



**Town Of Richmond Hill
ENERGY MANAGEMENT PLAN 2009**

[Last updated on August 2010]

Prepared by:

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Section 1 - Organization Profile

The Town of Richmond Hill is one of the fastest growing Municipalities in GTA area having the population of about 185,200 and 100 sq.km of area.

1.1 Key Personnel

- Address: The Town of Richmond Hill, 225, East Beaver Creek Road, Richmond Hill, Ontario. L4B 3P4.
Tel. No. 905-771-8800
Fax. No. 905-771-2405
- Italo Brutto: Commissioner, Environment & Infrastructure Services
- Pat Caron: Director of Asset Management
- Saroj Acharya: Facility Systems Manager
- Nick Kalyvas: Manager of Facility Assets

1.2 Organization Survey

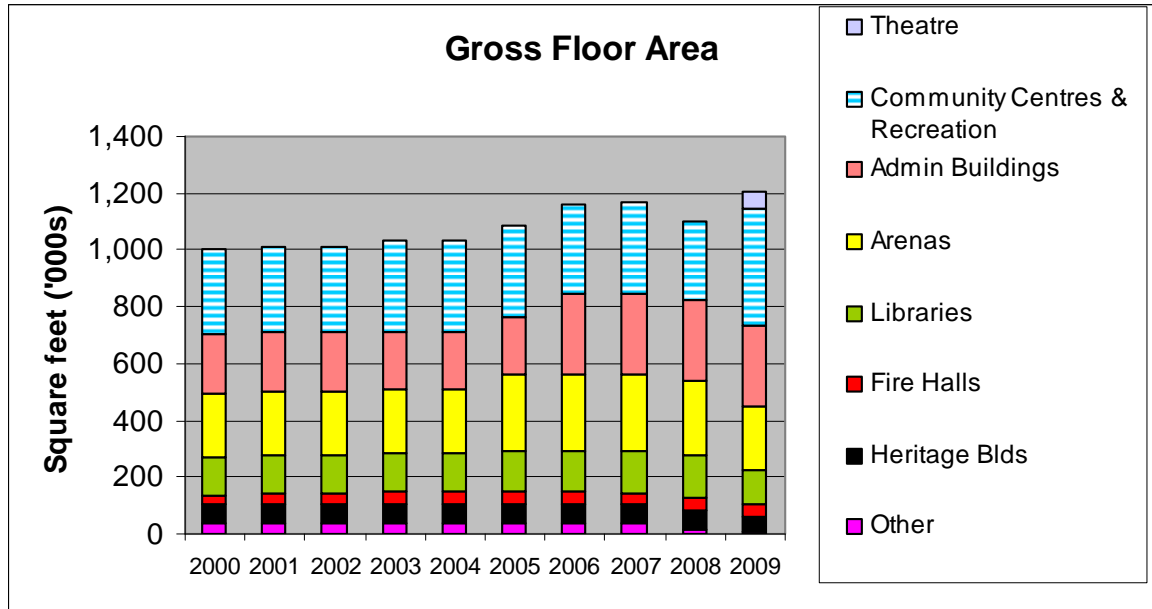
The Town owns 58 facilities that cover about GFA 1,205,739 Sq.ft. including Heritage buildings dating back to the Year 1825 to an ultramodern indoor Wave Pool and Performing Art Theater. About 500 full time and 450 part time employees work from these locations.

Table 1: Facilities Summary; details in Annexure 1.

S.No.	Facility Type	No of Buildings	Total GFA
1	Municipal Office Buildings	2	284,866
2	Swimming Pools & Community Centres	12	387,207
3	Arenas (7 Ice Pads)	5	220,475
4	Performing Art Theatre	1	57,156
5	Heritage Buildings	11	47,673
6	Libraries	4	125,058
7	Fire Halls	5	43,203
8	Recreation Buildings	10	29,319
9	Others	8	10,782
TOTAL		58	1,205,739

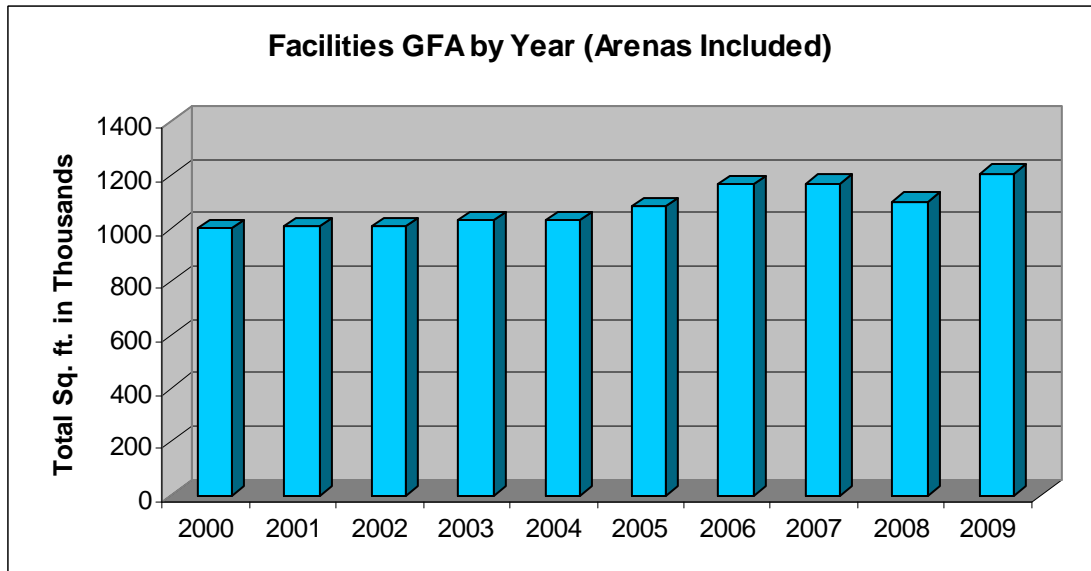
A graphical illustration of the GFA by facility type for the year 2000 to 2009 is shown on Figure 1 below:

Figure 1: GFA breakdowns as per Facilities



A graphical illustration of the GFA growth for all Town Facilities from year 2000 to 2009 shown in Figure 2 below:

Figure 2: Growth in Facilities from Year 2000 to Year 2009



Growth in 2005 – 2009 includes the decommissioning of Kenzie, Spruce, Lion’s and Old Central Library buildings and addition of Richmond Hill Performing Art Theater.

1.3 Background Description

1.3.1 General

The Asset Management Division is responsible in maintaining 58 Town own facilities, which includes the implementation of energy conservation measures to reduce the cost and CO2 emissions.

With the exception of the administrative office buildings all other buildings are open the public on average 16 Hrs a day; 365 days in a year. For the most part these facilities are located in urban areas and surrounded in most instances by parks and in some cases by commercial facilities.

The Hydro utility is supplied by PowerSteam and the Gas utility is supplied by Enbridge Gas.

1.3.2 Information on Issues and Events

- Asset Management is responsible for facility equipment upgrade and replacement plans, utilizing RECAPP (Renewal Capital Asset Planning Process), software for condition survey life cycle planning.
- Energy invoices are paid by the Finance Department directly.
- Asset Management extracts data from the invoices on monthly basis and inputs the data into a Microsoft Access data file.

1.3.3 Facility Component

- HVAC (Heating Ventilation and Air Conditioning) System: used for heating and cooling the buildings:
 - Roof Top Units
 - Centrifugal Chillers
 - Heat Pumps
 - Hot Water Boilers
 - Makeup Air Units
 - Heat Recovery Units
 - Dehumidifier and humidifiers
 - Baseboard and Radiators
 - Geothermal
- Electrical System:
 - Most of the buildings have T8 fluorescent light fixtures
 - Compact florescent lamps.
 - Occupancy sensor controlled lights
 - PLC (Programmable Logical Control) controller lights
 - Photo Cell Controlled lights

Section 2 - Energy Management Policy

2.1 Commitment by Town of Richmond Hill

In an attempt to reduce energy operation costs, while at the same time assisting in meeting Canada's international commitment to stabilize greenhouse gas emissions, the [Commissioner of Environmental & Infrastructure](#) is pleased to acknowledge through the commitment of Council that The Town of Richmond Hill is committed to undertaking economic measures to increase energy efficiency as means of limiting the production of greenhouse gas emissions.

The Town of Richmond Hill is also committed to undertake several actions listed in Annexure 6.

A letter of intent¹ from the former commissioner of E & PW and now the commissioner of Environment & Infrastructure Services is included in this report for reference.

¹ Refer to Figure# 3

Figure 3: Town of Richmond Hill Commitment

Environmental Policy for the Town of Richmond Hill's Engineering and Public Works Department

Our Vision

The Town of Richmond Hill's vision is to be an environmentally sustainable community. By developing a strategy to encourage stewardship of Richmond Hill's air, water and land resources, the Town is committed to enhancing our healthy and safe community.

Our Mandate

The Town of Richmond Hill, through the Engineering & Public Works Department, provides municipal engineering services to meet the present and future needs of the residents and businesses of the Town of Richmond Hill.


The primary responsibilities of the Engineering & Public Works Department include garbage & recycling, road/traffic signs, streetlights, traffic engineering, transportation planning, local road reconstruction, road & sidewalk snow clearing, water distribution, storm and sanitary sewers, stormwater management, property management, new subdivision infrastructure and environmental programs. The department also builds and maintains Town-owned facilities including libraries, community centres and fire halls and maintains the Town's fleet.

Our Commitment

All reasonable efforts will be taken by the Engineering & Public Works Department to minimize impacts to the environment through the development and implementation of an environmental management system to protect drinking water safety, prevent spills, maximize waste diversion, reduce air emissions, optimize energy and resource usage and manage natural systems and stormwater as a resource.

The Engineering & Public Works Department commits to complying with all applicable legal requirements and other requirements to which the organization subscribes that relate to our environmental aspects.

The performance of our environmental management system will be reviewed to ensure continual improvement. All activities will reflect a commitment to the prevention of pollution.


Commissioner of Engineering & Public Works
 September 27, 2005

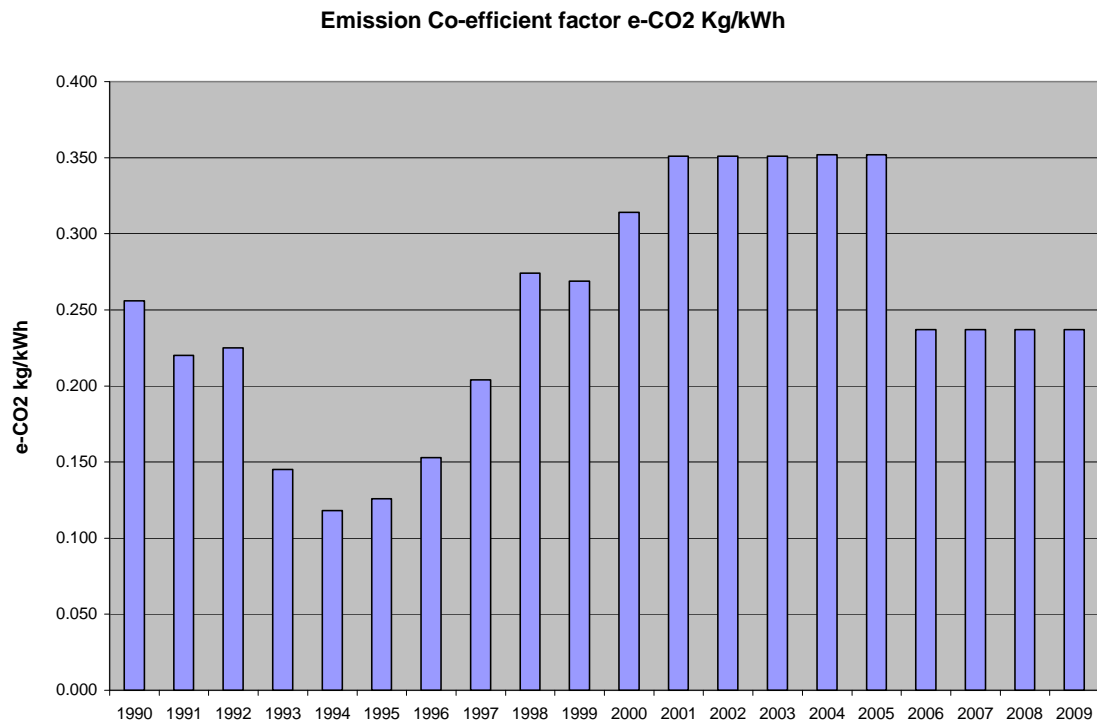
2.2 Energy Management and Greenhouse Gas Emission Goals and Targets

The GHG² emissions inventories were completed³ for the period 1994 to 2000, and projected back to 1990 to ensure future compatibility with the Town's plan and any future Kyoto requirements. This analysis provided background information and insight into the trend of GHG emissions growth over time.

GHG emissions within facility operations increased by 110% between 1990 and 2000, while energy use increased by 87%, and the facility's total gross floor area increased by 90%. The increase in energy consumption was a result of the renovation and construction of new facilities in Richmond Hill that totaled 18.

GHG emissions increased more than energy consumption since the fossil fuel content of the electricity generation mix was higher in 2000 than it was in 1990, on this basis, based on reasons beyond our control more GHG emissions⁴ were generated per unit of electricity use. As noted, Municipal government has no control on the power generation and related emission coefficient.

Figure 4 : Changes in Emission Co-efficient



² Greenhouse Gases

³ Study was completed by ICLEI for Town's Clean Air Program

⁴ Emission coefficient changes, refer to Figure # 4

2.2.1 Goals

The Town of Richmond Hill has identified three main goals. The starting point is 1990, as national agreement to “Kyoto protocol”.

1. Reduction in energy consumption
2. GHG reduction
3. Cost savings

To achieve these objectives the Town by the Year 2012 will target:

- a reduction in energy consumption by 2.04 kWh/ Sq.ft of electrical and 0.18M³/Sq.ft. of Natural Gas.
- reduction in GHG emission of 9×10^{-4} Tons / Sq. ft.
- a total cost savings of 10 % by 2012. This can be achieved by savings of 2% per year.

Table 2: Goals and Targets to conserve energy.

	From Year 1990 level	Goals by 2012	Target Year
Electrical Consumption	20.74 kWh / Sq.ft.	18.7 kWh / Sq. ft.	2012
Natural Gas Consumption	1.85 M ³ / Sq. ft.	1.67 M ³ / Sq. ft.	2012
GHG	88×10^{-4} Tons / Sq.ft.	79×10^{-4} Tons / Sq. ft.	2012
Total Energy Consumption in	143×10^{-3} GJ / Sq.ft.	128×10^{-3} GJ / Sq.ft.	2012

2.3 Energy Management Objectives

The main objectives for the Town of Richmond Hill facilities are:

- 2.3.1 To improve the efficiency of energy use through low – cost opportunities by implementing:
 - 2.3.1.1 Sound operating and maintenance practices.
 - 2.3.1.2 Employee training, and staff awareness.
 - 2.3.1.3 Monitoring and tracking system.
 - 2.3.1.4 Re-commissioning of buildings.
 - 2.3.1.5 Procure energy on fixed rate contracts.
 - 2.3.1.6 Maintain Energy Demand Management program.
- 2.3.2 To reduce energy operating costs through the initiation of energy retrofit program, this in return, will help reduce greenhouse gas emissions.
- 2.3.3 To improve efficiency of energy by determining the feasibility of implementing comprehensive initiatives.
- 2.3.4 To improve awareness of climate change and greenhouse gas emissions reductions.

2.4 Key Personnel Involvement (Planning Team)

The list of the planning team members and the roles of the team members that will be involved in undertaking the energy management actions are:

<u>Name</u>	<u>Title</u>	<u>Roles/Responsibility</u>
Pat Caron	Director, Asset Management	Provide Direction
Saroj K. Acharya	Manager, Facility Assets	Team Leader
Nick Kalyvas	Manager, Assets	Project co-ordination
Chris Turner	Facility Sys. Coordinator	Technical Team player
Mike Pitsillides	Facility Sys. Technician	Technical Team player
John Campea	Facility Oper. Technician	Technical Team player
Brian Hren	Life & Security Coordinator	Technical Team player
Building Technicians	Technicians	Trouble shooting
Other Department Support	Other Department Support	As required.

2.5 Additional policy Information

The Energy Management Plan complements goal four of the Town of Richmond Hill's Strategic Plan "Wise Management of Resources in Richmond Hill" by planning for and promoting energy efficient buildings and renewable energy.

2.5.1 Energy Management Policy Statement:

2.5.1.1 "We at the Town of Richmond Hill are committed to showcasing leadership in reducing energy consumption, stabilizing greenhouse gas emissions and implementing cost-effective measures."

2.5.2 Energy Efficiency Approach: Flexible Three Phase Approach Tactics will be utilized to meet various stages of Energy Management for the Town of Richmond Hill.

2.5.2.1 Phase # 1: Gaining Support

- 1) Obtaining Leadership from a project champion. In order to gain support in energy efficiency.
- 2) Build an Energy Team.
- 3) Understand the Cost of Energy
- 4) Benchmarking Energy Consumption
- 5) Conduct a high Level Assessment of the Opportunities
- 6) Affirm Support for Developing the Project(s)

2.5.2.2 Phase # 2: Develop the Project

Project development and implementation will require the:

- 1) Conducting Energy Audits
- 2) Identification of projects
- 3) Sourcing of incentive programs
- 4) Building of a business case
- 5) Approval of projects(s)

2.5.2.3 Phase # 3: Implement

Project implementation will require:

- 1) Program awareness
- 2) Program monitoring
- 3) Post program energy recording and cost savings verification

Section 3 - Energy Consumption and Costs

This section outlines the following criteria to be used in recording energy consumption, cost and GHG emission:

- Energy consumption and costs, including baseline, current, and forecasted.
- Methodology used to determine baseline and forecasted costs, consumption, energy intensity, and CO₂ emissions intensity.
- Special events or variables, which may influence consumption and costs.
- Energy consumption and cost per building.

3.1 Energy Consumption and costs will be recorded using following table

		TYPE OF ENERGY USE AND COSTS		
		Electricity (kWh)	Gas (M ³)	Oil (Liters)
Baseline	1990			
Total Area sq.ft.	495,519			
Total Cost	\$902,136	\$719,289	\$182,847	
Cost per sq.ft.		\$1.45	\$0.37	
Total Consumption		10,275,558	914,233	
Consumption per Sq. ft.		20.74 kWh	1.85 m ³	
Current	2009			
Total Area sq.ft.	1,205,739			
Total Cost	\$2,765,185	\$2,087,445	\$677,740	-
Cost per sq.ft.		\$ 1.73	\$ 0.56	
Consumption		19,483,348	1,479,501	-
Consumption per Sq. ft.		16.16 kWh	1.23 m ³	
Forecasted Goal	2012			
Total Area sq.ft.	1,545,000			
Total Cost	3,553,500	\$2,672,850	\$880,650	
Cost per sq.ft.		\$ 1.73	\$ 0.57	
Total Consumption		28,891,500	2,580,150	
Consumption per Sq. ft.		18.7 kWh	1.67 m ³	

3.1.1 Baseline Consumption and Cost Data

One of the six components required by the VCR Inc.⁵ (“Voluntary Registry Challenge Inc.”) is the determination of baseline data. Therefore, the action plan which includes a quantifiable baseline should be based on 1990 consumption. The main information that needs to be expanded is:

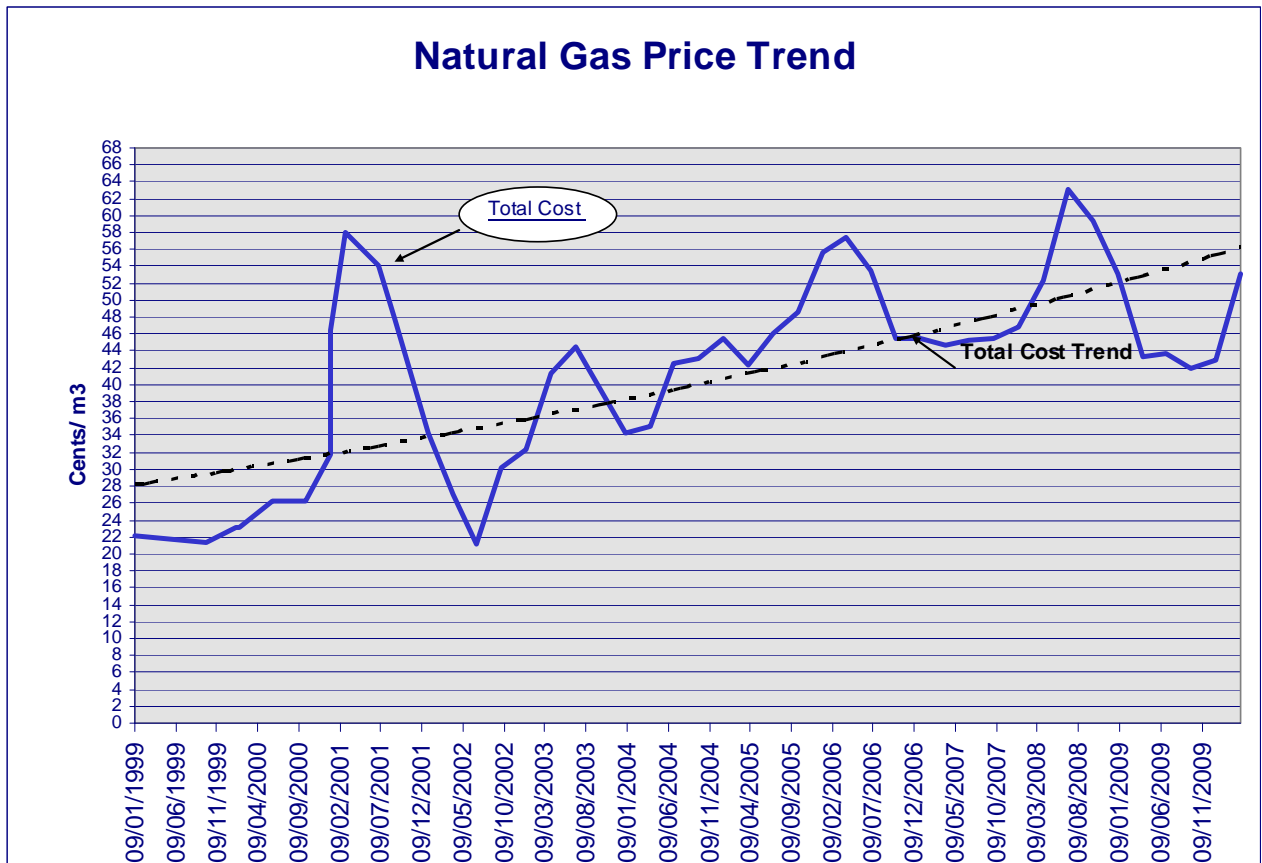
- Calculated or actual consumption of each fuel.
- Calculated energy consumption per unit.
- A description of the methodology used to determine the baseline should be included.
- Provide sample calculations in order to verify the data.

3.1.2 Current and Forecasted Consumption and Cost

This section will describe the energy consumption and cost for the current year, as well as projected for future years.

The cost of natural gas has fluctuated substantially from 1999 to 2007. Based on this history it is clear that the trend of cost will continue to increase.

Figure 5: Natural Gas Cost (\$ per m³) trend



⁵ Canadian National Action Program on Climate Change provides for voluntary measures, as well as regulatory, educational, fiscal and technological initiatives. The core of the voluntary component is the Climate Change Voluntary Challenge and Registry (VCR).

3.2 Special Events and Other Variables

Events or any special project, which may influence energy consumption, have been taken into account in order to justify any deviations in anticipated energy use and cost. Examples of events are as follows:

- Anticipated increase / decrease in building occupancy.
- Unusual weather (i.e. mild winter, hot and humid summers) reference Figure 6 & 7 below.
- Closing /decommissioning of a facility.
- An increase/decrease in unit energy cost by the supplier.
- Addition of new facilities.

Figure 6: Variation in annual heating hours.

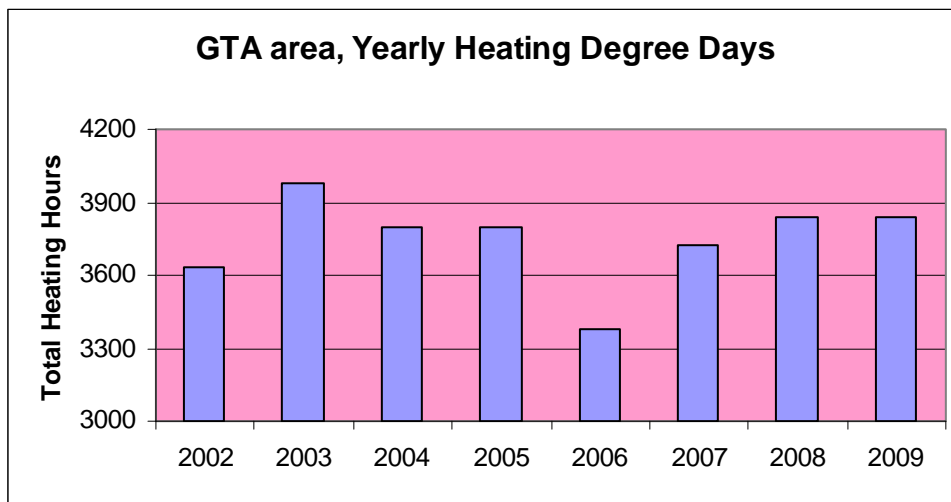
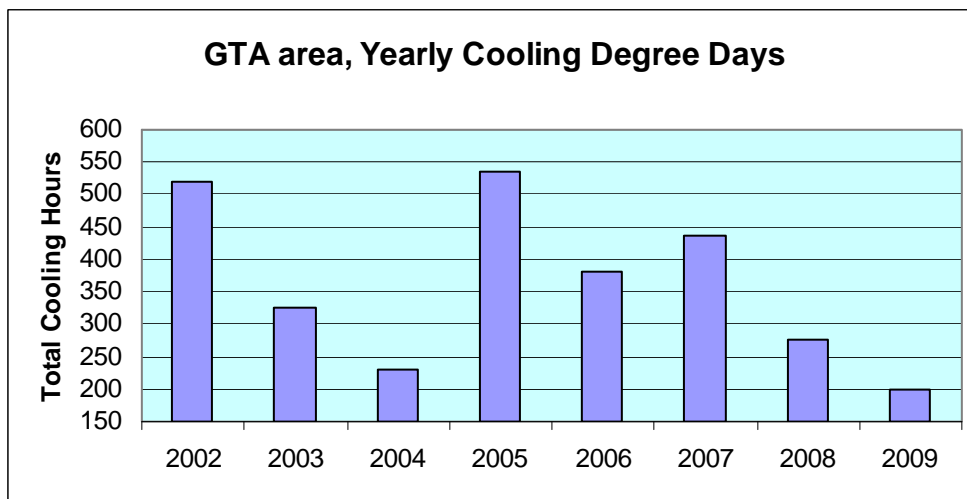


Figure 7: Variation in annual cooling hours.



3.3 Additional Optional Information

3.3.1 Identification of Current Energy Sources

Energy suppliers for the Town of Richmond Hill are as under:

- Electricity: PowerStream
- Natural Gas: Enbridge Gas.
- Oil: Petro Canada

Table 3 : Current Energy Use Breakdown.

Energy Use	Percentage of Total	Emissions
Electricity	60 %	Indirect
Natural Gas	38 %	Direct
Oil	2 %	Direct

3.3.2 Determination of Energy Intensity and CO2 Emissions

Baseline Data: Energy Intensity and CO2 Emissions

One of the six component required by the VCR Inc. is the determination of greenhouse gas emissions baseline data. The action plan must include a quantifiable baseline. The baseline should be based on the 1990 emissions, however another baseline year may be considered, by adjusting the 1990 data to the selected year.

The critical information that needs to be included is:

- Calculated or actual consumption (from bills) for each fuel.
- Calculated energy consumption per unit.
- Major Source of GHG emissions, including indirect emissions from the consumption of electricity.
- A description to determine the baseline.
- Provide sample calculations in order to verify the data.

Summary of CO2 emissions, preferable calculated on a total emissions basis and in terms of CO2 intensity. The baseline should include GHGs identified in the Kyoto Accord. These gases should be reported in terms of carbon dioxide equivalents. The following conversion factors shown in Table 4 below are excerpts form the VCR Inc.'s Registration Guide 1997.

Table 4: CO₂ Emission Factors (1997)

	CO ₂	CO ₂ tonnes/ Terajoules	CH ₄ (kg/ML)	NO ₂ (kg/ML)
Electricity in Ontario	0.169 tonnes/MWh	46.9		
Natural Gas	1.88 tonnes/ML	49.68	0.043	0.02
Diesel Oil	2.73 tonnes/m ³	70.69	0.05	0.1
Light Oil	2.83 tonnes/m ³	73.11	0.026	0.013
Gasoline	2.36 tonnes/m ³		0.25	0.21

1 ton = 1,000 kg = 1,000,000 g
 1 ML = 1,000,000 L = 1000 m³
 1 TJ = 1,000,000,000,000 J (10¹²)

Current and Forecasted: Energy Intensity and CO2 Emissions

This Section describes energy consumption and costs, and the resulting greenhouse gas emissions for the current year.

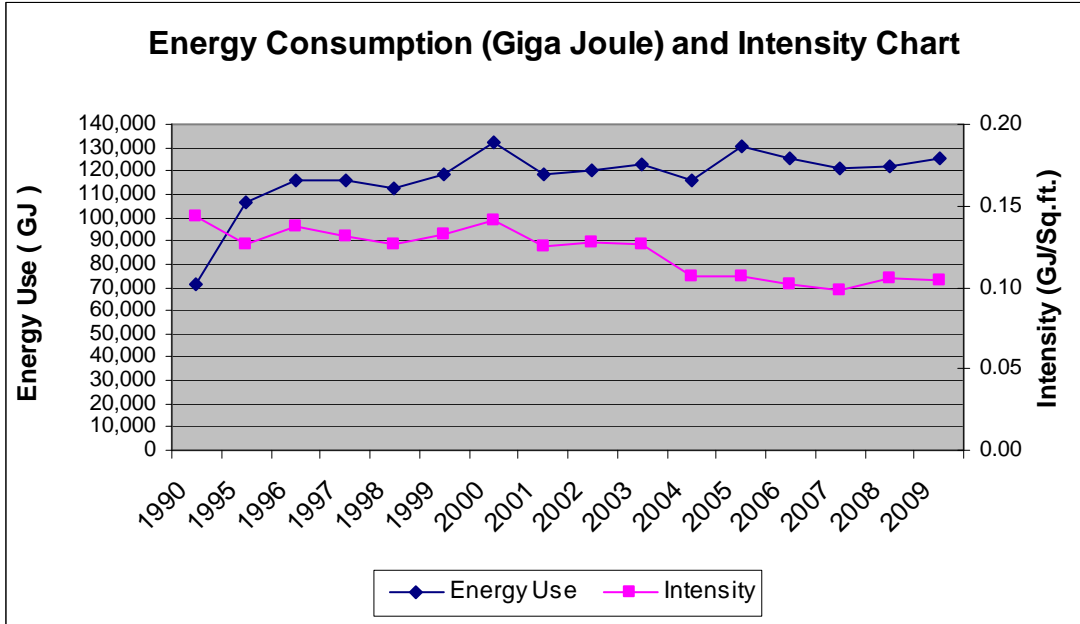
Table 5 – Energy Consumption and Cost Intensity Summary (Actual and Projected)

Year	Area (ft2)	Gas Consumption (m3)	Gas GJ	Electricity Consumption (kWh)	Electric GJ	Total Energy (GJ)	Total Energy Cost (\$)	Energy Intensity (GJ/ft2)	Cost Intensity (\$ / GJ)
1990	495,519	914,233	34,059	10,275,558	36,992	71,051	869,000	0.143	12.23
1995	846,170	1,213,184	45,196	17,038,625	61,339	106,535	910,800	0.126	8.55
1996	846,545	1,544,617	57,543	16,208,215	58,350	115,893	901,200	0.137	7.78
1997	887,743	1,538,935	57,331	16,359,377	58,894	116,225	908,900	0.131	7.82
1998	887,743	1,370,794	51,068	17,090,187	61,525	112,592	923,000	0.127	8.20
1999	894,652	1,502,411	55,971	17,338,356	62,418	118,389	1,781,700	0.132	15.05
2000	943,267	1,762,729	65,669	18,586,246	66,910	132,579	1,830,900	0.141	13.81
2001	943,267	1,440,659	53,670	18,000,320	64,801	118,471	2,275,600	0.126	19.21
2002	943,267	1,544,542	57,540	17,507,036	63,025	120,566	1,734,200	0.128	14.38
2003	971,460	1,695,188	63,153	16,543,472	59,556	122,709	2,070,000	0.126	16.87
2004	1,089,542	1,594,103	59,387	15,728,479	56,623	116,009	2,262,000	0.106	19.50
2005	1,232,627	1,589,126	59,201	19,900,400	71,641	130,843	2,581,900	0.106	19.73
2006	1,237,407	1,476,372	55,001	19,614,388	70,612	125,613	2,651,300	0.102	21.11
2007	1,237,407	1,533,844	57,142	17,715,619	63,776	120,918	2,604,200	0.098	21.54
2008	1,156,534	1,566,764	58,368	17,618,828	63,428	121,796	2,575,322	0.105	21.14
2009	1,205,749	1,479,501	55,117	19,483,348	70,140	125,257	2,765,185	0.104	22.08

Note: See the next graph for simple explanation

The following chart illustrate facilities, annual total energy consumption (Gega Joules⁶) Vs energy intensity i.e, Gega Joules per Sq. ft of area.

Figure 8 : Energy Intensity (Giga Joule per Sq. Ft.) and total energy consumption Chart



⁶ One Gega Joule = 277.78 kWh of electrical energy ; or 26.88 m³ of Natural Gas consumption

The table below illustrates the total annual emission produced by the aggregate of all the facilities in term of equivalent of tonnes of CO₂ and converted into intensity of CO₂ emission per ft².

CO₂ Emissions Summary and Figures

Table 6 : Direct and Indirect CO₂ Emission Produced

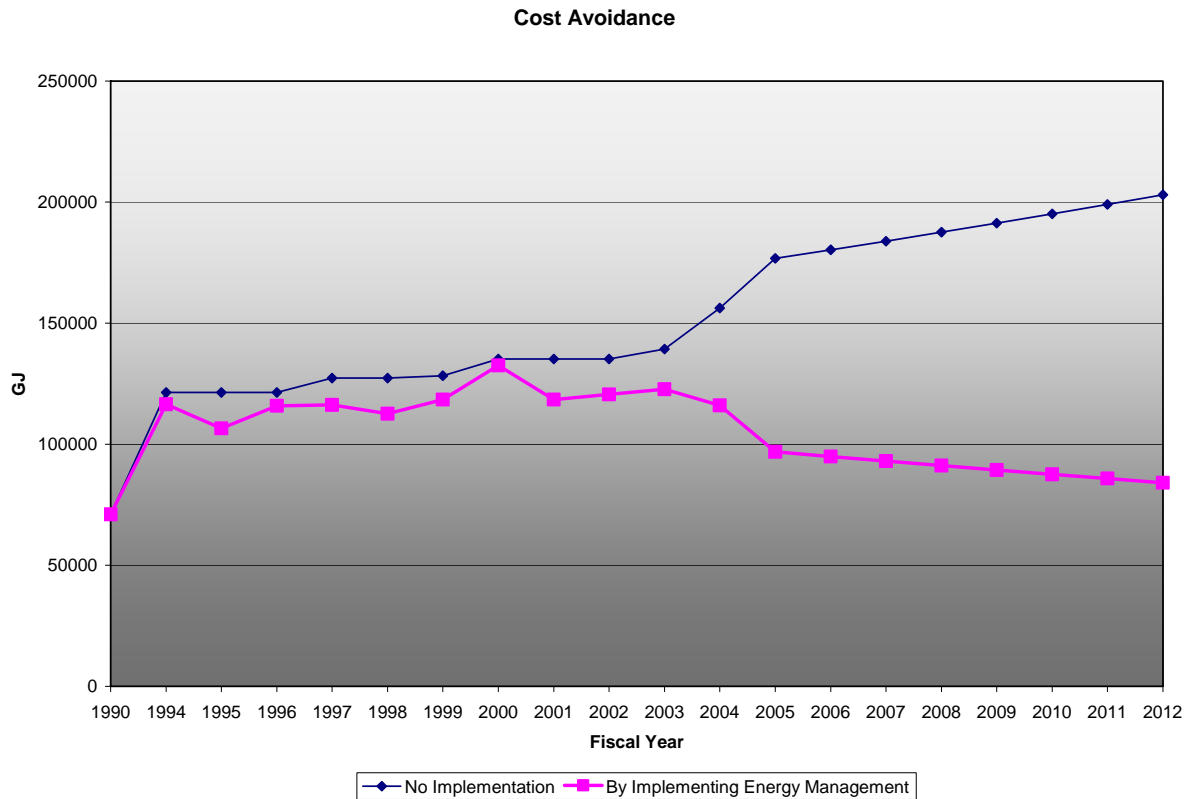
Year	Area Ft ²	Direct Emissions					Indirect Emissions		Total CO ₂ (tonnes)	CO ₂ Intensity tonnes per ft ²
		Gas Consumption (GJ)	CO ₂ (tonnes)	N ₂ O 0.0005376 (tonnes)	CH ₄ 0.001156 (tonnes)	CO ₂ equivalent Total 0.0505 (tonnes)	Electrical Consumption (kWh)	CO ₂ (tonnes)		
1990	495,519	34,059	1,718,267	18.31	39.37	1719.98	10,275,558	2,630,543	4,350,530	8.78
1995	846,170	45,196	2,280,136	24.30	52.25	2282.40	17,038,625	2,146,867	4,429,285	5.23
1996	846,545	57,543	2,903,053	30.94	66.52	2905.92	16,208,215	2,479,857	5,385,816	6.36
1997	887,743	57,331	2,892,373	30.82	66.27	2895.22	16,359,377	3,337,313	6,232,581	7.02
1998	887,743	51,068	2,576,358	27.45	59.03	2578.93	17,090,187	4,682,711	7,261,648	8.18
1999	894,652	55,971	2,823,728	30.09	64.70	2826.54	17,338,356	4,664,018	7,490,573	8.37
2000	943,267	65,669	3,312,986	35.30	75.91	3316.28	18,586,246	5,836,081	9,152,383	9.70
2001	943,267	53,670	2,707,667	28.85	62.04	2710.34	18,000,320	6,318,112	9,028,489	9.57
2002	943,267	57,540	2,902,912	30.93	66.52	2905.77	17,507,036	6,144,969	9,050,787	9.60
2003	971,460	63,153	3,186,045	33.95	73.00	3189.23	16,543,472	5,806,759	8,995,993	9.26
2004	1,089,542	59,387	2,996,060	31.93	68.65	2999.04	15,728,479	5,536,425	8,535,484	7.83
2005	1,232,627	59,201	2,572,737	31.83	68.44	2989.65	19,900,400	4,485,068	7,060,795	5.73
2006	1,237,407	54,921	2,770,752	29.53	63.49	2773.51	19,614,388	4,648,610	7,422,136	6.00
2007	1,237,407	57,142	2,882,805	30.72	66.06	2,885.67	17,715,619	4,198,602	7,084,293	5.73
2008	1,156,534	58,368	2,944,677	31.38	67.47	2,947.60	19,555,644	4,634,688	7,582,312	6.56
2009	1,205,742	55,117	2,780,669	29.63	63.72	2,783.43	19,483,348	4,617,553	7,401,006	6.14

Other Consumption and CO2 Reposting Mechanisms

Cost Avoidance Forecast

In order to realize the impacts of implementing the energy management action plan, a cost avoidance analysis has been made. This analysis indicates what the consumption; costs and gas emissions would be if no action was undertaken. The findings are illustrated in the chart shown in figure 8 below.

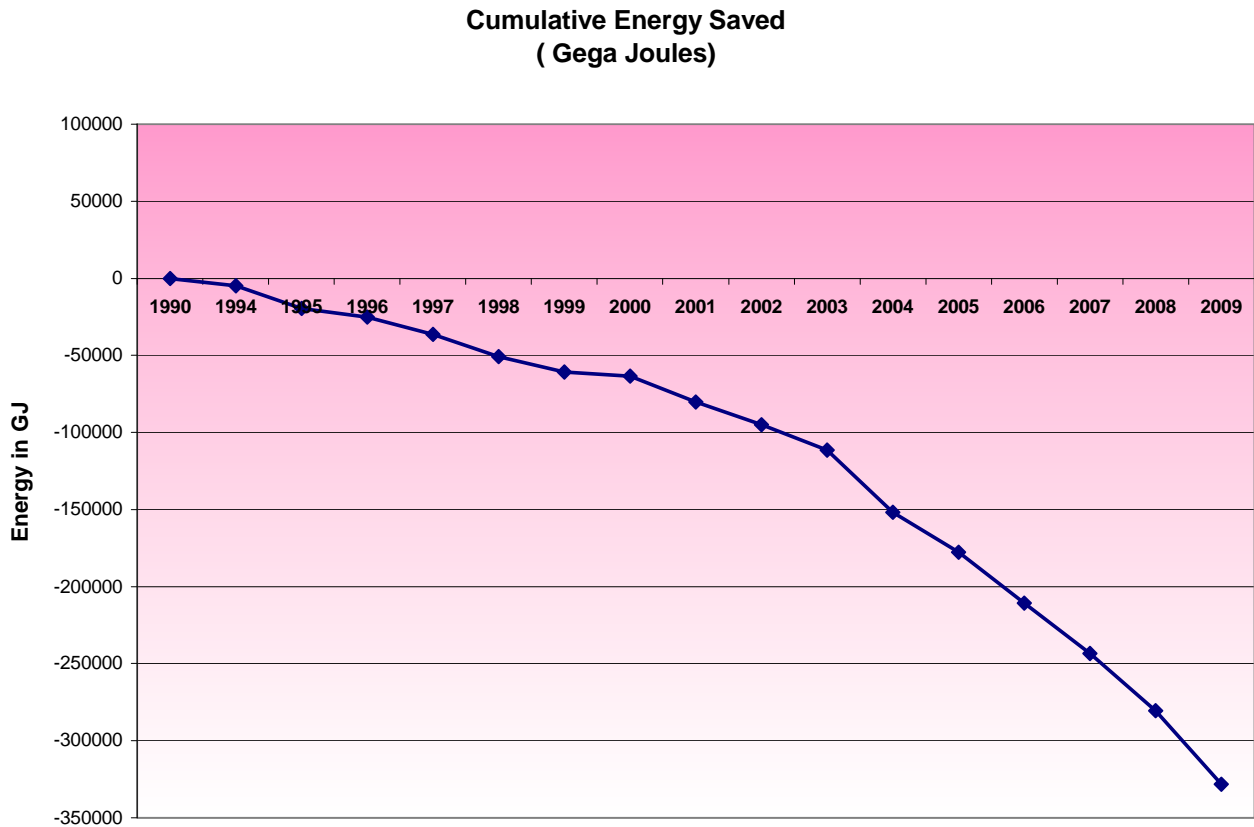
Figure 9 – Chart cost saving / avoidance forecast - by implementing Energy Management



Cumulative Savings by implementing Energy Management Program

By implementing various energy conservation measures such as building automation system, energy efficient equipment, lighting retrofits since 1990 and adding renewable energy sources, the Town saved 328,000 Gega Joules of energy, which converts to about \$ 7,244,400.

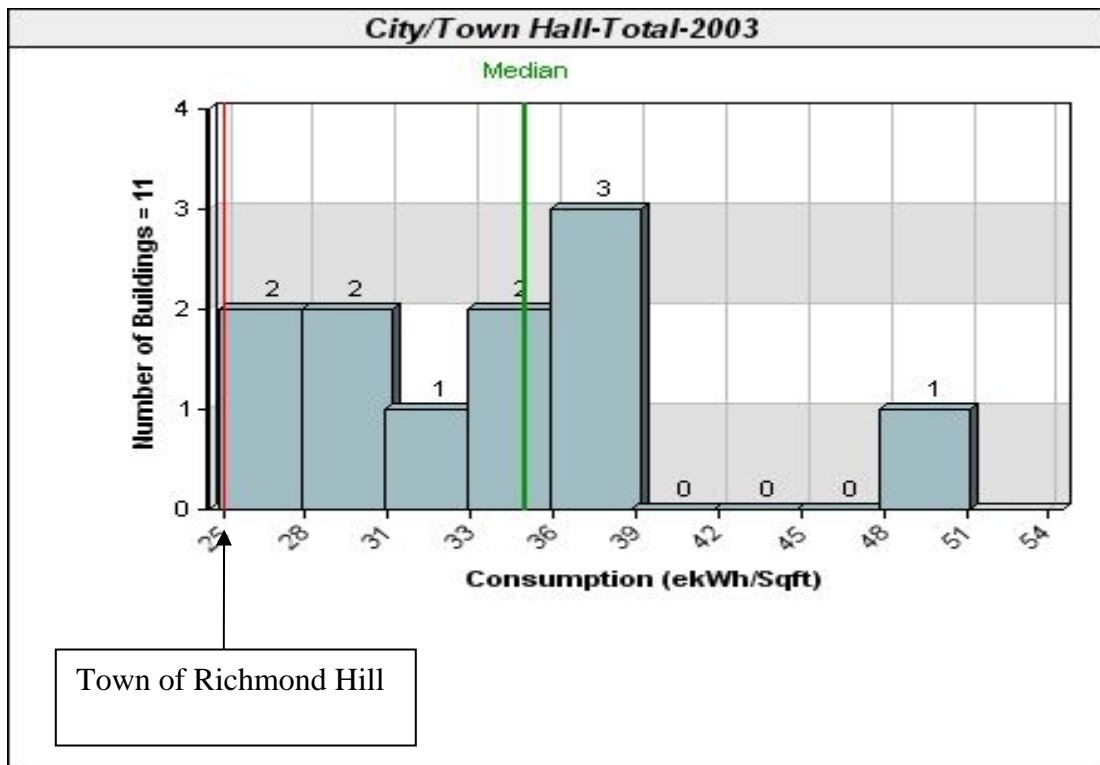
Figure 10 : Cumulative Energy Savings



Benchmark data

As part of the Town’s participation in the Mayor’s Megawatt Challenge 2003 Energy consumption data for Town Halls was collected from 12 GTA Municipalities.

From the data collected the Town of Richmond Hill had the most energy efficient Town Hall.



BENCHMARK BUILDINGS

1. Richmond Hill (-Richmond Hill Town Hall) has been benchmarked for the lease energy consumption (25.3 ekWh/Sqft) against all other GTA City Halls.

Section 4 - Energy Management Projects and Actions

4.1 Past and Current ongoing Projects and Actions

Past Building Energy Efficiency Retrofits since 1996

Facility	Description of Work	Year
Operations Centre	conversion of heating from electric to gas	1996
Operations Centre	energy efficient lighting installation	1996
Operations Centre	Hot water piping insulation	1996
Richmond Green Sports Complex	conversion of heating from electric to gas	1996
Richmond Green Sports Complex	energy efficient lighting installation	1996
Richvale Community Centre	Pool dry-o-tron installation	1996
Richvale Community Centre	lighting retrofit	1996
225 East Beaver Creek	lighting retrofit	1996
Wave Pool	lighting retrofit	1996
Centennial Pool	lighting retrofit	1996
Richvale Library	lighting retrofit	1996
Harold J Mills Fire Hall	lighting retrofit	1996
Lions Hall Community Centre	lighting retrofit	1996
Bayview Hill Community Centre	lighting retrofit	1996
Major Mackenzie Fire Hall	lighting retrofit	1996
Spruce Hall	lighting retrofit	1996
Centennial Pool	Building Automated System	1997
Richvale Community Centre	Building Automated System	1997
Wave Pool	Building Automated System	1997
Operations Centre	Building Automated System	1997
Major Mackenzie Fire Hall	Building Automated System	1997
Elgin Barrow Arena	power factor correction	2002
Elvis Stojko Arena	power factor correction	2002
Oak Ridges Arena	power factor correction	2002
Ed Sackfield Arena	power factor correction	2002
Operations Centre	power factor correction	2002
Central Library	power factor correction	2002
225 East Beaver Creek	connect perimeter baseboard heaters to building automated system	2003

Facility	Description of Work	Year
Central Library	Lighting control upgrade	2003
225 East Beaver Creek	Lighting modifications during renovations i.e. switching, emergency exit lighting retrofit	2003
225 East Beaver Creek	Building automated system upgrade	2003
225 East Beaver Creek	Replace electric humidifiers	2004
Central Library	Modify chiller water piping	2004
Bayview Hill CC	Roof vapour barrier repair	2004
Ed Sackfield Fitness Centre	Install Programmable controller on HVAC units	2004
Central Library	Recommissioning of Free Cooling	2004
Richvale CC	Heat Recovery Unit for change room	2005
Ed Sackfield Arena	HVAC Automation	2005
Arenas	Energy Auditing	2006
Central Library	Corrected Power factor and power surge	2006
R.G. Poultry Barn	Installed Light and Temperature controls	2006
R.G. Sports Centre	Installed Central AC and Heating System	2006
225 EBC	Installed Solar hot water system	2007
Ed Sackfield Arena	Installed energy efficient Roof Top Unit	2007
Farm House	Upgraded the windows	2007
Ed Sackfield Arena & 225 EBC	Replaced roof with high insulation	2007
225 East Beaver Creek	Replaced / upgraded Heat Pumps	2008
Central Library	Reconditioned Heat Exchangers # 1&2	2008
R.G. Sports Complex	Installed Building Automation System	2008
Wave Pool	Upgraded the Dry-O-Tron Unit	2008
Admin	Feasibility Study for Co-Generation Plant	2008
McConaghy Centre	Upgraded the Condensing Boilers	2009
Centennial Pool	Installed Condensing Boilers	2009
225 East Beaver Creek	Replaced Exit signs with LED lamps	2009
Farm House	Installed High Efficiency furnace	2009
Shaw House	Solar PV system	2009
Bayview Hill CC	Solar Pool Water Heating System	2009
Richvale CC	Installed energy efficient Roof top unit with	2009
Richmond Green	Installed Solar and Wind Power System	2009
Energy Auditing	Energy Auditing for 10 facilities	2009

4.2 Proposed Actions and Projects

Propose utilizing facilities Building Automation System (BAS) to standardize room temperature. Examples of room temperature standards are shown in Table 6 below.

Table 7 : Proposed standardized building temperature set points

Building General Operation Criteria						
Space / Function	Indoor Temperature °C				Relative Humidity	
	Winter		Summer		Winter	Summer
	Occupied	Un-occupied /After-hours	Occupied	Un-occupied /After-hours	RH	
Office	21-23	15-18	23-26	N/A	20%-30%	50%-60%
Dinning/Cafeteria	21-23	15-18	26	N/A	20%-30%	50%
Kitchen	21-23	15-18	29-31	N/A	N/A	N/A
Activity/Meeting	20-23	15-18	23-26	N/A	30%-35%	40%-60%
Daycare/Kindergarten	24	15-18	26	N/A	20%-30%	50%-60%
Gym	18-20	15-18	24-26	N/A	20%-30%	50%-60%
Storage	18	15 or lower	N/A	N/A	N/A	N/A
Locker/Shower	24	15-18	N/A	N/A	N/A	N/A
Toilet	22	15-18	N/A	N/A	N/A	N/A
Lobby/Corridor	20-23	15-18	23-26	N/A	30%-35%	40%-60%

4.3 Training, Communication and Awareness Programs

Employees and other occupants are integral to the operation of the facility therefore; they are the first priority when it comes to communicating change in the workplace. The occupants will obtain timely and accurate information about the facility so they are aware of how their building functions at all times and to ensure they are prepared for change. If the employees are not kept informed, changes to the facilities may not be received positively. A communication, awareness and training program is a key component in the overall energy management program and will be undertaken where needed including communication and awareness strategies.

Section 5 - Reporting and Evaluation

As part of the Town of Richmond Hill's commitment to energy management and its membership to the Energy Innovators Initiative, the Town will submit a progress report annually the Office of Energy Efficiency (OEE), Natural Resource Canada (NRCan), and to the Climate Change Voluntary Registry Challenge Inc. (VCR Inc.). The report will include at minimum:

- a brief description of ongoing objectives and methodologies;
- measured results of cost avoidance as a result of energy retrofits;
- current year energy use and costs and greenhouse gases inventory;
- variations in greenhouse gas emissions from baseline year;
- variations in actions from the original action plan;
- actions taken; and
- new or revised action plans, including new or revised goals and objectives.

5.1 Reporting, Verifying and Updating the Action Plan and Targets

In order to evaluate the progress towards the energy efficiency goals, the Town will implement a system to collect and analyze the necessary information. The system should be set up to collect the data on an on-going basis. Regular monitoring of the results paint a clear picture of utility use and cost in defined parts as a process of operation. Consistently good results indicate that targets could be altered to increase the challenge. The overall objective is to continually refine the targets performance to minimize the operations cost. The process is one of constantly re-evaluating targets.

As part of the Town's review process, it should include a review team. This team could be the planning team, as discussed in Section 2.4. The targets and action plan should be updated as necessary.

The following methodology used to report or monitor the goals, targets, energy efficiency measures, and other issues of the action plan.

- Determine a review team.
- Verify the targets and make appropriate adjustments.
- Update the projects, including removing or adding new projects.
- Provide recommendations to resolving areas of concern.

Section 6 - References for Further Help

Energy Management Policy and General Energy Efficiency Information

- Dollars to \$ense: Energy Master Plan Workshop
- CIPEC Energy Efficiency Planning and Management Guide
- A Manager's Guide to Comprehensive Training.
- A Manager's Guide to Creating Employee Awareness

Auditing, Energy Monitoring and Tracking, Calculating Energy Use and Greenhouse Gas Emissions

- Dollars to \$ense: Monitoring and Tracking Workshop
- Dollars to \$ense: Energy Auditing and Opportunities Workshop
- Energy Management Series of Documents
- Federal Building Initiative Audit Standard Guidelines.
- Voluntary Challenge and Registry (VCR Inc.) Participant's Handbook (for greenhouse gas emission calculations)
- Environment Canada's "Trends in Canada's Greenhouse Gas Emissions 1990 – 1995" (emission factors)
- The North American Energy Measurements & Verification Protocol (contact US Department of Energy at 1-800-363-3732)
- Environment Canada, Atlantic Region website contains how to calculate CO2 inventory <http://www.ns.ec.gc.ca/co2/worksheet.html>.
- Natural Resource Canada. Tel: (613) 995-6950, fax: (613) 947-4121 <http://www.nrc.ec.gc.ca/>

Section 7 - Annexes

Annexes used in this reports are listed here under:

1. Facilities Details
2. Utility bills
3. Sample calculations
4. Emissions calculations and factors
5. Facility by facility consumption and cost summaries and analysis
6. The energy efficiency to do list

ANNEXURE 1 Facilities Details

Building Name	Type	Year Built	TOTAL GFA Sq. Ft.
614-21 EBC OFFICE	Municipal Buildings	1992	166700
614-24 HILLHOUSE HOSPICE	Others	1955	2800
614-26 OPERATIONS CENTRE	Municipal Buildings	1984	118866
614-28 MILL STREET HOUSE	Others	1955	2982
614-31 AMOS WRIGHT HOUSE	Heritage/Halls	1840	2680
614-32 VANDERBURGH HOUSE	Heritage/Halls	1833	4099
614-33 BURR HOUSE	Heritage/Halls	1825	2296
614-34 FARM HOUSE	Heritage/Halls	1874	3085
614-35 GUILD HALL	Heritage/Halls	1857	1948
614-36 RAILWAY STATION	Heritage/Halls	1905	2046
614-37 RICHMOND HILL THEATER	Heritage/Halls	1897/2009	57,158
614-38 FORESTER FARMHOUSE	Heritage/Halls	1830	2382
614-39 EYER HOMESTEAD	Heritage/Halls	1828	4652
614-41 CENTRAL LIBRARY	Library	1991	122893
614-42 RICHVALE LIBRARY	Library	1982	7831
614-43 MORRAINE LIBRARY	Library	1990	5536
614-44 R.G. LIBRARY	Library	2004	12440
614-51 MILL ST COMFORT STN	Recreation	1996	375
614-52 ROYAL LEPAGE BLDG	Others	1936	5000
614-53 TOWN PARK SN BR/WR	Recreation	1973	837
614-54 SUNSET BEACH SNACK/COMFO	Recreation	1985	1161
614-55 SUNSET BEACH BOATHOUSE	Recreation	1985	1932
614-56 CROSBY TENNIS	Recreation	1972	2853
614-57 GREEN - FIELD HOUSE	Recreation	1991	892
614-58 GREEN - CATTLE BARN	Recreation	1985	12305
614-59 GREEN - FAIR STORAGE	Recreation	1985	1059
614-60 GREEN - POULTRY BLDG	Recreation	1985	6337
614-61 RAWLINSON PARK WASHROOM	Recreation	1999	301
614-64 SHAW HOUSE	Heritage/Halls	1836 /2005	1500
614-66 RICHMOND GREEN ICE PLANT	Recreation	2003	1267
614-67 TOM GRAHAM ARENA	Arena	1997	79828
614-68 FORESTER BARN	Heritage/Halls	1830	7186
614-71 MCCONAGHY CENTRE	Community Centre	1915	24055
614-72 BAYVIEW HILL CC	Community Centre	1992	46023
614-74 RICHVALE CC	Community Centre	1975	35150
614-75 LAKE WILCOX CC	Community Centre	1975	2398
614-76 ELGIN BARROW ARENA	Arena	1923	71750
614-77 OAKRIDGES ARENA	Arena	1972	35515
614-78 GREEN - SPORTS BLDG	Community Centre	1984	35750
614-79 ED SACKFIELD FITNESS (see Note 1)	Arena	1990	47014
614-81 ELVIS STOJKO ARENA	Arena	1986	31196
614-82 CONNER BUILDING	Others	1974	5561
614-83 ELGIN WEST CC	Community Centre	2000	38944
614-84 ROUGE WOODS CC	Community Centre	2000	27000
614-85 LANGSTAFF CC (see Note 2)	Community Centre	2003	23010
614-91 LOIS HANCEY AQUATIC CENTRE	Recreation	1991	26045
614-92 CENTENNIAL POOL	Recreation	1967	22182
615-81 MAJOR MAC FIRE HALL (ALFRED D. STONG)	Fire Hall	1978	14786
615-82 OAK RIDGES FIRE HALL (ROBERT G. KENNEDY)	Fire Hall	1996	6200
615-83 16TH AVE FIRE HALL (HAROLD J. MILLS)	Fire Hall	1989	5950
615-84 ELGIN MILLS FIRE HALL (RUSSEL CURLEY LYNETT)	Fire Hall	2000	6600
615-85 BAYVIEW GLEN FIRE HALL (BERT COOK)	Fire Hall	2000	9671

ANNEXURE 3 : Sample Calculation for Cost Analysis and Cash flow for a typical project.

The proposed energy savings measures, costs and simple payback periods are summarized as follows:

	Description of Energy Savings Measures	Estimated Utility Savings				Estimated Cost Savings					Cost of Retrofit	ROI
		Elec.	Elec.	Gas	Water	Elec. (Kwh)	Elec. (Kw)	Gas	Water	Total		
		Kwh	Kw	M3	M3	\$	\$	\$	\$	\$		
1	Combine the Two Heating Systems in One Boiler Plant	4,662		3,899		\$420		\$1,248		\$1,667	17000	10.2
2	Install Controls on DHW and Heating Systems			15,594				\$4,990		\$4,990	10,000	2
3	Install Melink System to Control the Hood's Exhaust	8,115		8,719		\$730		\$2,790		\$3,521	\$6,400	1.8
4	Set-up Constant Temperature for the Classroom's Supply Air Units	24,663				\$2,220				\$2,220	\$2,500	1.1
5	Install VFD's on the Supply Fan S.F-4 System	8,504				\$765				\$765	\$11,200	14.6
6	Implement Night Set Back for the Classrooms	6,126				\$551				\$551	\$1,000	1.8
7	Lighting Retrofit	168,049				\$15,124				15,124	\$118,440	7.8
8	Low-flow Toilets and Urinals				4,641				\$5,663	\$5,663	\$36,831	6.5
9	Install Photocells and Occupancy Sensors	59,525				\$5,357				\$5,357	\$29,340	5.5
10	Controls for Vending Machines	11,344				\$1,021				\$1,021	\$2,000	2
11	Tighten-Up the Operating Schedules	30,914			2,876			\$2,782	\$3,509	\$6,291	\$6,000	1
12	Install BAS for Relocatable Building	110,772				\$9,970				\$9,970	\$49,500	5
13	Replace the Existing Atmospheric Boilers			25,386				\$8,124		\$8,124	\$151,600	18.7
14	Training and Education	48,353		4,084	391	\$3,452		\$1,304	\$477	\$6,136	\$5,000	0.8
	Engineering, Project Management Commissioning									\$67,022		
	Rebate: Enbridge Gas \$0.05/m ³									(\$6,865)		
	Rebate : NRCan ERA (3) \$ 7.5/GJ **	1,732 GJ		2,565 GJ						4,297GJ	(\$32,229)	
	Total Estimated Savings	481,027		57,682	7,908	39,610		21,238	9,649	\$474,739	\$474,739	6.6
	Annual Baseline (Year): Gas, Electric and Water	2,417,655		204,184	19,547	\$217,589		\$65,339	\$23,853	\$306,780		
	Cost per Unit (Used in Calculations)	\$ 0.07		\$ 0.45	\$ 1.22							
	Percent Reduction	19.90%		28%	40%	19.90%		28.00%	40.00%	23.30%	23.10%	
Greenhouse Gas Emission Summary:		Elec.		Gas							Total	% Reduction
CO ₂ for Baseline (tonnes)												
CO ₂ Reduction (tonnes)												
General Building(s) Information												
Square Footage and Age of Building												
Hours of Occupancy												

ANNEXURE 4: Emissions Calculation and factors

Table 8: CO₂ Emission Factors (1997)

	CO₂	CH4 (kg/GJ)	NO2 (kg/GJ)
Electricity in Ontario	0.169 tonnes/MWh		
Natural Gas	0.0505 tonnes/GJ	1.156 x 10 ⁻³	5.376 x 10 ⁻⁴

- 1 ton = 1,000 kg = 1,000,000 g
- 1 ML = 1,000,000 L = 1000 m³
- 1 TJ = 1,000,000,000,000 J (10¹²)
- 1 M³ natural gas = 0.0372 GJ
- 1M³ natural gas = 35287 Btu
- 1GJ = 948451.6 Btu
- 1GJ = 277.78 kWh
- 1Btu = 1.054x10⁻⁶ GJ
- 1kWh = 3.6 x 10⁻³ GJ

ANNEXURE 5: Facility by facility consumption and cost summaries

Gas Consumption by Facility					
Bld. No.	Bld Name	Gas Account .	Rate	Annual Consumption M3	Budgeted Cost \$
21	EBC OFFICES	063525216332	6	59,853	\$27,176.25
26	OPERATIONS CENTRE	123535194911	6	135,661	\$61,596.88
28	MILL STREET HOUSE	033505133442	1	5,311	\$2,411.46
31	AMOS WRIGHT HOUSE - 19 CH	133565206912	1	3,849	\$1,747.64
34	FARM HOUSE	123535247914	1	3,590	\$1,630.04
37	OLD TOWN HALL	123555152000	6	39,340	\$17,862.33
39	REDSTONE FARMHOUSE	123535357311	1	4,982	\$2,262.08
41	CENTRAL LIBRARY	033575337212	6	103,744	\$47,104.96
42	RICHVALE LIBRARY	053560147003	6	12,067	\$5,479.02
43	MORRAINE LIBRARY	113515204021	6	6,851	\$3,110.70
51	MILL ST COMFORT STN	033505231614	6	3,187	\$1,447.06
60	GREEN - POULTRY BLDG	123535194510	6	18,758	\$8,517.07
71	MCCONAGHY CENTRE	133530208032	6	74,419	\$33,789.95
72	BAYVIEW HILL CC/POOL	133505114725	6	230,655	\$104,728.90
74	RICHVALE CC & POOL	033555008003	6	115,670	\$52,519.96
75	WILCOX CC	133501395001	6	6,143	\$2,789.23
78	GREEN - SPORTS BLDG	123535194612	6	55,789	\$25,331.00
79	ED SACKFIELD FITNESS	073505402314	6	51,383	\$23,330.45
82	CONNER BUILDING	113525125000	6	10,483	\$4,759.81
83	ELGIN WEST POOL & CC	123505829135	6	190,719	\$86,595.96
84	ROUGE WOODS CC	835117959996	6	35,839	\$16,272.70
91	WAVE POOL	033575335812	6	140,662	\$63,867.58
92	CENTENNIAL POOL	133535228413	6	105,166	\$47,750.62
681	MAJOR MACFIRE HALL	033575030001	6	46,738	\$21,221.39
682	OAK RIDGES FIRE HALL	113515217913	6	14,328	\$6,505.63
683	16TH AVE FIRE HALL	133525297615	6	22,424	\$10,181.62
684	ELGIN MILLS FIRE HALL	123535741815	6	27,441	\$12,459.59
685	BAYVIEW GLEN FIRE HALL	033570506213	6	48,119	\$21,848.43

Electrical Consumption by Facility				
Bld	Bld Name	Hydro Account	kWh Consumption	Budgeted \$
21	EBC OFFICES	011001811	2,750,000	\$349,250.00
24	HOSPICE RICHMOND HILL	744009061	91,480	\$11,617.96
26	OPERATIONS CENTRE	755000261	472,000	\$59,944.00
28	MILL STREET HOUSE	133002175	22,000	\$2,794.00
31	AMOS WRIGHT HOUSE - 19 CHURCH	112000092	15,000	\$1,905.00
33	BURR HOUSE	733008101	36,000	\$4,572.00
35	GUILD HALL	733008111	35,000	\$4,445.00
37	OLD TOWN HALL/ R.H. THEATER	744006691	220,000	\$27,940.00
38	RAWLINSON PROPERTY	322000072	30,000	\$3,810.00
39	REDSTONE FARMHOUSE	322000722	5,000	\$635.00
41	CENTRAL LIBRARY	013000981	1,650,000	\$209,550.00
42	RICHVALE LIBRARY	722001601	170,000	\$21,590.00
43	MORRAINE LIBRARY	766000531	90,000	\$11,430.00
51	MILL ST COMFORT STN	744009681	9,000	\$1,143.00
54	SUNSET SNACK/COMFO	766000301	12,000	\$1,524.00
55	SUNSET BOATHOUSE	766000321	8,000	\$1,016.00
56	CROSBY TENNIS	744005011	70,000	\$8,890.00
61	RAWLINSON PARK WR	755010281	9,000	\$1,143.00
71	MCCONAGHY CENTRE	744010102	380,000	\$48,260.00
72	BAYVIEW HILL CC/POOL	733005262	1,330,000	\$168,910.00
74	RICHVALE CC & POOL	733004051	1,000,000	\$127,000.00
75	WILCOX CC	766000331	9,000	\$1,143.00
78	GREEN - SPORTS BLDG	755000241	675,000	\$85,725.00
82	CONNER BUILDING	766001291	85,000	\$10,795.00
83	ELGIN WEST POOL & CC	755010081	1,270,000	\$161,290.00
84	ROUGE WOODS CC	744011872	440,000	\$55,880.00
91	WAVE POOL	733005122	1,380,000	\$175,260.00
92	CENTENNIAL POOL	744008501	800,000	\$101,600.00
681	MAJOR MACFIRE HALL	733004631	245,000	\$31,115.00
682	OAK RIDGES FIRE HALL	766002811	115,000	\$14,605.00
683	16TH AVE FIRE HALL	711012201	107,000	\$13,589.00
684	ELGIN MILLS FIRE HALL	744011331	74,000	\$9,398.00
685	BAYVIEW GLEN FIRE HALL	722005001	120,000	\$15,240.00

ANNEXURE 6 : Recommended Future Energy Efficiency Projects – subject to availability of budget and resources

	Energy Conservation Idea
1	Replace large DHW storage tanks with tankless instantaneous units
2	Replace older fire tube boilers & atmospheric boilers with new high efficiency condensing fire tube boilers such as the Cleaver Brooks Clearfire
3	Consider ground source heat pumps instead of boilers for pool heating
4	Replace electric humidifiers with natural gas fired units
5	Variable Frequency drive installation on VAV supply fan and return fan (AHU-4 & RF-1)
6	Variable Frequency drive installation on cooling tower fans instead of end-switch activation on dampers
7	Solar Heating Water System
8	Modify main make-up air unit (AHU-201) to frequency drive controlled by CO2 sensors located in building areas
9	Solar air units for fresh air make-up to buildings
10	Wind farm to shave peak loads
11	Heat Recovery Ventilators for Changerooms instead of current design of fresh air make-up and separate exhaust
12	Power Factor correction on large inductive loads (refrigeration compressors)
13	Ground Source heat pumps to replace conventional gas fired furnaces with A/C and/or baseboard heaters
14	Replace DHW tanks in infrequently used bldgs, with tankless units (where NG exists)
15	Replace front entrance door, sliding door & vestibule (designed too small) with revolving door
16	Add occupancy sensors tied into BAS for infrequently used rooms to control occu/unoccu settings
17	Replace all incandescent bulbs with compact fluorescents lamps
18	Isolate snow melting loop for sidewalk and replace with conventional shoveling
19	Heat recovery from dumped pool water for fresh water make-up pre-heating
20	Modify Dry-O-Tron to dump waste heat to both each pool & main pool as per design at Elgin West
21	Replace standard taps (that repeated get left running) with automated proximity sensor fixtures and a fixed blended supply water temp
22	Replace illuminate exit sign lamps with LED's