corporate fleet and the City of Kingston transit. The gasoline data captured for transit represents the gasoline consumed serving the municipality of the City of Kingston only.

Table 28 summarizes the Gasoline consumption, cost and GHG emission data for 2000 and 2006 to 2011.

Table 28: Gasoline: Consumption, Expenditures and Emissions for 2000 and 2006 to 2011

Year	2000	2006	2007	2008	2009	2010	2011
Gasoline: Consumption (liters)							
Consumption (liters)	319,035	489,267	503,575	502,095	443,746	561,951	601,459
Gasoline: Consumption (GJ)							
Total GJ:	11,058	16,958	17,454	17,403	15,380	19,477	20,847
% of Total Sectors:	**3%**	**4%**	**4%**	**4%**	**3%**	**4%**	**4%**
Gasoline: Energy Cost (Million$)							
Total Cost:	$220,772	$490,340	$480,092	$540,149	$372,052	$547,103	$731,377
% of Total Sectors:	**3%**	**5%**	**5%**	**5%**	**3%**	**5%**	**6%**
Cost/GJ:	**$19.97**	**$28.91**	**$27.51**	**$31.04**	**$24.19**	**$28.09**	**$35.08**
Gasoline: Greenhouse Gas Emissions (tonnes)							
Total Emissions	753	1,155	1,188	1,185	1,047	1,326	1,419
% of Total Sectors:	**2%**	**5%**	**4%**	**5%**	**5%**	**5%**	**6%**

Key finding from this data set are as follows:

- Between 2000 and 2011, the gasoline consumption, cost and GHG emissions increased.
- The proportion of the total corporate energy consumption, cost and GHG emissions represented by gasoline increased between 2000 and 2011.
- The gasoline gas cost per GJ has increased by 76% from $19.97/GJ in 2000 to $35.08/GJ in 2011.

5.5 DIESEL

Diesel is consumed by the corporate fleet, the outsourced BFI recycling trucks and transit. The diesel data captured represents the diesel consumed serving the municipality of the City of Kingston only. Table 29 summarizes the diesel consumption, cost and GHG emission data for 2000 and 2006 to 2011. The baseline inventory (2000) did not provide expenditure data.

Table 29: Diesel: Consumption, Expenditures and Emissions for 2000 and 2006 to 2009

Year	2000	2006	2007	2008	2009	2010	2011
Diesel: Consumption (liters)							
Diesel	1,805,946	2,083,349	2,288,680	2,236,785	2,246,430	2,537,943	2,870,839
Biodiesel	0	197,407	209,152	198,018	224,462	202,352	103,354
Total Diesel:	1,805,946	2,280,756	2,497,832	2,434,804	2,470,892	2,740,295	2,974,193
% Biodiesel:	**0%**	**9%**	**8%**	**8%**	**9%**	**7%**	**3%**
Diesel: Consumption (GJ)							
Total GJ:	69,854	80,584	88,526	86,519	86,892	98,168	111,044
% of Total Sectors:	**16%**	**20%**	**21%**	**19%**	**18%**	**21%**	**23%**
Diesel: Energy Cost (Million$)							
Total Cost:	$1,213,596	$2,017,138	$2,220,710	$2,681,084	$1,989,040	$2,537,943	$2,905,001
% of Total Sectors:	**15%**	**22%**	**24%**	**24%**	**18%**	**23%**	**24%**
Cost/GJ:	**$17.37**	**$25.03**	**$25.09**	**$30.99**	**$22.89**	**$25.85**	**$26.16**
Diesel: Greenhouse Gas Emissions (tonnes)							
Total Emissions	4,930	5,688	6,248	6,106	6,133	6,929	7,837
% of Total Sectors:	**15%**	**23%**	**23%**	**25%**	**27%**	**29%**	**31%**

Key finding from this data set are as follows:

- Between 2000 and 2011, the diesel consumption, cost and GHG emissions increased.
- The municipality introduced biodiesel into the diesel mix in 2006. Between 2006 and 2010, biodiesel represented approximately 7% to 9% of the total diesel mix. In 2011, the biodiesel mix was reduced to 3% of the total.
- The proportion of the total corporate energy consumption, cost and GHG emissions represented by diesel has increased between 2000 and 2011.
- The total diesel energy consumption, cost and GHG emissions have increased by 59% (41,190 GJ), 139% ($1.69 Million) and 59% (7,837 tonnes) respectively between 2000 and 2011.
- The diesel cost per GJ increased by 51% from $17.37/GJ in 2000 to $26.16 in 2011.
- The proportion of the total corporate GHG emissions represented by diesel has doubled, increasing from 15% in 2000 to 31% in 2011.

6.0 RECOMMENDATIONS FOR SUBSEQUENT CORPORATE GHG INVENTORIES and NEXT STEPS

The following recommendations are offered to assist the Corporation of the City of Kingston in advancing its objectives to reduce its corporate GHG emissions as well as to improve the quality and management of its energy consumption and cost data for future inventories.

Building Data Set Data Collection:

- The Utilities Kingston building data set for natural gas and electricity is currently only available as invoices in a pdf format. This format requires that individual pdf bills be opened and the data transposed. This is time consuming and introduces the opportunity for error. We would recommend that Utilities Kingston provide the annual cost and consumption data for each building account identified.

- Hydro One provides building electricity cost and consumption data. This data is provided on a monthly basis and the data for each month is provided on a separate spreadsheet. This requires the cost and consumption data to be compiled for the year. We recommend that Hydro One provide a summary of the total cost and consumption for each of the building accounts identified.

- Union Gas provides the natural gas for facilities outside of the city core. The data provided by union gas is housed on a website. Consumption and cost data is provided in a spreadsheet format for each year. This format makes it easy to capture the total consumption and cost data without introduction transposition errors. The challenge with this data set is the Union Gas only holds two (2) years of data at a time. Data is deleted from this website on a rolling month basis. Within the current inventory, some of the 2010 data had been deleted and estimates had to be made. We therefore recommend that the City of Kingston ensure that it downloads building natural gas data on an annual basis.

Streetlight and Traffic Light Data Collection:

- Utilities Kingston and Hydro One service streetlights and traffic lights within the city core and outside the city core respectively. In the current inventory the following data was available: cost and consumption data for Utilities Kingston and total cost data for the streetlights and traffic lights. We applied the $/kWh from Utilities Kingston data to the total cost data to determine the overall electricity consumption. The accuracy of the GHG emission estimates from this sector could be improved if we could obtain the cost and consumption data from Hydro One for streetlights and traffic lights.

Building Review

- Based on the findings of this inventory, a selection of buildings has been identified as being potentially problematic. The following buildings (from Table 6) had a greater than 20% increase in electricity consumption between 2010 and 2011:
    - Belle Park Fairways (83% increase; 99,190 kWh);
    - Oakwood Daycare (209% increase; 191,168 kWh);
    - Cooks Brother Arena (77% increase; 44,850 kWh);
    - City Greenhouse Building (24%, 3,604 kWh); and
    - Rodden Park Barn (45%, 7630 kWh).

  The following buildings (from Table 7) had a greater than 20% increase in natural gas consumption between 2010 and 2011:
    - Kingston Utilities Building (32%; 24,233 m3);
    - Portsmouth Olympic Harbour (19%; 15,073 m3);
    - Central Library (21%; 7,570 m3);
    - Pittsburgh Public Library (27%; 1399 m3);
    - Memorial Centre (61%; 98,049 m3);
    - 623 King St. (22%; 937 m3) and
    - KARC (20%; 10,331m3).

  The facilities listed on Table 8 represent the top ten corporate buildings by energy intensity (GJ/ft^2). Two (2) of these facilities are currently undergoing renovations (Transit Center and Artillery Park). We recommend that the remaining eight (8) facilities be flagged for follow up to determine why their energy intensity is elevated.

Fleet Review:

- Table 21 indicates that the energy efficiency (GJ/ per 1000km) of transit has remained relatively stable over time. Given the increased cost of fuel, it is recommended that the transit sector be reviewed to increase efficiencies. This could include increasing the volume of biodiesel incorporated into the fuel mix as well as adopting and implementing an E3 program. It is understood that a bus is a major investment and that as older transit buses are retired more efficient buses will be brought on-stream.

Waste Water Review:

- Ravensview Waste Water Treatment Plant: Between 2010 and 2011 the Ravensview Plant increased its consumption of electricity by 29% (1.2 Million kWh) resulting in an energy cost increase of $169,435 and GHG emission increase of 221 tonnes. We recommend that a more in-depth study be completed to identify the source of the increase and to identify measures for mitigation.

APPENDIX A

List of facilities removed from the building GHG Inventory

Building	Reason for Removal from Inventory
Public Play Areas - Courts	Not compiled on asset list; assumed to be a small consumer
Outdoor Rinks	Not compiled on asset list; assumed to be a small consumer
Solid Waste Admin. Building	Solid Waste has only 2 buildings (196 Lappan's Lane and 2701 Creekford Rd. This is a duplicate building
Solid Waste Garage	Solid Waste has only 2 buildings (196 Lappan's Lane and 2701 Creekford Rd. This is a duplicate building
Angrove Memorial Lot	Not on asset list; assumed to be a small consumer
Richardson Lot	Not on asset list; assumed to be a small consumer
KGH Waterfront Lot	Not on asset list; assumed to be a small consumer
Pump House Lot	Not on asset list; assumed to be a small consumer
Airport Hanger #3	Demolished since 2006 to 2009 inventory
Airport ILS	Not on asset list; assumed to be a small consumer; note: actual area is 120 ft2
Airport Glide Path	Not on asset list; assumed to be a small consumer; note: actual area is 120 ft2
Tercentennial Lodge	Demolished
Woodburn	Demolished since 2006 to 2009 inventory
Visitor Centre	Leased to tenant; not part of operational control of City
Crawford Wharf	Not on asset list; assumed to be a small consumer - lights
Registry Office	Formally Leased; now vacant;
	not part of operational control
Ambulance Building	leased to County; tenant pays utilities
Rideaucrest shed storage building	Not on asset list; assumed to be a small consumer
Boat Registration Building	Assumed to be a small consumer
Public Works - Salt Shed 1	Assumed to be a small consumer
Public Works - Salt Shed 2	Assumed to be a small consumer
Public Works - Sand Dome	Assumed to be a small consumer
Storage Building (garage & ws)	Previously captured - redundant
Neighbourhood Sharing Centre	Leased; utilities paid by tenant
Hockey Hall of Fame 277 York St.	Assumed to be captured by M-Centre..No bill available
Public Works Buildings	Renamed - redundant